**ENVIRONMENTAL
RESTORATION
PROGRAM**

**Quality Assurance/Quality Control
Summary Report on Phase 2
of the Clinch River Remedial Investigation
at the Oak Ridge Reservation,
Oak Ridge, Tennessee**

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and
Science Applications International Corporation**

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Energy Systems Environmental Restoration Program

**Quality Assurance/Quality Control
Summary Report on Phase 2
of the Clinch River Remedial Investigation
at the Oak Ridge Reservation,
Oak Ridge, Tennessee**

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PREFACE

This *Quality Assurance/Quality Control Summary Report on Phase 2 of the Clinch River Remedial Investigation at Oak Ridge National Laboratory, Oak Ridge, Tennessee* (ORNL/ER-385) was prepared as part the site characterization for the Clinch River/Poplar Creek Operable Unit (OU) on the Oak Ridge Reservation. This report was prepared under Work Breakdown Structure 1.4.12.3.1.02.41, Activity Data Sheet 9302, "Clinch River/Poplar Creek Operable Unit." The document provides the Environmental Restoration Program with information about the Phase 2 investigation performed at the OU.¹

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CONTENTS

PREFACE	iii
TABLES	vii
FIGURES	ix
ABBREVIATIONS	xi
EXECUTIVE SUMMARY	xv
1. INTRODUCTION	1
2. QUALITY ASSURANCE OBJECTIVES FOR MEASUREMENT OF DATA	1
3. COMPLETENESS	2
4. PRECISION	3
5. ACCURACY	4
6. REPRESENTATIVENESS	6
7. COMPARABILITY	6
7.1 COMPARISON OF MERCURY RESULTS	6
7.2 COMPARISON OF TOTAL AND DISSOLVED CONCENTRATIONS	7
8. SENSITIVITY	8
9. CORRECTIVE ACTIONS	8
10. QUALIFICATION OF THE DATA	8
11. DATA REVIEW	9
11.1 FIELD DATA REVIEW	9
11.2 ELECTRONIC DATA VERIFICATION	10
11.3 DATA INVENTORY	10
11.4 MANUAL REVIEW	11
11.5 CONTRACT COMPLIANCE SCREENING	11
11.6 ELECTRONIC REVIEW	11
11.7 VALIDATION	11
12. DATA MANAGEMENT SYSTEMS	12
13. AUDITS AND SURVEILLANCES	12

14. STANDARD OPERATING PROCEDURES AND TRAINING	15
15. LESSONS LEARNED	15
15.1 PROJECT STATEMENTS OF WORK	15
15.2 APO STATEMENTS OF WORK	16
15.3 FIELD DATA VALIDATION	16
15.4 SHIPPING	17
15.5 DATA PACKAGE RECEIPT, TRACKING, HANDLING	18
15.6 DATA BASE	18
15.7 ELECTRONIC DATA DELIVERABLES	19
15.8 BIOTA SAMPLES	19
15.9 INVENTORY	20
15.10 VALIDATION	20
15.11 PROGRAMMATIC EXCEPTION REPORTS	20
16. PHASE 1 QUALITY ASSURANCE/QUALITY CONTROL	20
17. TABLES	23
18. FIGURES	77
19. REFERENCES	85
Appendix A. FIELD QUALITY CONTROL	A-1
Appendix B. ANALYTICAL QUALITY CONTROL	B-1
Appendix C. ELECTRONIC QUALITY CONTROL EVALUATIONS	C-1
Appendix D. PERFORMANCE EVALUATION RESULTS	D-1

TABLES

1. Summary of samples for the Clinch River Remedial Investigation—Phase 2	25
2. Summary of analyses for the Clinch River Remedial Investigation—Phase 2	28
3. Summary of quantitative indicators for surface water	31
4. Summary of quantitative indicators for sediment	35
5. Summary of quantitative indicators for pore water	39
6. Brooks Rand and Lockheed mercury results for surface water where Lockheed reported at least two times the method detection limit	40
7. Brooks Rand and TMA-ARLI mercury results for sediment samples	41
8. Comparison of total values vs. dissolved values for surface water	43
9. Distribution of programmatic exceptions by laboratory	49
10. Programmatic exception report quality control categories and problem types	50
11. Organic analysis data qualifiers	52
12. Inorganic analysis data qualifiers	53
13. Radiological data analysis qualifiers	54
14. Data evaluation, validation, and historical data qualifiers	55
15. Reason codes used in data qualification	56
16. Derivation of overall result qualifiers	60
17. Reasons for the data use flag = "NO"	60
18. Summary of qualifiers assigned from full validation	61
19. Summary of reason codes and qualifiers by analyte	64
20. Summary of qualifiers assigned from electronic review	71
21. Summary of qualifiers assigned from technical review	72
22. Summary of reasons for rejection of data	73
23. Summary of rejected data by statement of work and analysis type	73
24. Clinch River ER analytical services	74

FIGURES

1. Percentage of laboratory replicates meeting the precision criteria	79
2. Comparison of Brooks Rand and TMA-ARLI sediment samples	80
3. PER occurrence rate by laboratory	81
4. Cumulative internal quality control findings	82
5. Cumulative external quality control findings	83
6. Cumulative internal root cause findings	84

ABBREVIATIONS

%D	percent difference
%R	percent recovery
AA	atomic absorption
ANSI	American National Standards Institute
ASC	Analytical Services Coordinator
ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing and Materials
BMAP	Biological Monitoring and Abatement Program
CCV	continuing calibration verification
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CLP	Contract Laboratory Program
COC	chain-of-custody
CRERP	Clinch River Environmental Restoration Program
CRDL	contract-required detection limit
CRM	Clinch River mile
CRR	Clinch River Remedial Investigation
CR/WBR	Clinch River/Watts Bar Reservoir
CV	cold vapor
CVAFS	cold vapor atomic fluorescence spectrometry
DCB	decachlorobiphenyl
DBC	dibutylchloroethane
DDD	dichlorodiphenyldichloroethane
DDE	dichlorodiphenyldichloroethene
DDT	dichlorodiphenyltrichloroethane
DER	duplicate error ratio
DL	detection limit
DMC	Document Management Center
DMR	Discharge Monitoring Report
DOE	U.S. Department of Energy
DOE-ORO	Department of Energy Oak Ridge Operations
DQO	data quality objective
DRG	data receipt group
ECD	electron capture detector
ECHEM	TVA Environmental Chemistry Laboratory
EFPC	East Fork Poplar Creek
EML	Environmental Measurements Laboratory
EMSL	Environmental Monitoring Systems Laboratory
EPA	U.S. Environmental Protection Agency
ER	Environmental Restoration
ERM	Emory River Mile
ESD	Environmental Sciences Division
ESSAP	Environmental Survey and Site Assessment Program
ETLS	Ecotek Laboratory Services, Inc.
FDA	U.S. Food and Drug Administration
FCTM	Field Collection Task Map

FFA	Federal Facility Agreement
FWHM	full width at half maximum
GC	gas chromatography
GFAA	graphite furnace atomic absorption
GPC	gel permeation chromatography
IAEA	International Atomic Energy Agency
ICP	inductively coupled plasma
ICS	interference check sample
ICSA	interference check sample, solution A
ICV	initial calibration verification
IDL	instrument detection limit
IDs	identifications
IPL	Isotope Products Laboratories
ISE	ion selective electrode
LCS	laboratory control sample
LLRAL	Low Level Radiological Analysis Laboratory
LOCK	Lockheed Engineering & Science Co.
LPTM	Laboratory Processing Task Map
LQAP	laboratory quality assurance plan
LCL	lower control limit
LWL	lower warning limit
MDA	minimum detectable activity
MDL	method detection limit
MeHg	methyl mercury
MS	mass spectrometry
MSA	method of standard addition
MSD	matrix spike duplicate
MSR	matrix spike recovery
NBS	National Bureau of Standards
NBZ	Nitrobenzene-d5
NIST	National Institute of Standards and Technology
NPL	National Priorities List
NRC	Nuclear Regulatory Commission
ORAS	Oak Ridge Analytical Services
ORNL	Oak Ridge National Laboratory
OREIS	Oak Ridge Environmental Information System
ORR	Oak Ridge Reservation
PER	programmatic exception report
PRM	Powell River Mile
PCB	polychlorinated biphenyl
PCK	Poplar Creek Kilometer
QA	quality assurance
QAP	quality assurance plan
QC	quality control
QL	quantitation limit
RAL	Radiological Analysis Laboratory
RCRA	Resource Conservation and Recovery Act of 1976
RFI	RCRA Facility Investigation

RI	remedial investigation
RPD	relative percent difference
RRF	relative response factor
RSD	relative standard deviation
SA	spike added
SAIC	Science Applications International Corporation
SAP	Sampling and Analysis Plan
SARA	Superfund Amendments and Reauthorization Act
SAS	Statistical Analysis System
SOP	standard operating procedure
SOW	Statement of Work
SPARCC	sensitivity, precision, accuracy, representativeness, completeness, and comparability
SQL	sample quantitation limit
SR	sample result
SRM	standard reference material
SSR	spiked sample result
STD	standard deviation
SVOs	semivolatile organics
SWRI	Southwest Research Institute
TCL	target compound list
TCX	tetrachloro-m-xylene
TCO	total combustible organics
TDEC	Tennessee Department of Environment and Conservation
TIC	tentatively identified compound
TIN	tentatively identified nuclide
TKN	total Kjeldahl nitrogen
TMAN	TMA/NORCAL
TMAR	TMA/ARLI
TMER	TMA/Eberline
TOC	total organic carbon
TRM	Tennessee River Mile
TVA	Tennessee Valley Authority
UCL	upper control limit
UWL	upper warning limit
WOC	White Oak Creek
WOCE	White Oak Creek Embayment

EXECUTIVE SUMMARY

Quality assurance (QA) objectives for Phase 2 were that (1) scientific data generated would withstand scientific and legal scrutiny; (2) data would be gathered using appropriate procedures for sample collection, sample handling and security, chain of custody, laboratory analyses, and data reporting; (3) data would be of known precision and accuracy; and (4) data would meet data quality objectives defined in the Phase 2 Sampling and Analysis Plan.

Approximately 4400 inorganic, 3000 organic, and 2000 radiological samples were analyzed resulting in over 160,000 contaminant and physical analyses. The QA completeness goal for the program was to obtain valid analytical results for at least 90% of the samples collected during the program. Overall completeness for all Phase 2 media and analyses exceeded this goal. Less than one percent of the analyses were rejected. Rejected data occurred because of low spike recoveries and low sensitivity.

A review of the QA systems and quality control (QC) data associated with the Phase 2 investigation is presented to evaluate whether the data were of sufficient quality to satisfy Phase 2 objectives. The data quality indicators of precision, accuracy, representativeness, comparability, completeness, and sensitivity were evaluated to determine any limitations associated with the data. Data were flagged with qualifiers that were associated with appropriate reason codes and documentation relating the qualifiers to the reviewer of the data. These qualifiers were then consolidated into an overall final qualifier to represent the quality of the data to the end user.

In summary, reproducible, precise, and accurate measurements consistent with CRRRI objectives and the limitations of the sampling and analytical procedures used were obtained for the data collected in support of the Phase 2 Remedial Investigation.

1. INTRODUCTION

A comprehensive QA program which included administrative controls, quality control samples, and quality reviews was implemented for Phase 2 of the Clinch River Remedial Investigation (CRRI). This document presents results of the QA activities.

A major portion of this document focuses on the results of the quality control samples. The **Completeness, Precision, Accuracy, Representativeness, Comparability, and Sensitivity** sections present a summary of the QC sample results. Much of this summary information is derived from Appendices A and B, which provide detailed results of the technical review of field and laboratory QC samples, and Appendix C which provides the results from the electronic data review. Therefore, the reader can often find additional information in the Appendices to support the summary statements in the text. The QC sample discussions are presented by media (surface water, sediment, biota) and analysis type (inorganics, organics, radiological). The data verification, validation, reviews and result qualification are summarized in the **Data Review** and **Qualification of Data** sections.

The administrative control through procedures and systems are described in **Standard Operating Procedures and Training**, and **Data Management Systems** sections. The quality reviews and reporting of quality issues are summarized in **Audit and Surveillance**, **Corrective Actions**, and **Lessons Learned** sections.

In addition to data from Phase 2, data from Phase 1 and the Oak Ridge Environmental Monitoring Program were used in the Clinch River Remedial Investigation Study. The quality of the Phase 1 data is reported in the Quality Assurance/Quality Control Summary Report for Phase 1 of the Clinch River Remedial Investigation (ORNL/ER-152). A summary of that quality assessment is presented in the **Phase 1 Quality Assurance/Quality Control** section. The quality of the Environmental Monitoring data is reported in the annual Oak Ridge Reservation Environmental Reports (e.g., Oak Ridge Reservation Environmental Report for 1992. ES/ESH-31.).

2. QUALITY ASSURANCE OBJECTIVES FOR MEASUREMENT OF DATA

The Quality Assurance/Quality Control (QA/QC) Program for Phase 2 of the Clinch River Remedial Investigation (CRRI) was designed to comply with both Department of Energy (DOE) Order 5700.6C and Environmental Protection Agency (EPA) QAMS-005/80 (EPA 1980a) guidelines. QA requirements and the general QA objectives for Phase 2 data were defined in the Phase 2 Sampling and Analysis Plan (SAP) (DOE/OR/01-1111&D3)-Quality Assurance Project Plan, and scope changes noted in the Phase 2 Sampling and Analysis Plan Addendum-DOE/OR/01-1254&D1). The QA objectives for Phase 2 data were the following:

- Scientific data generated will withstand scientific and legal scrutiny.
- Data will be gathered using appropriate procedures for sample collection, sample handling and security, chain-of-custody (COC), laboratory analyses, and data reporting.

- Data will be of known precision and accuracy.
- Data will meet data quality objectives (DQOs) defined in the Phase 2 SAP.

The QA objective for all data collected during Phase 2 was, therefore, to obtain reproducible, precise, and accurate measurements consistent with the intended use of the data and the limitations of the sampling and analytical procedures used. These objectives were met through the development and implementation of a thorough data assessment process that included data evaluation, data quality indicators, sampling uncertainty, field quality control, analytical laboratory quality control, data and records management systems, and a QA oversight program of audits and surveillances.

One hundred and thirty-four sampling events were conducted for sediment and water. Separate contaminant studies on heron, mink, geese, and fish were also conducted. Approximately 4,400 inorganic, 3,000 organic, and 2,000 radiological samples were analyzed by ten laboratories during the Phase 2 site characterization (Tables 1 and 2. Tables called out in the document are presented in Section 17.). Matrices included sediment, water, fish, heron, mink, mayflies, geese and duck. In addition, over 500 pH, alkalinity, and total suspended particle determinations were conducted by Clinch River Environmental Restoration Program (CRERP) staff. Toxicity and bioindicator measurements were also performed by Environmental Sciences Division (ESD) staff for the CRERP.

The data were compiled by the laboratories into over 900 sample data packages that contained raw sample data and all quality control associated with each sample for most of the samples collected prior to July 1994. After July 1994, approximately 90% of the sediment and water data were reported as Level C or Level III data packages. Level C packages contained signed chain-of-custody forms, case narratives, sample results, and all quality control information such as calibration, spike, blank, and duplicate data. The only difference between the Level C (or III) and Level D (or IV) packages was that the Level D packages contained raw data, sample preparation records, and copies of pertinent logbook information. Sample results were also received electronically by the project data base manager and loaded into a large working data base.

Both qualitative and quantitative criteria are used as indicators of the quality of the data. In determining whether the data are usable, especially for the decision process, the integrity and authenticity of the data must be evaluated, and the analytical uncertainty must be known. Indicators generally used to assess the data quality are completeness, precision, accuracy, representativeness, comparability, and sensitivity. Tables 3, 4, and 5 summarize the quantitative indicators of precision, accuracy and sensitivity for water, sediment, and pore water.

3. COMPLETENESS

The overall completeness goal was to implement proper field collection methods and obtain valid analytical results for at least 90 percent of the samples collected during the program. Overall completeness for all Phase 2 media and analyses exceeded this goal. Of the samples collected, 99.9% were analyzed and 99.7% of the analytical results were considered valid (Tables 1 and 2). The most common causes for rejected data were low spike recovery and low sensitivity. Approximately 15% of the samples were validated.

4. PRECISION

The laboratory replicates and field duplicates were used to assess the precision of the laboratory method and the overall precision of the sample data. Precision in organics and inorganic analyses was evaluated using the relative percent difference (RPD),

$$RPD = \frac{|S-D|}{(S+D)/2} \times 100$$

where S is the sample result and D is the duplicate result. RPD is the statistic specified by EPA for comparing duplicate results (EPA ILM03.0, EPA 1991) and it is required in the analytical data validation procedure (ER/CR-SOP1020). The acceptance criteria for inorganics was $RPD \leq 20\%$ for water samples and $RPD \leq 35\%$ for sediment samples. The acceptance criteria for organics was $RPD \leq 30\%$ for water samples and $RPD \leq 50\%$ for sediment samples. Precision in radiological analyses was evaluated using the duplicate error ratio (DER),

$$DER = \frac{|S-D|}{(2.5\sigma_S + 2.5\sigma_D)}$$

where S is the sample result, D is the duplicate result, and σ is the sample uncertainty. DER is the statistic required by the analytical data validation procedure (ER/CR-SOP1020) for comparing duplicate radiological results. The acceptance criteria for radiological analyses was $DER \leq 1$.

Analysis of **laboratory replicates** provided an assessment of the precision associated with the laboratory method. For **inorganic** analyses performed by Lockheed for surface and pore water, approximately 83% of the duplicate results met the precision criteria of a $RPD \leq 20\%$. For the inorganic analyses performed by TMA-ARLI for sediment, approximately 90% of the duplicate results met the precision criteria of a $RPD \leq 35\%$. Mercury speciation analyses performed at Brooks Rand met the precision criteria for 86% of the water results and 100% of the sediment results. For all **radiological** analyses performed at the ESD Radiological Analysis Laboratory and Oak Ridge Analytical Services the duplicates met the precision criteria of a $DER \leq 1$ (Figure 1).

Analysis of **matrix spike duplicates** provided an assessment of the precision associated with the organic laboratory methods. For **semivolatile** analyses performed by Lockheed for surface and pore water, approximately 94% of the duplicates met the precision criteria of a $RPD \leq 30\%$. For the semivolatile analyses performed by TMAR for sediment, 100% of the duplicates met the precision of a $RPD \leq 50\%$. For the **pesticide** analyses performed by Lockheed for surface and pore water, 100% of the duplicates met the precision of a $RPD \leq 30\%$. For the pesticide analyses performed by TMAR for sediment, 100% of the duplicates met the precision criteria of a $RPD \leq 50\%$. Figure 1 provides a summary of the laboratory method precision evaluation.

Analysis of the **field duplicates**, which include both field and laboratory variability, provided an assessment of the overall precision of the sample data. For **water** samples, 80% of the inorganic field duplicates met the precision criteria of a $RPD \leq 20\%$, and 98% of the radiological field duplicates met the precision criteria of $DER \leq 1$. Most of the water field duplicates did not contain any detectable organic analytes, therefore, there was not sufficient data to evaluate the overall organic precision. Failure to meet criteria was most often attributed to antimony, boron, copper, or

zinc. For **sediment** samples, 78% of the inorganic field duplicates met the precision criteria of a $RPD \leq 35\%$, 80% of the organic field duplicates met the precision criteria of a $RPD \leq 50\%$, and 84% of the radiological field duplicates met the precision criteria of a $DER \leq 1$. The sediment field duplicates were two separate samples rather than splits from the same sample. Consequently, natural variability in the sediment may be contributing to the duplicates failing the precision criteria.

Although not all laboratory replicates, matrix spike duplicates, or field duplicates met the project's precision criteria no sample results were rejected on the basis of precision. All sample results associated with duplicates that failed the precision criteria were qualified as estimated in the project data base.

Evaluation of sampling precision may be determined from the differences between the overall precision and the analytical precision. The usefulness of the precision data is limited to samples that contain contaminants at concentrations above the method detection limit (MDL). Also, the analytical process must be in statistical control or the estimates of precision will not be meaningful.

5. ACCURACY

Accuracy was primarily evaluated in Phase 2 through holding times, blanks, calibrations, LCSs, matrix spikes, surrogate spikes, and performance evaluation samples.

Holding times were met for approximately 95% of the samples. Of the holding times that were missed, only 68 resulted in rejected data (sediment and water, mercury).

Blanks, both in the field and the analytical laboratory, were used to check for bias resulting from contamination. Blanks were treated the same as samples. No blank corrections were performed on the Phase 2 data and no data were rejected on the basis of blank results. When significant analyte concentrations were found in either lab QC blanks or field QC blanks, qualifiers were assigned to the associated regular sample results. Either a nondetect qualifier (U,UJ) or an estimated qualifier (J) were assigned depending on the reported value of the routine sample.

No significant contamination was found in the inorganic **method blanks**. A few radiological method blanks had results higher than the MDA for either U, Sr, Tc, gross alpha, or gross beta. The detectable organics in water method blanks were aldrin, benzo(ghi)perylene, bis(2-ethylhexyl) phthalate, di-n-butylphthalate and diethylphthalate. The detectable organics in sediment method blanks were benzoic acid, 1,4-dichlorobenzene, 4-nitrophenol, butylbenzylphthalate, bis(2-ethylhexyl) phthalate, di-n-butylphthalate, diethylphthalate, methoxychlor, pentachlorophenol, pyrene, and alpha-BHC.

The **field QC blanks** included **field equipment rinse blanks (FRB)**, **laboratory equipment rinse blanks (LRB)**, **field blanks (FB)**, **trip blanks (TB)** and **milli-Q blanks (MQB)**. Detailed discussion of the blank results for the water sampling and sediment sampling are presented in Appendix A, sections A.1.2 and A.2.2 respectively. Overall, 37 different analytes were detected in surface water field QC blanks. The frequency and concentration at which some analytes were detected, particularly metals and some major ions, suggest that sources of contamination from laboratory processing and field collection activities may have impacted routine water sample results. The sediment field QC blanks also had a high frequency of detectable concentrations, especially for metals.

The presence of these contaminants may have had an affect on the routine sediment sample results. The affected routine sample data were qualified in the project data base.

Calibration data were used to estimate data variability whenever possible because analytical error could be introduced from variability in calibration constants, infrequent recalibration or over-calibration of the analytical system, and unstable calibration standards. Most of the calibrations met criteria. Several batches exhibited continuing calibration criterion outside the acceptance limits in the sediment semivolatile data. For ^{90}Sr analyses, two of the instrument performance assessments were not within acceptance criteria which resulted in flagged data.

Evaluation of the **laboratory control samples** showed that most met criteria. None of the exceptions resulted in rejected data. Boron recovery for some sample results failed to meet requirements because of the use of borosilicate glassware in the laboratory. Deviations occurred with the semivolatile water LCSs for 4-chloroaniline, 2,4-dinitrotoluene, hexachloroethane, and diethylphthalate. Since none of these compounds were detected in the samples, no qualification of the data was necessary.

The percent recoveries,

$$\text{Recent recoveries} = \frac{\text{Concentration found}}{\text{Concentration spiked}} \times 100, \text{ of}$$

analytical, matrix, and surrogate spikes were used to assess accuracy also. Metals, anions, total Kjeldahl nitrogen, and total organic carbon recoveries ranged from 80–100%. For sediment, average recoveries for acidic semivolatile compounds ranged from 40–90%, basic semivolatile compounds ranged from 50–90%, pesticide/PCB compounds ranged from 65–80%, and metals ranged from 15–100%. The lowest metal average recoveries were for antimony, cadmium, and selenium. For surface water and pore water, average recoveries for acidic semivolatile compounds ranged around 60%, basic semivolatile compounds ranged from 15–65%, and pesticide/PCB compounds ranged around 60–80%.

Average recoveries for the organic surrogates are summarized below:

	Sediment	Water	Pore water	Fish
2-chlorophenol-d4	76%			
phenol-d5	82%	63%	58%	
2-fluorophenol	79%	71%	64%	
2,4,6-tribromophenol	84%	85%	75%	
1,2-dichlorobenzene-d4	68%			
nitrobenzene-d5	73%	78%	75%	
2-fluorobiphenyl	83%	74%	72%	
terphenyl-d14	97%	82%	52%	
tetrachloro-m-xylene	87%	63%	48%	90%
decachlorobiphenyl	92%	67%	41%	90%

6. REPRESENTATIVENESS

All measures taken to ensure that bias was not introduced into the sampling and analysis also contributed to sample **representativeness**. Measures such as proper preservation, use of standard analytical methods, adherence to appropriate holding times, and use of field and laboratory blanks, equipment rinsates, and proper containers were utilized so that the data would accurately reflect the analyte of interest at the environmental site.

7. COMPARABILITY

The use of accepted methods and SOPs and participation in interlaboratory performance evaluation testing demonstrated **comparability**. Sample collection, preservation, storage, preparation, analysis, and reporting were performed consistently so that the end user could confidently compare data sets generated by different sampling events or different laboratories.

7.1 COMPARISON OF MERCURY RESULTS

Results for total mercury from two different laboratories were compared (Brooks Rand and Lockheed for surface water, Brooks Rand and TMA-ARLI for sediment). Sediment samples were splits from the same core, while surface water samples were collected at the same site, on the same date, at approximately the same time.

There were 410 pairs of surface water sample results available for comparison. Lockheed reported nondetectable mercury for 385 of the 410 samples (94%). For all but one of those 385 samples Brooks Rand reported either nondetectable mercury or mercury levels below the Lockheed 0.2 ug/L detection limit. In the one exception Brooks Rand reported a value of 0.247 ug/L. For 15 samples Lockheed reported mercury values between 0.2 and 0.4 ug/L, the corresponding Brooks Rand values ranged from nondetected mercury to 0.22 ug/L. The agreement between the two labs is reasonable for these values so close to the Lockheed detection limit.

The results of the remaining 10 of the 410 samples (2%) are presented in Table 6. For these 10 samples, the Lockheed results are always higher than the Brooks Rand values and in four of the samples Brooks Rand reported values that are much lower than the Lockheed detection limit. Samples sent to Brooks Rand were collected by a specialized technique (SOP#BR-040) requested by the laboratory, in order to minimize contamination. Brooks Rand provided mercury free decontaminated Teflon sample containers and tubing for sample collection. The decontamination included hot acid washing overnight by Brooks Rand staff. The sample bottles were filled with dilute HCL and shipped to ORNL. Shipping was done in non-metal, sealed containers. The lower values reported by Brooks Rand may in part be from this increased effort to prevent contamination. However, it is unlikely that contamination explains all the differences presented in Table 1. In summary, both analytical methods worked well for screening samples with mercury content less than 0.2 ug/L, but when quantifying the amount of mercury greater than 0.2 ug/L the methods did not

agree. Since the Lockheed method has the higher detection limit those results are the most suspect, however, a direct comparison of the two methods using samples of known mercury content would be required to definitively determine which lab was more accurate.

There were 80 pairs of sediment sample results available for comparison. Of these only two pairs had values reported as nondetectable mercury. In both cases TMA-ARLI reported the nondetects, but the concentrations reported by Brooks Rand were also relatively low (0.0259 and 0.237 mg/kg) for these samples. The values for the remaining 78 samples are presented in Table 8 and Figure 2. With the exception of a few apparent outlying anomalies, the results from the two labs are reasonably scattered about the 1:1 line that would represent perfect agreement between the labs. A line fit to the log transformed data has an R-Square of 0.84 indicating a strong correlation between the results from the two labs.

7.2 COMPARISON OF TOTAL AND DISSOLVED CONCENTRATIONS

The total analyte concentration is the concentration determined on an unfiltered sample following vigorous digestion. The dissolved analyte is defined as the analyte present in a representative water sample which passes through a 0.45 micron membrane filter. Theoretically, the dissolved concentration of an analyte does not exceed total concentration. For a sample with a high particulate associated concentration the reported total concentration should always exceed the dissolved concentration when determined using the same analytical method. However, when the total concentration is near the method detection limit or when the analyte being measured tends to be entirely in the dissolved form, including oxyanion-forming elements such as boron, molybdenum, arsenic, chromium, and most major cations, it is not unexpected to see the dissolved concentration reported as higher than the total concentration. In fact, when the true dissolved and total concentrations are the same one would expect to have the dissolved reported higher 50% of the time, although the absolute difference between the dissolved and total should be small.

Table 8 summarizes the comparison of the total and dissolved concentrations for the surface water samples. The table presents the number of samples where the total concentration exceeded the dissolved, the number of samples where the dissolved concentration exceeded the total, and summarizes the relative differences between the two results. The total and dissolved values were only compared when both concentrations were greater than the detection limit. The relative difference was only calculated for cases where the dissolved concentration exceeded the total and it was defined as the percent of the difference between the dissolved and total concentrations divided by the total concentration.

The organic analyte total concentrations were nearly always greater than the dissolved concentrations. In the few cases where some dissolved values were higher than the total concentrations the total concentrations were near the detection limit.

A number of inorganic analytes have reported dissolved concentrations higher than total concentrations. Most of these differences can be attributed to the error associated with approaching the detection limit for antimony, arsenic, chromium, copper, lead, molybdenum, nickel, uranium, vanadium, and zinc.

8. SENSITIVITY

Sensitivity was achieved by requesting the lowest detection limits possible for each analysis, as well as meeting holding times and using the correct sample preservation. The ability to accurately report a contaminant of concern at or above the detection limits was a primary concern in evaluating false positives and false negatives. Early in the project, Brooks Rand failed to qualify data near the method detection limit. During evaluation of the data, the average of the trip blanks was used to qualify the data as detects or nondetects.

9. CORRECTIVE ACTIONS

During the sampling and analysis process as well as the review process, problems were documented using a Programmatic Exception Report (PER) form (ER/CR-SOP1024). Approximately 400 PERs were filed containing ~850 individual exceptions. A FoxPro data base was used to track each exception and to provide responses back to the disposition team, composed of quality assurance staff, the Analytical Services Coordinator (ASC), the Data Base Manager, and other pertinent personnel. Each deficiency was tracked to closure by Clinch River personnel. Key words that summarized a type of quality problem were assigned to each exception to track quality control trends. The problems were further categorized into internal or external problems to denote those items which were internal to the program and thus root cause could be addressed. Several types of problems were considered repairable during the review process. These included missing information, transcription errors, illegible information, missing chain-of-custody forms, errors in calculation, and missing or incorrect units. A summary of PERs by laboratory is given in Table 9 and Figure 3. Table 10 and Figures 4 and 5 summarize the distribution of the types of quality control problems that were found. Figure 6 shows the distribution of the root causes for internal findings.

Two major quality control problems identified in internal PERs were data package and field errors. Root causes listed most frequently were inattention to detail, mistakes in specifications, and procedural problems. Externally, the most frequent quality control problems were errors in data packages, electronic data, sample identifications and sample results/units. Although these problems were corrected with no long-term effects on the data quality, the errors did create scheduling conflicts and increased chances of error during the data assessment.

10. QUALIFICATION OF THE DATA

During review of the field and analytical data, two sets of qualifiers were assigned to the data. The first set was assigned by the analytical laboratory, as required by each individual method. These qualifiers are summarized in Tables 11–13. The second set was assigned by the data reviewers. These qualifiers are summarized in Table 14. The review qualifiers were also accompanied by one or more reason codes (Table 15). Analytical results included the concentration of the analyte in the sample if it was present and measurable. When an analyte was not detected in a sample, the sample minimum quantitation limit for that particular sample was reported accompanied by a “U” suffix. When spectral

data indicated the presence of an organic compound that met the identification criteria but the result was less than the sample quantitation limit, a "J" qualifier was assigned, indicating that the result was an estimated value. In data analyses, these "J" values were treated as measurable results.

The result qualifiers assigned by the laboratories, validators, and electronic screening were summarized into an overall qualifier for end users for those data that were loaded into the computer. Only qualifiers which affected how the data were used were included in the overall qualifier. Those qualifiers that required manual entry were prioritized according to the effects on the data. All qualifiers resulting in rejection were entered. Under the risk assessment guidelines used for the project, data were either rejected, treated as nondetects, or used as reported. Table 16 summarizes the rules for determining the final qualifier. Additional data checking was performed as the data were summarized and evaluated for the health and ecological baseline risk assessments.

An end result use flag was also assigned to each data result. The use flag was either "Y" to symbolize that the data were usable or "N" for unusable data. Although rejected data was assigned an "N" for unusable, the primary reason for unusable data was duplication of sample results because of dilution, reanalysis, analysis by another method, or second column confirmation analysis for pesticides/PCBs. Table 17 summarizes the reasons why the use flag was set to "N".

Table 18 presents an overall summary of the quality control problems found during data validation using the reason codes assigned for each validation flag. Table 19 presents a further breakdown of the reason codes that were assigned during validation by analyte. Table 20 and 21 summarize the quality control problems found during the electronic and technical reviews respectively, using the reason codes. Tables 22 and 23 summarize the frequency of rejection and also the reasons by reason code and also by SOW and analysis group. This summary shows that the predominant reasons for rejected results were poor spike recoveries, poor sensitivity and holding times.

11. DATA REVIEW

The primary QA goal of the Clinch River Environmental Restoration Program was to ensure that the analysis of all these environmental samples produced data of known quality. According to EPA, "the quality of data is known when all components associated with its derivation are thoroughly documented, with such documentation being verifiable and defensible" (EPA 1990). To meet this goal, data used in this CRRRI report were evaluated using the following techniques, as applicable: **field data review, electronic data verification, data inventory, contract compliance screening, electronic review, manual review, and Level C or D validation**. During each level of review, if problems were found which might affect the useability of the data, the sample results were qualified. The origination of the qualifier and the reason for qualifying the data were also documented. These qualifiers were condensed into one final useability code for the end user. The final phase of the evaluation which entailed assessing the contaminant data by location and risk used these final qualifiers and useability codes as indicators of the quality of the data.

11.1 FIELD DATA REVIEW

For the **field data review**, a field data package containing all field sampling related documentation was assembled for each water and sediment sampling event. The field sampling related documentation included the weekly sampling schedule, the Field COCs, the Field Collection

Task Map (FCTM), the Laboratory Processing Task Map (LPTM), the Sample Collection Information form, site maps or geographic positioning system data, field data forms, the Field Sampling Review Checklist, and copies of pertinent field logbook pages. An internal inventory and field data review was initially conducted by the sampling team leader according to ER/CR-SOP2020. Documentation of the internal inventory and review was also included in the field data package. Following the internal review, an independent assessment was performed by a field validator. The field validator was a person experienced in field sample collection who was not a member of the sampling team. Field data obtained during the sample collection event were assigned qualifiers by the field validator. A more detailed discussion of field quality control is included in Appendix A.

The first five water and sediment sampling events for Phase 2 occurred in November 1993. Seventy-two PER indices were initiated which pertained to the sample collection and processing activities for these five sampling events. Twenty-four indices pertained to improper/missing signature or corrections, twenty-three pertained to missing data, six pertained to inadequate sample volume, six pertained to incorrect task maps, and four pertained to COC problems. The remaining nine indices pertained to six other quality control categories.

The remaining 126 sampling events for Phase 2 occurred after November 1993. Only 24 additional PER indices were initiated which pertained to sample collection and processing activities. For the five quality control categories which accounted for 63 of the 72 PER indices initiated for the first five sampling events, only 5 additional PER indices were initiated for the subsequent 126 sampling events. Seven PER indices pertained to field equipment failure, three PER indices pertained to calibration problems, and three PER indices pertained to inadequate equipment backup. The remaining 11 PER indices pertained to 10 other quality control categories. The considerable reduction of PER indices initiated for the last 126 sampling events versus the first five sampling events demonstrates the value of both a field sample collection documentation/field data validation review process and a program level exception documentation and resolution process for environmental restoration activities. As a result of the field data review, the sampling events were completely and consistently documented.

11.2 ELECTRONIC DATA VERIFICATION

During the **electronic data verification**, an evaluation of the project data base was performed to ensure accountability, traceability, correctness, and completeness. Accountability checks included confirming that data collectors and generators were identified and reviewing data transfer and data entry documentation. Data base entries were cross checked with hard copy sources such as COCs, Sample Collection forms, data packages and data validation reports. Correctness checks involved verification of data transfer processes, double data entry, and comparison of data base values with the source. Completeness checks verified that all required descriptors for both samples and individual results were present, correct, and consistent with applicable plans and procedures, and/or Oak Ridge Environmental Information System (OREIS) formats. These checks reviewed locations, coordinates, sample IDs, units, dates, laboratory sample IDs, methods, parameter names, result formats, laboratory flags, and validation flags, among others.

11.3 DATA INVENTORY

Data inventory of all data packages was conducted to verify completeness and ensure that any missing deliverables could be obtained before the final report was compiled. Inventory was conducted according to procedure ER/CR-SOP1019.

11.4 MANUAL REVIEW

A **manual review** of all data package batch narratives was conducted and summarized. These reviews were also used to flag data that did not meet criteria. All rejected data were flagged but estimated data were flagged as computing resources permitted. These summaries are included in Appendix B on analytical laboratory quality control.

11.5 CONTRACT COMPLIANCE SCREENING

Contract compliance screening (CCS) was used initially for EPA Contract Laboratory Program (CLP) electronic deliverables to assess the adequacy of the electronic files. One hundred and twelve electronic deliverables were screened for potential formatting problems and CLP SOW compliance.

11.6 ELECTRONIC REVIEW

An **electronic review** of selected quality control information was conducted. Results of these checks were compared with other available information such as the CCS, inventory and validation. Data that did not meet criteria were flagged with the appropriate qualifiers and reason codes and the type of review was designated. Organic laboratory blank contamination for sediment and water samples was assessed electronically and the data were flagged according to the guidelines in ER/CR-SOP1020. Holding times, surrogates, matrix spikes, and detection limits were also evaluated for sediment and water data. Biota data were evaluated when available electronically. Electronic data reviews are included in Appendix C. For recovery data, outliers were considered to be negative numbers and those recoveries exceeding 130%. These were removed and evaluated separately.

11.7 VALIDATION

Validation was conducted according to ER/CR-SOP1020 which was written to address EPA criteria, Clinch River data quality objectives as expressed in a given laboratory Statement of Work (SOW), and specific method requirements. Approximately 118 sample data packages were validated by an independent third-party subcontractor, SAIC, from the 900 data packages that were received. Subcontractor personnel performing the validation were required by the Clinch River ER Program SOW to be trained, experienced, and proven able to perform the review procedures. The Clinch River ER Program required, reviewed, and approved resumes and work training records. Data review deliverables for the validation consisted of the following:

- A data validation narrative summarizing by fraction the problems found that affected the data quality and the potential impact on the sample results. (Each narrative includes the name and signature of the data reviewer.)
- A completed checklist that detailed the review elements and QC problems
- Report forms for each sample with validation qualifiers and reason codes assigned to each analyte result
- A list of data review qualifiers and their meanings for use in the data evaluation

After validation was completed, the subcontractor entered the validation qualifiers into the data base. Each qualifier was also accompanied by one or more reason codes that summarized the qualifier assignment as well as a code which identified the source of the qualifier.

12. DATA MANAGEMENT SYSTEMS

A comprehensive Information Management System (IMS) was used to provide organization, integrity, security, traceability, and consistency of the data generated during Phase 2. Specifically, the IMS supported the project data life cycle, including field sampling preparation, field measurements, sample tracking, laboratory analyses of environmental samples, data verification and validation, data consolidation and storage, and data transfer to OREIS, data analysis and interpretation, summarization and reduction of data, risk assessment calculations, data presentation, and data and document archival.

An ORACLE® data base was used to implement the IMS. Constraints were defined in the data base to ensure proper linkage of sample collection and analysis data and to enforce use of standardized codes. The data base resides on the Clinch River Project SPARC 10 workstation. The data base is protected from unauthorized access, deletion and modification by the ORACLE® security. Daily and weekly backups of the data base were performed and the weekly backup tapes were stored off-site.

Records generated by the program that are required to (1) provide a complete and accurate history of sample collection, analysis, and data reporting; (2) document conduct of program business; and (3) support any future legal or administrative actions that may be taken are retained in the project files. Similarly, records that furnish documentation or evidence of quality (e.g., program work plans and results of QA oversight activities) were designated QA records and added to the project files.

Records identified for Phase 2 sampling and analysis activities included project plans and approvals, training records, audit records, calibration records for field sampling and field laboratory equipment and instruments, field and laboratory notebooks, chain-of-custody and request-for-analysis forms, instrument listings for gamma spectroscopy, analytical laboratory data packages, and data validation summary reports.

A hard-copy repository is maintained in the Clinch River ER Program Document Management Center (DMC), which is located at ORNL, Building 1505. This repository and associated index data base provide for the organization, protection, retrievability, and accountability of project records. The indexing system provides sufficient information to permit identification of the record and the items or activities to which it applies. A CERCLA administrative record file will be the recipient of officially designated documents.

13. AUDITS AND SURVEILLANCES

Audits and surveillances were performed by DOE Oak Ridge Operations (DOE-ORO); Martin Marietta Energy Systems, Inc. Central QA; and the Energy Systems Environmental Restoration (ER) QA specialist who reviewed and evaluated the adequacy of field and laboratory performance and ascertained whether the QA/QC Plan was completely and uniformly implemented. Results of these audits and surveillances were documented and reported to management. Follow-up corrective actions were taken as needed. Implementation was monitored by the Clinch River QA specialist and verified by the auditing organization.

The chronology of Readiness Review Assessments, Audits and Surveillances was as follows:

March 23–25, 1993	93CRRI-Q1 Surveillance to assess the state of readiness for Phase 2 Biota Field Sampling and Analysis.
April 28, 1993	93CRRI-L1 Surveillance to determine the TVA-Chattanooga Environmental Chemistry Laboratory plans to document and track all corrective actions for internal and external problems associated with samples received from the CR-ERP.
April 30, 1993	93CRRI-Q2 Surveillance to assess the state of readiness for Phase 2 Sediment Field Sampling and Analysis(S&A) & Water Toxicity Testing.
May 26, 1993	93CRRI-Q3 Surveillance to assess the state of readiness for Phase 2 Expanded Water & Sediment Toxicity Field Sampling and Analysis.
June 23, 1993	93CRRI-M3 Surveillance to verify that Phase 2 Biota (fish) Field Sampling and Analysis is conducted in accordance with the Phase 2 S&A Plan & SOPs.
June 28 to	DOE-ER Annual CR-ER Program Audit to evaluate the overall
July 21, 1993	effectiveness of the CR-RI in collecting data of sufficient quality for technically defensible site remediation decisions.
August 30, 1993	Readiness Assessment Meeting for Phase 2 of the CR-RI.
September 28, 1993	93CRRI-M4 Surveillance to monitor and assess Phase 2 Sediment Field Sampling.
October 26, 1993	93CRRI-M5 Surveillance to verify that Phase 2 Biota (fish) S&A done by the TVA-Norris Aquatic Biology Group is being accomplished in accordance with the CRRI-Phase 2 S&A Plan and SOPs.
November 18, 1993	93CRRI-M6 Surveillance conducted to verify that CR-ERP Phase 2 Expanded Water S&A Field Activities are being done in accordance with the CR-ERP Phase 2 S&A Plan and SOPs.
December 20, 1993	93CRRI-M7 Surveillance to verify that corrective actions for deficiencies identified in surveillance 93CRRI-M6 have been satisfactorily completed.
Dec. 15–16, 1993	DOE-ER CR-ERP Field Surveillance to evaluate the overall effectiveness of the CR-RI Phase 2 Sampling Program in collecting data of sufficient quality for technically defensible site remediation decisions.
February 24, 1994	94CRRI-M1 Surveillance to verify that Phase 2 Sample Management/Tracking and Related Documentation are being conducted according to CR-ERP Phase 2 guidelines and procedures.
February 24–25, 1994	94CRRI-M2 Surveillance to verify the Traceability of Records from Phase 2 Field S&A activities are being maintained according to applicable sections of the CR-ERP Phase 2 Technical Management Plan.

March 30, 1994	94CRRI-M3 Surveillance to determine the Status of Corrective Actions that are due for completion from past DOE-ER, MMES-ER, and other Phase 2 internal/project audits/surveillances.
April 25-29, 1994	94CRRI-M4 Surveillance to verify that Phase 2 Multi-Head Ballchek Sediment Core S&A is conducted in accordance with the CRRI Phase 2 S&A Plan, Sect. 3.3, and CR-ERP Work Aid WA-93-SW-10.
May 9-23, 1994	94CRRI-M5 Surveillance to verify that Field Sampling Activities for Other Biota (Blue Heron, Woodduck, & Contaminant Pathways in Food Webs—May Flies & Crayfish) is being conducted in accordance with the CR-ERP S&A Plan, Sect.3,4 and pertinent Phase 2 CR-ERP Biota procedure or work aid.
June 10, 1994	94CRRI-M6 Surveillance to verify that Phase 2 Deliverables from Subcontracted Analytical laboratories are being tracked to assure Phase 2 Task/SOW requirements and time frames are met.
July, 1994	DOE-ER Annual CR-ER Program Audit
August 26, 1994	94CRRI-M7 Surveillance to evaluate the effectiveness of the system being used to track all types(i.e., QC) of Phase 2 samples for the QA/QC report.
Sept. 28-29,1994	94CRRI-M8 Surveillance to evaluate the Phase 2 Data Validation results and assessment to date.
Oct. 26, 1994	94CRRI-M9 Surveillance to verify that Phase 2 Biota (fish-Biology Survey) Field S&A is conducted in accordance with the Phase 2 CR-ERP S&A and SOPs.
Nov. 29-30, 1994	94CRRI-M10 Surveillance to verify that all CR-ERP Phase 2 Task Leaders can account for all, of their samples per requirements of Phase 2 S&A Plan, Addendum DOE/OR/01-1254&D1, Sect. 3.0.
Dec. 19, 1994	94CRRI-M11 Surveillance to verify that all CR-ERP Phase 2 documentation and records are being maintained in a traceable manner to ensure the defensibility of all Phase 2 data.
Jan. 27, 1995	95CRRI-M1 Surveillance to verify that all Phase 2 Deliverables from Subcontracted Analytical Laboratories, and Data Validation results are being completed and useability determined(per CR-ERP FY-95 milestone schedule for the RI/FS.
Feb. 28, 1995	95CRRI-M2 Surveillance to determine if the Status and Schedule for the Preparation and Peer Review Process for the CR/Poplar Creek RI/FS Report has been established to ensure that all RI/FS sub-elements are completed in time to meet established dates.
Mar. 30, 1995	95CRRI-M3 Surveillance to determine the Status of Corrective Actions that are due for completion from past DOE-ER, MMES-ER, and other internal/project audits/surveillances.

14. STANDARD OPERATING PROCEDURES AND TRAINING

Whenever applicable, existing procedures were used for CRRI activities. Field sampling procedures from Kimbrough et al. (1990) were used, and many EPA Contract Laboratory Program (CLP) analytical procedures were specified. Procedures were developed to support technical and administrative activities of the CRRI when none existed. These activities included the following:

- Sampling processes
- Sample handling/custody
- Calibration of equipment used in obtaining samples and/or data
- Analytical processes
- Data reduction, validation, and reporting
- Internal QC checks
- Audits
- Surveillance and corrective action processes
- Specific routine functions required to assess data precision and completeness

The CRRI training program consisted of a training plan, which defined requirements for training frequency and trainer designation; a training needs assessment, which identified personnel to be trained; and the actual training on CRRI procedures. Training was completed as required in the appropriate SOP, and training records were maintained by the training coordinator for the CRRI. Generally, the extent of training was commensurate with the scope, complexity, and nature of the activity and the education, experience, and proficiency of the person.

15. LESSONS LEARNED

15.1 PROJECT STATEMENTS OF WORK

- Provide guidance/requirements in SOWs on how the laboratory should proceed if sample volume is insufficient to perform all requested analyses, including that the laboratory will be required to get guidance from CR-ERP as to which analyses are priority. This applies especially to biota samples, where volumes may vary depending on individual animals.
- Specify that the case narrative must list the IDs for samples reported in the package and must provide a cross-reference to laboratory sample IDs. Specify that any references to samples must include the project sample ID.
- Specify that the pages in the data package must be single-sided and on 8-1/2 x 11 paper and that notes should not be left on pages unless they are taped down so that they will go through the copier. (Response to TVA packages)
- In the future, the SOW should state that if the laboratory needs to report sample matrix/type other than as on COC (perhaps for software reasons), the laboratory should explain why in the case narrative (i.e., why the forms don't match COC). For example, if the sample matrix is listed

as CART F on the COC and the laboratory had to report it as water due to software/program requirements, the case narrative should state that this occurred. (See PER-0228)

- All method numbers listed in SOWs should be verified before the SOW is final to ensure that the numbers referenced are for the desired method.
- Require that laboratories batch, analyze, and report no more than 20 samples in a batch. Check logins to ensure that no more than 20 are listed.
- Do not assign SDGs before samples are shipped. Track outgoing samples by the COC number. After the samples are logged in by the laboratory, track them by the SDG assigned by the laboratory.
- In results, laboratories sometimes discussed/referenced only pesticides or only PPCBs. (See response to PER-0093.)
- Resolve with Brooks Rand the question of the volume required for spikes. (Reference -0111.) They received what they requested but responded to PERs regarding batches of more than 20 samples by saying they had inadequate sample volume.
- Require the laboratory to more fully document the temperature and condition of cooler contents when they send confirmation of receipt of a shipment. Revise the sample log in form to include a blank space for the laboratory to record temperature.
- To the extent possible, it is preferable to have only one SOW with a laboratory for like matrices and analyses (i.e., it would have been preferable to have SOWs 191 and 194 combined rather than separate.)
- To eliminate the possibility of misunderstanding, the SOWs with the laboratories should state that the due dates for deliverables are based on calendar days, not work days (i.e., 60 days means 60 calendar days, not 12 work weeks).
- Place more emphasis on and include specific instructions regarding how the laboratories should notify the project about problems, especially those discovered at receipt of samples.

15.2 APO STATEMENTS OF WORK

- Review of analytical laboratory SOWs needs to include a requirement that laboratories have back-up analytical equipment, parts, or access to back-up equipment in the event that primary equipment fails. (Ref. PER-94-CRRI-0108) (Suzanne Benson's file: 006769)
- The laboratory should prepare an electronic data deliverable (EDD) as part of the PE package. The ability of the laboratory to provide an acceptable EDD should be considered part of the qualification of the laboratory to provide services.

15.3 FIELD DATA VALIDATION

- Field validation proved to be very successful in identifying types of errors made at the beginning of field sample collection and processing. This enabled the field teams to proactively implement corrective actions that prevented recurrences of the errors.
- The internal review by the sampling team of collection activities through examination of documentation precluded the need for programmatic exception reports.

15.4 SHIPPING

- The Coleman Sample Manager™ brand aluminum coolers proved to be more effective than the plastic coolers in consistently maintaining the samples at the desired temperature range of 4°C (+/- 2°) while in transit to the designated laboratory. Typically, these metal coolers were capable of maintaining the desired internal chamber temperature for one day longer than the plastic coolers.²
- The metal coolers provided more protection for the glass sample containers, resulting in less breakage.
- For the first few months, glass sample containers were wrapped with plastic air-bubble packaging only once around the entire glass circumference, including the top and bottom. In response to the recurring problem of glass bottle breakage, sample containers were double wrapped with the bubble wrap material, and this significantly reduced instances of glass container breakage.
- Preparing coolers simultaneously for shipments to multiple analytical laboratories resulted in incorrect marking of the outside of one cooler, delivery to the wrong laboratory, and a two-day delay in delivery of samples to the correct laboratory. The temperatures of the affected samples were elevated above required preservation levels. To prevent this type of incident from recurring, whenever samples were shipped to two or more off-site laboratories on the same day, all shipping transactions were completed for one laboratory at a time.
- There was a total inventory of 25 coolers used for shipping Phase 2 samples to the various laboratories. This number was barely adequate even under the scaled down volume of the revised Phase 2 sample collections. During each of the three separate large-scale sampling events, the number of available coolers was less than adequate. CRERP should probably have had 15 to 20 more coolers in order to have been able to consistently ship samples within one or two days after field collection rather than sometimes waiting three to four days to ship organic samples, and five to 8 days to ship inorganic samples. Additionally, supplies of blue ice packs sometimes became a bigger issue than the coolers themselves during peak periods of shipping samples from large-scale sampling events.
- Lockheed Analytical Services was the best of all the laboratories used during Phase 2 in returning coolers and ice pack supplies in a consistent, timely manner (i.e., return receipt usually within four days of leaving ORNL). The other out-of-state laboratories were slower, usually taking about ten to fourteen days for a cooler to return. There were several instances when the laboratory was contacted and faster turnaround times on returning CR-ERP coolers was requested. This resulted in only marginal, sporadic improvements. No consistent improvements were noticed. The only way to compensate for most of the laboratories being slow to return coolers would be to have more coolers and associated cooler supplies.
- One large commercial TRUE™ refrigerator and two standard household-type refrigerators were planned for use during Phase 2. Had the numbers of samples been collected as originally planned for Phase 2, one or more refrigerators would most likely have to have been procured and set up in the greenhouse. Since the original sampling volume for Phase 2 was significantly scaled down, the available refrigerator storage space was always sufficient. The refrigerator storage space was sometimes a little tight, but nevertheless adequate.

²Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise, does not necessarily constitute or imply endorsement, recommendation or favoring by the United States Government or any agency thereof.

- During Phase 2, leakage of water from sediments collected in the 8 oz. and 16 oz. plastic jars was a continuing problem even though there were internal adjustments to sample collection and processing. The root cause was determined to be excessive sediment on the threads of the sample jar even though CRERP personnel wiped the jar threads and lids. In the future, jars with wider openings will be used so that sediments can be put into the jars without getting grains of sample on the threads.
- Double bagging samples in plastic bags prevented liquid leaking out of the bags when sample containers broke or lids cracked during shipment.
- Include a temperature trip blank with shipments. Also include additional volume of chilled water in the cooler if only a few samples (i.e., 6–10) are shipped in a large cooler.
- During Phase 2, samples were wrapped the day before they were scheduled to be shipped from ORNL. This proved to be a good practice because it always allowed sufficient time to correct or compensate for any unplanned deviation or added work task associated with preparing a specific batch of samples for off-site shipment.
- Ensure that all samples, including biota samples, are shipped according to CRERP procedures or alternative procedures that have been reviewed and accepted by CRERP.
- Shipping work aids were written and implemented for preparation of required shipping records, sample tracking, and sample packaging and shipping. All three of these work aids proved to be very helpful.
- The use of a separate shipping folder for each day for each laboratory was very helpful.
- The establishment and use of a sample shipment checklist was very helpful to ensure a minimum number of errors or omissions when packing coolers and shipping to the associated analytical laboratory.

15.5 DATA PACKAGE RECEIPT, TRACKING, HANDLING

- For future projects, the data group assigned by the laboratory should be entered into the data base from the login faxed from the laboratory instead of when the data package is received.
- Improve review of the login for correct entry by the laboratory of sample ID, analysis, date received, etc.
- DMC photocopying errors indicate a need for upgraded photocopying equipment.
- In the future a space similar to that provided for the data base support staff would enable analytical services staff to work more efficiently. The space could also be used for the collection and maintenance of a project file.
- The use of colored folders was very helpful.

15.6 DATA BASE

- Do not start the project until the data base is ready.
- The use of data base-generated COC and SAR forms worked well. The project believes this approach contributed to quality by eliminating errors related to transcription, poor handwriting, or reproduction of handwritten COC or SAR forms.

- Consider supplying an electronic form of the COC to laboratories when samples are shipped. Having the laboratory use the electronic COC could eliminate transcription errors in IDs by the laboratory.
- Track all samples, including biota samples, in one data base.
- Use ORACLE rather than SAS for interactive data entry-type systems to avoid data base deadlock.

15.7 ELECTRONIC DATA DELIVERABLES

- The format of EDDs should be determined and communicated to the laboratory before the project begins.
- The laboratory should be required to demonstrate its ability to provide data in desired formats as part of qualification for the work.
- Memos transmitting EDDs to the Information Management Group should include the date the EDD was received.
- All copies of all disks should have the date received written on the label, including copies made by Information Management Group.
- Printing a list of files on diskette deliverables and taping the list to the diskette was a good idea.
- Lesson reinforced: All diskettes and data received by the project, including data received via modem, should be scanned for viruses.
- File EDDs and revised EDDs in diskette box holders by laboratory and SOW. After all diskettes are received, transfer to notebooks. This will enable all versions of a diskette to be filed together sequentially easily during the project. Don't attempt to submit EDDs to the DMC until the end of the project.
- Require the laboratories to submit a printed copy of the electronic files and verify in writing that the EDD has been checked against the hard copy data package. Until no problems with the EDD exist, verify all electronic files against hard copy packages.

15.8 BIOTA SAMPLES

- Avoid the use of the following letters in sample IDs: "O," which may be incorrectly entered by the laboratory as a zero; "S," which may be entered as 5; "Z," which may be entered as 2; and "L" or "I," which may be entered as 1. Handwritten zeroes should be crossed to avoid confusion with the letter "O."
- Ensure that biota samples are shipped according to CR-ERP procedures or alternative procedures that have been reviewed and accepted by CR-ERP.
- Generate Task Maps and COC and Sample Analysis Request forms for biota samples from the data base in the future.

15.9 INVENTORY

- Revise the inventory procedure, refining what is to be reviewed (e.g., CAS numbers?).
- Revise the inventory procedure to require that all handwritten PERs identify samples affected by the CRERP ID number, i.e., that the PER does just not say "a sample was _____" without identifying the sample by ID.
- Revise the inventory procedure to note that if a case narrative says all QC parameters were in control, the inventory specialist should take that to include calibration, continuing calibration, spikes, blanks, holding times.
- Revise inventory procedure to identify forms not required for a given analysis (e.g., Form 4 for tritium analyses, Form 11 for ICP/MS analyses.)

15.10 VALIDATION

- Revise the validation procedure so that any detection limits that are below the method detection limits will be reviewed specifically for compliance to the SOW, not the method.

15.11 PROGRAMMATIC EXCEPTION REPORTS

- Review and close PERs in a more timely manner.
- When items are identified as missing during inventory or validation, before contacting the laboratory review the hard copy original received from the laboratory to ensure that omission is not a project photocopying error.
- To avoid entering the same item twice in the PER tracking data base, write a program that will query the operator when a sample ID is entered and has already been entered once.
- Centralize the PER data base.
- Revise the PER procedure to lessen paperwork and redefine responsibilities.

16. PHASE 1 QUALITY ASSURANCE/QUALITY CONTROL

Phase 1 of the CRRI was a preliminary study in selected areas of the Clinch River/Watts Bar Reservoir. Fish, sediment, and water samples were collected and analyzed for inorganic, organic, and radiological parameters. Phase 1 was designed to (1) obtain high-quality data to confirm existing historical data for contaminant levels; (2) determine the range of contaminant concentrations present in the river-reservoir system; (3) identify specific contaminants of concern; and (4) establish the reference (background) concentrations for those contaminants.

Quality assurance (QA) objectives for Phase 1 were that (1) scientific data generated would withstand scientific scrutiny; (2) data would be gathered using appropriate procedures for field sampling, chain-of-custody, laboratory analyses, and data reporting; and (3) data would be of known precision and accuracy. These objectives were met through the development and implementation of (1) a QA oversight program of audits and surveillances; (2) standard operating procedures

accompanied by a training program; (3) field sampling and analytical laboratory quality control requirements; (4) data and records management systems; and (5) validation of the data by an independent reviewer.

Approximately 1700 inorganic samples, 1500 organic samples, and 2200 radiological samples were analyzed and validated. The QA completeness objective for the project was to obtain valid analytical results for at least 95% of the samples collected. Overall completeness for all Phase 1 media and analyses was 88%.

Valid data were obtained for 98% of the water samples. Most of the rejected analyses occurred because of improper sample preservation, holding-time exceedances, and/or poor surrogate recoveries.

Both sediment core and grab samples were evaluated. Valid data were obtained for 96% of the core samples and 91% of the grab samples. Rejected data occurred because of low spike recoveries, holding-time exceedances, and calibration difficulties.

For fish tissue analyses, only 68% of the data was considered valid; 50% of the semivolatile data was rejected because of inadequate surrogate recoveries. The CRRI completeness objective of 95% was attained for all analysis types except the semivolatiles.

The data quality indicators of precision, accuracy, representativeness, comparability, completeness, and sensitivity were evaluated to determine any limitations associated with the data. To provide an overall qualitative assessment of the data, each analyte (or analyte group) was assigned a grade of A, >90% acceptable data (very adequate); B, 70% to 90% acceptable data (mostly adequate with some deficiencies); or C, <70% acceptable data (inadequate).

For water data the overall assessment grade for inorganic results was very adequate, with representativeness and comparability grades as mostly adequate. Pesticide/PCB organic analytes were graded only mostly adequate because of the absence of results from Poplar Creek. Semivolatile organic compounds and radionuclides, except tritium, were all graded very adequate; tritium data was graded inadequate.

For sediment results the overall assessment for gamma-emitting radionuclide analyses for grab and core samples was graded very adequate. Organic and inorganic analyses of sediment grabs were judged to be inadequate, and further sampling and analysis is warranted. Inorganic analyses of sediment core samples were judged to be mostly adequate except for arsenic, chromium, copper, lead, nickel, mercury, selenium, and zinc, which were determined to be inadequate because of excessive detection limits. Organic data from sediment cores were judged to be mostly adequate and acceptable for risk screening analysis; however, because of high detection limits and the number of rejected samples, additional sampling is warranted. Alpha-emitting radionuclide data were judged to be mostly adequate; the only limitation is that there is no measure of field precision. Only one reference site sample was collected, which prevents statistically valid comparison to be made with affected sites. This limits the value of the entire sediment data base.

For fish tissue data the overall assessment graded inorganic analyses very adequate except for lead analyses, which were graded mostly adequate. The PCB and radionuclides data were also graded very adequate. The pesticides data met validation requirements for risk assessment and were judged mostly adequate, but some QC results were less than desirable, indicating consideration of further sampling and analysis for pesticides in Phase 2. Although 50% of the semivolatile fish data were usable, the overall objective was compromised so the semivolatiles data were graded inadequate.

17. TABLES

Table 1. Summary of samples for the Clinch River Remedial Investigation—Phase 2

Statement of Work	Lab Analysis Group	Task	Matrix	Collected	Lost Before Shipping	Shipped	Lost Before Analysis	Analyzed	Validated
CRERP-0003	PPCB	B1	Biota	137	0	137	0	137	24
CRERP-0006	PPCB	B1	Biota	394	0	394	0	394	25
CRERP-0008	MET	B1	Biota	288	0	288	0	288	20
CRERP-0019	GAMMA	S1.B	Pore Water	113	0	113	0	113	11
CRERP-0019	GAMMA	S1.B	Sediment	173	0	173	1	172	11
CRERP-0019	GAMMA	S2	Sediment	7	0	7	0	7	0
CRERP-0019	GAMMA	W1.1	Water	475	0	475	0	475	27
CRERP-0020	PPCB	B1	Biota	214	0	214	0	214	14
CRERP-0021	MET	B1	Biota	137	0	137	0	137	20
MOU-0011	H2OTOX	W2	Water	99	0	99	0	99	0
MOU-0011	PWTOX	S3	Sediment	30	0	30	0	30	0
MOU-0011	SEDTOX	S3	Sediment	38	0	38	0	38	0
MOU-0011B	BIOIND	B1	Biota	986	0	986	0	986	0
SOW-041	HG	B4.2	Biota	77	0	77	0	77	0
SOW-041	PPCB	B4.2	Biota	89	0	89	0	89	0
SOW-048A	HG	B4.1	Biota	10	0	10	0	10	10
SOW-048A	PPCB	B4.1	Biota	10	0	10	0	10	10
SOW-048B	RAD5	B4.1	Biota	10	0	10	0	10	10
SOW-048B	SR90	B4.1	Biota	10	0	10	0	10	10
SOW-049	MET	B4.2	Biota	117	4	113	0	113	58
SOW-049	PCBLIP	B4.2	Biota	98	0	98	0	98	29
SOW-050	CONGENERS	B4.3	Biota	169	0	169	0	169	14
SOW-050	HG	B4.3	Biota	200	0	200	0	200	45
SOW-050	LIPIDS	B4.3	Biota	169	0	169	0	169	0
SOW-050	PPCB	B4.3	Biota	64	0	64	0	64	14
SOW-052	SVOA	B1	Biota	10	0	10	0	10	10
SOW-072	CONGENERS	B5	Biota	9	0	9	0	9	9
SOW-072	LIPIDS	B5	Biota	9	0	9	0	9	0
SOW-072	MET	B5	Biota	9	0	9	0	9	9
SOW-072	PPCB	B5	Biota	9	0	9	0	9	9
SOW-191	ANIONS	W1.1	Water	225	0	225	0	225	14
SOW-191	CN	W1.1	Water	465	0	465	0	465	42
SOW-191	MET	W1.1	Water	471	0	471	0	471	27
SOW-191	MET	W1.4	Water	21	0	21	0	21	0
SOW-191	NO3NO4	W1.4	Water	226	0	226	0	226	14
SOW-191	PPCB	W1.4	Water	456	1	455	0	455	17

Table 1. (continued)

Statement of Work	Lab Analysis Group	Task	Matrix	Collected	Lost Before Shipping	Shipped	Lost Before Analysis	Analyzed	Validated
SOW-191	SVOA	W1.4	Water	456	0	456	0	456	19
SOW-192	MET	S1.B	Sediment	169	0	169	0	169	9
SOW-192	PPCB	S1.B	Sediment	169	0	169	0	169	26
SOW-192	SVOA	S1.B	Sediment	169	0	169	0	169	26
SOW-192	TKN	S1.B	Sediment	169	0	169	0	169	9
SOW-193	HG	S1.B	Pore Water	103	0	103	0	103	28
SOW-193	HG	S1.B	Sediment	81	0	81	0	81	21
SOW-193	HG	W1.1	Water	513	0	513	0	513	61
SOW-193	HG	W1.4	Water	23	0	23	0	23	0
SOW-194	AMMON	S1.B	Pore Water	111	0	111	0	111	6
SOW-194	AMMON	W1.1	Water	221	0	221	0	221	14
SOW-194	MET	S1.B	Pore Water	129	0	129	0	129	7
SOW-194	PPCB	S1.B	Pore Water	75	0	75	0	75	24
SOW-194	SVOA	S1.B	Pore Water	74	0	74	0	74	10
SOW-194	TKN	S1.B	Pore Water	113	0	113	0	113	6
SOW-194	TOC	S1.B	Pore Water	109	0	109	0	109	6
SOW-195	PHYSC	S1.B	Sediment	168	0	168	2	166	12
SOW-196	CONGENERES	B4.2	Biota	111	0	111	0	111	25
SOW-196	MET	B4.2	Biota	103	0	103	0	103	27
SOW-196	PPCB	B4.2	Biota	89	0	89	0	89	25
SOW-217	3H	W1.1	Water	247	0	247	0	247	49
SOW-217	GAB	S1.B	Pore Water	10	0	10	0	10	0
SOW-217	GAB	W1.1	Water	245	0	245	0	245	49
SOW-217	GAB	W1.4	Water	31	0	31	0	31	0
SOW-217	GAMMA	S1.B	Pore Water	1	0	1	0	1	0
SOW-217	GAMMA	W1.1	Water	4	0	4	0	4	0
SOW-217	RAD2	S1.B	Sediment	65	0	65	0	65	8
SOW-217	RAD3	S1.B	Sediment	3	0	3	0	3	0
SOW-217	SR90	S1.B	Pore Water	109	0	109	0	109	26
SOW-217	SR90	S1.B	Sediment	157	0	157	0	157	18
SOW-217	SR90	W1.1	Water	251	0	251	0	251	35
SOW-217	U	S1.B	Pore Water	39	0	39	0	39	2
SOW-218	HG	B4.3	Biota	105	0	105	0	105	5
SOW-218	PPCB	B4.3	Biota	105	0	105	0	105	5
SOW-219A	RAD4	B4.1	Biota	10	0	10	0	10	10
SOW-219A	RAD5	B4.1	Biota	20	0	20	0	20	10

Table 1. (continued)

Statement of Work	Lab Analysis Group	Task	Matrix	Collected	Lost Before		Lost Before		Validated
					Shipping	Shipped	Analysis	Analyzed	
SOW-219A	SR90	B4.1	Biota	15	0	15	0	15	10
SOW-219B	MET	B4.1	Biota	55	0	55	0	55	55
SOW-219B	PPCB	B4.1	Biota	7	0	7	0	7	7
SOW-X1503	NTPHAL	W1.1	Water	214	0	214	0	214	214
SOW-X1503	NTPHAL	W1.4	Water	51	0	51	2	49	49
SOW-X1503	TSP	W1.1	Water	214	0	214	2	212	208
SOW-X1503	TSP	W1.4	Water	51	0	51	0	51	51
SOW-X1503	WEIGHT	S1.B	Sediment	169	2	167	1	166	0
SOW-X1503	WEIGHT	S2	Sediment	4	0	4	0	4	0
SOW-XRPD	RPRD	B1	Biota	112	0	112	0	112	0
TOTALS				11473	7	11466	8	11458	1675

Table 2. Summary of analyses for the Clinch River Remedial Investigation—Phase 2

Statement of Work	Lab Analysis Group	Task	Matrix	Samples Analyzed	Samples Validated	Parameters Per Sample ^a	Analyses Validation	Analyses Rejected	Analyses Rejected ER/TR/E ^b	Total Analyses Rejected
CRERP-0003	PPCB	B1	Biota	137	24	15	2075	0	0	0
CRERP-0006	PPCB	B1	Biota	394	25	70	22944	0	0	0
CRERP-0008	MET	B1	Biota	288	20	4	1207	0	0	0
CRERP-0019	GAMMA	S1.B	Pore Water	113	11	2	226	0	0	0
CRERP-0019	GAMMA	S1.B	Sediment	172	11	2	330	0	0	0
CRERP-0019	GAMMA	S2	Sediment	7	0	2	14	0	0	0
CRERP-0019	GAMMA	W1:1	Water	475	27	2	950	0	0	0
CRERP-0020	PPCB	B1	Biota	214	14	57	12366	0	0	0
CRERP-0021	MET	B1	Biota	137	20	5	660	0	1	1
MOU-0011	H2OTOX	W2	Water	99	0	1	0	0	0	0
MOU-0011	PWTOX	S3	Sediment	30	0	1	0	0	0	0
MOU-0011	SEDTOX	S3	Sediment	38	0	1	0	0	0	0
MOU-0011B	BIOIND	B1	Biota	986	0		24142	0	0	0
SOW-041	HG	B4.2	Biota	77	0	1	0	0	0	0
SOW-041	PPCB	B4.2	Biota	89	0	28	0	0	0	0
SOW-048A	HG	B4.1	Biota	10	10	1	10	0	0	0
SOW-048A	PPCB	B4.1	Biota	10	10	28	280	0	0	0
SOW-048B	RAD5	B4.1	Biota	10	10	7	70	0	0	0
SOW-048B	SR90	B4.1	Biota	10	10	1	10	0	0	0
SOW-049	MET	B4.2	Biota	113	58	3	351	0	0	0
SOW-049	PCBLIP	B4.2	Biota	98	29	59	0	0	0	0
SOW-050	CONGENERS	B4.3	Biota	169	14	51	0	0	0	0
SOW-050	HG	B4.3	Biota	200	45	1	0	0	0	0
SOW-050	LIPIDS	B4.3	Biota	169	0	1	92	0	0	0
SOW-050	PPCB	B4.3	Biota	64	14	28	3	0	0	0
SOW-052	SVOA	B1	Biota	10	10	66	573	87	0	87
SOW-072	CONGENERS	B5	Biota	9	9	51	459	0	0	0
SOW-072	LIPIDS	B5	Biota	9	0	1	0	0	0	0
SOW-072	MET	B5	Biota	9	9	5	45	0	0	0
SOW-072	PPCB	B5	Biota	9	9	21	189	0	0	0
SOW-191	ANIONS	W1.1	Water	225	14	4	899	0	0	0
SOW-191	CN	W1.1	Water	465	42	1	465	0	0	0
SOW-191	MET	W1.1	Water	471	27	26	12246	0	0	0
SOW-191	MET	W1.4	Water	21	0	26	546	0	0	0
SOW-191	NO3NO4	W1.4	Water	226	14	1	226	0	0	0
SOW-191	PPCB	W1.4	Water	455	17	28	12738	0	2	2

Table 2. (continued)

Statement of Work	Lab Analysis Group	Task	Matrix	Samples Analyzed	Samples Validated	Parameters Per Sample ^a	Analyses Validation	Analyses Rejected	Analyses Rejected ER/TR/E ^b	Total Analyses Rejected
SOW-191	SVOA	W1.4	Water	456	19	63	28638	0	167	167
SOW-192	MET	S1.B	Sediment	169	9	25	4190	8	28	36
SOW-192	PPCB	S1.B	Sediment	169	26	28	4702	0	30	30
SOW-192	SVOA	S1.B	Sediment	169	26	66	11151	2	2	4
SOW-192	TKN	S1.B	Sediment	169	9	1	167	0	0	0
SOW-193	HG	S1.B	Pore Water	103	28	2	206	0	0	0
SOW-193	HG	S1.B	Sediment	81	21	2	157	0	0	0
SOW-193	HG	W1.1	Water	513	61	2	1020	0	0	0
SOW-193	HG	W1.4	Water	23	0	2	46	0	0	0
SOW-194	AMMON	S1.B	Pore Water	111	6	1	111	0	0	0
SOW-194	AMMON	W1.1	Water	221	14	1	221	0	0	0
SOW-194	MET	S1.B	Pore Water	129	7	26	3353	0	1	1
SOW-194	PPCB	S1.B	Pore Water	75	24	68	2015	85	0	85
SOW-194	SVOA	S1.B	Pore Water	74	10	63	4610	81	3	84
SOW-194	TKN	S1.B	Pore Water	113	6	1	113	0	0	0
SOW-194	TOC	S1.B	Pore Water	109	6	1	109	0	0	0
SOW-195	PHYSC	S1.B	Sediment	166	12		5274	0	0	0
SOW-196	CONGENERES	B4.2	Biota	111	25	51	0	0	0	0
SOW-196	MET	B4.2	Biota	103	27	26	0	0	0	0
SOW-196	PPCB	B4.2	Biota	89	25	21	0	0	0	0
SOW-217	3H	W1.1	Water	247	49	1	241	0	6	6
SOW-217	GAB	S1.B	Pore Water	10	0	2	20	0	0	0
SOW-217	GAB	W1.1	Water	245	49	2	486	0	4	4
SOW-217	GAB	W1.4	Water	31	0	2	62	0	0	0
SOW-217	GAMMA	S1.B	Pore Water	1	0	2	2	0	0	0
SOW-217	GAMMA	W1.1	Water	4	0	2	8	0	0	0
SOW-217	RAD2	S1.B	Sediment	65	8	4	253	0	7	7
SOW-217	RAD3	S1.B	Sediment	3	0	5	15	0	0	0
SOW-217	SR90	S1.B	Pore Water	109	26	1	109	0	0	0
SOW-217	SR90	S1.B	Sediment	157	18	1	154	1	2	3
SOW-217	SR90	W1.1	Water	251	35	1	251	0	0	0
SOW-217	U	S1.B	Pore Water	39	2	3	112	0	5	5
SOW-218	HG	B4.3	Biota	105	5	1		0	0	0
SOW-218	PPCB	B4.3	Biota	105	5			0	0	0
SOW-219A	RAD4	B4.1	Biota	10	10	6	70	0	0	0
SOW-219A	RAD5	B4.1	Biota	20	10	7	120	0	0	0

Table 2. (continued)

Statement of Work	Lab Analysis Group	Task	Matrix	Samples Analyzed	Samples Validated	Parameters Per Sample ^a	Analyses Validation	Analyses Rejected	Analyses Rejected ER/TR/E ^b	Total Analyses Rejected
SOW-219A	SR90	B4.1	Biota	15	10	1	15	0	0	0
SOW-219B	MET	B4.1	Biota	55	55	6	227	0	0	0
SOW-219B	PPCB	B4.1	Biota	7	7	28	196	0	0	0
SOW-X1503	NTPHAL	W1.1	Water	214	214	2	414	0	0	0
SOW-X1503	NTPHAL	W1.4	Water	49	49	2	69	0	0	0
SOW-X1503	TSP	W1.1	Water	212	208	3	636	0	0	0
SOW-X1503	TSP	W1.4	Water	51	51	3	153	0	0	0
SOW-X1503	WEIGHT	S1.B	Sediment	166	0	5	845	0	0	0
SOW-X1503	WEIGHT	S2	Sediment	4	0	5	20	0	0	0
SOW-XRPD	RPRD	B1	Biota	112	0	7	994	0	0	0
TOTALS				11458	1675		165671	264	258	522

^aParameters per Sample = Number of individual analyses reported per sample

^bAnalyses Rejected ER/TR/E = number of analyses rejected by electronic review

Table 3. Summary of quantitative indicators for surface water

	Sensitivity	Accuracy			Precision					
	ug/liter									
	MDL	% Recovery			Lab RPD			Field RPD		
Aluminum	9	97.7	±	7.8	18.5	±	15.3	29.5	±	30.1
Antimony	1	98.4	±	4.6						
Arsenic	2	100.2	±	5.1						
Barium-dissolved	1	96.4	±	5.3				4.0	±	3.4
Barium-total	1	96.4	±	5.3				3.7	±	2.4
Beryllium	1	100.1	±	5.1						
Boron-dissolved	19	95.0	±	18.1	29.6	±	23.4	18.0	±	20.1
Boron-total	19	95.0	±	18.1	46.1	±	41.6	9.8	±	1.0
Cadmium	1	102.8	±	4.3						
Calcium-dissolved	27	89.6	±	26.9	2.5	±	2.3	2.2	±	2.8
Calcium-total	27	89.6	±	26.9	1.8	±	2.1	1.7	±	1.4
Chromium	1	98.8	±	4.4						
Cobalt	1	97.6	±	4.2						
Copper	3	95.4	±	6.3				22.9	±	20.3
Iron-dissolved	19	96.1	±	6.0				8.2	±	7.7
Iron-total	19	96.1	±	6.0				21.7	±	23.9
Lead	1	96.7	±	4.5						
Magnesium-dissolved	9	101.7	±	14.4	2.6	±	2.4	2.7	±	4.3
Magnesium-total	9	101.7	±	14.4	2.8	±	2.2	2.4	±	1.4
Manganese	1	99.1	±	5.3						
Mercury	0.2	99.0	±	8.1	7.9	±	6.2			
Molybdenum	2	98.5	±	4.6						
Nickel	1	98.0	±	4.1				3.4	±	4.2
Potassium-dissolved	13	95.3	±	5.4				2.1	±	0.9
Potassium-total	13	95.3	±	5.4				3.0	±	2.1
Selenium	2	107.9	±	6.9						
Silver	1	93.0	±	10.8						
Sodium-dissolved	20	94.9	±	10.5	2.8	±	2.2	2.1	±	2.5
Sodium-total	20	94.9	±	10.5	2.5	±	2.1	3.8	±	4.5
Thallium	1	96.8	±	4.3						
Uranium	1	97.6	±	5.9						
Vanadium	1	100.2	±	4.5						
Zinc	8	102.8	±	5.6				12.5	±	11.9
Bromide	0.08	99.9	±	5.5						
Chloride-dissolved	0.02	97.0	±	3.6	2.4	±	2.3	21.2	±	33.3

Table 3. (continued)[illegible]

Table 3. (continued)

	Sensitivity ug/liter MDL	Accuracy			Precision		
		% Recovery			Lab RPD		Field RPD
Dimethylphthalate	5						
Acenaphthylene	5						
2,6-Dinitrotoluene	5						
3-Nitroaniline	20						
Acenaphthene	5						
2,4-Dinitrophenol	20						
4-Nitrophenol	20						
Dibenzofuran	5						
2,4-Dinitrotoluene	5	58.7	±	13.5	11.4	±	9.7
Diethylphthalate	5	88.1	±	19.0	17.2	±	30.2
4-Chlorophenyl-phenyl ether	5						
Fluorene	5						
4-Nitroaniline	20						
4,6-Dinitro-2-methyl phenol	20						
N-Nitrosodiphenylamine	5	58.8	±	24.2	22.4	±	28.8
4-Bromophenyl-phenyl ether	5						
Hexachlorobenzene	5	84.5	±	15.7	7.2	±	8.0
Pentachlorophenol	20						
Phenanthrene	5						
Anthracene	5						
Carbazole	5						
Di-n-butylphthalate	5						
Fluoranthene	5						
Pyrene	5						
Butylbenzylphthalate	5						
3,3'-Dichlorobenzidine	5						
Benzo(a)anthracene	5						
Chrysene	5						
Bis(2-ethylhexyl)phthalate	5						
Di-n-octylphthalate	5						
Benzo(b)fluoranthene	5						
Benzo(k)fluoranthene	5						
Benzo(a)pyrene	5	59.0	±	22.1	29.6	±	43.6
Indeno(1,2,3-cd)pyrene	5						
Dibenz(a,h)anthracene	5						

Table 3. (continued)

	Sensitivity ug/liter MDL	Accuracy			Precision		
		% Recovery			Lab RPD		Field RPD
Benzo(g,h,i)perylene	5						
alpha-BHC	0.01						
beta-BHC	0.01						
delta-BHC	0.01						
gamma-BHC	0.01	86.1	±	9.8	7.2	±	8.9
Heptachlor	0.01						
Aldrin	0.01						
Heptachlor epoxide	0.01	83.9	±	9.6	6.8	±	8.5
Endosulfan I	0.01						
Dieldrin	0.02	84.5	±	10.0	5.5	±	6.6
4,4-DDE	0.02	78.4	±	16.8	8.2	±	11.1
Endrin	0.02	85.4	±	12.7	10.4	±	11.7
Endosulfan II	0.02						
4,4'-DDD	0.02						
Endosulfan sulfate	0.02	73.7	±	17.6	8.6	±	16.1
4,4'-DDT	0.02						
Methoxychlor	0.10						
Endrin ketone	0.02						
Alpha-chlordane	0.01						
Gamma-Chlordane	0.01	86.8	±	15.4	6.0	±	7.4
Toxaphene	1.00						
Endrin aldehyde	0.02						
Aroclor-1016	0.20						
Aroclor-1221	0.40						
Aroclor-1232	0.20						
Aroclor-1242	0.20						
Aroclor-1248	0.20						
Aroclor-1254	0.20						
Aroclor-1260	0.20						

Table 4. Summary of quantitative indicators for sediment

	Sensitivity	Accuracy			Precision					
	ug/kg MDL	% Recovery			Lab RPD			Field RPD		
Aluminum					12.9	±	9.2	19.9	±	12.2
Antimony	0.5	15.4	±	13.5						
Antimony (post-digestion)		85.0	±	13.0						
Arsenic		81.2	±	24.5	21.1	±	21.8	24.5	±	19.0
Arsenic (post-digestion)		102.2	±	8.2						
Barium		96.3	±	5.1	6.8	±	8.7	22.0	±	17.1
Beryllium		89.3	±	5.9	6.5	±	4.0	20.6	±	12.7
Boron	1.5	84.1	±	7.7	39.9	±	0.2	28.0	±	19.6
Cadmium		97.6	±	27.0	33.3	±	39.5	26.5	±	22.0
Cadmium (post-digestion)		97.4	±	11.6						
Calcium					5.5	±	11.0	16.7	±	21.3
Chromium		101.5	±	12.6	9.9	±	11.2	25.0	±	32.1
Cobalt		73.1	±	24.0	11.8	±	11.7	22.5	±	18.2
Cobalt (post-digestion)		95.0	±	14.7						
Copper		88.5	±	20.2	4.0	±	3.8	22.9	±	27.3
Iron					5.1	±	3.9	13.6	±	8.8
Lead		88.1	±	29.3	27.9	±	24.9	30.4	±	27.2
Lead (post-digestion)		101.1	±	17.6						
Magnesium					6.4	±	4.9	14.8	±	13.1
Manganese		89.9	±	27.0	9.5	±	12.4	25.2	±	20.2
Mercury	0.0	76.6	±	32.5	16.8	±	15.4	59.0	±	48.2
Molybdenum	1.7	85.2	±	6.4						
Nickel		97.8	±	6.4	2.8	±	2.0	29.0	±	29.5
Potassium					17.1	±	13.8	18.4	±	12.5
Selenium	0.6	29.1	±	23.8						
Selenium (post-digestion)		67.0	±	17.4						
Silver	0.0	68.6	±	22.5	21.1	±	20.1	41.1	±	39.4
Silver (post-digestion)		104.8	±	10.3						
Sodium	34.7							13.7	±	12.6
Thallium	0.2	85.4	±	7.2						
Thallium (post-digestion)		95.6	±	11.2						
Uranium	4.8	85.3	±	19.1	16.6	±	24.1			
Vanadium		98.8	±	4.9	9.0	±	6.4	12.6	±	10.0
Zinc		97.2	±	7.1	5.0	±	4.9	15.6	±	17.5
Kjeldahl nitrogen	9.8	74.6	±	35.4	25.8	±	28.3	53.9	±	42.1

Table 4. (continued)[illegible]

Table 4. (continued)

	Sensitivity	Accuracy			Precision				
	ug/kg MDL	% Recovery			Lab RPD			Field RPD	
Acenaphthene	420	86.5	±	11.9	6.3	±	4.0		
2,4-Dinitrophenol	960								
4-Nitrophenol	970	76.6	±	25.5	9.9	±	12.1		
Dibenzofuran	480							19.5	± 15.3
2,4-Dinitrotoluene	400	88.2	±	14.5	7.3	±	8.4		
Diethylphthalate	410								
4-Chlorophenyl-phenyl ether	400								
Fluorene	420							20.3	± 4.8
4-Nitroaniline	960								
4,6-Dinitro-2-methyl phenol	960								
N-Nitrosodiphenylamine	400								
4-Bromophenyl-phenyl ether	400								
Hexachlorobenzene	400								
Pentachlorophenol	980	60.0	±	28.8	14.2	±	13.9		
Phenanthrene	210							38.0	± 29.2
Anthracene	430								
Carbazole	430							44.9	± 13.6
Di-n-butylphthalate	500								
Fluoranthene	240							36.1	± 24.4
Pyrene	220	89.5	±	20.8	7.8	±	7.1	33.0	± 25.4
Butylbenzylphthalate	430								
3,3'-Dichlorobenzidine	400								
Benzo(a)anthracene	350							41.6	± 27.3
Chrysene	380							27.2	± 24.9
Bis(2-ethylhexyl)phthalate	450							28.9	± 12.2
Di-n-octylphthalate	400								
Benzo(b)fluoranthene	230							34.3	± 25.2
Benzo(k)fluoranthene	500							27.1	± 17.7
Benzo(a)pyrene	430							30.4	± 21.0
Indeno(1,2,3-cd)pyrene	520							32.5	± 24.8
Dibenz(a,h)anthracene	430							12.8	± 1.5
Benzo(g,h,i)perylene	480							32.9	± 13.8
alpha-BHC	1.2								
beta-BHC	1.2								
delta-BHC	1.2								

Table 4. (continued)

	Sensitivity	Accuracy			Precision					
	ug/kg									
	MDL	% Recovery			Lab RPD			Field RPD		
gamma-BHC	1.2	79.6	±	17.7	12.3	±	13.9			
Heptachlor	1.3	74.2	±	14.6	12.4	±	12.1	14.5	±	6.1
Aldrin	1.2	69.8	±	17.4	21.7	±	40.4			
Heptachlor epoxide	1.2									
Endosulfan I	1.2									
Dieldrin	2.4	79.0	±	19.6	20.8	±	41.3			
4,4'-DDE	2.4									
Endrin	2.4	85.0	±	17.3	13.4	±	13.3			
Endosulfan II	2.4									
4,4'-DDD	2.4									
Endosulfan sulfate	2.4									
4,4'-DDT	2.4	80.6	±	15.4	11.0	±	11.5			
Methoxychlor	12.4									
Endrin ketone	2.4									
Alpha-chlordane	1.2									
Gamma-Chlordane	1.2									
Toxaphene	123.6									
Endrin aldehyde	2.4									
Aroclor-1016	24.0									
Aroclor-1221	48.7									
Aroclor-1232	24.0									
Aroclor-1242	24.0									
Aroclor-1248	24.5							73.6	±	4.7
Aroclor-1254	23.7							54.1	±	57.3
Aroclor-1260	22.0							40.4	±	35.2

Table 5. Summary of quantitative indicators for pore water

	Sensitivity	Accuracy			Precision					
	ug/liter									
	MDL	% Recovery			Lab RPD			Field RPD		
Aluminum	11	102.3	±	5.3						
Antimony	1	99.1	±	4.2						
Arsenic	2	102.6	±	5.2						
Barium	1	99.8	±	4.7				13.9	±	15.9
Beryllium	1	98.1	±	5.1						
Boron	23	104.5	±	4.7	25.7	±	17.3	70.0	±	28.3
Cadmium	1	105.3	±	4.0						
Calcium	43	103.2	±	22.4	1.0	±	0.9	12.3	±	12.1
Chromium	1	101.8	±	4.4						
Cobalt	1	101.2	±	3.9				3.8	±	4.5
Copper	2	95.6	±	7.1						
Iron	17	103.8	±	6.4				2.3	±	1.0
Lead	1	101.0	±	4.0						
Magnesium	12	98.2	±	14.2	2.0	±	1.9	12.7	±	14.1
Manganese	1	102.0	±	13.1	2.2	±	2.5	24.6	±	13.2
Mercury	0.2	101.8	±	8.6						
Molybdenum	3	101.8	±	5.0						
Nickel	2	100.0	±	4.4				32.1	±	43.1
Potassium	25	101.1	±	7.1				13.0	±	10.2
Selenium	2	109.5	±	7.3						
Silver	1	99.6	±	6.8						
Sodium	36	101.5	±	8.6	1.1	±	0.8	5.3	±	4.1
Thallium	1	100.3	±	4.5						
Uranium	1	100.5	±	3.1						
Vanadium	1	102.4	±	4.3						
Zinc	9	102.7	±	5.0				59.3	±	74.1
Ammonia nitrogen					1.5	±	1.5	27.6	±	19.8
Kjeldahl nitrogen		98.6	±	12.3	3.2	±	4.1	25.0	±	18.5
Total Organic Carbon		94.4	±	7.2	2.7	±	2.2	15.3	±	21.4

Table 6. Brooks Rand and Lockheed mercury results for surface water where Lockheed reported at least two times the method detection limit

Date	Site	Water Type	Brooks Rand	Lockheed	Units
24 FEB 1994	PCM 5.5	WHOLE	0.552	0.670	UG/L
24 FEB 1994	PCM 5.5	WHOLE	0.374	0.531	UG/L
24 FEB 1994	PCM 5.5	WHOLE	0.226	0.400	UG/L
15 JUN 1994	CRM 6.0	FILTERED	0.00434*	1.300	UG/L
28 JUN 1994	PCM 1.0	WHOLE	0.555	1.000	UG/L
28 JUN 1994	PCM 1.0	WHOLE	0.554	0.795	UG/L
28 JUN 1994	PCM 2.9	FILTERED	0.009	0.730	UG/L
28 JUN 1994	PCM 2.9	WHOLE	0.202	0.460	UG/L
29 JUN 1994	PCM 7.5	FILTERED	0.0034*	0.660	UG/L
29JUL 1994	PCM 0.1B	WHOLE	0.0904	1.100	UG/L

*reported as a nondetected value.

Table 7. Brooks Rand and TMA-ARLI mercury results for sediment samples

Date	Site	Brooks Rand	TMA-ARLI	Units
15 NOV 93	TRM 570.8	0.111	0.126	MG/KG
15 NOV 93	TRM 572.3	0.109	0.120	MG/KG
15 NOV 93	TRM 572.3	0.088	0.133	MG/KG
15 NOV 93	TRM 573.8	0.064	0.100	MG/KG
16 NOV 93	CRM 0.0	1.054	1.100	MG/KG
10 JAN 94	CRM 10.0L	0.216	0.290	MG/KG
10 JAN 94	CRM 10.0L	0.376	0.346	MG/KG
10 JAN 94	CRM 10.0R	6.723	12.300	MG/KG
10 JAN 94	CRM 10.1L	0.227	0.930	MG/KG
10 JAN 94	CRM 10.1R	0.066	0.140	MG/KG
11 JAN 94	CRM 10.8L	3.886	2.000	MG/KG
11 JAN 94	CRM 10.8R	6.946	10.800	MG/KG
11 JAN 94	CRM 10.9L	1.162	3.400	MG/KG
11 JAN 94	CRM 10.9R	0.084	0.170	MG/KG
25 JAN 94	CRM 51.5	0.052	0.069	MG/KG
21 FEB 94	PCM 0.5	137.766	23.600	MG/KG
21 FEB 94	PCM 0.5	141.052	35.254	MG/KG
28 FEB 94	CRM 9.0	0.533	0.313	MG/KG
07 MAR 94	PCM 2.9	1.980	0.374	MG/KG
07 MAR 94	PCM 4.3	5.868	6.100	MG/KG
14 MAR 94	PCM 5.1	0.031	0.061	MG/KG
14 MAR 94	PCM 7.0	0.185	0.250	MG/KG
04 APR 94	CRM 13.7	0.175	0.170	MG/KG
04 APR 94	CRM 14.5	0.093	0.092	MG/KG
11 APR 94	CRM 12.4	0.070	0.050	MG/KG
11 APR 94	CRM 12.4	0.096	0.063	MG/KG
11 APR 94	CRM 13.2	0.055	0.045	MG/KG
25 APR 94	CRM 12.1	0.095	0.076	MG/KG
25 APR 94	CRM 13.0	0.252	0.115	MG/KG
25 APR 94	CRM 13.4	0.029	0.050	MG/KG
02 MAY 94	CRM 6.5	0.112	0.130	MG/KG
02 MAY 94	CRM 7.2	1.958	1.900	MG/KG
02 MAY 94	CRM 7.8	1.631	0.732	MG/KG
09 MAY 94	CRM 3.9	2.876	2.100	MG/KG
09 MAY 94	CRM 4.3	6.961	4.200	MG/KG
09 MAY 94	CRM 4.3	3.606	4.814	MG/KG
16 MAY 94	CRM 2.6	1.690	1.800	MG/KG
16 MAY 94	CRM 2.7	2.675	2.362	MG/KG
16 MAY 94	CRM 3.1	0.726	0.540	MG/KG

Table 7. (continued)

Date	Site	Brooks Rand	TMA-ARLI	Units
16 MAY 94	CRM 3.6	1.792	1.500	MG/KG
17 MAY 94	CRM 4.2	0.948	0.840	MG/KG
17 MAY 94	CRM 4.8	0.264	0.340	MG/KG
17 MAY 94	CRM 6.2	2.939	3.600	MG/KG
17 MAY 94	CRM 6.7	0.003	0.260	MG/KG
24 MAY 94	CRM 52.0	0.017	0.032	MG/KG
24 MAY 94	CRM 52.5	0.022	0.050	MG/KG
25 MAY 94	CRM 53.5	0.049	0.080	MG/KG
25 MAY 94	CRM 54.0	0.069	0.070	MG/KG
03 JUN 94	MBM 0.2	0.109	0.160	MG/KG
03 JUN 94	MBM 0.4	0.160	0.315	MG/KG
03 JUN 94	WBM 0.6	0.764	0.880	MG/KG
07 JUN 94	PCM 1.3	4.848	4.842	MG/KG
07 JUN 94	PCM 1.8	2.484	2.000	MG/KG
07 JUN 94	PCM 2.2	3.978	104.000	MG/KG
20 JUN 94	PCM 2.3	15.008	51.000	MG/KG
20 JUN 94	PCM 2.3	9.262	7.819	MG/KG
20 JUN 94	PCM 2.5	5.138	5.200	MG/KG
20 JUN 94	PCM 2.7	7.304	4.900	MG/KG
27 JUN 94	PCM 2.8	4.979	3.500	MG/KG
27 JUN 94	PCM 3.1	30.661	62.600	MG/KG
27 JUN 94	PCM 3.3	8.360	4.200	MG/KG
18 JUL 94	PCM 4.0	0.628	0.420	MG/KG
18 JUL 94	PCM 4.5	9.293	5.800	MG/KG
18 JUL 94	PCM 4.8	4.606	1.800	MG/KG
02 AUG 94	PCM 0.0C	3.702	3.100	MG/KG
02 AUG 94	PCM 0.0L	2.063	0.070	MG/KG
02 AUG 94	PCM 0.0R	55.847	43.200	MG/KG
02 AUG 94	PCM 0.0R	49.430	64.100	MG/KG
08 AUG 94	PCM 6.0	1.219	1.200	MG/KG
08 AUG 94	PCM 6.5	0.194	0.100	MG/KG
08 AUG 94	PCM 7.5	0.122	0.030	MG/KG
08 AUG 94	PCM 7.6	0.052	0.040	MG/KG
06 SEP 94	PCM 3.9	3.118	2.800	MG/KG
06 SEP 94	PCM 4.0R	36.956	42.500	MG/KG
06 SEP 94	PCM 4.1	12.720	9.500	MG/KG
12 SEP 94	PCM 0.8	4.476	5.000	MG/KG
12 SEP 94	PCM 0.8	4.630	3.700	MG/KG
12 SEP 94	PCM 1.4	7.109	5.500	MG/KG

Table 8. Comparison of total values vs dissolved values for surface water

13:21 Monday, September 11, 1995

PARAM_ TYP CODE	PARAM_ STD NAM	Relative Difference					Total Values >=	Dissolved Values	Total Values <	Dissolved Values
		Number	Minimum	Maximum	Mean	Standard Deviation	Number	Percent of total	Number	Percent of total
I	Aluminum	0.00					194.00	100.00		
	Antimony	11.00	121.74	790.91	313.82	229.96	183.00	94.33	11.00	5.67
	Arsenic	10.00	3.03	60.00	30.22	18.86	184.00	94.85	10.00	5.15
	Barium	6.00	0.29	12.63	3.77	4.71	188.00	96.91	6.00	3.09
	Beryllium	0.00	.	.	.	.	194.00	100.00	.	.
	Boron	56.00	1.62	256.73	50.63	58.00	138.00	71.13	56.00	28.87
	Cadmium	0.00	.	.	.	.	194.00	100.00	.	.
	Calcium	50.00	0.19	10.21	2.60	2.25	144.00	74.23	50.00	25.77
	Chromium	30.00	1.35	440.00	59.93	81.96	164.00	84.54	30.00	15.46
	Cobalt	0.00	.	.	.	.	194.00	100.00	.	.
	Copper	84.00	4.35	1754.55	110.42	220.28	110.00	56.70	84.00	43.30
	Cyanide	0.00	.	.	.	.	194.00	100.00	.	.
	Iron	3.00	76.02	249.14	170.83	87.73	191.00	98.45	3.00	1.55
	Lead	3.00	20.00	54.55	32.26	19.34	191.00	98.45	3.00	1.55
	Magnesium	61.00	0.16	8.02	2.34	1.84	133.00	68.56	61.00	31.44
	Manganese	1.00	70.67	70.67	70.67	.	193.00	99.48	1.00	0.52
	Mercury	3.00	30.43	153.85	80.99	64.66	370.00	99.20	3.00	0.80
	Methyl mercury	4.00	2.78	45.16	23.40	18.49	171.00	97.71	4.00	2.29
	Molybdenum	2.00	7.14	10.00	8.57	2.02	192.00	98.97	2.00	1.03
	Nickel	76.00	1.40	485.71	87.25	116.10	118.00	60.82	76.00	39.18
	Potassium	31.00	0.09	13.85	3.67	3.18	163.00	84.02	31.00	15.98
	Selenium	0.00	.	.	.	.	194.00	100.00	.	.

Table 8. (continued)

PARAM_ TYP CODE	PARAM_ STD NAM	Relative Difference					Total Values	>=	Dissolved Values	Total Values	<	Dissolved Values
		Number	Minimum	Maximum	Mean	Standard Deviation	Number	Percent of total	Number	Percent of total	Number	Percent of total
O	Silver	0.00	.	.	.	.	194.00	100.00	.	.	.	.
	Sodium	50.00	0.31	11.01	2.85	2.45	144.00	74.23	50.00	25.77	.	.
	Thallium	0.00	.	.	.	.	194.00	100.00	.	.	.	.
	Uranium	4.00	2.00	19.41	7.33	8.11	190.00	97.94	4.00	2.06	.	.
	Vanadium	1.00	20.00	20.00	20.00	.	193.00	99.48	1.00	0.52	.	.
	Zinc	40.00	0.89	546.46	73.26	103.35	154.00	79.38	40.00	20.62	.	.
	1, 2, 4-Trichlorobenzene	0.00	.	.	.	.	188.00	100.00	.	.	.	.
	2,2'-oxybis (1-chloropropane)	0.00	.	.	.	.	188.00	100.00	.	.	.	.
	2,4,5-Trichlorophenol	0.00	.	.	.	.	188.00	100.00	.	.	.	.
	2,4,6-Trichlorophenol	0.00	.	.	.	.	188.00	100.00	.	.	.	.
	2,4-Dichlorophenol	0.00	.	.	.	.	188.00	100.00	.	.	.	.
	2,4-Dimethylphenol	0.00	.	.	.	.	188.00	100.00	.	.	.	.
	2,4-Dinitrophenol	0.00	.	.	.	.	188.00	100.00	.	.	.	.
	2,4-Dinitrotoluene	0.00	.	.	.	.	188.00	100.00	.	.	.	.
	2,6-Dinitrotoluene	0.00	.	.	.	.	188.00	100.00	.	.	.	.
	2-Chloronaphthalene	0.00	.	.	.	.	188.00	100.00	.	.	.	.
	2-Chlorophenol	0.00	.	.	.	.	188.00	100.00	.	.	.	.
	2-Methyl-4,6 dinitrophenol	0.00	.	.	.	.	188.00	100.00	.	.	.	.
	2-Methylnaphthalene	0.00	.	.	.	.	188.00	100.00	.	.	.	.
	2-Methylphenol	0.00	.	.	.	.	188.00	100.00	.	.	.	.
	2-Nitroaniline	0.00	.	.	.	.	188.00	100.00	.	.	.	.
	2-Nitrophenol	0.00	.	.	.	.	188.00	100.00	.	.	.	.

Table 8. (continued)

PARAM_ TYP_ CODE	PARAM_ STD NAM	Relative Difference					Total Values >=	Dissolved Values	Total Values <	Dissolved Values
		Number	Minimum	Maximum	Mean	Standard Deviation	Number	Percent of total	Number	Percent of total
O	3,3'-Dichlorobenzidine	0.00	.	.	.	.	188.00	100.00	.	.
	3-Nitroaniline	0.00	.	.	.	.	188.00	100.00	.	.
	4,4'-DDD	0.00	.	.	.	.	188.00	100.00	.	.
	4,4'-DDE	0.00	.	.	.	.	188.00	100.00	.	.
	4,4'-DDT	0.00	.	.	.	.	188.00	100.00	.	.
	4-Bromophenyl phenyl ether	0.00	.	.	.	.	188.00	100.00	.	.
	4-Chloro-3- methylphenol	0.00	.	.	.	.	188.00	100.00	.	.
	4-Chlorobenzenamine	0.00	.	.	.	.	177.00	100.00	.	.
	4-Chlorophenyl- phenyl ether	0.00	.	.	.	.	188.00	100.00	.	.
	4-Methylphenol	0.00	.	.	.	.	188.00	100.00	.	.
	4-Nitroaniline	0.00	.	.	.	.	188.00	100.00	.	.
	4-Nitrophenol	0.00	.	.	.	.	188.00	100.00	.	.
	Acenaphthene	0.00	.	.	.	.	188.00	100.00	.	.
	Acenaphthylene	0.00	.	.	.	.	188.00	100.00	.	.
	Aldrin	0.00	.	.	.	.	188.00	100.00	.	.
	Anthracene	0.00	.	.	.	.	188.00	100.00	.	.
	Benzo(a)anthracene	0.00	.	.	.	.	188.00	100.00	.	.
	Benzo(a)pyrene	0.00	.	.	.	.	187.00	100.00	.	.
	Benzo(b)fluoranthene	0.00	.	.	.	.	188.00	100.00	.	.
	Benzo(ghi)perylene	0.00	.	.	.	.	188.00	100.00	.	.
	Benzo(k)fluoranthene	0.00	.	.	.	.	188.00	100.00	.	.

Table 8. (continued)

PARAM_ TYP_ CODE	PARAM_ STD NAM	Relative Difference					Total Values >=		Dissolved Values <	
		Number	Minimum	Maximum	Mean	Standard Deviation	Number	Percent of total	Number	Percent of total
O	Benzoic acid	0.00	.	.	.	.	188.00	100.00	.	.
	Benzyl alcohol	0.00	.	.	.	.	188.00	100.00	.	.
	Bis(2-chloroethoxy) methane	0.00	.	.	.	.	188.00	100.00	.	.
	Bis(2-chloroethyl) ether	0.00	.	.	.	.	188.00	100.00	.	.
	Bis(2ethylhexyl) phthalate	0.00	.	.	.	.	188.00	100.00	.	.
	Butylbenzylphthalate	0.00	.	.	.	.	188.00	100.00	.	.
	Carbazole	0.00	.	.	.	.	188.00	100.00	.	.
	Chrysene	0.00	.	.	.	.	188.00	100.00	.	.
	Di-n-butylphthalate	3.00	28.57	100.00	76.19	41.24	185.00	98.40	3.00	1.60
	Di-n-octylphthlate	0.00	.	.	.	.	188.00	100.00	.	.
	Dibenz(a,h)anthracene	0.00	.	.	.	.	188.00	100.00	.	.
	Dibenzofuran	0.00	.	.	.	.	188.00	100.00	.	.
	Dieldrin	0.00	.	.	.	.	188.00	100.00	.	.
	Diethylphthalate	1.00	50.00	50.00	50.00	.	187.00	99.47	1.00	0.53
	Dimethylphthalate	0.00	.	.	.	.	188.00	100.00	.	.
	Endosulfan I	0.00	.	.	.	.	188.00	100.00	.	.
	Endosulfan II	0.00	.	.	.	.	188.00	100.00	.	.
	Endosulfansulfate	0.00	.	.	.	.	186.00	100.00	.	.
	Endrin	0.00	.	.	.	.	188.00	100.00	.	.
	Endrin aldehyde	0.00	.	.	.	.	188.00	100.00	.	.

Table 8. (continued)

PARAM_ TYP_ CODE	PARAM_ STD NAM	Relative Difference					Total Values >=	Dissolved Values	Total Values <	Dissolved Values
		Number	Minimum	Maximum	Mean	Standard Deviation	Number	Percent of total	Number	Percent of total
O	Endrin ketone	0.00	.	.	.	.	188.00	100.00	.	.
	Fluoranthene	0.00	.	.	.	.	188.00	100.00	.	.
	Fluorene	0.00	.	.	.	.	188.00	100.00	.	.
	Heptachlor	0.00	.	.	.	.	188.00	100.00	.	.
	Heptachlorepoxyde	0.00	.	.	.	.	188.00	100.00	.	.
	Hexachlorobenzene	0.00	.	.	.	.	188.00	100.00	.	.
	Hexachlorobutadiene	0.00	.	.	.	.	188.00	100.00	.	.
	Hexachloro-									
	cyclopentadiene	0.00	.	.	.	.	188.00	100.00	.	.
	Hexachloroethane	0.00	.	.	.	.	188.00	100.00	.	.
	Indeno(1,2,3-cd)									
	pyrene	0.00	.	.	.	.	188.00	100.00	.	.
	Isophorone	0.00	.	.	.	.	188.00	100.00	.	.
	Lindane	0.00	.	.	.	.	188.00	100.00	.	.
	Methoxychlor	0.00	.	.	.	.	188.00	100.00	.	.
	N-Nitroso-di-n-									
	propylamine	0.00	.	.	.	.	188.00	100.00	.	.
	N-Nitrosodipheny-									
	lamine	0.00	.	.	.	.	187.00	100.00	.	.
	Naphthalene	0.00	.	.	.	.	188.00	100.00	.	.
	Nitrobenzene	0.00	.	.	.	.	188.00	100.00	.	.
	PCB-1016	0.00	.	.	.	.	188.00	100.00	.	.
	PCB-1221	0.00	.	.	.	.	188.00	100.00	.	.
	PCB-1232	0.00	.	.	.	.	188.00	100.00	.	.

Table 8. (continued)

PARAM_ TYP_ CODE	PARAM_ STD NAM	Relative Difference					Total Values $\geq$ Dissolved Values		Total Values $<$ Dissolved Values	
		Number	Minimum	Maximum	Mean	Standard Deviation	Number	Percent of total	Number	Percent of total
O	PCB-1242	0.00	.	.	.	.	188.00	100.00	.	.
	PCB-1248	0.00	.	.	.	.	188.00	100.00	.	.
	PCB-1254	0.00	.	.	.	.	188.00	100.00	.	.
	PCB-1260	0.00	.	.	.	.	188.00	100.00	.	.
	Pentachlorophenol	0.00	.	.	.	.	188.00	100.00	.	.
	Phenanthrene	0.00	.	.	.	.	188.00	100.00	.	.
	Phenol	0.00	.	.	.	.	188.00	100.00	.	.
	Pyrene	0.00	.	.	.	.	188.00	100.00	.	.
	Toxaphene	0.00	.	.	.	.	188.00	100.00	.	.
	alpha-BHC	1.00	38.46	38.46	38.46	.	187.00	99.47	1.00	0.53
	alpha-Chlordane	0.00	.	.	.	.	188.00	100.00	.	.
	beta-BHC	0.00	.	.	.	.	188.00	100.00	.	.
	delta-BHC	0.00	.	.	.	.	188.00	100.00	.	.
	gamma-Chlordane	0.00	.	.	.	.	188.00	100.00	.	.

Relative difference = $[(\text{Dissolved Total})/\text{Total}] \times 100$.

Table 9. Distribution of programmatic exceptions by laboratory

Laboratory	Type	Matrix	Number of Exceptions	Number of Samples
Brooks Rand	Mercury speciation	Sediment, water	69	720
Ecotek	Alpha/beta	All ¹	120	839
Lockheed	Inorg/Org	Water	213	3152
TMA/ARLI	Inorg/Org	Sediment	73	676
ORAS ²	Alpha/beta	All ¹	5	323
SWRI ²	Inorg/Org/Phys	Biota, sediment	138	1520
TMA/Eberline	Alpha/beta	Biota	8	45
TVA ²	Inorg/Org	Fish	85	1170
ESD ²	Gamma	All ¹	48	768
Y-12	Alpha/beta	Biota, water	1	50
Totals			760	9263

¹All = sediment, water, biota²ORAS = Oak Ridge Analytical Services

ESD = Environmental Sciences Division

SWRI = Southwest Research Institute

TVA = Tennessee Valley Authority

Table 10. Programmatic exception report quality control categories and problem types

QC Category	Problem Type
COC	<ul style="list-style-type: none"> Not completed properly Continuation sheets not filled out completely Relinquished time and received by time incorrect Corrections not initialed and dated Not signed and dated COC does not match other documents Missing COC Samples listed on COC but not received Incorrect sample volume listed Incorrect analysis indicated
Calibration	<ul style="list-style-type: none"> Hydrolab field meter was post calibrated for dissolved oxygen only No alkalinity check point standard run. Alkalinity check standard result greater than limit Incorrect percent recovery for CCV reported
Date	<ul style="list-style-type: none"> Sampling, preparation or analysis date is incorrect Date received is incorrect
Data Package	<ul style="list-style-type: none"> Logbooks and/or worksheets are incorrect or missing. Case narrative inconsistent or incomplete Data package is incomplete (i.e., missing form, case narrative, illegible information/reproduction error) EDD is incomplete Improperly numbered Improper/missing signature or corrections Data missing Raw data not labeled correctly
Detection Limits	<ul style="list-style-type: none"> Uncertainty not reported Results reported as MDA, not results and uncertainty Required detection limit exceeded Instrument detection limit missing or incorrect
Electronic Data	<ul style="list-style-type: none"> Disk/hard copy inconsistent Disk structure or format incompatible (i.e., info in wrong columns, CCS structural defects) Missing or incomplete data
Electronic Data	<ul style="list-style-type: none"> Diskette infected with a virus No EDD
Field	<ul style="list-style-type: none"> Inadequate sample volume Incorrect/insufficient preservative used Incorrect task maps Sample contamination Field equipment failure Inadequate equipment backup

Table 10. (continued)

QC Category	Problem Type
Holding Time	Holding times exceeded
ID	Incorrect identification of sample id/analyte/matrix
Lab Control Sample	No laboratory control sample reported
Personnel	Human error (APO bid form requested TCLP extraction, original data package misplaced, wrong analysis type, pages out of place, no document Id bar code)
Results/Units	Form 1 is missing Units incorrect Improperly qualified results Missing or incomplete data Calculational problems
SOW/Method	Samples were analyzed as part of a multi-client batch. Greater than 20 samples reported in a batch Sample used for QC is in another SDG SOW, SDG, work order numbers, and project numbers inconsistent within batch Method use problems (No 2XCRDL was performed) Samples were air dried prior to analysis.
Shipping	SOW deficiency Leaking samples Broken sample No COC seals Coolers not packed correctly Coolers didn't arrive on time.
Shipping	Cooler temperature upon arrival was too hot. Samples were frozen. Sample not received. Sample cap or bottle cracked. Samples were partially thawed.
Spikes	Trip blanks used as spike No sample collected for spike Another client's sample was used for the spike.
Tracking	Package numbers inconsistently assigned. Login number incorrect. Duplicate login COC reports. Lab login forms do not match. Corrections to lab login form are improper. No temperature noted on login sheet. No PER initiated concerning exceeded cooler temperature or broken sample containers. CRERP did not respond to the broken sample containers, cracked lids, or exceeded temperatures.

Table 11. Organic analysis data qualifiers

Qualifier	Description
U	This qualifier indicates the analyte was analyzed for, but was not detected above, the reported sample quantitation limit. The sample quantitation limit is corrected for dilution and percent moisture
J	This qualifier indicates an estimated value. It is used when there are tentatively identified compounds with a 1:1 response assumed or when the mass spectral data indicate the presence of a compound that meets the identification criteria but the result is less than the sample quantitation limit but greater than zero
N	This qualifier is only used for tentatively identified compounds, where the identification is based on a mass spectral library search
P	This qualifier is used for a pesticide/Aroclor target analyte when there is greater than a 25% difference for detected concentrations between the two GC columns. The lower of the two values is reported on Form I and qualified with a "P"
C	This qualifier applies to pesticide results where the <i>identification</i> has been confirmed by GC/MS.
B	This qualifier is used when the analyte is found in the associated blank as well as in the sample. It indicates possible/probable blank contamination and warns the data user to take appropriate action. This qualifier must be used for a tentatively identified compound (TIC) as well as for a positively identified target compound
E	This qualifier identifies compounds whose concentrations exceed the calibration range of the GC/MS instrument for that specific analysis. All such compounds with a response greater than full scale should have the concentration qualified with an "E" on Form I for the original analysis
D	This qualifier identifies all compounds identified in an analysis at a secondary dilution factor. A "DL" suffix is appended to the sample number on Form I for the diluted sample and <i>all</i> concentration values reported on that Form I are qualified with the "D" qualifier. This qualifier alerts data users that any discrepancies between the concentrations reported may be due to dilution of the sample or extract
A	This qualifier indicates that a TIC is a suspected aldol-condensation product
X	This is a laboratory-specified qualifier. It must be fully described in the case narrative
PD	Pesticide surrogate diluted out
SD	Semivolatile surrogate diluted out
*	Surrogate values outside of contract required QC limits
VD	Surrogate diluted out
Y	Other specific qualifiers were required to properly define the results
Z	Other specific qualifiers were required to properly define the results
H	Analysis performed outside holding time requirement

Table 12. Inorganic analysis data qualifiers

Qualifier	Description
<i>Concentration qualifiers</i>	
B	This qualifier is used when the reported value was obtained from a reading that was less than the contract-required detection limit but greater than or equal to the instrument detection limit
U	This qualifier indicates the analyte was analyzed for but not detected
<i>Quality qualifiers</i>	
E	This qualifier is used when the reported value was estimated because of the presence of interference
M	This qualifier indicates duplicate injection precision was not met
N	This qualifier indicates spiked sample recovery was not within control limits
S	This qualifier indicates the reported value was determined using the method of standard additions (MSA)
W	This qualifier indicates postdigestion spike for Furnace AA analysis was out of control limits while sample absorbance was less than 50% of spike absorbance
*	This qualifier indicates the duplicate analysis was not within control limits
b	This qualifier indicates that the RPD cannot be computed because the sample/duplicate concentration was below the RDL
a	This qualifier indicates that the recovery/RPD cannot be evaluated due to low spike level relative to the sample concentration
X	This qualifier applies to TMA uranium results and indicates that
+	This qualifier indicates the correlation coefficient for the MSA is less than 0.995
<i>Method qualifiers</i>	
P	This qualifier denotes ICP
A	This qualifier denotes Flame AA
F	This qualifier denotes Furnace AA
CV	This qualifier denotes Manual Cold Vapor AA
AV	This qualifier denotes Automated Cold Vapor AA
AS	This qualifier denotes Semi-Automated Spectrophotometric
C	This qualifier denotes Manual Spectrophotometric
T	This qualifier denotes Titrimetric
NR	This qualifier is used if the analyte is not required to be analyzed

Table 13. Radiological data analysis qualifiers

Qualifier	Description
U	This qualifier indicates that the numerical value reported was less than the MDA
J	This qualifier indicates the radionuclide was positively identified; the associated numerical value is the approximate activity of the analyte in the sample
N	This qualifier indicates poor spike recovery
*	This qualifier indicates poor duplicates results
JN	This qualifier indicates that the quantitation of the Tentatively Identified Radionuclides was estimated
K	This qualifier indicates that one or more lines was missing in the spectrum
R	The qualifier indicates that the sample results have been rejected due to serious deficiencies in the ability to analyze the sample and meet quality control criteria
A	This qualifier indicates net estimated activity
AJ	This qualifier indicates net estimated activity
U0	This qualifier indicates that the result is not significantly greater than 0
C	This qualifier indicates that the case narrative should be seen for further explanation
M	This qualifier indicates that the target MDA was not achieved

Note: Data qualifiers were applied to the sample analysis result by the analytical laboratories and/or independent data validator. In cases where there was no data qualifier required, "=" has been inserted in the data qualifier field for this report.

Table 14. Data evaluation, validation, and historical data qualifiers

Qualifier	Description
U	This qualifier indicates the analyte was analyzed for, but was not detected above, the reported sample quantitation limit
J	This qualifier indicates the analyte was positively identified; the associated numerical value is the approximate concentration of the analyte in the sample
N	This qualifier indicates the analysis showed the presence of an analyte for which there is presumptive evidence to make a "tentative identification"
NJ	This qualifier indicates the analysis showed the presence of an analyte that has been "tentatively identified," and the associated numerical value represents its approximate concentration
UI	This qualifier indicates the analyte was not detected above the reported sample quantitation limit. However, the reported quantitation limit is approximate and may or may not represent the actual limit of quantitation necessary to accurately and precisely measure the analyte in the sample
R	This qualifier indicates the sample results have been rejected due to serious deficiencies in the ability to analyze the sample and meet quality control criteria. The presence or absence of the analyte cannot be verified
DL	The detection limit requirements were not met
UI	Uncertain identification for gamma spectroscopy
VD	Surrogate diluted out (Volatile)
JI	Value estimated from statistical model
=	This qualifier indicates that the result has been verified and is a valid result

Note: Data qualifiers were applied to the sample analysis result by the analytical laboratories and/or independent data validator. In cases where there was no data qualifier required, "=" has been inserted in the data qualifier field for this report.

Table 15. Reason codes used in data qualification

Code	Description
A01	Extraction holding times were exceeded

Table 15. (continued)

Code	Description
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Table 16. Derivation of overall result qualifiers

Result qualifier assigned by laboratory, validator, or electronic screening	Overall result qualifier
R	R
U	U
A,UJ,AJ	UJ
UX	UX
Other qualifiers	NULL

Table 17. Reasons for the data use flag = "NO"

Reason	Number
Result from alternate GC column	37496
Dilution/reanalysis; other value was used	2829
Method of standard addition; result on another record	966
Rejected by validator	525
U from TMAR; TMAN U values were selected	168
Other percent solid value selected	94
Interferences from U-234	5
Total	42083

Table 14. Data evaluation, validation, and historical data qualifiers

Qualifier	Description
U	This qualifier indicates the analyte was analyzed for, but was not detected above, the reported sample quantitation limit
J	This qualifier indicates the analyte was positively identified; the associated numerical value is the approximate concentration of the analyte in the sample
N	This qualifier indicates the analysis showed the presence of an analyte for which there is presumptive evidence to make a "tentative identification"
NJ	This qualifier indicates the analysis showed the presence of an analyte that has been "tentatively identified," and the associated numerical value represents its approximate concentration
UJ	This qualifier indicates the analyte was not detected above the reported sample quantitation limit. However, the reported quantitation limit is approximate and may or may not represent the actual limit of quantitation necessary to accurately and precisely measure the analyte in the sample
R	This qualifier indicates the sample results have been rejected due to serious deficiencies in the ability to analyze the sample and meet quality control criteria. The presence or absence of the analyte cannot be verified
DL	The detection limit requirements were not met
UI	Uncertain identification for gamma spectroscopy
VD	Surrogate diluted out (Volatile)
JI	Value estimated from statistical model
=	This qualifier indicates that the result has been verified and is a valid result

Note: Data qualifiers were applied to the sample analysis result by the analytical laboratories and/or independent data validator. In cases where there was no data qualifier required, "=" has been inserted in the data qualifier field for this report.

Table 15. Reason codes used in data qualification

Code	Description
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 judgement was used to qualify the data.
B01	Mass calibration was in error, even after applying expanded criteria.
B02	Mass calibration was not performed every 12 hours.
B03	Mass calibration did not meet ion abundance criteria.
B04	Professional judgement was used to qualify the data.
C01	Initial calibration RRF was <0.05.
C02	Initial calibration RSD 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	RSD 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 >20%.
C13	Combined breakdown of endrin/DDT was >30%.
C14	Professional judgement was used to qualify the data.
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	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 judgement was used to qualify the data.
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.

Table 15. (continued)

Code	Description
E07	Serial dilution criteria were not met.
E08	Professional judgement was used to qualify the data.
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 <CRQL
F07	Contaminant concentration level < the action limit, but >CRQL.
F08	Concentration of the contaminant detected at a level > the action level.
F09	No laboratory blanks were analyzed.
F10	Blank had a negative value >5 's the IDL.
F11	Blanks were not analyzed at required frequency.
F12	Professional judgement was used to qualify the data.
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 judgement was used to qualify the data.
G07	Radiological chemical recovery was <20%.
G08	Radiological chemical recovery was >150%.
H01	MS/MSD recovery was above the upper control limit.
H02	MS/MSD recovery was below the lower control limit.
H03	MS/MSD recovery was <10%.
H04	MS/MSD pairs exceed the RPD limit.
H05	No action was taken on MS/MSD results.
H06	Professional judgement was used to qualify the data.
H07	Rad MS/MSD recovery <50% for aqueous samples; <40% for solids.
H08	Rad MS/MSD recovery >150% for aqueous samples; >160% for solids.
H09	Rad MS/MSD samples were not analyzed at the required frequency.
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 judgement was used to qualify the data.
J01	Duplicate RPD/radiological duplicate error ratio (DER) outside control limit.
J02	Duplicate sample results were >5 he CRDL.
J03	Duplicate sample results were <5 the CRDL

Table 15. (continued)

Code	Description
J04	Professional judgement was used to qualify the data.
J05	Duplicate was not analyzed at the required frequency.
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 seconds.
K04	Professional judgement was used to qualify the data.
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 judgement was used to qualify the data.
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 judgement was used to qualify the data.
M08	The %D between the two pesticide/PCB column checks was >25%.
N01	Quantitation limits were affected by large off-scale peaks.
N02	MDLs reported by the laboratory exceeded corresponding CRQLs.
N03	Professional judgement used to qualify the data.
O01	Compound was suspected lab contaminant and was not detected in the blank.
O02	TIC result was not above 10 the level found in the blank.
O03	Professional judgement was used to qualify analytical data.
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	Rad LCS recovery was <50% for aqueous samples; <40% for solids.
P07	Rad LCS recovery >150% for aqueous samples; >160% for solids.
P08	Professional judgement was used to qualify the data.
Q01	Field duplicate RPDs were >30% for waters and/or > 50% for soils.
Q02	Radiological field duplicate error ratio (DER) was outside the control limit.
Q03	Duplicate sample results were >5 the CRDL.
Q04	Duplicate sample results were <5 the CRDL.
R01	Efficiency calibration criteria were not met.
R02	Energy calibration criteria were not met.

Table 15. (continued)

Code	Description
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 judgement was used to qualify the data.
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 judgement was used to qualify the data.
T01	Detection limits were not met.
T02	Analytical uncertainties were not met and/or not reported.
T03	Inappropriate aliquot sizes were used.
T04	Professional judgement was used to qualify the data.
U01	Energy was not within 2 KeV of the observed peak.
U02	Gamma spectra criteria were not met.
U03	Professional judgement was used to qualify the data.
V01	High background levels or a shift in the energy calibration were observed.
V02	Extraneous peaks were observed.
V03	Loss of resolution was observed.
V04	Peak-tailing or peak splitting may result in inaccurate quantitation observed.
V05	Professional judgement was used to qualify the data.

Table 16. Derivation of overall result qualifiers

Result qualifier assigned by laboratory, validator, or electronic screening	Overall result qualifier
R	R
U	U
A,UJ,AJ	UJ
UX	UX
Other qualifiers	NULL

Table 17. Reasons for the data use flag = "NO"

Reason	Number
Result from alternate GC column	37496
Dilution/reanalysis; other value was used	2829
Method of standard addition; result on another record	966
Rejected by validator	525
U from TMAR; TMAN U values were selected	168
Other percent solid value selected	94
Interferences from U-234	5
Total	42083

Table 18. Summary of qualifiers assigned from full validation

Validation result qualifier = R (rejected)		
Code	Reason description	Frequency
G03	Surrogate recovery was <10%.	192
K02	Extremely low area counts or performance was exhibited by a major drop off.	87
I03	MS recovery was <30%.	8
H03	MS/MSD recovery was <10%.	6
G02	Surrogate/radiological chemical recovery was below the lower control limit.	4
G07	Radiological chemical recovery was <20%.	1
H06	Professional judgment was used to qualify the data.	1
Validation result qualifier = U (not detected)		
Code	Reason description	Frequency
F01	Sample data were qualified as a result of the method blank.	246
F06	Concentration of the contaminant was detected at a level below the CRQL.	175
F07	Contaminant concentration level < the action limit, but > the CRQL.	75
T02	Analytical uncertainties were not met and/or not reported.	43
I01	MS recovery was above the upper control limit.	20
U03	Professional judgment was used to qualify the data.	13
K01	Area counts were outside the control limits.	5
C05	Continuing calibration %D was >25%.	4
M07	Professional judgment was used to qualify the data.	3
F03	Sample data were qualified as a result of the equipment rinsate.	2
G02	Surrogate/radiological chemical recovery was below the lower control limit.	1
K02	Extremely low area counts or performance was exhibited by a major drop off.	1
Validation result qualifier = UJ (estimated quantitation limit)		
Code	Reason description	Frequency
G02	Surrogate/radiological chemical recovery was below the lower control limit.	1917
C09	RSD criteria were not met.	884
G01	Surrogate/radiological chemical recovery was above the upper control limit.	717
P02	LCS recovery was below lower control limit.	599
G06	Professional judgment was used to qualify the data.	510

Table 18. (continued)

Validation result qualifier = UJ (estimated quantitation limit)		
Code	Reason description	Frequency
C05	Continuing calibration %D was >25%.	324
C08	RPD criteria were not met.	72
C02	Initial calibration RSD was >30%.	66
J01	Duplicate RPD/radiological duplicate error ratio (DER) outside control limit.	57
K01	Area counts were outside the control limits.	57
T02	Analytical uncertainties were not met and/or not reported.	44
R06	Absorption curve criteria were not met.	42
R07	Plateau curve criteria were not met.	35
A03	Analysis holding times were exceeded.	34
E03	Post digestion spike recovery was outside the control limit.	35
I02	MS recovery was below the lower control limit.	28
S05	Cross-talk verification criteria were not met.	23
P05	LCS was not analyzed at required frequency.	14
R01	Efficiency calibration criteria were not met.	12
F01	Sample data were qualified as a result of the method blank.	11
H01	MS/MSD recovery was above the upper control limit.	10
H02	MS/MSD recovery was below the lower control limit.	10
I01	MS recovery was above the upper control limit.	10
U03	Professional judgment was used to qualify the data.	9
N03	Professional judgment used to qualify the data.	6
E08	Professional judgment was used to qualify the data.	4
H06	Professional judgment was used to qualify the data.	2
H09	Radiological MS/MSD samples were not analyzed at the required frequency.	2
M08	The %D between the two pesticide/PCB column checks was >25%.	2
M08	The %D between the two pesticide/PCB column checks was >25%.	2098
G06	Professional judgment was used to qualify the data.	872
G01	Surrogate/radiological chemical recovery was above the upper control limit.	529
G02	Surrogate/radiological chemical recovery was below the lower control limit.	178
Validation result qualifier = UJ (estimated quantitation limit)		
Code	Reason description	Frequency
C09	RSD criteria were not met.	149
C05	Continuing calibration %D was >25%.	90
I02	MS recovery was below the lower control limit.	87
M07	Professional judgement was used to qualify the data.	75
J01	Duplicate RPD/radiological duplicate error ratio (DER) outside control limit.	64
A05	Samples were not preserved properly.	60
A03	Analysis holding times were exceeded.	49

Table 18. (continued)

Validation result qualifier = UJ (estimated quantitation limit)		
Code	Reason description	Frequency
F01	Sample data were qualified as a result of the method blank.	44
R06	Absorption curve criteria were not met.	43
R07	Plateau curve criteria were not met.	43
I01	MS recovery was above the upper control limit.	42
S05	Cross-talk verification criteria were not met.	41
I04	No action was taken on MS data.	39
D10	Professional judgment was used to qualify the data.	35
R01	Efficiency calibration criteria were not met.	32
P05	LCS was not analyzed at required frequency.	25
E03	Post digestion spike recovery was outside the control limit.	24
Validation result qualifier = J (estimated)		
Code	Reason description	Frequency
J05	Duplicate was not analyzed at the required frequency.	21
G03	Surrogate recovery was <10%.	19
H06	Professional judgement was used to qualify the data.	18
H09	Radiological MS/MSD samples were not analyzed at the required frequency.	16
C14	Professional judgment was used to qualify the data.	14
I03	MS recovery was <30%.	9
P02	LCS recovery was below lower control limit.	9
E07	Serial dilution criteria were not met.	8
D03	ICV recovery was below the lower control limit.	7
D05	CCV recovery was below the lower control limit.	7
E05	MSA correlation coefficient was <0.995.	7
D04	CCV recovery was above the upper control limit.	5
F10	Blank had a negative value >5 's the IDL.	5
H02	MS/MSD recovery was below the lower control limit.	5
A06	Professional judgment was used to qualify the data.	4
J02	Duplicate sample results were >5 the CRDL.	4
J03	Duplicate sample results were <5 the CRDL.	4
N03	Professional judgment used to qualify the data.	3
C02	Initial calibration RSD was >30%.	2
F08	Concentration of the contaminant detected at a level > the action level.	1
U03	Professional judgment was used to qualify the data.	1

Table 19. Summary of reason codes and qualifiers by analyte

Reason Codes for Accepted and Rejected Analyses

Type: Inorganic

[illegible]

Table 19. (continued)

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CLASS		Acc.		Reason		Reason		TOTAL		M	
Noj.											
TOTAL											
Analytic											
1,2,4-Triethoxybenzene		4		5						2	
1,2-Dichlorobenzene		1		4							
1,3-Dichlorobenzene		1		4							
1,4-Dichlorobenzene		1		4							
2,3,3',3',4,4',5-Mercaphtoloxobiphenyl		14		5		14					
2,3,3',3',4,4',5',5'-Oxantholoxobiphenyl		14		20		14					
2,3,3',3',4,4',5',5',6'-Oxantholoxobiphenyl		5		14		14					
2,3,3',3',4,4',5',5',6'-Oxantholoxobiphenyl		14		14		14					
2,3,3',3',4,4',5',5',6'-Oxantholoxobiphenyl		14		14		14					
2,3,3',3',4,4',5',5',6'-Oxantholoxobiphenyl		14		14		14					
2,3,3',3',4,4',5',5',6'-Oxantholoxobiphenyl		14		14		14					
2,3,3',3',4,4',5',5',6'-Oxantholoxobiphenyl		14		14		14					
2,3,3',3',4,4',5',5',6'-Oxantholoxobiphenyl		14		14		14					
2,3,3',3',4,4',5',5',6'-Oxantholoxobiphenyl		14		14		14					
2,3,3',3',4,4',5',5',6'-Oxantholoxobiphenyl		14		14		14					
2,3,3',3',4,4',5',5',6'-Oxantholoxobiphenyl		14		14		14					
2,3,3',3',4,4',5',5',6'-Oxantholoxobiphenyl		14		14		14					
2,3,3',3',4,4',5',5',6'-Oxantholoxobiphenyl		14		14		14					
2,3,3',3',4,4',5',5',6'-Oxantholoxobiphenyl		14		14		14					
2,3,3',3',4,4',5',5',6'-Oxantholoxobiphenyl		14		14		14					
2,3,3',3',4,4',5',5',6'-Oxantholoxobiphenyl		14		14		14					
2,3,3',3',4,4',5',5',6'-Oxantholoxobiphenyl		14		14		14					
2,3,3',3',4,4',5',5',6'-Oxantholoxobiphenyl		14		14		14					
2,3,3',3',4,4',5',5',6'-Oxantholoxobiphenyl		14		14		14					
2,3,3',3',4,4',5',5',6'-Oxantholoxobiphenyl		14		14		14					
2,3,3',3',4,4',5',5',6'-Oxantholoxobiphenyl		14		14		14					
2,3,3',3',4,4',5',5',6'-Oxantholoxobiphenyl		14		14		14					
2,3,3',3',4,4',5',5',6'-Oxantholoxobiphenyl		14		14		14					
2,3,3',3',4,4',5',5',6'-Oxantholoxobiphenyl		14		14		14					
2,3,3',3',4,4',5',5',6'-Oxantholoxobiphenyl		14		14		14					
2,3,3',3',4,4',5',5',6'-Oxantholoxobiphenyl		14		14		14					
2,3,3',3',4,4',5',5',6'-Oxantholoxobiphenyl		14		14		14					
2,3,3',3',4,4',5',5',6'-Oxantholoxobiphenyl		14		14		14					
2,3,3',3',4,4',5',5',6'-Oxantholoxobiphenyl		14		14		14					
2,3,3',3',4,4',5',5',6'-Oxantholoxobiphenyl		14		14		14					
2,3,3',3',4,4',5',5',6'-Oxantholoxobiphenyl		14		14		14					
2,3,3',3',4,4',5',5',6'-Oxantholoxobiphenyl		14		14		14					
2,3,3',3',4,4',5',5',6'-Oxantholoxobiphenyl		14		14		14					
2,3,3',3',4,4',5',5',6'-Oxantholoxobiphenyl		14		14		14					
2,3,3',3',4,4',5',5',6'-Oxantholoxobiphenyl		14		14		14					
2,3,3',3',4,4',5',5',6'-Oxantholoxobiphenyl		14		14		14					
2,3,3',3',4,4',5',5',6'-Oxantholoxobiphenyl		14		14		14					
2,3,3',3',4,4',5',5',6'-Oxantholoxobiphenyl		14		14		14					
2,3,3',3',4,4',5',5',6'-Oxantholoxobiphenyl		14		14		14					
2,3,3',3',4,4',5',5',6'-Oxantholoxobiphenyl		14		14		14					
2,3,3',3',4,4',5',5',6'-Oxantholoxobiphenyl		14		14		14					
2,3,3',3',4,4',5',5',6'-Oxantholoxobiphenyl		14		14		14					
2,3,3',3',4,4',5',5',6'-Oxantholoxobiphenyl		14		14		14					
2,3,3',3',4,4',5',5',6'-Oxantholoxobiphenyl		14		14		14					
2,3,3',3',4,4',5',5',6'-Oxantholoxobiphenyl		14		14		14					
2,3,3',3',4,4',5',5',6'-Oxantholoxobiphenyl		14		14		14					
2,3,3',3',4,4',5',5',6'-Oxantholoxobiphenyl		14		14		14					
2,3,3',3',4,4',5',5',6'-Oxantholoxobiphenyl		14		14		14					
2,3,3',3',4,4',5',5',6'-Oxantholoxobiphenyl		14		14		14					
2,3,3',3',4,4',5',5',6'-Oxantholoxobiphenyl		14		14		14					
2,3,3',3',4,4',5',5',6'-Oxantholoxobiphenyl		14		14		14					
2,3,3',3',4,4',5',5',6'-Oxantholoxobiphenyl		14		14		14					
2,3,3',3',4,4',5',5',6'-Oxantholoxobiphenyl		14		14		14					
2,3,3',3',4,4',5',5',6'-Oxantholoxobiphenyl		14		14		14					
2,3,3',3',4,4',5',5',6'-Oxantholoxobiphenyl		14		14		14					
2,3,3',3',4,4',5',5',6'-Oxantholoxobiphenyl		14		14		14					
2,3,3',3',4,4',5',5',6'-Oxantholoxobiphenyl		14		14		14					
2,3,3',3',4,4',5',5',6'-Oxantholoxobiphenyl		14		14		14					
2,3,3',3',4,4',5',5',6'-Oxantholoxobiphenyl		14		14		14					
2,3,3',3',4,4',5',5',6'-Oxantholoxobiphenyl		14		14		14					
2,3,3',3',4,4',5',5',6'-Oxantholoxobiphenyl		14		14		14					
2,3,3',3',4,4',5',5',6'-Oxantholoxobiphenyl		14		14		14					
2,3,3',3',4,4',5',5',6'-Oxantholoxobiphenyl		14		14		14					
2,3,3',3',4,4',5',5',6'-Oxantholoxobiphenyl		14		14		14					
2,3,3',3',4,4',5',5',6'-Oxantholoxobiphenyl		14		14		14					
2,3,3',3',4,4',5',5',6'-Oxantholoxobiphenyl		14		14		14					
2,3,3',3',4,4',5',5',6'-Oxantholoxobiphenyl		14		14		1					

Manuscript codes for accepted and rejected analyses

 

Analyte	Sample																																TOTAL																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																
	 																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																
	A01	A03	C02	C05	C08	C09	C14	P01	P02	P03	P06	P07	P08	Q01	Q02	Q03	Q06	Q07	Q08	Q09	Q10	Q11	Q12	Q13	Q14	Q15	Q16	Q17	Q18	Q19	Q20	Q21		Q22	Q23	Q24	Q25	Q26	Q27	Q28	Q29	Q30	Q31	Q32	Q33	Q34	Q35	Q36	Q37	Q38	Q39	Q40	Q41	Q42	Q43	Q44	Q45	Q46	Q47	Q48	Q49	Q50	Q51	Q52	Q53	Q54	Q55	Q56	Q57	Q58	Q59	Q60	Q61	Q62	Q63	Q64	Q65	Q66	Q67	Q68	Q69	Q70	Q71	Q72	Q73	Q74	Q75	Q76	Q77	Q78	Q79	Q80	Q81	Q82	Q83	Q84	Q85	Q86	Q87	Q88	Q89	Q90	Q91	Q92	Q93	Q94	Q95	Q96	Q97	Q98	Q99	Q100	Q101	Q102	Q103	Q104	Q105	Q106	Q107	Q108	Q109	Q110	Q111	Q112	Q113	Q114	Q115	Q116	Q117	Q118	Q119	Q120	Q121	Q122	Q123	Q124	Q125	Q126	Q127	Q128	Q129	Q130	Q131	Q132	Q133	Q134	Q135	Q136	Q137	Q138	Q139	Q140	Q141	Q142	Q143	Q144	Q145	Q146	Q147	Q148	Q149	Q150	Q151	Q152	Q153	Q154	Q155	Q156	Q157	Q158	Q159	Q160	Q161	Q162	Q163	Q164	Q165	Q166	Q167	Q168	Q169	Q170	Q171	Q172	Q173	Q174	Q175	Q176	Q177	Q178	Q179	Q180	Q181	Q182	Q183	Q184	Q185	Q186	Q187	Q188	Q189	Q190	Q191	Q192	Q193	Q194	Q195	Q196	Q197	Q198	Q199	Q200	Q201	Q202	Q203	Q204	Q205	Q206	Q207	Q208	Q209	Q210	Q211	Q212	Q213	Q214	Q215	Q216	Q217	Q218	Q219	Q220	Q221	Q222	Q223	Q224	Q225	Q226	Q227	Q228	Q229	Q230	Q231	Q232	Q233	Q234	Q235	Q236	Q237	Q238	Q239	Q240	Q241	Q242	Q243	Q244	Q245	Q246	Q247	Q248	Q249	Q250	Q251	Q252	Q253	Q254	Q255	Q256	Q257	Q258	Q259	Q260	Q261	Q262	Q263	Q264	Q265	Q266	Q267	Q268	Q269	Q270	Q271	Q272	Q273	Q274	Q275	Q276	Q277	Q278	Q279	Q280	Q281	Q282	Q283	Q284	Q285	Q286	Q287	Q288	Q289	Q290	Q291	Q292	Q293	Q294	Q295	Q296	Q297	Q298	Q299	Q300	Q301	Q302	Q303	Q304	Q305	Q306	Q307	Q308	Q309	Q310	Q311	Q312	Q313	Q314	Q315	Q316	Q317	Q318	Q319	Q320	Q321	Q322	Q323	Q324	Q325	Q326	Q327	Q328	Q329	Q330	Q331	Q332	Q333	Q334	Q335	Q336	Q337	Q338	Q339	Q340	Q341	Q342	Q343	Q344	Q345	Q346	Q347	Q348	Q349	Q350	Q351	Q352	Q353	Q354	Q355	Q356	Q357	Q358	Q359	Q360	Q361	Q362	Q363	Q364	Q365	Q366	Q367	Q368	Q369	Q370	Q371	Q372	Q373	Q374	Q375	Q376	Q377	Q378	Q379	Q380	Q381	Q382	Q383	Q384	Q385	Q386	Q387	Q388	Q389	Q390	Q391	Q392	Q393	Q394	Q395	Q396	Q397	Q398	Q399	Q400	Q401	Q402	Q403	Q404	Q405	Q406	Q407	Q408	Q409	Q410	Q411	Q412	Q413	Q414	Q415	Q416	Q417	Q418	Q419	Q420	Q421	Q422	Q423	Q424	Q425	Q426	Q427	Q428	Q429	Q430	Q431	Q432	Q433	Q434	Q435	Q436	Q437	Q438	Q439	Q440	Q441	Q442	Q443	Q444	Q445	Q446	Q447	Q448	Q449	Q450	Q451	Q452	Q453	Q454	Q455	Q456	Q457	Q458	Q459	Q460	Q461	Q462	Q463	Q464	Q465	Q466	Q467	Q468	Q469	Q470	Q471	Q472	Q473	Q474	Q475	Q476	Q477	Q478	Q479	Q480	Q481	Q482	Q483	Q484	Q485	Q486	Q487	Q488	Q489	Q490	Q491	Q492	Q493	Q494	Q495	Q496	Q497	Q498	Q499	Q500	Q501	Q502	Q503	Q504	Q505	Q506	Q507	Q508	Q509	Q510	Q511	Q512	Q513	Q514	Q515	Q516	Q517	Q518	Q519	Q520	Q521	Q522	Q523	Q524	Q525	Q526	Q527	Q528	Q529	Q530	Q531	Q532	Q533	Q534	Q535	Q536	Q537	Q538	Q539	Q540	Q541	Q542	Q543	Q544	Q545	Q546	Q547	Q548	Q549	Q550	Q551	Q552	Q553	Q554	Q555	Q556	Q557	Q558	Q559	Q560	Q561	Q562	Q563	Q564	Q565	Q566	Q567	Q568	Q569	Q570	Q571	Q572	Q573	Q574	Q575	Q576	Q577	Q578	Q579	Q580	Q581	Q582	Q583	Q584	Q585	Q586	Q587	Q588	Q589	Q590	Q591	Q592	Q593	Q594	Q595	Q596	Q597	Q598	Q599	Q600	Q601	Q602	Q603	Q604	Q605	Q606	Q607	Q608	Q609	Q610	Q611	Q612	Q613	Q614	Q615	Q616	Q617	Q618	Q619	Q620	Q621	Q622	Q623	Q624	Q625	Q626	Q627	Q628	Q629	Q630	Q631	Q632	Q633	Q634	Q635	Q636	Q637	Q638	Q639	Q640	Q641	Q642	Q643	Q644	Q645	Q646	Q647	Q648	Q649	Q650	Q651	Q652	Q653	Q654	Q655	Q656	Q657	Q658	Q659	Q660	Q661	Q662	Q663	Q664	Q665	Q666	Q667	Q668	Q669	Q670	Q671	Q672	Q673	Q674	Q675	Q676	Q677	Q678	Q679	Q680	Q681	Q682	Q683	Q684	Q685	Q686	Q687	Q688	Q689	Q690	Q691	Q692	Q693	Q694	Q695	Q696	Q697	Q698	Q699	Q700	Q701	Q702	Q703	Q704	Q705	Q706	Q707	Q708	Q709	Q710	Q711	Q712	Q713	Q714	Q715	Q716	Q717	Q718	Q719	Q720	Q721	Q722	Q723	Q724	Q725	Q726	Q727	Q728	Q729	Q730	Q731	Q732	Q733	Q734	Q735	Q736	Q737	Q738	Q739	Q740	Q741	Q742	Q743	Q744	Q745	Q746	Q747	Q748	Q749	Q750	Q751	Q752	Q753	Q754	Q755	Q756	Q757	Q758	Q759	Q760	Q761	Q762	Q763	Q764	Q765	Q766	Q767	Q768	Q769	Q770	Q771	Q772	Q773	Q774	Q775	Q776	Q777	Q778	Q779	Q780	Q781	Q782	Q783	Q784	Q785	Q786	Q787	Q788	Q789	Q790	Q791	Q792	Q793	Q794	Q795	Q796	Q797	Q798	Q799	Q800	Q801	Q802	Q803	Q804	Q805	Q806	Q807	Q808	Q809	Q810	Q811	Q812	Q813	Q814	Q815	Q816	Q817	Q818	Q819	Q820	Q821	Q822	Q823	Q824	Q825	Q826	Q827	Q828	Q829	Q830	Q831	Q832	Q833	Q834	Q835	Q836	Q837	Q838	Q839	Q840	Q841	Q842	Q843	Q844	Q845	Q846	Q847	Q848	Q849	Q850	Q851	Q852	Q853	Q854	Q855	Q856	Q857	Q858	Q859	Q860	Q861	Q862	Q863	Q864	Q865	Q866	Q867	Q868	Q869	Q870	Q871	Q872	Q873	Q874	Q875	Q876	Q877	Q878	Q879	Q880	Q881	Q882	Q883	Q884	Q885	Q886	Q887	Q888	Q889	Q890	Q891	Q892	Q893	Q894	Q895	Q896	Q897	Q898	Q899	Q900	Q901	Q902	Q903	Q904	Q905	Q906	Q907	Q908	Q909	Q910	Q911	Q912	Q913	Q914	Q915	Q916	Q917	Q918	Q919	Q920	Q921	Q922	Q923	Q924	Q925	Q926	Q927	Q928	Q929	Q930	Q931	Q932	Q933	Q934	Q935	Q936	Q937	Q938	Q939	Q940	Q941	Q942	Q943	Q944	Q945	Q946	Q947	Q948	Q949	Q950	Q951	Q952	Q953	Q954	Q955	Q956	Q957	Q958	Q959	Q960	Q961	Q962	Q963	Q964	Q965	Q966	Q967	Q968	Q969	Q970	Q971	Q972	Q973	Q974	Q975	Q976	Q977	Q978	Q979	Q980	Q981	Q982	Q983	Q984	Q985	Q986	Q987	Q988	Q989	Q990	Q991	Q992	Q993	Q994	Q995	Q996	Q997	Q998	Q999	Q1000	Q1001	Q1002	Q1003	Q1004	Q1005	Q1006	Q1007	Q1008	Q1009	Q1010	Q1011	Q1012	Q1013	Q1014	Q1015	Q1016	Q1017	Q1018	Q1019	Q1020	Q1021	Q1022	Q1023	Q1024	Q1025	Q1026	Q1027	Q1028	Q1029	Q1030	Q1031	Q1032	Q1033	Q1034	Q1035	Q1036	Q1037	Q1038	Q1039	Q1040	Q1041	Q1042	Q1043	Q1044	Q1045	Q1046	Q1047	Q1048	Q1049	Q1050	Q1051	Q1052	Q1053	Q1054	Q1055	Q1056	Q1057	Q1058	Q1059	Q1060	Q1061	Q1062	Q1063	Q1064	Q1065	Q1066	Q1067	Q1068	Q1069	Q1070	Q1071	Q1072	Q1073	Q1074	Q1075	Q1076	Q1077	Q1078	Q1079	Q1080	Q1081	Q1082	Q1083	Q1084	Q1085	Q1086	Q1087	Q1088	Q1089	Q1090	Q1091	Q1092	Q1093	Q1094	Q1095	Q1096	Q1097	Q1098	Q1099	Q1100	Q1101	Q1102	Q1103	Q1104	Q1105	Q1106	Q1107	Q1108	Q1109	Q1110	Q1111	Q1112	Q1113	Q1114	Q1115	Q1116	Q1117	Q1118	Q1119	Q1120	Q1121	Q1122	Q1123	Q1124	Q1125	Q1126	Q1127	Q1128	Q1129	Q1130	Q1131	Q1132	Q1133	Q1134	Q1135	Q1136	Q1137	Q1138	Q1139	Q1140	Q1141	Q1142	Q1143	Q1144	Q1145	Q1146	Q1147	Q1148	Q1149	Q1150	Q1151	Q1152	Q1153	Q1154	Q1155	Q1156	Q1157	Q1158	Q1159	Q1160	Q1161	Q1162	Q1163	Q1164	Q1165	Q1166	Q1167	Q1168	Q1169	Q1170	Q1171	Q1172	Q1173	Q1174	Q1175	Q1176	Q1177	Q1178	Q1179	Q1180	Q1181	Q1182	Q1183	Q1184	Q1185	Q1186	Q1187	Q1188	Q1189	Q1190	Q1191	Q1192	Q1193	Q1194	Q1195	Q1196	Q1197	Q1198	Q1199	Q1200	Q1201	Q1202	Q1203	Q1204	Q1205	Q1206	Q1207	Q1208	Q1209	Q1210	Q1211	Q1212	Q1213	Q1214	Q1215	Q1216	Q1217	Q1218	Q1219	Q1220	Q1221	Q1222	Q1223	Q1224	Q1225	Q1226	Q1227	Q1228	Q1229	Q1230	Q1231	Q1232	Q1233	Q1234	Q1235	Q1236	Q1237	Q1238	Q1239	Q1240	Q1241	Q1242	Q1243	Q1244	Q1245	Q1246	Q1247	Q1248	Q1249	Q1250	Q1251	Q1252	Q1253	Q1254	Q1255	Q1256	Q1257	Q1258	Q1259	Q1260	Q1261	Q1262	Q1263	Q1264	Q1265	Q1266	Q1267	Q1268	Q1269	Q1270	Q1271	Q1272	Q1273	Q1274	Q1275	Q1276	Q1277	Q1278	Q1279	Q1280	Q1281	Q1282	Q1283	Q1284	Q1285	Q1286	Q1287	Q1288	Q1289	Q1290	Q1291	Q1292	Q1293	Q1294	Q1295	Q1296	Q1297	Q1298	Q1299	Q1300	Q1301	Q1302	Q1303	Q1304	Q1305	Q1306	Q1307	Q1308	Q1309	Q1310	Q1311	Q1312	Q1313	Q1314	Q1315	Q1316	Q1317	Q1318	Q1319	Q1320	Q1321	Q1322	Q1323	Q1324	Q1325	Q1326	Q1327	Q1328	Q1329	Q1330	Q1331	Q1332	Q1333

Table 19. (continued)

Sep 11 12:00 qualreas02.out 4

Analyte	Reason															
	Acc.								Reason							
	A01	A03	C02	C05	C08	C09	C14	P01	P02	P03	P06	P07	P08	Q01	Q02	Q03
4-Mitrophenol	4															
Acenaphthene	4															
Acenaphthylene	4															
Aldein	3	19														
Anthracene	4															
Benzo(a)anthracene	4															
Benzo(a)pyrene	4															
Benzo(b)fluoranthene	4															
Benzo(g,h)pyrene	4															
Benzo(k)fluoranthene	4															
Benzoic acid	4															
Benzylic alcohol	4															
Bis(2-chloroethoxy)methane	4															
Bis(2-chloroethyl) ether	4															
Bis(2-ethylhexyl) phthalate	4															
Butylbenzylphthalate	4															
Carbazole	4															
Chloroene	4															
Chrysene	4															
Di-n-butylphthalate	4															
Di-n-octylphthalate	4															
Dibenz(a,h)anthracene	4															
Dibenzofuran	4															
Dieldrin	4															
Dibenzylphthalate	4															
Dimethylphthalate	4															
Endosulfan II	3															
Endosulfan sulfate	3															
Endrin	3															
Endrin aldehyde	3															
Endrin ketone	3															
Fluoranthene	4															
Fluoranthene	4															
Heptachlor epoxide	3															
Hexachlorobenzene	4															

Class

Table 19. (continued)

Sep 11 12:00 qualreas02.out 5

Reason Codes for Accepted and Rejected Analyses

Type: Organics

Analyte	Class																														TOTAL	
	Acc.																								Rej.							
	Reason																								Reason							
	A01	A03	C02	C05	C08	C09	C14	F01	F02	F03	F06	F07	F08	G01	G02	G03	G06	H02	H04	K01	K02	M07	M08	M03	F02	A02	G02	G03	H03	K02		M
Hexachlorobutadiene	4	5													17														2		28	
Hexachlorocyclopentadiene	4	5													17														2		28	
Hexachloroethane	4	5													17				1										2		29	
Indeno(1,2,3-cd)pyrene	4	5													17					1									2		9	38
Isophorone	4	5													17														2		28	
Lindane	3	19	9	9	4	4									137		4		8							30	1		3			231
Methoxychlor	3	19		9	4	10		2							137		4							2		20	1		3			214
N-Nitroso-di-n-propylamine	4	5													17				2										2			30
N-Nitrosodiphenylamine	4	5													16				8								1	2	2			38
Naphthalene	4	5													4	17													2			32
Nitrobenzene	4	5													17														2			28
Oxychlordanes				3											4								31									38
PCB-1016	3	19													253		4							2		20	1		3			305
PCB-1221	3	19													253		4								20	1		3				303
PCB-1232	3	19													253		4								20	1		3				303
PCB-1242	3	19													253		4								20	1		3				303
PCB-1248	3	19					5								255		4						10	1	20	1		3				321
PCB-1254	3	22					4	26							6	263		4						647		20	1		3			999
PCB-1260	3	19					5	21							6	260		4						560	1	20	1	1	3			904
Pentachlorophenol	4	5						1							3				1										9	3		26
Phenanthrene	4	5													1	17													2			29
Phenol	4	5														3													9			21
Pyrene	4	5						4							1	17					9								2		1	43
Total organic carbon (TOC)	19	3																														22
Toxaphene	3	19														137		4							20	1		3				187
alpha-BHC	3	19	8			4										138		4						2		20	1		3			202
alpha-Chlordane	3	19		3												141		4						11		20	1		3			205
alpha-Chlordene				14	5	16										7																42
beta-BHC	3	19		9	16											137		4								20	1		3			212
cis-Monochlor				13				18								7								717								755
delta-BHC	3	19	9	9	4	4										137		4							20	1		3				213
gamma-Chlordane	3	19		23	4											144		4		4				531		20	1		3			756
gamma-Chlordene				14												7								2								23
trans-Monochlor				14				28								7								676								725
TOTAL	358	866	68	418	72	1032	14	538	6	61	45	28	2	89	10692	1	112	1	102	62	1	3	16770	9	600	28	4	317	26	87	32412	

Table 19. (continued)

Sep 11 12:00 qualreas02.out 11

Reason Codes for Accepted and Rejected Analyses

Type: Physical

	Class				
	Acc.		Reason		
	A01	A03	J01	N	TOTAL
Analyte					
Moisture	1	4			5
Suspend particles (total)			61		61
Turbidity			1		1
TOTAL	1	4	62		67

Table 19. (continued)

Sep 11 12:00 qualreas02.out 12

Reason Codes for Accepted and Rejected Analyses

Type: Radionuclides

Analyte	Class																					
	Acc.																	Rej.				
	Reason																	Reason				
	F01	G01	G02	H01	H02	H09	I01	J01	P01	P02	R01	R06	R07	S05	T01	T02	U03	G07	G08	H07	H08	TOTAL N
Cesium-137	5																11					16
Cobalt-60	5																12					17
Gross alpha activity	9			56	20			22		17	3	207	20	207		12					4	577
Gross beta activity	58			32				22		20	3	207	20	207	5	11						585
Plutonium-238			18					20														38
Plutonium-239			5																			5
Plutonium-239/240			14																			14
Strontium-90	39	2	44	13	15			10		27	38	418	38	417	6	41		1	2			1111
Technetium-99		4	1		21		10	10							7	1				2		56
Tritium															53	20					6	79
Uranium-234	4	1	4	8		55		10	5									1			4	92
Uranium-235		1	4	8	10	55										2		1				81
Uranium-236			2																			2
Uranium-238	18	1	4	9	22	55		10										1			3	123
TOTAL	138	9	96	126	88	165	10	104	5	64	44	832	78	831	71	87	23	4	2	2	17	2796

Table 20. Summary of qualifiers assigned from electronic review

<i>Validation result qualifier = R (rejected)</i>		
Code	Reason description	Frequency
G03	Surrogate recovery was <10%.	266
I03	MS recovery was <30%.	32
A02	Extraction holding times were grossly exceeded.	28
H03	MS/MSD recovery was <10%.	25
H08	Radiological MS/MSD recovery >150% for aqueous samples; 160% for solid samples.	17
A04	Analysis holding times were grossly exceeded.	4
H07	Radiological MS/MSD recovery <50% for aqueous samples; <40% for solid samples.	2
<i>Validation result qualifier = U (not detected)</i>		
Code	Reason description	Frequency
F01	Sample data were qualified as a result of the method blank.	894
F03	Sample data were qualified as a result of the equipment rinsate.	59
I02	MS recovery was below the lower control limit.	16
F02	Sample data were qualified as a result of the field blank.	6
<i>Validation result qualifier = UJ (estimated quantitation limit)</i>		
Code	Reason description	Frequency
G02	Surrogate/radiological chemical recovery was below the lower control limit.	3721
A03	Analysis holding times were exceeded.	912
A01	Extraction holding times were exceeded.	340
<i>Validation result qualifier = J (Estimated)</i>		
Code	Reason description	Frequency
M08	The %D between the two pesticide/PCB column checks was >25%.	16501
G02	Surrogate/radiological chemical recovery was below the lower control limit.	5261
J01	Duplicate RPD/radiological duplicate error ratio (DER) outside control limit.	826
A03	Analysis holding times were exceeded.	263
H04	MS/MSD pairs exceed the RPD limit.	118
I02	MS recovery was below the lower control limit.	79
G01	Surrogate/radiological chemical recovery was above the upper control limit.	74
A04	Analysis holding times were grossly exceeded.	46
A01	Extraction holding times were exceeded.	19
I03	MS recovery was <30%.	9
H01	MS/MSD recovery was above the upper control limit.	4
H02	MS/MSD recovery was below the lower control limit.	3

Table 21. Summary of qualifiers assigned from technical review

<i>Validation result qualifier = r (rejected)</i>			
Code	Reason	Description	Frequency
	G07	Radiological chemical recovery was <20%.	4
	G08	Radiological chemical recovery was >150%.	2
	A03	Analysis holding times were exceeded.	1
<i>Validation result qualifier = j (estimated)</i>			
Code	Reason	Description	Frequency
	R06	Absorption curve criteria were not met.	281
	S05	Cross-talk verification criteria were not met.	281
	H09	Radiological MS/MSD samples were not analyzed at the required frequency.	139
	F01	Sample data were qualified as a result of the method blank.	89
	H01	MS/MSD recovery was above the upper control limit.	72
	H02	MS/MSD recovery was below the lower control limit.	25
	G02	Surrogate/radiological chemical recovery was below the lower control limit.	16
	J01	Duplicate RPD/radiological duplicate error ratio (DER) outside control limit.	10
	P02	LCS recovery was below lower control limit.	8
	P01	LCS recovery was above upper control limit.	5
	G01	Surrogate/radiological chemical recovery was above the upper control limit.	3
<i>Validation result qualifier = uj (estimated quantitation limit)</i>			
Code	Reason	Description	Frequency
	R06	Absorption curve criteria were not met.	528
	S05	Cross-talk verification criteria were not met.	528
	H02	MS/MSD recovery was below the lower control limit.	51
	P02	LCS recovery was below lower control limit.	48
	H01	MS/MSD recovery was above the upper control limit.	40
	F01	Sample data were qualified as a result of the method blank.	39
	G02	Surrogate/radiological chemical recovery was below the lower control limit.	36
	J01	Duplicate RPD/radiological duplicate error ratio (DER) outside control limit.	28
	H09	Rad MS/MSD samples were not analyzed at the required frequency.	26

Table 22. Summary of reasons for rejection of data

Code	Reason description	Frequency
G03	Surrogate recovery was <10%.	458
K02	Extremely low area counts or performance was exhibited by a major drop off.	87
I03	MS recovery was <30%.	40
H03	MS/MSD recovery was <10%.	31
A02	Extraction holding times were grossly exceeded.	28
H08	Rad MS/MSD recovery >150% for aqueous samples; 160% for solid samples.	17
G07	Radiological chemical recovery was <20%.	5
G02	Surrogate/radiological chemical recovery was below the lower control limit.	4
A04	Analysis holding times were grossly exceeded.	4
H07	Rad MS/MSD recovery <50% for aqueous samples; <40% for solid samples.	2
G08	Radiological chemical recovery was >150%.	2
A03	Analysis holding times were exceeded.	1
H06	Professional judgment was used to qualify the data.	1

Table 23. Summary of rejected data by statement of work and analysis type

Statement of work	Analysis type	Frequency
CRERP-0021	MET	1
SOW-049	PPCB	31
SOW-050	PPCB	1
SOW-052	SVOA	87
SOW-191	PPCB	2
SOW-191	SVOA	90
SOW-192	MET	40
SOW-192	PPCB	30
SOW-192	SVOA	3
SOW-194	MET	1
SOW-194	PPCB	85
SOW-194	SVOA	53
SOW-217	3H	6
SOW-217	GAB	4
SOW-217	RAD2	7
SOW-217	SR90	3
SOW-217	U	5

Table 24. Clinch River ER analytical services

APO #	CRERP #	Comments	Laboratory
SOW-46A	CRERP-0001	Arsenic Study: June Sampling, 1992	K-25 Analytical Department
SOW-41	CRERP-0002	Great Blue Heron Study: 1992	Southwest Research Institute
	CRERP-0003	TVA Fish Biocont Study: 1991 PCBs	Tennessee Valley Authority Environmental Chemistry Lab-Chatt.
SOW-72	CRERP-0004	Arsenic Study: October Sampling, 1992	ORNL Analytical Chemistry Division
	CRERP-0005	TVA Source Study: Sediment and Water	Tennessee Valley Authority Environmental Chemistry Lab-Chatt.
	CRERP-0006	TVA Fish Study: Fall 1992, Spring 1993, PCBs	Tennessee Valley Authority Environmental Chemistry Lab-Chatt.
SOW-89	CRERP-0007	Arsenic Study: December Sampling 1992	K-25 Analytical Department
	CRERP-0008	TVA Fish Study: Spring 1993, Metals	Tennessee Valley Authority Environmental Chemistry Lab-Chatt.
SOW-219A	CRERP-0009	Geese/Deer Tissue: Rads	TMA/ EBERLINE-OR
SOW-218	CRERP-0010	Mink Study: Fish Analysis	Southwest Research Institute
	CRERP-0011	Toxicity Studies	ESD/TVA
	CRERP-0012	TVA Sediment Transport Modeling	Tennessee Valley Authority-UC
SOW-191	CRERP-0013	Phase 2 Water Sample Analysis	Lockheed Engineering & Science
SOW-192	CRERP-0014	Phase 2 Sediment Sample Analysis	TMA/ARLI TMA/NORCAL
SOW-217	CRERP-0015	Phase 2 Rad Analyses: Alpha, Beta, Gamma	Eco Tek Laboratory Services, Inc.
SOW-193	CRERP-0016	Phase 2 Speciation: Mercury	Brooks Rand
SOW-196	CRERP-0017	Great Blue Heron Study: 1993	Southwest Research Institute
SOW-050	CRERP-0018	Mink Study: Tissue Analysis	Southwest Research Institute
	CRERP-0019	Phase 2 Rad Analyses: Gamma	ORNL Environmental Sciences Division-Low Level Radiological Analysis Laboratory

Table 24. (continued)

APO #	CRERP #	Comments	Laboratory
	CRERP-0020	TVA Fish Study: Fall 1993, PCBs	TVA
	CRERP-0021	TVA Fish Study: Spring 1994	TVA
SOW-194	CRERP-0022	Pore Water Analysis	Lockheed Engineering & Science
SOW-195	CRERP-0023	Particle Size Analysis	Southwest Research Institute
SOW-052	CRERP-0024	Phase 2 Semivolatiles in Fish	Southwest Research Institute
SOW-219B	CRERP-0025	Geese/Deer Tissue: Nonrads	EcoTek Laboratory Services, Inc.
SOW-152	CRERP-0026	Chlorophyll-a	Savannah
	CRERP-0027	Cyanide: Source Area Study	Y-12 Analytical Department
SOW-049	CRERP-0028	Great Blue Heron 1994	Southwest Research Institute
SOW-072	CRERP-0029	Crayfish Mayflies	Southwest Research Institute
SOW-048A	CRERP-0030	Geese 1994	Southwest Research Institute
SOW-048B	CRERP-0030	Geese 1994	Y-12 Analytical Department

18. FIGURES

Inorganics		83	90
Semivolatiles		94	100
Pesticides		100	100
Radiological		100	100

Fig.1. Percentage of laboratory replicates meeting the precision criteria.

Fig. 2. Comparison of Brooks Rand and TMA-ARLI sediment samples.

Fig. 3. PER occurrence rate by laboratory.

Fig. 4. Cumulative internal quality control findings. CRR Phase 2 as of 26 July 1995.

Fig. 5. Cumulative external quality control findings. CRR Phase 2 as of 26 July 1995.

Fig. 6. Cumulative internal root cause findings. CRR1 Phase 2 as of 26 July 1995.

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Appendix A
FIELD QUALITY CONTROL

INTRODUCTION

Analyses of field and processing laboratory Quality Control (QC) data contains both quantitative and qualitative aspects, using the QC sample definitions given Table A1. Field, preparation lab and analytical laboratory QC data apply across all subtasks within the larger water and sediment tasks. All data will be combined for the comparisons indicated below. Certain of these data may be qualified by verification / validation of analytical laboratory QC results. Though some of these field QC samples were factored into the verification/validation of field data packages, the focus of field QC samples is on aspects of precision, accuracy, representativeness, sensitivity, comparability and completeness (the PARSCC parameters) that cannot be addressed through verification and validation of analytical laboratory QC results. For contaminant analyses, data focus on either indicator analytes, or those that were not screened out for the contaminant characterization section.

Field and processing lab QC results will be compared either using a paired QC sample to specific regular (REG) sample type analysis, or through application of particular QC data to a range of REG sample collection dates and sites. The criteria used to evaluate these results are the same as those used for validation as specified in the analytical Data Validation procedure (ER/CR-SOP1000). The QC results are divided by sample type code as follows:

Field Replicate (FR). Direct, spot check comparison of FR samples to specified REG samples at the same date and site, will calculate relative percent difference (RPD) for these sample pairs. Values greater than 20% indicate that the duplicate and REG samples may differ significantly, though the magnitude of the analytical results, and proximity to the analytical detection limit will influence the interpretation of RPD values.

Field Blank (FB). Direct, spot check comparison to specified REG samples (same date and site) for the purpose of determining the contribution of collection technique and other extraneous contaminant sources to observed levels at the given site. They are associated only with total (unfiltered) water samples. If five times the FB result exceeds the corresponding REG result, then some source other than the sample medium may be responsible for analyte of concern levels at this site on this date, and corresponding data may need to be flagged.

Field Rinse Blank (FRB). These results are applicable to a range of sample collection dates and sites, extending from the previous FRB to the present FRB for the purpose of assessing the cleanliness of sample collection equipment and the potential for cross-contamination between sites. They are assessed only for unfiltered samples. If five times the FRB result exceeds any REG result during the comparison period, then field collection equipment cleaning for the time period in question may have been inadequate to prevent cross contamination of the samples, or the REG sample had an low value for the time period in question.

Laboratory Rinse Blank (LRB). These results are applicable to a range of sample collection dates and sites, extending from the previous LRB to the present LRB for the purpose of assessing the cleanliness of sample processing equipment and potential for cross-contamination between sequentially processed samples. Only filtered-processed sample were submitted for LRB assessment. If five times the LRB result exceeds any REG result during the comparison period, either sample processing equipment cleaning for the time period in question was inadequate to prevent cross contamination of the samples, or the REG sample had an low value for the time period in question.

Trip Blank (TB). This is a range comparison for mercury speciation only. These results are applicable to a range of sample collection dates and sites, extending from the previous TB to the present TB to assess sources of contamination encountered during the trip, from collection to analysis, including shipment; normally, trip blanks were done on a daily basis, at the request of the analytical laboratory. If five times a TB result exceeds any REG result during the comparison period, either some source other than the site may be responsible for contamination of the sample, or the REG sample had an low value for the time period in question.

Milli-Q Blank (MQB). These results are applicable to the full range of QC samples prepared between the previous MQB to the present MQB. These blanks assess contamination originating with the ultrapure water system in the prep lab; these QC samples are unique in that they also have implication for all QC blank samples collected during the time period in question. A MQB result that exceeds any other QC blank result during the period of comparison indicates that either the ultrapure water system is contaminated, or that the QC blank sample had an unusually low value for the time period in question.

Program requirements were implemented to reduce the risk of **contamination or cross-contamination** of samples. The sample collection, processing, and shipping activities were performed in accordance with procedures (ER/CR-SOP 2200, 2210, 2220) and program work aids. These requirements specified the types of sampling and processing equipment that should be used and the cleaning methods for that equipment. The shipping requirements specified double containment for all samples.

1. WATER SAMPLING

Regular water samples were collected from 42 sites on 204 separate site visits for task W1.1 (Table A2). To distribute the collection of QC samples spatially, FR were collected 17 times from 13 different sites (8.3% of site visits), FB 17 times from 11 sites (8.3% of site visits) and FRB 15 times from 11 different sites (7.4% of site visits). Laboratory rinse blanks were also collected, but were not tied to a specific field site. Trip blanks were analyzed for mercury and methyl mercury to detect contamination contributed to field samples during transport, and were normally collected each sampling day. In addition, Milli-Q samples were analyzed to test the purity of the laboratory water used to clean sampling and lab processing equipment, and for providing water for field and lab blanks. The goal of collecting at least one in 20 QC samples (5%) was exceeded for all sample types. Due to financial considerations, FRB and LRB samples were combined to meet the 5% goal (DOE/OR/01-1254&D1, 1994). Lab rinse blanks alone were collected at a rate of 4.9% (Table A3). The collection of QC samples was distributed throughout the November, 1993 to September, 1994 field collection task. Figure A1 shows the cumulative percentage of QC samples collected by date. Task W1.4 included five site visits to three separate sites and is not included in these totals.

1.1 PRECISION

Precision in water samples was assessed through the collection and analysis of field duplicates. For inorganic analytes, this assessment was made by (1) calculating the relative percent difference (RPD) of matched duplicate sample pairs if the value of both samples exceeded five times the average detection limit (DL), or (2), calculating the absolute value of the difference between the two samples if the value of either was less than five times the average DL. Organic analytes are evaluated only by the RPD. If sample pairs were evaluated by the RPD, precision was considered acceptable for inorganic analytes with an RPD of less than 20%, and organic analytes with an RPD of less than 30%. For sample pairs evaluated by the difference between the sample values, precision was acceptable for differences less than the average DL. If either sample in the matched pairs was a nondetect, no evaluation of precision could be made.

Table A4 summarizes QC field duplicate data for phase 2 surface water organic and inorganic samples. Analytes are separated into total and dissolved portions, and only duplicate pairs where both samples were detects are included in the table. For both total and dissolved organics, precision is difficult to evaluate, because only one duplicate pair existed in each category for which both samples were detects. This is a reflection of the overall low number of organic analytes found in surface water samples. Overall, 80.1% of surface water sample pairs had RPD values of less than 20%. Though 77% of all dissolved inorganic sample pairs met precision criteria, for 11 of the 21 inorganic analytes, 100% of samples met the criteria. More than 50% of the duplicate samples of four dissolved analytes (antimony, boron, copper, and zinc) failed to meet precision criteria, with precision in only one of 11 antimony sample pairs acceptable. For total inorganic water samples, 85% of all sample pairs were of acceptable precision. In 10 of 19 analytes, 100% of duplicate pairs met criteria, and with the exception of mercury (Lockheed) which had only one sample pair, no analytes had fewer than 50% acceptable precision. Duplicate samples for aluminum and boron showed relatively low precision for both total and dissolved portions (67% and 55% for aluminum, 50% and 44% for boron). Duplicate pairs for copper, iron, and nickel also showed low to moderate precision. The observation that one-half of all analytes meet and the other one-half fail the precision acceptance criteria highlights the differences in analytical precision between analytes, and may not reflect problems with field collection protocols.

Precision in radionuclide duplicate pairs was evaluated by calculating the duplicate error ratio (DER),

$$\text{DER} = \frac{|S - D|}{(2.5\sigma_s + 2.5\sigma_D)}$$

where S is the routine sample and D is the duplicate sample. Duplicate error ratios of less than one are considered acceptable. Analytes are separated by laboratory performing the analysis, and into total and dissolved portions (Table A5). Only duplicate pairs where both samples were detects are included in the table. Duplicate error ratios were calculated for 88 duplicate samples. Only two sample pairs (2.3%), both total water samples analyzed for tritium by Oak Ridge Analytical Services (ORAS), exceeded precision criteria. Of these two samples, one barely exceeded precision criteria (DER=1.15), while the other had a routine sample result of 168 pCi/L, a duplicate sample result of 1150 pCi/L, and a DER of 3.64.

1.2 REPRESENTATIVENESS

Field equipment rinse blanks (FRB), laboratory equipment rinse blanks (LRB), field blanks (FB), and trip blanks (TB) were collected to help determine overall sample representativeness, as discussed in the introduction to this appendix. These QC samples mentioned above, results were considered acceptable if blank sample values were less than 20% of the associated routine sample result. Milli-Q blank samples (MQB) were also evaluated to assess contamination originating from the ultrapure water system in the water processing lab, and are associated only with QC samples.

A summary of surface water QC samples is presented in Table A6. Only analytes for which contaminants were detected in the blank samples are listed in the table, and the 95 samples collected for task W1.4 are included. The values presented are means for the blank sample detects, and for detects in the associated routine samples. Also listed for comparison purposes, is the mean value of all routine samples for each analyte. A total of 29 different analytes were detected in LRB samples, two organic and 27 inorganic analytes. Most frequently detected were zinc (11 of 11 samples analyzed), sodium (10 of 11), chloride (9 of 12), iron and nickel (9 of 11 each). Aluminum, barium, boron, chromium, copper, and potassium were detected in at least five samples. Beryllium, cadmium, cobalt, molybdenum, silver, thallium, and vanadium were detected in LRB samples, but not the associated field samples. The mean values of 17 analytes were at least 20% of the mean for the routine samples with which they were associated, indicating a possible source of contamination from lab processing activities. Of these 17 analytes, 12 had LRB values greater than the associated field mean values. The high mean value of the LRB for several metals can be traced to one sample (LRB sample 15914) collected on August 24, 1994, which had exceptionally high values. When it was removed from consideration, the number of analytes which exceeded 20% of field means fell from 17 to 11, and only four analytes (compared to 12 previously) had LRB means greater than the associated routine samples.

The analysis of FB results found detects in 24 analytes (four organic, three radionuclides, and 17 inorganic analytes, Table A6). Zinc was most frequently detected (16 of 17 samples analyzed), followed by chromium (12 of 17), and boron, copper, and sodium (11 of 17 each). The mean FB values of nine analytes exceeded 20% of the field sample means with which they were associated. Field Blanks analyzed for copper, gross beta activity, and zinc had higher mean values than the

associated field samples. Field Blanks for arsenic, boron, chromium, methyl mercury, and nickel exceed 20% of the associated field sample means. Di-n-butylphthalate, endrin ketone, lead, PCB-1254, Strontium-90, and tritium were detected in FB samples, but not the associated field samples.

Sixteen field rinse blank samples were submitted for organic, radionuclide and inorganic analysis categories. A total of 19 different analytes were detected in FRBs: two organics, three radionuclides and fourteen inorganics (Table A6). For organic analysis, Bis(2-ethylhexyl)-phthalate (7 samples) and Di-n-butylphthalate (4) were detected frequently relative to the number of detects observed in the routine samples (7/8 and 4/24 respectively). Of the radionuclides, tritium (2), gross alpha activity (1) and gross beta activity (1) were detected, though infrequently (2/29, 1/12 and 1/57 respectively) relative to the number of detects observed in routine samples. Inorganics yielded zinc (14 samples), chromium (10), aluminum, boron, sodium (9 each), and iron (8) as the most frequently detected, though their FRB detection rate relative to regular samples was substantially lower than that for either organics or radionuclides (Table A6). The mean values of ten analytes exceeded 20% of the associated field sample means, suggesting that data for these ten analytes should be scrutinized more carefully, particularly during the time periods bounded by a particular set of FRBs.

A combined total of 383 samples were collected for analysis by Brooks Rand for mercury and methyl mercury (including task W1.4) with 75 associated trip blanks (Table A6). The mean value of trip blanks for total mercury was 2.2 ng/L, less than 3% of the field sample mean (74.11 ng/L). The mean value for trip blanks analyzed for methyl mercury was 0.065 ng/L, nearly 24% of the routine sample mean, though very close to the functional limits of detection (0.02 ng/L).

In order to test the purity of the water processing laboratory ultrapure (Milli-Q) water system, 55 samples were submitted for a variety of analyses. This represents 13.2% of the total of all blank samples submitted. Milli-Q water was used for cleaning field collection and laboratory processing equipment, as well as a source of water for all QC blank samples, except trip blanks. Milli-Q samples are associated with FB and FRB samples collected between the previous MQB and the present MQB. Only analytes which were detected in the Milli-Q samples are shown in Table A6. The associated blank samples in Table A6 represent FB or FRB detects in samples that were associated with the MQB. A total of 37 detects were found from 20 different analytes. Zinc (5 detects), methyl mercury (4), and boron (3 detects) were found most frequently. No other analyte had more than two detects. Antimony, barium, and copper were found in MQBs, but not in the associated QC blank samples. Mean values for the major ions calcium, magnesium, potassium, and sodium were unusually high for the MQB sample collected August 9, 1994; for each of these analytes, the MQB value is one to two orders of magnitude higher than the associated blank values. Data for the next MQB sample, collected on August 17, 1994, reflected background values.

1.3 SUMMARY

Overall, 37 different analytes were detected in surface water rinse samples. The frequency and concentration at which some analytes were detected, particularly metals and some major ions, suggests that sources of contamination from laboratory processing and field collection activities may have impacted sample results, though analytical laboratory QC criteria must be factored in.

Most of the routine - FR filtered surface water sample pairs had RPD values of less than 20%. However, more than 50% of the duplicate samples of filtered antimony, copper, and zinc failed criteria, with only one of 11 antimony REG-FR pairs acceptable. Field collection protocols may be

less a factor in these high RPD failure rates than analytical method limitations, and the proximity of these analytes to the detection limit.

Though the mean values of 17 LRB analytes were at least 20% of the regular means, these high mean LRB values for several metals is due to a single sample. Without this sample, the number of analytes exceeding the criteria fell from 17 to 11, and only four analytes (compared to 12 previously) had LRB means greater than the associated routine samples.

For nine analytes the mean of the FB results were at least 20% of the means reported for routine samples. The FB results for copper, gross beta activity, and zinc had higher mean values than the associated routine samples. Di-n-butylphthalate, endrin ketone, lead, PCB-1254, Strontium-90, and tritium were detected in FB samples, but not the associated routine samples.

A total of 37 detects were observed in MQBs for 20 different analytes, with zinc, methyl mercury, and boron found most frequently. Antimony, barium, and copper were found in MQBs, but not in the associated QC blank samples. Mean values for the major ions calcium, magnesium, potassium, and sodium were unusually high for a single MQB sample; for each of these analytes, the MQB value is one to two orders of magnitude higher than any other associated blank values, suggesting that either the MQB sample was contaminated during preparation or analysis, or that the Milli-Q source water for that sample may have been contaminated. Because these values were not observed in other blank sample results, the contamination is likely limited to the individual MQB sample.

2. SEDIMENT AND PORE WATER SAMPLING

Sediment and pore water samples were collected from eight study reaches during 92 site visits for task S1.B (Table A7). Sampling efforts were concentrated in reaches three and four, and 75% of QC samples were collected in those two reaches. A spatial distribution of QC samples was achieved by collecting field duplicates, field blanks, and field rinse blanks eight times from four different study reaches (8.7% of site visits). Laboratory rinse blanks were collected routinely, but were not tied to a specific site. Field duplicates, field rinse blanks, and lab rinse blanks were submitted for both sediment and pore water. Since field blanks were collected and submitted as liquid media, they are shown in Table A7 in association with pore water; however, the results of field blank samples also apply to sediment. Trip blanks were analyzed to detect trace levels of contamination in mercury and methyl mercury in porewater samples, and Milli-Q blank samples were submitted to test the purity of the processing laboratory ultrapure water system. The goal of collecting 5% of each QC sample type was achieved (Table A8). Due to financial considerations, FRB and LRB samples for sediment were combined to meet the goal. The collection of QC samples was distributed throughout the November, 1993 to September, 1994 field collection task. Figure A2 shows the cumulative percentage of QC samples collected by date.

2.1 PRECISION

The evaluation criteria for precision in sediment samples is similar to that described above (Sect. 2.1), with two exceptions: (1) acceptable RPD levels for inorganics and organics in sediment are 30% and 50%, respectively; and (2), if either value in the sample pair is less than five times the DL, the absolute value of the difference between samples must be less than twice the average DL to be acceptable. The duplicate pairs for sediment and pore water are true duplicates rather than sample splits. That is, samples submitted for analysis are from two separate samples rather than sediment (or pore water) split from the same sample. Consequently, differences in sample results may tell more about natural variability in the field than the precision of the sample collection process or analytical variability. That is likely more so the case with sediment than water, because water samples collected from the same site at the same time may more reasonably be expected to be uniform. Nonetheless, precision for sediment is discussed by the criteria described above.

Table A9 summarizes precision for sediment and pore water field QC samples. Only duplicate pairs where both samples were detects are included in the table. Among sediment samples, 186 sample pairs from 25 different organic analytes, and 285 sample pairs from 24 inorganic analytes were available for precision evaluation. Overall, 80% of organic duplicate pairs met precision criteria, as did 78% of inorganic samples. Eight organic analytes had 100% acceptable sample precision, although five of those analytes had two or fewer pairs to evaluate. Among organic analytes that had 10 or more sample pairs that were detects, 78.5% met sample precision criteria. Among inorganic analytes, two had 100% of samples that met precision criteria, and nine had fewer than 80% which met criteria.

The evaluation criteria for pore water is identical to surface water, described above (Sect. A.1.1). Precision for pore water samples is summarized in Table A9. Ninety-three sample pairs from 18 different analytes are included. Total organic carbon is the only organic analyte listed. Only four analytes had as many as seven duplicate pairs. Consequently, evaluating precision in pore water samples is difficult. In general, the metals had relatively low precision, and overall, inorganic samples met precision criteria 62% of the time.

Duplicate Error Ratios (Table A10) are divided by matrix and laboratory performing the analysis, and only duplicate pairs for which both samples were detects are displayed. For sediment cores, DERs were computed for a total of 71 duplicate pairs for ^{137}Cs , ^{60}Co , ^{90}Sr , ^{99}Tc , ^{234}U , ^{235}U , and ^{238}U . Overall, 84.5% of sample pairs met precision criteria. Fifty percent (7 of 14) of ^{137}Cs duplicates analyzed by XRAD exceeded acceptable criteria ($\text{DER} < 1$). One sample each of ^{90}Sr , ^{99}Tc , ^{234}U , and ^{238}U analyzed by ETLS exceeded criteria.

2.2 REPRESENTATIVENESS

A summary of sediment and porewater QC samples is presented in Table A11. Only analytes for which contaminants were detected in the blank samples are listed in the table. The values shown are means for the blank sample detects, and for detects in the associated routine samples. Also listed for comparative purposes is the mean value of all routine samples for each analyte from the entire sample population. No contaminants were detected in Milli-Q blanks associated with sediment or pore water tasks. Consequently, none are listed in Table A11.

Cesium-137 was detected in two sediment LRB samples. The mean value for these samples was negative when the uncertainty term was subtracted. A total of 16 different analytes were found in pore water LRB samples (one organic, 2 radionuclides, and 13 inorganic contaminants). Eight pore water

LRB samples were submitted for metals analysis. Zinc and aluminum were found in seven, sodium was found in six, and boron, chromium, copper, iron, nickel, and potassium were each found in five samples (Table A11). Since these contaminants were found in blank samples with a relative high frequency, the field samples they are associated with often make up the entire sample population for that analyte. Consequently, the mean values for those sample groups are the same. The mean LRB values for aluminum, boron, chromium, copper, nickel, ^{90}Sr , and Zinc all exceed 20% of the mean values of the associated field blanks. Mean values for boron, chromium, copper, ^{90}Sr , and zinc are all at least 50% of field values.

Contaminants were found in a total of 19 analytes in field blank samples. Eight FB samples were submitted for metals analysis. Zinc was detected in all eight samples, sodium in seven, chromium in six, and potassium, boron, and aluminum were detected in five samples each. Aluminum, boron, chromium, total mercury (Brooks Rand), nickel, ^{90}Sr , and zinc all had FB mean values greater than 20% of the field sample mean.

Two radionuclides, ^{137}Cs and ^{90}Sr were found in sediment FRB samples. The mean value for ^{137}Cs was negative when the uncertainty term was subtracted, and the ^{90}Sr FRB value was greater than the associated field samples. A total of 22 different analytes were detected in pore water FRB samples. Eight FRB pore water samples were submitted for metals analysis, and aluminum, barium, calcium, copper, magnesium, manganese, potassium, sodium, and zinc were detected in all 12 samples. Twelve analytes (aluminum, benzoic acid, boron, cadmium, chromium, copper, iron, lead, total mercury (Lockheed), nickel, ^{90}Sr , and zinc) had LRB mean values greater than 20% of associated field samples. For aluminum, cadmium, chromium, copper, lead, mercury, ^{90}Sr , and zinc, the LRB mean value was greater than the field sample mean.

A total of 71 sediment and 43 routine pore water samples were submitted to Brooks Rand laboratory for analysis for total and methyl mercury analysis. In addition, 23 trip blanks were submitted to determine the contaminant contribution from field collection, analysis, and shipping. The mean value of trip blanks for total mercury was 2.43 ng/l, less than 5% of associated pore water field values. For methyl mercury, the mean value of trip blanks was 0.07 ng/L, 10.4% of the field sample mean.

2.3 SUMMARY

The above evaluation of QC samples associated with sediment and porewater field activities indicates a relatively high frequency and concentration of some analytes, particularly metals. The presence of these contaminants may have an affect on whether the sample results are representative of the sampling site.

Overall, 80% of organic duplicate pairs met precision criteria, as did 78% of inorganic samples. Eight organic analytes had 100% acceptable sample precision, although five of those analytes had two or fewer pairs to evaluate. Among organic analytes that had 10 or more sample pairs that were detects, 78.5% met sample precision criteria. Among inorganic analytes, two had 100% of samples that met precision criteria, and nine had fewer than 80% which met criteria. In general, the metals had relatively low precision, and overall, inorganic samples met precision criteria 62% of the time.

For sediment cores, DERs were computed for a total of 71 duplicate pairs for ^{137}Cs , ^{60}Co , ^{90}Sr , ^{99}Tc , ^{234}U , ^{235}U , and ^{238}U . Overall, 84.5% of sample pairs met precision criteria. Fifty percent (7 of 14)

of ^{137}Cs duplicates analyzed by XRAD exceeded acceptable criteria ($\text{DER} < 1$). One sample each of ^{90}Sr , ^{99}Tc , ^{234}U , and ^{238}U analyzed by ETLIS exceeded criteria.

Eight pore water LRB samples were submitted for metals analysis. Zinc and aluminum were found in seven, sodium was found in six, and boron, chromium, copper, iron, nickel, and potassium were each found in five samples (Table A11). The mean LRB values for aluminum, boron, chromium, copper, nickel, ^{90}Sr , and Zinc all exceed 20% of the mean values of the associated field blanks. Mean values for boron, chromium, copper, ^{90}Sr , and zinc are all at least 50% of field values.

Zinc was detected in all eight samples, sodium in seven, chromium in six, and potassium, boron, and aluminum were detected in five samples each. Aluminum, boron, chromium, total mercury (Brooks Rand), nickel, ^{90}Sr , and zinc all had FB mean values greater than 20% of the field sample mean.

The mean value for ^{137}Cs was negative when the uncertainty term was subtracted, and the ^{90}Sr FRB value was greater than the associated field samples. A total of 22 different analytes were detected in pore water FRB samples. Aluminum, barium, calcium, copper, magnesium, manganese, potassium, sodium, and zinc were detected in all had LRB mean values greater than 20% of associated field samples. For aluminum, cadmium, chromium, copper, lead, mercury, ^{90}Sr , and zinc, the LRB mean value was greater than the field sample mean.

The mean value of trip blanks for total mercury was 2.43 ng/l, less than 5% of associated pore water field values. For methyl mercury, the mean value of trip blanks was 0.07 ng/L, 10.4% of the field sample mean.

3. FILTER COMPARISON FOR RELATIVE PARTICLE RETENTION IN RESPONSE TO ENVIRONMENTAL QUALITY ASSESSMENT AUDIT FINDING EQA: 94-07-21-F

This section documents the results of a filter comparison test conducted to determine the relative particle retention on two different types of filters used for particle retention analysis during water sample collection for Phase 2 of the CR-ERP. The objective of this study was to compare the Relative Particle Retention on filters that were used to determine total suspended particles (TSP) and to determine particle-associated gamma (γ) contamination.

This comparison was being done in order to satisfactorily document the response to finding EQA: 94-07-21-F from the DOE Environmental Quality Assessment audit, conducted during June and July of 1994 by DOE-ORO personnel. The finding stated that, "since the pore size of a glass fiber filter (Whatman 0.7 μm) is likely to be of a lesser trap efficiency than the field filter cartridge (0.45 μm), a greater quantity of sediment per liter may be counted than is obtained via the suspended solids analysis. This would tend to bias the results on the high side." Samples from two different sites were taken and processed for total suspended particles (TSP) and gamma spectrometry in order to evaluate the variability between the different pore sizes. A possible pair of results from this comparison might have been that either 1) Correction factors be applied to Phase 2 particle associated gamma data in order to correct for any over-estimation of the particle retention by the cartridge filters, or 2) No correction factors are warranted based on these results.

Water sampling and processing for this task was performed following approved CR-ERP procedures and work-aids (ER/CR SOP-2300, Collection of Surface Water Samples; ER/CR SOP-2350 Total Suspended Particle (TSP) Determination; and WA-93-SW-17, Collection of Water Samples for Dissolved and Particle-Associated Gamma Determination; WA-93-SW-20, Calibration and Use of the Mettler AE-260 Analytical Balance). For each TSP sample, 8.0 liters of water was filtered through 16 (4.7 cm diameter; 0.7 μ m) Whatman glass microfiber filters (0.500L per filter) in order to provide equal sample volumes for both filter types. After TSP determination was completed, the 16 glass fiber filters were placed (stacked 16 high) into a small petri dish (50.55 mm in diameter by 7.10 mm high), and submitted to the ESD X-RAD laboratory for gamma spectrometry; this laboratory also did the gamma-spectrometric analyses for all CR-ERP Phase 2 samples. The cartridge filters had TSP determination performed on them, as well as gamma spectrometry. These cartridge filters were taken directly from sealed plastic bags and weighed prior to sample collection. After sampling, the cartridge filters were submitted to the ESD X-RAD laboratory for gamma spectrometry. Upon returning from the X-RAD lab, the cartridge filters were cut open using a pipe cutter and dried in a drying oven for approximately 24-36 hours at 60°C in order to allow for the excess water to evaporate. The filters were then dry weighed in order to determine the TSP values.

Analytical services were procured following the specific instructions in the analytical SOWs for analytical services in support of this Phase 2 subtask. Preparation and analyses of all routine samples followed the procedures specified in analytical SOWs.

Samples were collected at two sites: a reference site (CRM 21.8) on January 20, 1995 and a site for which the particle-associated gamma levels have been previously characterized (WOCM 0.0) on January 18, 1995. Samples from these two sites were analyzed for TSP and particle-associated gamma spectrometry determination. Five samples of equal volumes (8.0 liters) for each analysis (5 TSP/5 Gamma Spec.) were taken per site. The equal volumes allowed for direct comparison of the difference in particle capture for each filter type. The results of this comparison will be used to determine the amount of variation of particle capture there is between the Whatman glass fiber filter (0.7 μ m pore size) and the field filter cartridge (0.45 μ m pore size).

Five TSP and 5 gamma spectrometric routine sample were collected per site, per collection series. One duplicate and one sampler rinse blank was collected 5% of the time or at least once per collection series. For this subtask, a field replicate sample for (one for TSP and one for Gamma Spectrometry) was taken at WOCM 0.0, and an equipment rinse blank (one for TSP and one for Gamma Spectrometry) at CRM 21.8.

The objective of this study was to test the hypothesis that the filter retention capacity for suspended particles is greater for the cartridge filters than for the glass fiber filters (H_R : CF retention > GFF retention). The greater retention capacity should be due to the smaller pore size (0.45 μ m pore size) of the cartridge filters. This hypothesis was tested against the null hypothesis that there is no difference in retention capacity for both types of filter (H_N : CF retention=GFF retention). Analysis of the test hypothesis (H_R) was carried out using an analysis of variance to compare the TSP concentrations between filter types. Comparisons were also performed in order to see if the particular site affects the particle retention capacity. The results were compared to a specified significance level of 0.001. This low level was chosen in order to make the statistical tests strict, so that any decisions made about the effectiveness of the different filter types would be based on the performance of the filter and not on random sampling error.

The analysis of the samples for Gamma Spectrometry yielded results which supported the null hypothesis. There were no statistically significant differences in the sites which were sampled, the

sub-samples taken within each site, or between the cartridge filters and the glass fiber filters. The mean gamma concentration was compared for the site, filter type, and the interaction between the site and filter type at $\alpha = 0.001$. Neither the analysis of variance nor the Bonferroni method yielded significant results (Table A12). The results were all well above the specified significance level (p-values for site, filter, and sub-sample in site were all greater than 0.001).

The analysis for total suspended particles (TSP) yielded results which conflicted with the null hypothesis. Analysis of variance and the Bonferroni method were also used to compare the mean concentration of TSP for site to site differences, filter to filter differences, and the interaction of site and filter. The results were compared to a significance level of 0.001.

There was no statistically significant difference in mean particle concentrations for the sites sampled (p-value for site = $0.2294 > 0.001$). Certain circumstances (for example: one downstream from a dredging site vs. upstream site) may affect the amount of TSP collected, but in general, the sites have no effect.

The analysis of the interaction between the site and the filter type also yielded statistically non-significant results (p-value for the interaction = 0.3353 which is much higher than the specified 0.001). The amount of TSP captured in the particular filter type is not affected by the site that is sampled.

The comparison of the cartridge filters and the glass fiber filters yielded statistically significant results. The p-value for the filter to filter comparison was 0.0001 which is well below the specified level of 0.001 . However, this data was suspect. The TSP data for the cartridge filters at WOCM 0.0 were essentially invalid. The post weights were lower than the initial weights in almost all cases. This resulted in negative TSP values. This problem may have been due to residual moisture inside the plastic filter housing which affected the pre-weight. The statistical analyses for the site to site differences (for only the GFF) and the filter type differences (for only CRM 21.8) were repeated. Again, the site to site comparison resulted in non-significant results (p-value = $0.4434 > 0.001$; Table A13). The re-analysis for the filter comparison yielded a very different result with the "corrupted" cartridge filter data left out. By dropping the data from WOCM 0.0, the difference in filters was non-significant (p-value = $0.0930 > 0.001$; Table A14). The mean TSP concentration for the glass fiber filters was distinctly higher than the mean concentration for the cartridge filters with and without the corrupted data (Tables A13 and A14).

In conclusion, the gamma spectrometry results allowed for the conclusion to be drawn that particle-associated ^{137}Cs was not observed in any samples. The lack of contamination observed, even in a known contaminated site (WOCM 0.0), was probably due to high surface water flow on the days the samples were collected. During the sampling events, water flow was recorded to be between 9900–16400 cubic feet per second on January 18 and 9200–19000 cubic feet per second on January 20. Any contaminated particles were probably swept downstream due to the strong currents.

The results from the total suspended particle (TSP) determination allowed for the following conclusions to be drawn: 1) The difficulty in manipulating (having to cut them open in order to dry them, possible moisture retention, etc.) the cartridge filters, would make their use in the determination of total suspended particle concentrations impractical; and 2) Even with the adverse sampling conditions, no significant difference in the particle retention capacity was observed for the two filter types. The cartridge filters were not better than the glass fiber filters for TSP retention which means that no high bias in the results due to the difference in pore sizes of the filters used during the analysis of water samples occurred. Therefore, no manipulation of the data is appropriate.

4. TOXICITY TEST RESULTS

Toxicity test QC result data were analyzed following toxicity test standard procedures, as outlined in the ESD Toxicology Laboratory Quality Assurance Manual. All QC criteria were within acceptable levels. Data are available upon request from the ESD Toxicology Laboratory.

5. FIELD LOCATION QUALITY CONTROL

Sample collection sites for water and sediment were based on historic and current releases to the Clinch River and Poplar Creek, initially identified through review and analysis of historic, monitoring and Phase 1 data (DOE/OR/01-1111&D3 1993, DOE/OR/01-1254&D1 1994). During Phase 2 sample collection, these sites were sampled at the frequency proposed either in the Phase 2 Sampling and Analysis Plan (DOE/OR/01-1111&D3 1993) or the Addendum to the Phase 2 Sampling and Analysis Plan (DOE/OR/01-1254&D1 1994), following the guidelines established in the Technical Management Plan (ORN/ER-218 1994).

During sampling, collection locations were logged using a Global Positioning System (GPS) satellite navigation system using C/A code GPS signals, post-processed against a base station. Hardcopy maps of the sampling locations were also marked in the field as a GPS back up. GPS data were downloaded, post-processed and compared with Field Collection Task Map (FCTM) specified locations. These data were then displayed on maps using GIS and compared with hardcopy maps to verify sampling locations. Additionally, Positional Dilution of Precision (PDOP, 0 to 10) and root mean square (RMS, m) of the GPS coordinates were used as metrics for accuracy of the GPS data. Standard GPS rules of thumb values of PDOP and RMS are less than 6 and less than 5 respectively. The RMS values were related to both boat drift, if any, and the GPS signal degradation (selective/availability) built into the system for military purposes. PDOP is a metric for the geometric relationship of the satellites to the GPS antenna. For surface water sampling, acceptable PDOP values were achieved on 68 of the 74 sample collection dates, or 258 of the 266 site visits (Fig. A3). All RMS values are plotted by date on Fig. A4. The backup hardcopy maps were substituted when GPS data was not available.

Sediment sampling locations initially included the full length of the Clinch River below Melton Hill Dam. However, as part of Phase 2, the U.S. Army Corps of Engineers conducted a hydroacoustic survey of the Clinch River bottom to determine sediment density and thickness, among other things. As a result of this survey, indicating that the bottom of the Clinch River upstream from Grassy Creek was composed primarily of exposed bed rock and sands, no further sample collection was conducted in this portion of the Clinch. Acceptable PDOP values were achieved for all sites visited (Fig. A5). All RMS values are plotted by date on Fig. A6. The backup hardcopy maps were substituted when GPS data was not available.

6. FIELD AND PROCESSING LABORATORY ANALYSIS AND SUPPORT OPERATIONS RESULTS

These field analyses include Hydrolab and water current meter data; laboratory analyses include alkalinity, total suspended solids and NTU results. For field activities this includes a summary of Hydrolab calibration results (frequency of out-of-tolerance events for particular parameters for particular units) and a summary of Water Current Meter use / failure frequency. For processing laboratory analyses, this includes summary of alkalinity check point standard results (difference from the standard plus or minus the standard deviation), results from replicate analyses of total suspended particles data (difference between replicates plus or minus the standard deviation), results from turbidity analyses (difference from the standard plus or minus the standard deviation), and a summary of turbidimeter calibration results.

6.1 HYDROLAB CALIBRATION RECORDS

Hydrolab instruments were used to determine water column profiles of temperature, pH, conductivity, dissolved oxygen and oxidation/reduction potential; the units also include a depth sensor which was also calibrated. Use and calibration of the Hydrolab instruments are governed by CR-ERP SOP-2370 (ES/INT-72). Records were obtained for the calibration of the Hydrolab units used during the Phase 2 sampling events. Calibration for the dissolved oxygen, pH, and conductivity sensors was performed and recorded prior to and following each event in which the Hydrolab was used to collect data; the oxidation-reduction sensor was calibrated less frequently and temperature was not calibrated, per manufacturers specification (Hydrolab, 1993). However, temperature was checked against a NIST standard reference thermometer and these data recorded on the calibration form. The Hydrolab was used for a total of 58 sample collection events, covering approximately 55 sample collection dates. Of these 58 events and 232 sensor calibrations, an "out of tolerance" was recorded for one sensor or another 30 times (approximately 12.9%). Some caution must be taken when reviewing these recorded out-of-tolerances since the response of certain Hydrolab sensors are intimately dependent on other sensors; one sensor may be out-of-tolerance only relative to a second sensor that is truly in need of maintenance.

There were two "out of tolerances" recorded during pre-calibration of the Hydrolab units. In both cases, the conductivity would not calibrate to within specified tolerance levels. Also, for both of these, the problem occurred with the same data probe (sonde unit #11471). Another out of tolerance was recorded when the Dissolved Oxygen (D.O.) probe was not functioning (sonde unit #05872 on 03MAR94). The rest of the calibration problems (27 out of the 30 or approximately 11.6%) occurred during post-calibration. The post-calibration problems can be separated into three general areas: 1) D.O. did not post-calibrate a total of 7 times (1 for sonde #11416; 4 for sonde #11417; and 2 for sonde #11418); 2) Conductivity did not post-calibrate a total of 15 times (1 for sonde #11416; 9 for sonde #11417; 1 for sonde #11418; and 4 for sonde #19439); and 3) pH did not post-calibrate a total of 5 times (4 for sonde #11418 -- this occurred only 2 times separately; 3 times there is overlap with DO problems). No out-of-tolerance events were recorded for the temperature sensor.

Problems with Hydrolab units in the field were recorded for a total of 14 events. Variable parameter readings was the most common problem (recorded on 6 dates). The variation in readings meant the values for each parameter fluctuated so much a reliable reading could not be recorded, largely due to strong water currents that prohibited the Hydrolab unit from sinking properly in the water column. Problems occurred with the conductivity, D.O., and pH readings. The variation in readings can be explained by the strong current which occurred on 24FEB94 and 19APR94.

Routine maintenance was performed on all units used during Phase 2. All problems identified during calibration were fixed prior to the instruments being returned to service. Routine maintenance, as called for in the SOP helped to prevent such problems from recurring. All maintenance performed in the preparation lab or at the manufacturer was recorded in the proper Hydrolab maintenance logbook.

6.2 WATER CURRENT METER RECORDS

A Water Current Meter was used to measure water flow and direction during field activities. WCM use is governed by CR-ERP SOP-2373 (ES/INT-72). The use / failure frequency of the WCM will be presented.

6.3 ALKALINITY CHECK POINT STANDARD RESULTS

Alkalinity determinations were done using the Gran titration method. Quality control for alkalinity consisted of consistent use of ultrapure acid for titration, calibration of volumetric pipettes prior to analysis, and determination of check point standard values, as controlled by CR-ERP SOP-2341 (ES/INT-72). All alkalinity check point standards used from 01FEB94 through 29JUL94 were in tolerance (Fig. A7). Each calculated alkalinity value for the standards fell within the specified of ± 3 standard deviations of the calculated mean. Beginning on 09AUG94, a new check point standard was used. All calculated alkalinity values from this new standard, with the exception of the value for 24AUG94, were in tolerance. The standard alkalinity for the specified date was greater than 4 standard deviations away from the calculated mean (Fig. A7).

6.4 TOTAL SUSPENDED PARTICLE REPLICATE RESULTS

Total suspended particle (TSP) concentrations were determined using a gravimetric technique, filtering a known volume of water through a tared 0.7 micron pore size filter to collect the suspended particles, drying them and then re-weighing following CR-ERP SOP-2350 (ES/INT-72). Quality control for TSP determinations included use of a calibrated analytical balance (see balance calibration records, below) and analysis of replicate samples for TSP determinations. Differences between replicated measurements ideally should be zero. These differences between replicates are plotted along with 2 and 3 standard deviation from zero values for all samples, and serve as a control chart for TSP determinations (Table A15, Fig. A8). Of 206 samples, 8 (5.8%) were greater than 2 standard deviations from zero, and 4 more (1.9%) being greater than 3 standard deviations from zero (Fig. A8).

6.5 TURBIDITY DUPLICATE AND CALIBRATION RESULTS

Turbidity was measured directly on field samples using laboratory equipment. Quality control for turbidity determinations consisted of use of calibration standards and duplicate analysis, following CR-ERP SOP-2360. Differences between replicate measurements ideally should be zero. These differences were plotted along with the 2 and 3 standard deviation values serve as a control chart for turbidity determinations (Table A16, Fig. A9). Twenty-two of 264 samples (9.4%) were greater than two standard deviations from zero, with only 3 more (1.1%) being greater than 3 standard deviations from zero (Fig. A9).

6.6 SUMMARY

Of these 58 events and sensor 232 calibrations, an "out of tolerance" was recorded for one sensor or another 30 times (approximately 12.9%). Some caution must be taken when reviewing these recorded out-of-tolerances since the response of certain Hydrolab sensors are intimately dependent on other sensors; one sensor may be out-of-tolerance only relative to a second sensor that is truly in need of maintenance. Routine maintenance was performed on all units used during Phase 2. All problems identified during calibration were fixed prior to the instruments being returned to service. Routine maintenance, as called for in the SOP helped to prevent such problems from recurring. All maintenance performed in the preparation lab or at the manufacturer was recorded in the proper Hydrolab maintenance logbook.

All alkalinity check point standards were in tolerance, with the exception of the value for 24AUG94, were in tolerance. Eight of 206 TSP samples (5.8%) were greater than 2 standard deviations from zero, and 4 more (1.9%) were greater than 3 standard deviations from zero. Twenty-two of 264 turbidity samples (9.4%) were greater than two standard deviations from zero, with only 3 more (1.1%) being greater than 3 standard deviations from zero.

7. PROCESSING LABORATORY SUPPORT OPERATIONS

Support operations include equipment check standard data for analytical balances, thermometers (hand-held) and the Milli-Q system, and sample preservation data from refrigerator temperature logs and sample pH checks. This section summarizes these equipment check standard data. Raw data for this section may be found both in the Laboratory Operations Manual and associated log books for the 1503/6 laboratory, and in the Clinch River Document Management Center. They are not reprinted here.

7.1 REFRIGERATOR TEMPERATURE LOG REVIEW

Sample storage refrigerator temperatures were monitored and recorded constantly. Temperatures were recorded for two refrigerators and two freezers, though only the two refrigerators were utilized for storage of Phase 2 sediment and water samples from processing to shipment to the analytical laboratories. In the following discussion, refrigerator #2 is a 21 cubic foot capacity unit (VWR), that utilizes a highly sensitive thermostat commonly used in maintaining temperatures in commercial milk coolers; refrigerator #4 is a 72 cubic foot capacity commercial unit (True Manufacturing Company) commonly used in the food service industry. Both refrigerators were located in a non-climate controlled greenhouse. The bulk of the samples, particularly those for organic analysis, were stored in refrigerator #4.

A review of the temperature logs, governed by Water and Characterization Task Work Aid WA-W-26, which established an acceptable tolerance of $4^{\circ}\text{C} \pm 2^{\circ}\text{C}$ (per manufacturers and analytical preservation specifications), these units to be periodically out of tolerance. Exceeding the lower boundary a problem primarily for freezing of the sample and/or container breakage [temperature less than or equal to zero (≤ 0) $^{\circ}\text{C}$]. Exceedances of the upper boundary violates one of the criteria for preservation of certain samples. Sample preservation guidelines are found in Appendix B of ORNL/ER-218, 1994. The span of time the refrigerator was out of tolerance was also important.

Samples that were out of tolerance ($\leq 0^{\circ}\text{C}$ or $> 6^{\circ}\text{C}$) for more than 5 hours were considered suspect. A five- hour time span would allow for thorough warming or freezing of the samples, altering the integrity of the samples.

Suspect storage dates were grouped into seasons by refrigerator, with winter classified as from November to February (Fig. A10, Fig. A11), spring from March through May (Fig. A12), summer stretching from June through August (Fig. A13) and fall from September through October. The majority of out-of-tolerances events were recorded during the winter (Fig. A10, Fig. A11). Both refrigerators yielded temperatures at or below freezing for extended periods (as long as 24 hours) during the winter. Temperatures in refrigerator #2 exceeded the upper tolerance limits on several occasions (Fig. A12, Fig. A13). Temperatures in refrigerator #4 were maintained at or below 6°C at all times.

The temperature fluctuations in the refrigerators was partially, if not wholly, caused by their location. Ambient air temperatures around the refrigerators reflected those of the season, with enhanced heating during the summer. During winter, when outside temperatures were very cold, violations of the lower limit occurred. Warm to hot ambient conditions in the spring and summer led to violations of the upper temperature limit. The impact on sample integrity should be minimal, given that organic samples were stored in refrigerator #4, and samples for metals analysis, ^{90}Sr and gross alpha-beta, which were chemically preserved and did not require a specific temperature range, were stored in refrigerator #2.

7.2 BALANCE CALIBRATION RECORDS

Analytical and laboratory electronic balances were used to determine sample weights for TSP, determine pipette volumes for alkalinity determinations, and for sediment wet and dry weights. Use and recording requirements are found in Water and Sediment Characterization Task Work Aids WA-SW-19 (for the Mettler 3000 BasalBal), WA-SW-20 (for the Mettler AE260 Analytical Balance) and WA-SW-25 (for the Sartorius L2200S Balance). A review of the records showed that the calibration of each balance was checked prior to use. The calibration checks were performed with certified standard masses, that were calibrated bi-annually against an ORNL maintained NIST certified standard mass. All balance calibration checks met the specified mass used. No out-of-tolerance events were observed or recorded in the Balance Calibration Logbook. The required frequency for balance calibration and cleaning is once every six months. All balances and the standard masses used for calibration checks were cleaned and calibrated twice during Phase 2 sample collection, on December 7, 1993 and on June 1, 1994. No out of tolerance conditions were reported by I and C during these calibration checks and cleanings.

7.3 DRYING OVEN TEMPERATURE RECORDS

Sample drying ovens (model VWR 1300U), located in laboratory 6 building 1503, were mainly used in TSP determination. Oven temperature was consistently monitored in accordance with CR-ERP SOP 2350, and Water and Sediment Characterization Task Work Aid WA-SW-24. Temperatures were to be maintained at $104^{\circ}\text{C} \pm 2^{\circ}\text{C}$ in order to properly perform the TSP determination. The ovens were on constantly and in consistent use, throughout Phase 2 sampling. Due to constant use, the temperature was checked approximately every two weeks (and often more frequently). The ovens were in tolerance on all dates except: 08MAR94, 15MAR94, 12APR94, and 25JUL94. For these four dates, the ovens were at the most 3.1°C out of tolerance on the high side and 0.6°C on the low side. It is not likely that the TSP samples for these dates were

biased as the temperature swings were not extreme enough to have caused volatilization of some particulates, and samples were adequately dried to prevent water retention in the filter (lower temperatures). Oven calibration is required every six months. Calibration was performed on September 30, 1993 and March 14, 1994. No out of tolerance conditions were recorded by I and C during calibration.

7.4 SAMPLE PRESERVATION CHECKS

Chemical preservation of samples was verified by pH checks, with one sample checked per preservation type per sample collection day. Preservation checks followed Water and Sediment Characterization Task Work Aid WA-SW-07. Sample preservation check results that were verified in the field were recorded in the field log book; preservation checks performed in the laboratory were recorded in the laboratory calibration logbook. All sample preservation checks indicated that samples were preserved to the level specified by analytical SOWs.

7.5 MILLI-Q SYSTEM PERFORMANCE

Adequate performance of the Milli-Q water system, which supplied all of the water for rinsing equipment, making stock solutions and for blanks, was controlled by Water and Sediment Characterization Task Work Aid WA-SW-22. Milli-Q blank results are summarized by analyte, in section A.1.2. Maintenance performed on the Milli-Q system was recorded in the Milli-Q maintenance log book.

7.6 SUMMARY

The majority of out-of-tolerances events were recorded during the winter (Fig. A10, Fig. A11). Both refrigerators yielded temperatures at or below freezing for extended periods (as long as 24 hours) during the winter. Temperatures in refrigerator #2 exceeded the upper tolerance limits on several occasions (Fig. A12, Fig. A13). Temperatures in refrigerator #4 were maintained at or below 6°C at all times. All balances and the standard masses used for calibration checks were cleaned and calibrated twice during Phase 2 sample collection, on December 7, 1993 and on June 1, 1994. I and C reported no out of tolerance conditions during these calibration checks and cleanings.

The ovens were in tolerance on all dates except: 08MAR94, 15MAR94, 12APR94, and 25JUL94. For these four dates, the ovens were at the most 3.1°C out of tolerance on the high side and 0.6°C on the low side. It is not likely that the TSP samples for these dates were biased as the temperature swings were not extreme enough to have caused volatilization of some particulates, and samples were adequately dried to prevent water retention in the filter (lower temperatures). Oven calibration is required every six months. Calibration was performed on 30SEPT93 and 14MAR94. No out of tolerance conditions were recorded by I and C during calibration. Sample preservation check results that were verified in the field were recorded in the field log book; preservation checks performed in the laboratory were recorded in the laboratory calibration logbook. All sample preservation checks indicated that samples were preserved to the level specified by analytical SOWs.

8. PROGRAMMATIC EXCEPTION REPORT SUMMARY

For the CR-ERP's Phase 2 sampling events, approximately 99 separate issues were addressed by Programmatic Exception Reports (PERs) [39 separate PERs and multiple sub-sections within PERs]. The topics of the generated PERs were broadly separated into the following categories:

- 1) Equipment Malfunction (8 occurrences)
- 2) Logbook Problems (7 occurrences)
- 3) Sample container/volume problems (14 occurrences)
- 4) Alkalinity/NTU/pH (22 occurrences)
- 5) Task Maps/COCs/Forms (42 occurrences)
- 6) Miscellaneous (8 occurrences)

The different categories of PERs contained the following classifications:

8.1 EQUIPMENT MALFUNCTION

- **Hydrolab probe malfunctions** (PER-94-CRRI-0041-01; PER-94-CRRI-0049-01; and PER-94-CRRI-0064-01)
- **Hydrolab Post-calibration problems** (PER-94-CRRI-0027-01 and PER-94-CRRI-0045-01)
- **Water Current Meter malfunction** (PER-94-CRRI-0050-01 and PER-94-CRRI-0078-01)
- **GPS Battery failure** (PER-94-CRRI-0160-01)

8.2 LOGBOOK PROBLEMS

- **Corrections/Cross-out not properly initialed and dated** (PER-93-CRRI-0009-04; PER-93-CRRI-0011-05; PER-93-CRRI-0012-07; and PER-94-CRRI-0016-10)
- **Data improperly recorded** (PER-93-CRRI-0011-07; PER-93-CRRI-0012-06; and PER-94-CRRI-0015-04)

8.3 SAMPLE CONTAINER/VOLUME PROBLEMS

- **Sample received with less than required volume** (PER-94-CRRI-0023-01)
- **GAB and Sr-90 volume listed improperly on Field Collection Task Map** (PER-93-CRRI-0041-08 and 09; PER-94-CRRI-0015-15; and PER-94-CRRI-0016-07)
- **Laboratory Processing Task Map container type/size inconsistent with Technical Plan** (PER-93-CRRI-0009-10; PER-93-CRRI-0011-11; and PER-93-CRRI-0012-12 and 13)
- **Sediment and Water submitted for Gamma Spectrometry with insufficient volumes** (PER-94-CRRI-0022-01; PER-94-CRRI-0202-01; PER-94-CRRI-0264-01; PER-94-CRRI-0274-01; and PER-94-CRRI-0317-01)

8.4 ALKALINITY/NTU/pH

- **Alkalinity data forms improperly completed** (PER-93-CRRI-0010-01 thru 06; PER-94-CRRI-0015-07 thru 11 and 14; PER-94-CRRI-0016-06 and 07; and PER-95-CRRI-0367-01)
- **Calibration info/Location/Logbook ID not included in Daily File for NTU and pH** (PER-93-CRRI-0009-07 and PER-94-CRRI-0015-06)
- **Alkalinity Check Standard >1 standard deviation lower than reported standard** (PER-94-CRRI-0039-02)
- **No Alkalinity Check Standard run as required by ER/CR SOP 2341** (PER-94-CRRI-0031-01; PER-94-CRRI-0034-01; and PER-94-CRRI-0196-01)
- **Alkalinity Samples not run/exceeded holding times** (PER-94-CRRI-0039-01)

8.5 TASK MAPS/COCS/DATA FORMS

- **Task Maps/COCs have incomplete/improperly filled out headings** (PER-93-CRRI-0009-01 and 02 and 05; PER-93-CRRI-0011-01 thru 02 and 09 thru 10; PER-93-CRRI-0012-01 and 03 thru 04 and 08; PER-94-CRRI-0015-01 and 02; PER-94-CRRI-0016-01 and 03 thru 04; PER-94-CRRI-0032-02; PER-94-CRRI-0090-01; PER-94-CRRI-0101-01)
- **GPS printouts not signed/dated** (PER-93-CRRI-0007-03; PER-93-CRRI-0011-03; PER-93-CRRI-0012-02; PER-94-CRRI-0015-03; and PER-94-CRRI-0016-02)
- **Water Current Meter calibration information not included in Daily File** (PER-93-CRRI-0009-06 and PER-94-CRRI-0015-05)
- **Analysis for specific samples documented improperly on Task Maps** (PER-93-CRRI-0012-11; PER-94-CRRI-0015-17; PER-94-CRRI-0016-09; and PER-94-CRRI-0336-05)
- **Pencil used on Laboratory Processing Task Map; Violation of ER/CR-SOP 2000** (PER-94-CRRI-0016-16 and PER-94-CRRI-0016-080)
- **TSP data form incomplete; Sample lost** (PER-94-CRRI-0276-01)

8.6 MISCELLANEOUS

- **For SOW-194: Samples received with wrong preservatives** (PER-94-CRRI-0019-01)
- **TOC samples collected in wrong containers with headspace** (PER-94-CRRI-0330-01)
- **Possible sample contamination due to sample contact with knit gloves** (PER-93-CRRI-0013-01)
- **NTU vials broken—No turbidity readings taken for 15MAR94 and 16MAR94** (PER-94-CRRI-0046-01 and PER-94-CRRI-0048-01)
- **Organic samples taken with Peristaltic Pump instead of Niskin bottle** (PER-94-CRRI-0194-01)
- **Metals sample not field filtered** (PER-94-CRRI-0195-01)

Of the 99 reported PER topics, 68 (69%) occurred for sampling dates in November 1993. These dates coincide with the beginning of Phase 2. Mistakes and inconsistencies that occurred during in the earlier stages of the sampling were largely corrected as both the sampling and PER processes were worked out. Only 31 PERs dealing with the sediment/water sampling were initiated for sampling dates occurring after January 1994 (31%). Of these 31, 11 PERs (35%) dealt with equipment malfunction (see the Miscellaneous and Equipment Malfunction groups). Twenty-three out of 99 PERs (23%) dealt with not signing and dating forms or not initialling and dating corrections (see the Logbook, Alkalinity, and Task Map groups). This particular topic occurred only 2 times after January 1994. With repetition of the various tasks involved in each sampling event, mistakes were lessened, and the number of PERs dropped significantly as Phase 2 progressed.

Figure A.1. Cumulative percentage of the number of surface water quality control (QC) samples to the number of routine surface water samples.

Figure A2. Cumulative percentage of the number of sediment and pore water quality control (QC) samples to the number of routine sediment and pore water samples.

Figure A3. Plot of positional dilution of precision (PDOP) from global positioning system (GPS) site location data for surface water sampling. Values less than six (6) are considered acceptable.

Figure A4. Plot of root mean square error (RMSE) in meters from global positioning system site (GPS) location data for sediment sampling. Values less than five (5) are considered acceptable.

Figure A5. Plot of positional dilution of precision (PDOP) from global positioning (GPS) system site location data for sediment sampling. Values less than six (6) are considered acceptable.

Figure A6. Plot of root mean square error (RMSE) in meters from global positioning system (GPS) site location data for sediment sampling. Values less than five (5) are considered acceptable.

A-30

Figure A8. Plot of differences between replicate total suspended particle (TSP) samples with 2 and 3 standard deviation lines for Phase 2 Clinch River Remedial Investigation water sampling.

Figure A10. Plot of refrigerator #2 winter out-of-tolerance events.

Figure A11. Plot of all refrigerator #4 out-of-tolerance events.

Figure A12. Plot of refrigerator #2 spring out-of-tolerance events.

Figure A13. Plot of refrigerator #2 summer out-of-tolerance events.

Table A1. Field sample definitions taken from the Phase 2 technical and sampling and analysis plans

Description	Definition (see also the CRRI Phase 2 Quality Assurance Project Plan, DOE/OR/01-1111&D2, Section 8.2)	Required analyses	PARCC Indicator	Code
Regular field sample	A portion of material received to be analyzed that is contained in single or multiple containers and identified by a unique CR-ERP sample number. Frequency: NA.	All specified under Subtask W1.1		REG
Field equipment rinse blank	The QAPjP has two types of these samples, the field rinsate and the lab rinsate. The field rinsate consists of a sample of Milli-Q water (placed into a clean intermediated container) used in the field for the final rinse of field sampling equipment. The lab rinsate consists of a sample of final rinse water from the cleaned sample collection apparatus. In either case, samples should be apportioned into proper analytical containers from the collection equipment without further analytical processing (no intermediate flasks or filtration) and preserved for shipment to appropriate analytical laboratories. Frequency: 1 for every 20 REG field collections <i>PURPOSE: Determine 1) If laboratory cleaning procedures are adequate {for lab rinsates}, or 2) If the decontamination procedure is adequate to avoid carryover of contamination from one sampling location to another {for field rinsates}.</i>	Metals, Semivolatile organics, PCB/Pesticides, ⁹⁰ Sr, Gross alpha-beta, Cyanide, Mercury speciation, ³ H, Gamma spectroscopy (liquid fraction)	Sampling Accuracy	FRB
Laboratory equipment rinse blank	Milli-Q water placed into a clean intermediated container (properly cleaned, with documentation) and then passed through cleaned sample processing equipment, including filter funnels, filter paper, holding flasks and other devices. Sample should then be apportioned into proper analytical containers and preserved for shipment to appropriate analytical laboratories. There is no QAPjP parallel to this sample. Frequency: 1 for every 20 REG field collections <i>PURPOSE: Determine the contribution of contamination from laboratory processing equipment</i>	Metals, Semivolatile organics, PCB/Pesticides, Cyanide, Anions, NH ₃ -N, NO ₃ -N, Mercury speciation, Gamma spectroscopy (liquid fraction)	Sample processing accuracy	LRB

Table A1. (continued)

Description	Definition (see also the CRRI Phase 2 Quality Assurance Project Plan, DOE/OR/01-1111&D2, Section 8.2)	Required analyses	PARCC Indicator	Code
Field blank	<p>Milli-Q water placed into a clean intermediated container (properly cleaned, with documentation), sealed and taken to the field. While field samples are being collected, the sample should be poured into the proper analytical containers without further analytical processing (no intermediate flasks or filtration) and preserved for shipment to appropriate analytical laboratories. This is a much more rigorous test of field blanks than that of the QAPJP; field blanks in the QAPJP consist merely of water being brought to the field in sealed containers, opened and exposed to ambient conditions during sampling activities, closed, and transported back to the laboratory.</p> <p>Frequency: 1 for every 20 REG field collections.</p> <p><i>PURPOSE: Determine the contribution of contamination introduced by the boat, or other non-matrix sources associated with sample collection</i></p>	Metals, Semivolatile organics, PCB/Pesticides, ⁹⁰ Sr, Gross alpha-beta, Cyanide, Mercury speciation, ³ H, Gamma spectroscopy (liquid fraction)	Sampling accuracy	FB
Field duplicate sample	<p>Sample collected at the same time, from the same site, under the same conditions as a regular sample. This definition is identical to that given in the QAPJP.</p> <p>Frequency: 1 for every 20 REG field collections.</p> <p><i>PURPOSE: determine the reproducibility of field sampling events</i></p>	All specified under subtask W1.1	Total precision	FR
Trip blank	<p>Distilled water samples pre-preserved and packaged in appropriate sample containers by the analytical laboratory and shipped to the field sampling team with the other pre-cleaned teflon sample containers. Trip blank samples are kept with the field samples throughout the field collection even and returned to the processing laboratory for shipment to the analytical laboratory. The sample bottle is never opened during the collection, processing or shipping steps. Sample submitted with regular samples.</p> <p>Frequency: 1 for every sampling trip.</p> <p><i>PURPOSE: determine the contribution of transportation to and from the field to contaminant concentrations</i></p>	Mercury Speciation	Sampling accuracy	TB

Table A1. (continued)

Description	Definition (see also the CRRI Phase 2 Quality Assurance Project Plan, DOE/OR/01-1111&D2, Section 8.2)	Required analyses	PARCC Indicator	Code
Matrix spike sample	<p>Regular sample collection, with two to three times the volume for most analyses. For metals analyses in surface water, the volume submitted routinely is sufficient for matrix spike determinations. This may not be true for porewater samples</p> <p>Frequency: 1 for every 20 REG field collection,</p> <p><i>PURPOSE: provide sufficient volume for analytical laboratory performed matrix spike and matrix spike duplicate analyses</i></p>	<p>Metals, Semivolatile organics, PCB/Pesticides, ⁹⁰Sr + Gross alpha-beta, Cyanide, Mercury speciation</p>		SPK
Milli-Q blank sample	<p>Sample of Milli-Q water collected directly from the Milli-Q water system directly into cleaned sample containers, preserved and submitted with regular samples. This may also serve the purpose of the preservative blank, as defined in Appendix L of the CR-ERP Phase 2 Technical Plan</p> <p>Frequency: Prior to the initiation of analytical services with specific laboratories and following the change out of Milli-Q system filters.</p> <p><i>PURPOSE: determine the contribution of contaminants introduced directly from the Milli-Q water system</i></p>	<p>Metals, Semivolatile organics, PCB/Pesticides, ⁹⁰Sr + Gross alpha-beta, Cyanide, Mercury speciation, ³H, Gamma spectroscopy (liquid fraction)</p>		MQB

Table A2. Surface water quality control samples collected by site

Task W1.1				
Site	Number of site visits	Number of site visits QC samples collected		
		FD	FB	FRB
CRM 1.0	6	2	0	0
CRM 1.0B	3	1	0	0
CRM 6.0	6	0	1	0
CRM 9.0	2	0	0	0
CRM 9.0B	3	0	0	0
CRM 11.5	1	1	0	1
CRM 11.8A	3	0	0	0
CRM 11.8B	3	0	0	0
CRM 11.8C	3	0	0	0
CRM 14.5	1	1	1	1
CRM 19.0	4	0	0	1
CRM 19.0B	3	0	0	0
CRM 20.2A	3	0	0	0
CRM 20.2B	3	0	0	0
CRM 20.2C	3	0	0	0
CRM 22.0	3	0	0	0
CRM 23.9	1	1	0	0
CRM 36.9B	3	0	0	0
CRM 41.5	6	0	1	1
CRM 41.5B	3	0	0	0
CRM 43.0B	3	0	0	0
CRM 46.0B	3	1	0	0
CRM 46.2	1	0	0	1
CRM 51.5	1	0	0	0
CRM 52.0	1	0	0	0
MBM 0.2	8	1	2	0
MBM 0.2A	3	0	1	1
MBM 0.2B	3	0	0	0
MBM 0.2C	3	0	0	0
MBM 0.4	2	0	0	0
MBM 0.4B	3	0	0	0
PCM 0.1B	3	0	1	0
PCM 1.0	13	2	1	0
PCM 2.9	13	0	3	4
PCM 4.3	14	1	4	1
PCM 5.1	13	2	0	1
PCM 6.0	13	2	0	1
PCM 6.5	12	1	1	0
PCM 7.0	13	0	1	1
PCM 7.5	11	1	0	1
WBM 0.4	2	0	0	0
WOCM 0.0B	3	0	0	0
Total	204	17	17	15
Percent of Total		8.3%	8.3%	7.4%

FB = Field Blank

FD = Field Duplicate

FRB = Field Rinse Blank

Table A3. Number and frequency of field quality control samples collected for surface water

<i>Total Surface Water</i>										
Processing Group	REG	FB	%FB	FD	%FD	FRB	%FRB	MQB	TB	TOTAL
Tritium	195	17	8.0%	15	7.1%	14	6.7%	6	0	247
Cyanide	194	17	8.1%	14	6.7%	15	7.2%	6	0	246
Gross Alpha Beta	226	17	7.0%	14	5.8%	14	5.8%	5	0	276
Gamma	0	12	100.0%	0	0.0%	10	100.0%	5	0	27
Mercury	204	17	7.7%	15	6.8%	16	7.3%	5	75	332
Metals	219	17	7.2%	15	6.4%	16	6.8%	6	0	273
NTU,pH, Alkalinity	218	0	0.0%	15	6.4%	1	0.5%	0	0	234
Pest/PCB	189	15	7.4%	14	6.9%	14	6.9%	8	0	240
Sr90	199	17	7.9%	14	6.6%	15	7.0%	6	0	251
SemiVols	191	15	7.3%	14	6.8%	14	6.8%	8	0	242
Total	1835	144	7.3%	130	6.6%	129	6.6%	55	75	2368

<i>Dissolved Surface Water</i>						
Processing Group	REG	FD	%FD	LRB	%LRB	Total
Ammonia	196	14	6.7%	11	5.3%	221
Anions	198	15	7.0%	12	5.7%	225
Cyanide	194	14	6.7%	11	5.4%	219
Gamma	195	16	7.6%	0	0.0%	211
Mercury	179	14	7.3%	11	5.8%	204
Metals	194	14	6.7%	11	5.4%	219
Nitrate/Nitrite	199	15	7.0%	11	5.2%	225
Pest/PCB	190	14	6.9%	11	5.5%	215
SemiVols	189	14	6.9%	11	5.5%	214
Total	1734	130	7.0%	89	4.9%	1953

FB = Field Blanks FRB=Field Rinse Blanks
 FD = Field Duplicates LRB=Lab Rinse Blanks
 REG = Routine Samples TB=Trip Blanks

Table A4. Assessment of precision of field quality control water samples

Analyte	Samples evaluated	Samples exceeding precision criteria	Samples acceptable	Per cent meeting precision criteria
<i>Surface Water-Dissolved Organics</i>				
Di-n-butylphthalate	1	1	0	0%
<i>Surface Water-Dissolved Inorganics</i>				
Aluminum	11	5	6	55%
Ammonium Nitrogen	5	2	3	60%
Antimony	11	10	1	9%
Arsenic	3	0	3	100%
Barium	14	0	14	100%
Boron	9	5	4	44%
Calcium	14	0	14	100%
Chloride	15	4	11	73%
Chromium	8	0	8	100%
Copper	13	9	4	31%
Fluoride	7	2	5	71%
Iron	11	4	7	64%
Lead	1	0	1	100%
Magnesium	14	0	14	100%
Manganese	14	0	14	100%
Nickel	13	6	7	54%
Nitrate/nitrate	14	0	14	100%
Potassium	14	0	14	100%
Sodium	14	0	14	100%
Sulfate	15	0	15	100%
Zinc	13	7	6	46%
Total	233	54	179	77%
<i>Surface Water-Total Organics</i>				
Bis(2-ethylhexyl)phthalate	1	0	1	100%
<i>Surface Water-Total Inorganics</i>				
Aluminum	15	5	10	67%
Arsenic	3	0	3	100%
Barium	15	0	15	100%
Boron	12	6	6	50%
Calcium	15	0	15	100%
Chromium	13	1	12	92%
Cobalt	2	0	2	100%
Copper	14	3	11	79%
Iron	15	4	11	73%
Lead	8	1	7	88%

Table A4. (continued)

Analyte	Samples evaluated	Samples exceeding precision criteria	Samples acceptable	Per cent meeting precision criteria
Manganese	15	0	15	100%
<i>Surface Water-Total Inorganics</i>				
Mercury	1	1	0	0%
Nickel	14	3	11	79%
Potassium	15	0	15	100%
Sodium	15	0	15	100%
Uranium	3	0	3	100%
Vanadium	3	0	3	100%
Zinc	15	7	8	53%
Total	208	31	177	85%

Table A5. Duplicate error ratio for radionuclides in surface water

Analyte	Sample pairs analyzed	Pairs exceeding criteria	Min.	Duplicate error ratio		
				Max.	Mean	Std. Dev.
<i>Total Surface Water</i>						
Lab: Ecotek Laboratory Services, Inc.						
Gross Alpha Activity	10	0	0.02	0.9	0.25	0.28
Gross Beta Activity	10	0	0.05	0.89	0.31	0.25
Strontium-90	11	0	0.03	0.29	0.13	0.08
Tritium	10	2	0	3.64	0.5	1.16
Lab: Oak Ridge Analytical Services						
Gross alpha Activity	4	0	0.01	0.06	0.03	0.02
Gross Beta Activity	4	0	0.01	0.3	0.14	0.15
Strontium-90	3	0	0.08	0.26	0.19	0.1
Tritium	4	0	0	0	0	0
<i>Dissolved Surface Water</i>						
Lab: Environmental Sciences Division/Radiological Analysis Services						
Cesium-137	16	0	0	0.77	0.34	0.24
Cobalt-60	16	0	0.02	0.54	0.23	0.17

Table A6. Summary of quality control blanks for surface water samples

Analyte	Sample Type	N	Mean	Std. Dev.	Min.	Max.	Mean of all routine samples
<i>Lab Rinse Blanks (Units are ug/L unless noted otherwise)</i>							
Aluminum	Lab Rinse Blanks	5	588.72	1275.28	13.50	2870.00	
	Routine Samples	136	21.75	35.49	6.19	418.54	23.03
Ammonium Nitrogen (mg/L)	Lab Rinse Blanks	1	0.22	.	0.22	0.22	
	Routine Samples	29	78.03	35.75	51.00	190.00	79.85
Antimony	Lab Rinse Blanks	7	1410.70	3721.38	1.10	9850.00	
	Routine Samples	161	5.49	2.46	1.20	13.10	5.49
Arsenic	Lab Rinse Blanks	2	4105.55	5804.57	1.10	8210.00	
	Routine Samples	12	1.35	0.38	1.00	2.30	1.71
Barium	Lab Rinse Blanks	5	777.84	1734.16	1.20	3880.00	
	Routine Samples	113	31.29	8.71	20.20	51.85	29.55
Beryllium	Lab Rinse Blanks	1	3.60	.	3.60	3.60	
	Routine Samples	0	.	.	.	.	
Bis(2-ethylhexyl)phthalate	Lab Rinse Blanks	2	7.50	4.95	4.00	11.00	
	Routine Samples	17	32.24	66.36	1.00	230.00	29.37
Boron	Lab Rinse Blanks	5	44.68	32.64	17.50	86.90	
	Routine Samples	149	49.12	27.30	3.16	164.20	
Cadmium	Lab Rinse Blanks	1	1220.00	.	1220.00	1220.00	49.12.
	Routine Samples	0	.	.	.	.	

Table A6. (continued)

Analyte	Sample Type	N	Mean	Std. Dev.	Min.	Max.	Mean of all routine samples
<i>Lab Rinse Blanks (Units are ug/L unless noted otherwise)</i>							
Calcium	Lab Rinse Blanks	3	5536.33	8393.84	59.00	15200.00	26511.28
	Routine Samples	30	29014.67	2950.04	23100.00	37700.00	
Chloride	Lab Rinse Blanks	9	2.61	6.54	0.02	20.00	4775.00
	Routine Samples	198	4775.00	5433.22	850.00	55000.00	
Chromium	Lab Rinse Blanks	7	147.59	384.70	1.10	1020.00	2.01
	Routine Samples	120	2.01	1.17	1.00	8.40	
Cobalt	Lab Rinse Blanks	1	26.50	.	26.50	26.50	.
	Routine Samples	0	.	.	.	.	
Copper	Lab Rinse Blanks	6	35.97	81.84	1.20	203.00	4.59
	Routine Samples	179	4.62	7.92	1.00	65.70	
Di-n-butylphthalate	Lab Rinse Blanks	2	2.50	0.71	2.00	3.00	2.36
	Routine Samples	19	2.16	2.03	1.00	9.00	
Iron	Lab Rinse Blanks	9	4966.77	14824.97	9.40	44500.00	145.87
	Routine Samples	131	145.87	269.81	11.50	2650.00	
Mercury (Lockheed)	Lab Rinse Blanks	1	0.41	.	0.41	0.41	0.64
	Routine Samples	2	0.45	0.30	0.23	0.66	
Lead	Lab Rinse Blanks	4	7.00	7.65	1.20	17.60	1.60
	Routine Samples	18	1.60	0.54	1.01	3.00	
Magnesium	Lab Rinse Blanks	2	916.25	1179.10	82.50	1750.00	7622.24
	Routine Samples	30	8078.17	1304.44	5660.00	12800.00	

Table A6. (continued)

Analyte	Sample Type	N	Mean	Std. Dev.	Min.	Max.	Mean of all routine samples
<i>Lab Rinse Blanks (Units are ug/L unless noted otherwise)</i>							
Manganese	Lab Rinse Blanks	4	24.33	45.92	1.10	93.20	35.39
	Routine Samples	176	34.93	35.67	1.10	178.00	
Molybdenum	Lab Rinse Blanks	1	10.80	.	10.80	10.80	.
	Routine Samples	0	.	.	.	.	
Nickel	Lab Rinse Blanks	9	43.64	119.43	1.20	362.00	3.95
	Routine Samples	167	4.00	2.97	1.10	16.40	
Potassium	Lab Rinse Blanks	6	6867.93	16672.30	13.90	40900.00	1594.14
	Routine Samples	166	1610.33	448.42	966.00	3250.00	
Silver	Lab Rinse Blanks	1	96.80	.	96.80	96.80	.
	Routine Samples	0	.	.	.	.	
Sodium	Lab Rinse Blanks	10	2198.93	5904.28	28.60	18900.00	3620.81
	Routine Samples	188	3577.35	1240.31	23.80	8730.00	
Sulfate	Lab Rinse Blanks	1	0.17	.	0.17	0.17	21792.93
	Routine Samples	168	20583.33	5152.08	13000.00	35000.00	
Thallium	Lab Rinse Blanks	1	1.20	.	1.20	1.20	.
	Routine Samples	0	.	.	.	.	
Vanadium	Lab Rinse Blanks	1	23.60	.	23.60	23.60	.
	Routine Samples	0	.	.	.	.	
Zinc	Lab Rinse Blanks	11	92.07	276.28	4.30	925.00	8.31
	Routine Samples	176	8.31	15.72	2.00	128.00	

Table A6. (continued)

Analyte	Sample Type	N	Mean	Std. Dev.	Min.	Max.	Mean of all routine samples
<i>Field Blanks (Units are ug/L unless noted otherwise)</i>							
Aluminum	Field Blanks	7	51.60	88.09	10.70	250.00	309.68
	Routine Samples	7	211.03	200.06	45.10	643.00	
Arsenic	Field Blanks	1	1.20	.	1.20	1.20	1.76
	Routine Samples	1	2.20	.	2.20	2.20	
Brooks Rand Mercury (ng/L)	Field Blanks	4	2.22	1.04	1.11	3.50	43.47
	Routine Samples	4	24.56	43.92	1.21	90.40	
Barium	Field Blanks	2	1.40	0.14	1.30	1.50	34.10
	Routine Samples	2	28.60	7.21	23.50	33.70	
Bis(2-ethylhexyl)phthalate	Field Blanks	4	3.75	3.59	1.00	9.00	11.63
	Routine Samples	1	70.00	.	70.00	70.00	
Boron	Field Blanks	11	26.02	13.56	10.80	48.80	51.45
	Routine Samples	10	55.88	23.34	28.10	95.30	
Calcium	Field Blanks	3	90.67	15.33	73.50	103.00	26745.78
	Routine Samples	3	29256.67	1520.08	27670.00	30700.00	
Chromium	Field Blanks	12	1.37	0.43	1.00	2.40	2.07
	Routine Samples	12	1.82	0.40	1.30	2.60	
Copper	Field Blanks	11	8.65	24.59	1.00	82.80	5.71
	Routine Samples	11	2.87	1.24	1.00	5.00	
Di-n-butylphthalate	Field Blanks	4	2.00	1.41	1.00	4.00	.
	Routine Samples	0	.	.	.	.	

Table A6. (continued)

Analyte	Sample Type	N	Mean	Std. Dev.	Min.	Max.	Mean of all routine samples
<i>Field Blanks (Units are ug/L unless noted otherwise)</i>							
Endrin Ketone	Field Blanks	1	0.01	.	0.01	0.01	
	Routine Samples	0	.	.	.	.	.
Gross Beta Activity (pCi/L)	Field Blanks	4	5.71	2.75	3.21	9.20	
	Routine Samples	4	4.95	1.38	3.33	6.26	8.36
Iron	Field Blanks	6	32.42	41.38	8.10	116.00	
	Routine Samples	6	574.83	381.32	97.00	1150.00	514.10
Lead	Field Blanks	1	1.80	.	1.80	1.80	
	Routine Samples	0	.	.	.	.	1.82
Magnesium	Field Blanks	4	38.90	31.83	17.00	85.80	
	Routine Samples	4	8465.00	1010.56	7680.00	9940.00	7538.48
Methyl Mercury (ng/L)	Field Blanks	5	0.08	0.02	0.05	0.12	
	Routine Samples	5	0.11	0.04	0.05	0.17	0.13
Nickel	Field Blanks	3	1.87	1.24	1.10	3.30	
	Routine Samples	3	4.33	2.25	2.10	6.60	3.69
PCB-1254	Field Blanks	1	0.54	.	0.54	0.54	
	Routine Samples	0	.	.	.	.	.
Potassium	Field Blanks	5	38.72	18.94	17.50	66.80	
	Routine Samples	5	1606.00	302.46	1390.00	2130.00	1628.44
Silver	Field Blanks	1	3.00	.	3.00	3.00	
	Routine Samples	0	.	.	.	.	.

Table A6. (continued)

Analyte	Sample Type	N	Mean	Std. Dev.	Min.	Max.	Mean of all routine samples
Field Blanks (Units are ug/L unless noted otherwise)							
Sodium	Field Blanks	11	78.74	38.77	28.90	151.00	4563.67
	Routine Samples	11	5193.18	1828.41	2935.00	8740.00	
Strontium-90	Field Blanks	1	9.17	.	9.17	9.17	.
	Routine Samples	0	.	.	.	.	
Tritium	Field Blanks	1	799.00	.	799.00	799.00	.
	Routine Samples	0	.	.	.	.	
Zinc	Field Blanks	16	14.48	39.37	2.10	162.00	15.23
	Routine Samples	16	11.09	7.47	2.17	24.20	
Field Rinse Blanks							
Aluminum	Field Rinse Blanks	9	27.57	36.18	9.70	123.00	309.68
	Routine Samples	204	312.33	257.18	18.00	1180.00	
Arsenic	Field Rinse Blanks	1	1.60	.	1.60	1.60	1.76
	Routine Samples	32	1.86	1.14	1.00	5.40	
Barium	Field Rinse Blanks	2	2.65	0.35	2.40	2.90	34.10
	Routine Samples	181	33.80	8.74	23.20	60.10	
Bis(2-ethylhexyl)phthalate	Field Rinse Blanks	7	9.71	11.86	2.00	27.00	11.63
	Routine Samples	8	11.63	23.71	1.00	70.00	
Boron	Field Rinse Blanks	9	42.28	47.01	11.20	159.00	51.45
	Routine Samples	151	53.61	31.81	4.60	163.00	

Table A6. (continued)

Analyte	Sample Type	N	Mean	Std. Dev.	Min.	Max.	Mean of all routine samples
<i>Field Rinse Blanks</i>							
Calcium	Field Rinse Blanks	5	450.54	559.26	49.60	1270.00	26745.78
	Routine Samples	179	26509.55	6023.43	11300.00	37800.00	
Chromium	Field Rinse Blanks	10	1.64	0.49	1.10	2.50	2.07
	Routine Samples	149	2.10	0.95	1.00	8.20	
Copper	Field Rinse Blanks	7	1.50	0.78	1.00	3.20	5.71
	Routine Samples	189	6.01	11.10	1.00	83.20	
Di-n-butylphthalate	Field Rinse Blanks	4	1.50	0.58	1.00	2.00	2.00
	Routine Samples	27	2.00	1.62	1.00	7.00	
Gross Alpha Activity (pCi/L)	Field Rinse Blanks	1	1.14	.	1.14	1.14	2.18
	Routine Samples	12	2.95	2.24	1.00	8.20	
Gross Beta Activity (pCi/L)	Field Rinse Blanks	1	4.12	.	4.12	4.12	8.36
	Routine Samples	57	13.04	23.20	2.01	144.00	
Iron	Field Rinse Blanks	8	46.76	54.04	10.50	172.00	514.10
	Routine Samples	208	517.25	397.91	32.30	2740.00	
Magnesium	Field Rinse Blanks	3	127.70	138.85	22.20	285.00	7538.48
	Routine Samples	179	7550.06	1714.44	3700.00	12900.00	
Manganese	Field Rinse Blanks	2	5.10	4.81	1.70	8.50	76.66
	Routine Samples	180	76.05	40.31	18.50	232.00	
Nickel	Field Rinse Blanks	6	1.13	0.14	1.00	1.30	3.69
	Routine Samples	174	3.56	1.65	1.10	10.70	

Table A6. (continued)

Analyte	Sample Type	N	Mean	Std. Dev.	Min.	Max.	Mean of all routine samples
<i>Field Rinse Blanks</i>							
Potassium	Field Rinse Blanks	7	65.86	63.80	18.40	186.00	
	Routine Samples	179	1656.03	437.12	1010.00	3310.00	1628.44
Sodium	Field Rinse Blanks	9	277.84	496.11	51.40	1590.00	
	Routine Samples	195	4439.58	1453.54	2330.00	9180.00	4563.67
Tritium (pCi/L)	Field Rinse Blanks	2	500.00	176.78	375.00	625.00	
	Routine Samples	29	6683.55	16112.72	215.00	64200.00	6683.55
Zinc	Field Rinse Blanks	14	5.43	2.45	2.10	10.10	
	Routine Samples	201	15.67	23.75	2.00	200.00	15.23
<i>Trip Blanks (Units are ng/L)</i>							
Mercury	Trip Blank	75	2.197	2.175	0.062	12.400	
	Routine Samples	127	66.785	88.890	0.433	554.000	66.785
Methyl Mercury	Trip Blank	75	0.065	0.043	0.003	0.251	
	Routine Samples	28	0.265	0.165	0.037	0.732	0.265
<i>Milli-Q Blanks (all units are ug/L, except Brooks Rand mercury and methyl mercury, which are ng/L)</i>							
Aluminum	Milli-Q Blanks	1	6.10	.	6.10	6.10	
	Assoc. Blanks	1	10.20	.	10.20	10.20	
Antimony	Milli-Q Blanks	1	2.40	.	2.40	2.40	
	Assoc. Blanks	0	.	.	.	.	
Mercury (Brooks Rand)	Milli-Q Blanks	3	2.13	1.08	1.10	3.25	
	Assoc. Blanks	18	3.70	3.50	0.53	12.40	

Table A6. (continued)

Analyte	Sample Type	N	Mean	Std. Dev.	Min.	Max.	Mean of all routine samples
<i>Milli-Q Blanks (all units are ug/L, except Brooks Rand mercury and methyl mercury, which are ng/L)</i>							
Barium	Milli-Q Blanks	1	24.30	.	24.30	24.30	
	Assoc. Blanks	0	.	.	.	.	
Bis(2-ethylhexyl)phthalate	Milli-Q Blanks	1	8.00	.	8.00	8.00	
	Assoc. Blanks	9	8.89	10.51	2.00	27.00	
Boron	Milli-Q Blanks	3	28.60	8.43	19.00	34.80	
	Assoc. Blanks	18	34.59	34.55	11.20	159.00	
Calcium	Milli-Q Blanks	2	15072.10	21252.66	44.20	30100.00	
	Assoc. Blanks	3	58.63	12.97	49.60	73.50	
Cesium-137	Milli-Q Blanks	1	-2.21	.	-2.21	-2.21	
	Assoc. Blanks	8	3.59	5.35	-3.38	12.70	
Chromium	Milli-Q Blanks	2	1.70	0.28	1.50	1.90	
	Assoc. Blanks	20	1.45	0.44	1.00	2.50	
Copper	Milli-Q Blanks	1	1.80	.	1.80	1.80	
	Assoc. Blanks	0	.	.	.	.	
Di-n-butylphthalate	Milli-Q Blanks	1	2.00	.	2.00	2.00	
	Assoc. Blanks	3	2.00	1.73	1.00	4.00	
Iron	Milli-Q Blanks	1	16.70	.	16.70	16.70	
	Assoc. Blanks	11	36.31	48.17	8.10	172.00	
Mercury (Lockheed)	Milli-Q Blanks	2	1.57	0.66	1.10	2.04	
	Assoc. Blanks	0	.	.	.	.	

Table A6. (continued)

Analyte	Sample Type	N	Mean	Std. Dev.	Min.	Max.	Mean of all routine samples
<i>Milli-Q Blanks (all units are ug/L, except Brooks Rand mercury and methyl mercury, which are ng/L)</i>							
Magnesium	Milli-Q Blanks	1	8190.00	.	8190.00	8190.00	
	Assoc. Blanks	1	21.50	.	21.50	21.50	
Methyl Mercury	Milli-Q Blanks	4	0.07	0.01	0.05	0.07	
	Assoc. Blanks	29	0.08	0.03	0.03	0.17	
Nickel	Milli-Q Blanks	1	1.20	.	1.20	1.20	
	Assoc. Blanks	1	3.30	.	3.30	3.30	
Potassium	Milli-Q Blanks	2	686.70	938.05	23.40	1350.00	
	Assoc. Blanks	3	47.57	45.49	17.50	99.90	
Sodium	Milli-Q Blanks	3	1115.10	1780.10	45.30	3170.00	
	Assoc. Blanks	15	86.42	57.83	28.90	254.00	
Tritium	Milli-Q Blanks	1	897.00	.	897.00	897.00	
	Assoc. Blanks	1	625.00	.	625.00	625.00	
Zinc	Milli-Q Blanks	5	4.20	2.27	2.80	8.20	
	Assoc. Blanks	27	10.65	30.31	2.10	162.00	

Table A7. Sediment and pore water quality control samples collected by study reach

<i>Sediment and Pore Water</i>				
Reach	Number of site visits	Number of site visits QC samples collected		
		FD	FB	FRB
0	9	0	0	0
2	10	1	1	1
3	27	4	4	4
4	33	2	2	2
7/8	3	0	0	0
13	6	0	0	0
18	4	1	1	1
Total	92	8	8	8
Percentage of total		8.70%	8.70%	8.70%

FB = Field Blank

FD = Field Duplicate

FRB = Field Rinse Blank

Table A8. Number and frequency of field quality control samples collected

Processing Group	REG	FD	%FD	FRB/LRB	%FRB/LRB	Total						
<i>Sediment</i>												
Gamma	150	15	9.1%	15	9.1%	180						
Metals	200	18	8.3%	15	7.0%	233						
Mercury	71	8	10.1%	8	10.1%	87						
Physical	149	15	9.1%	0	0.0%	164						
Pest/PCB	153	15	8.9%	13	7.8%	181						
RAD2	60	5	7.7%	0	0.0%	65						
SR90	143	13	8.3%	14	8.9%	170						
SemiVols	153	15	8.9%	13	7.8%	181						
TKN	153	13	7.8%	2	1.3%	168						
Uranium	165	16	8.8%	0	0.0%	181						
Total	1397	133	8.7%	80	5.4%	1610						
<i>Pore water</i>												
Processing Group	REG	FB	%FB	FD	%FD	FRB	%FRB	LRB	%LRB	TB	%TB	Total
Ammonia	80	8	9.1%	7	8.0%	8	9.1%	8	9.1%	0	0	111
Gross Alpha Beta	8	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0	8
Gamma	75	2	2.6%	7	8.5%	8	9.6%	7	8.5%	0	0	99
Mercury	43	7	14.0%	7	14.0%	7	14.0%	8	15.7%	23	34.8%	95
Metals	82	8	8.9%	7	7.9%	8	8.9%	8	8.9%	0	0	113
Pest/PCB	37	6	14.0%	6	14.0%	6	14.0%	6	14.0%	0	0	61
SR90	68	7	9.3%	6	8.1%	7	9.3%	7	9.3%	0	0	95
SemiVols	36	6	14.3%	6	14.3%	6	14.3%	6	14.3%	0	0	60
Total Kjedahl Nitrogen	80	8	9.1%	7	8.0%	8	9.1%	8	9.1%	0	0	111
Total Organic Carbon	78	8	9.3%	7	8.2%	8	9.3%	8	9.3%	0	0	109
Uranium	31	1	3.1%	5	13.9%	1	3.1%	1	3.1%	0	0	39
Total	618	61	9.0%	65	9.5%	67	9.8%	67	9.8%	23	3.6%	901

FD = Field Duplicates

FRB = Field Rinse Blanks

LRB = Lab Rinse Blanks

REG = Routine Samples

TB = Trip Blanks

Table A9. Assessment of precision for sediment and pore water samples

Analyte	Samples evaluated	Samples exceeding precision criteria	Samples acceptable	Per cent meeting precision criteria
<i>Sediment Organics-Pesticides/PCBs</i>				
2-Methylnaphthalene	12	3	9	75%
Acenaphthene	1	0	1	100%
Anathrecene	1	0	1	100%
Benzo(a)anthracene	10	3	7	70%
Benzo(a)pyrene	12	1	11	92%
Benzo(b)fluoranthene	13	3	10	77%
Benzo(ghi)perylene	10	2	8	80%
Benzo(k)fluoranthene	6	1	5	83%
Bis(2-ethylhexyl)phthalate	6	0	6	100%
Butylbenzylphthalate	1	1	0	0%
Carbazole	2	1	1	50%
Chrysene	13	2	11	85%
Dibenz(a,h)anthracene	3	0	3	100%
Dibenzofuran	6	0	6	100%
Fluoranthene	14	3	11	79%
Fluorene	2	0	2	100%
Heptachlor	2	0	2	100%
Indeno(1,2,3-cd)pyrene	11	2	9	82%
Naphthalene	10	2	8	80%
PCB-1248	2	2	0	0%
PCB-1254	11	4	7	64%
PCB-1260	8	2	6	75%
Phenanthrene	14	3	11	79%
Phenol	2	0	2	100%
Pyrene	14	3	11	79%
Total	186	38	148	80%
<i>Sediment Inorganics</i>				
Aluminum	14	2	12	86%
Arsenic	14	4	10	71%
Barium	14	2	12	86%
Beryllium	14	2	12	86%
Boron	5	3	2	40%
Cadmium	14	4	10	71%
Calcium	14	3	11	79%
Chromium	14	2	12	86%
Cobalt	14	3	11	79%
Copper	14	2	12	86%
Iron	14	0	14	100%
Kjeldahl Nitrogen	11	6	5	45%
Lead	14	3	11	79%
Magnesium	14	1	13	93%

Table A9. (continued)

Analyte	Samples evaluated	Samples exceeding precision criteria	Samples acceptable	Per cent meeting precision criteria
<i>Sediment Inorganics</i>				
Manganese	14	4	10	71%
Mercury (TMAR)	11	7	4	36%
Mercury (Brooks Rand)				
Methyl Mercury				
Nickel	14	4	10	71%
Potassium	14	2	12	86%
Silver	8	5	3	38%
Sodium	12	1	11	92%
Vanadium	14	0	14	100%
Zinc	14	2	12	86%
Total	285	62	223	78%
<i>Pore Water Organics</i>				
Total Organic Carbon (TOC)	7	1	6	86%
<i>Pore Water Inorganics</i>				
Ammonium Nitrogen	6	3	3	50%
Barium	6	1	5	83%
Boron	5	4	1	20%
Calcium	6	1	5	83%
Chromium	4	1	3	75%
Cobalt	4	0	4	100%
Copper	6	3	3	50%
Iron	7	3	4	57%
Kjeldahl Nitrogen	6	3	3	50%
Magnesium	6	2	4	67%
Manganese	5	3	2	40%
Molybdenum	2	0	2	100%
Nickel	7	3	4	57%
Potassium	6	1	5	83%
Sodium	6	0	6	100%
Uranium	4	3	1	25%
Zinc	7	4	3	43%
Total	93	35	58	62%

Table A10. Duplicate error ratios for sediment and pore water samples

Analyte	Sample pairs analyzed	Pairs exceeding criteria	Duplicate error ratio			
			Min.	Max.	Mean	Std. Dev.
Sediment						
Lab: Ecotek Laboratory Services, Inc.						
Strontium-90	10	1	0.01	6.85	0.73	2.15
Technitium-99	5	1	0.08	4.65	1.28	1.90
Uranium-234	5	1	0.15	1.29	0.50	0.46
Uranium-235	4	0	0.15	0.46	0.28	0.14
Uranium-238	5	1	0.12	1.12	0.52	0.38
Lab: Oak Ridge Analytical Services						
Strontium-90	2	0	0.15	0.21	0.18	0.04
Technitium-99	3	0	0.04	0.49	0.20	0.25
Uranium-234	3	0	0.29	0.83	0.54	0.27
Uranium-235	3	0	0.03	0.37	0.19	0.17
Uranium-238	3	0	0.44	1.00	0.66	0.29
Lab: Environmental Sciences Division/Radiological Analysis Services						
Cesium-137	14	7	0.23	10.69	2.54	3.03
Cobalt-60	14	0	0.00	0.73	0.19	0.25
Pore Water						
Lab: Ecotek Laboratory Services, Inc.						
Strontium-90	4	1	0.09	1.95	0.59	0.91
Uranium-234	3	1	0.16	1.29	0.65	0.58
Uranium-235	2	0	0.02	0.22	0.12	0.14
Uranium-238	3	1	0.11	1.47	0.65	0.73
Lab: Oak Ridge Analytical Services						
Strontium-90	2	0	0.19	0.34	0.27	0.10
Uranium-234	2	0	0.09	0.54	0.31	0.31
Uranium-235	2	0	0.13	0.14	0.13	0.00
Uranium-238	2	0	0.31	0.45	0.38	0.10
Lab: Environmental Sciences Division/Radiological Analysis Services						
Cesium-137	7	0	0.01	0.51	0.19	0.22
Cobalt-60	7	0	0.00	0.68	0.18	0.26

Table A11. Quality control blanks for sediment and pore water samples

Analyte	Sample type	N	Mean	Std Dev	Min.	Max.	Mean of all routine samples
<i>Lab Rinse Blanks, Sediment</i>							
Cesium-137 (pCi/L)	Lab Rinse Blanks	2	-1.92	0.38	-2.19	-1.65	
	Routine Samples	77	2.62	5.46	-0.09	36.67	4.53
<i>Lab Rinse Blanks, Pore Water (Units are ug/L unless noted otherwise)</i>							
Aluminum	Lab Rinse Blanks	7	15.73	4.26	10.60	23.60	
	Routine Samples	69	56.75	103.85	6.20	620.00	56.75
Arsenic	Lab Rinse Blanks	1	1.70	.	1.70	1.70	
	Routine Samples	22	15.23	35.70	1.10	126.00	12.02
Barium	Lab Rinse Blanks	1	4.50	.	4.50	4.50	
	Routine Samples	57	62.58	31.94	16.10	223.32	60.50
Bis(2-ethylhexyl)phthalate	Lab Rinse Blanks	1	1.00	.	1.00	1.00	
	Routine Samples	5	1.60	0.55	1.00	2.00	1.60
Boron	Lab Rinse Blanks	5	44.44	42.01	16.80	116.00	
	Routine Samples	66	65.19	141.68	14.50	1170.00	65.19
Cesium-137 (pCi/L)	Lab Rinse Blanks	3	-1.37	0.44	-1.87	-1.07	
	Routine Samples	49	3.31	4.88	-8.21	17.00	-0.38

Table A11. (continued)

Analyte	Sample type	N	Mean	Std Dev	Min.	Max.	Mean of all routine samples
<i>Lab Rinse Blanks, Pore Water</i>							
Chromium	Lab Rinse Blanks	5	1.78	0.56	1.20	2.40	
	Routine Samples	38	1.76	0.67	1.00	3.70	1.70
Copper	Lab Rinse Blanks	5	2.50	2.05	1.20	6.10	
	Routine Samples	79	3.50	2.98	1.10	23.20	3.50
Iron	Lab Rinse Blanks	5	25.74	17.61	12.00	56.60	
	Routine Samples	76	294.29	894.00	14.00	6030.00	294.29
Kjeldahl Nitrogen (mg/L)	Lab Rinse Blanks	2	0.16	0.04	0.13	0.19	
	Routine Samples	77	1.67	1.29	0.17	7.20	1.67
Manganese	Lab Rinse Blanks	2	1.35	0.35	1.10	1.60	
	Routine Samples	47	4417.26	3521.26	1.50	20473.70	3590.30
Nickel	Lab Rinse Blanks	5	2.10	1.91	1.10	5.50	
	Routine Samples	77	10.46	12.66	1.04	101.00	10.46
Potassium	Lab Rinse Blanks	5	61.82	36.76	20.90	103.00	
	Routine Samples	78	1956.65	523.48	735.00	3590.00	1956.65
Sodium	Lab Rinse Blanks	6	82.02	63.68	22.00	198.00	
	Routine Samples	78	4869.39	1677.27	2570.00	9980.00	4869.39

Table A11. (continued)

Analyte	Sample type	N	Mean	Std Dev	Min.	Max.	Mean of all routine samples
<i>Lab Rinse Blanks, Pore Water</i>							
Strontium-90 (pCi/L)	Lab Rinse Blanks	1	4.28	.	4.28	4.28	
	Routine Samples	10	5.60	7.12	1.98	25.60	5.60
Zinc	Lab Rinse Blanks	7	6.04	1.35	3.40	7.90	
	Routine Samples	78	10.56	10.31	2.40	73.50	10.56
<i>Field Blanks, Pore Water</i>							
Aluminum	Field Blanks	5	18.44	12.79	6.40	39.70	
	Routine Samples	5	22.98	12.19	9.50	41.70	56.75
Ammonium Nitrogen (mg/L)	Field Blanks	2	0.06	0.00	0.05	0.06	
	Routine Samples	2	1.33	1.23	0.46	2.20	1.54
Arsenic	Field Blanks	1	1.30	.	1.30	1.30	
	Routine Samples	1	6.70	.	6.70	6.70	12.02
Benzoic Acid	Field Blanks	1	2.00	.	2.00	2.00	
	Routine Samples	0	.	.	.	.	1.50
Bis(2-ethylhexyl)phthalate	Field Blanks	1	.	8.00	8.00	8.00	
	Routine Samples	0	.	.	.	.	1.60

Table A11. (continued)

Analyte	Sample type	N	Mean	Std Dev	Min.	Max.	Mean of all routine samples
<i>Field Blanks, Pore Water</i>							
Boron	Field Blanks	5	45.54	29.79	16.80	85.10	
	Routine Samples	5	76.88	77.98	14.50	194.00	65.19
Calcium	Field Blanks	2	50.35	20.01	36.20	64.50	
	Routine Samples	2	42500.00	5374.01	38700.00	46300.00	36242.40
Cesium-137 (pCi/L)	Field Blanks	1	-3.12	.	-3.12	-3.12	
	Routine Samples	1	6.57	.	6.57	6.57	-0.38
Chromium	Field Blanks	6	1.72	0.66	1.10	2.60	
	Routine Samples	5	1.78	0.61	1.20	2.60	1.70
Copper	Field Blanks	4	1.15	0.10	1.10	1.30	
	Routine Samples	3	10.18	11.33	2.63	23.20	3.50
Iron	Field Blanks	4	29.23	18.26	15.10	55.90	
	Routine Samples	4	146.03	154.87	22.22	372.00	294.29
Kjeldahl Nitrogen (mg/L)	Field Blanks	1	0.13	.	0.13	0.13	
	Routine Samples	1	1.70	.	1.70	1.70	1.67
Mercury (ng/L)(Brooks Rand)	Field Blanks	1	4.12	.	4.12	4.12	
	Routine Samples	1	14.90	.	14.90	14.90	48.98

Table A11. (continued)

Analyte	Sample type	N	Mean	Std Dev	Min.	Max.	Mean of all routine samples
<i>Field Blanks, Pore Water</i>							
Methyl Mercury (ng/L)	Field Blanks	2	0.07	0.00	0.07	0.07	
	Routine Samples	2	0.93	0.70	0.44	1.43	0.67
Nickel	Field Blanks	2	1.05	0.07	1.00	1.10	
	Routine Samples	2	4.07	4.29	1.04	7.10	10.46
Potassium	Field Blanks	5	49.22	30.05	21.40	88.30	
	Routine Samples	5	2498.22	612.28	1880.00	3331.11	1956.65
Sodium	Field Blanks	7	59.91	37.91	19.50	114.00	
	Routine Samples	7	4957.04	2418.53	2960.00	9980.00	4869.39
Strontium-90 (pCi/L)	Field Blanks	1	6.13	.	6.13	6.13	
	Routine Samples	1	25.60	.	25.60	25.60	5.60
Zinc	Field Blanks	8	4.30	1.83	2.30	7.20	
	Routine Samples	8	12.37	12.50	3.00	40.61	10.56
<i>Field Rinse Blanks, Sediment (pCi/L)</i>							
Cesium-137	Field Rinse Blanks	2	-1.05	1.78	-2.31	0.21	
	Routine Samples	105	2.80	5.31	-0.09	36.67	4.53

Table A11. (continued)

Analyte	Sample type	N	Mean	Std Dev	Min.	Max.	Mean of all routine samples
<i>Field Rinse Blanks, Sediment (pCi/L)</i>							
Strontium-90	Field Rinse Blanks	1	4.26	.	4.26	4.26	
	Routine Samples	6	2.47	1.85	0.75	5.79	2.47
<i>Field Rinse Blanks, Pore Water (Units are ug/L unless noted otherwise)</i>							
Aluminum	Field Rinse Blanks	8	146.23	160.64	16.10	525.00	
	Routine Samples	69	56.75	103.85	6.20	620.00	56.75
Ammonium Nitrogen (mg/L)	Field Rinse Blanks	6	0.07	0.02	0.05	0.11	
	Routine Samples	78	1.54	1.39	0.06	9.00	1.54
Arsenic	Field Rinse Blanks	2	1.15	0.07	1.10	1.20	
	Routine Samples	29	12.02	31.46	1.10	126.00	12.02
Mercury (ng/L) (Brooks Rand)	Field Rinse Blanks	2	5.95	7.42	0.70	11.20	
	Routine Samples	20	48.98	134.36	4.92	602.00	48.98
Barium	Field Rinse Blanks	8	3.23	2.66	1.10	9.00	
	Routine Samples	81	60.50	33.68	16.10	223.32	60.50
Benzoic acid	Field Rinse Blanks	1	1.00	.	1.00	1.00	
	Routine Samples	2	1.50	0.71	1.00	2.00	1.50

Table A11. (continued)

Analyte	Sample type	N	Mean	Std Dev	Min.	Max.	Mean of all routine samples
<i>Field Rinse Blanks, Pore Water</i>							
Boron	Field Rinse Blanks	5	44.34	25.98	15.80	75.60	
	Routine Samples	66	65.19	141.68	14.50	1170.00	65.19
Cadmium	Field Rinse Blanks	4	3.53	2.93	1.10	7.70	
	Routine Samples	1	1.00	.	1.00	1.00	1.00
Calcium	Field Rinse Blanks	8	936.25	894.62	244.00	2900.00	
	Routine Samples	78	36242.40	10460.70	19300.00	79053.84	36242.40
Cesium-137 (pCi/L)	Field Rinse Blanks	2	-1.13	2.43	-2.85	0.59	
	Routine Samples	41	3.21	4.89	-8.21	17.00	-0.38
Chromium	Field Rinse Blanks	7	2.07	0.68	1.10	3.00	
	Routine Samples	58	1.70	0.63	1.00	3.70	1.70
Copper	Field Rinse Blanks	8	7.05	5.21	1.90	15.70	
	Routine Samples	79	3.50	2.98	1.10	23.20	3.50
Iron	Field Rinse Blanks	6	256.53	258.81	19.30	752.00	
	Routine Samples	76	294.29	894.18	14.00	6030.00	294.29
Kjeldahl Nitrogen (mg/L)	Field Rinse Blanks	3	0.17	0.06	0.11	0.22	
	Routine Samples	77	1.67	1.29	0.17	7.20	1.67

Table A11. (continued)

Analyte	Sample type	N	Mean	Std Dev	Min.	Max.	Mean of all routine samples
<i>Field Rinse Blanks, Pore Water</i>							
Lead	Field Rinse Blanks	2	1.80	0.99	1.10	2.50	
	Routine Samples	3	1.77	0.89	1.20	2.80	1.77
Magnesium	Field Rinse Blanks	8	171.25	106.75	75.60	336.00	
	Routine Samples	78	9981.49	2775.03	5180.00	19514.23	9981.49
Manganese	Field Rinse Blanks	8	27.69	18.76	6.00	52.20	
	Routine Samples	73	3590.30	3173.27	1.50	20473.70	3590.30
Mercury (Lockheed)	Field Rinse Blanks	2	5.95	7.42	0.70	11.20	
	Routine Samples	3	0.33	0.20	0.20	0.56	0.45
Nickel	Field Rinse Blanks	6	3.28	2.38	1.30	7.40	
	Routine Samples	77	10.46	12.66	1.04	101.00	10.46
Potassium	Field Rinse Blanks	8	130.93	75.96	57.80	236.00	
	Routine Samples	78	1956.65	523.48	735.00	3590.00	1956.65
Sodium	Field Rinse Blanks	8	590.10	765.11	58.80	2230.00	
	Routine Samples	78	4869.39	1677.27	2570.00	9980.00	4869.39
Strontium-90 (pCi/L)	Field Rinse Blanks	1	11.00	.	11.40	11.40	
	Routine Samples	10	5.60	7.12	1.98	25.60	5.60

Table A11. (continued)

Analyte	Sample type	N	Mean	Std Dev	Min.	Max.	Mean of all routine samples
<i>Field Rinse Blanks, Pore Water</i>							
Zinc	Field Rinse Blanks	8	100.90	69.88	36.70	209.00	
	Routine Samples	78	10.56	10.31	2.40	73.50	10.56
<i>Trip Blanks (Units are ng/L for liquids, and ng/g for sediment)</i>							
Mercury	Trip Blank	23	2.43	3.00	0.74	14.40	
	Routine Samples (Sed)	71	5729.32	18202.35	2.88	141052.00	
	Routine Samples (PW)	20	48.98	134.36	4.92	602.00	
Methyl Mercury	Trip Blank	23	0.07	0.04	0.02	0.20	
	Routine Samples (Sed)	67	1.97	2.62	0.01	12.10	
	Routine Samples (PW)	9	0.67	0.57	0.20	1.80	

Table A12. SAS® Printout for gamma concentration analysis

Mean Gamma Concentrations for SITE & FILTER				
General Linear Models Procedure				
Bonferroni (Dunn) T tests for variable: AVGGAM				
NOTE: This test controls the II error rate than REGWQ.				
Alpha= 0.001 df= 10 MSE= 0.051209				
Critical Value of T= 4.59				
Minimum Significant Difference= 0.4238				
Means with the same letter are not significantly different.				
Bon Grouping	Mean	N	SITE	
A	0.16084	12	1	
A				
A	0.01313	12	2	
Mean Gamma Concentrations for SITE & FILTER				
General Linear Models Procedure				
Bonferroni (Dunn) T tests for variable: AVGGAM				
NOTE: This test controls the II error rate than REGWQ.				
Alpha= 0.001 df= 10 MSE= 0.051209				
Critical Value of T= 4.59				
Minimum Significant Difference= 0.4238				
Means with the same letter are not significantly different.				
Bon Grouping	Mean	N	SITE	
A	0.09443	12	CF	
A				
A	0.07954	12	PD	

Site 1= WOCM 0.0 and Site 2 = CRM 21.8

Table A12. (continued)

Analysis for Gamma Concentrations					
General Linear Models Procedure					
Dependent Variable: AVGGAM					
Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	13	0.89153083	0.068579	1.34	0.3262
Error	10	0.51209396	0.051209		
Corrected Total	23	1.40362479			
	R-Square	C.V.	Root MSE	AVGGAM Mean	
	0.635163	260.1608	0.226295	0.08698	
Source	DF	Type III SS	Mean Square	F Value	Pr > F
REP	5	0.24544877	0.04909	0.96	0.4861
SITE	1	0.13090873	0.130909	2.56	0.1409
REP(SITE)	5	0.45726531	0.091453	1.79	0.2034
FILT	1	0.0013293	0.001329	0.03	0.8752
SITE*FILT	1	0.05657871	0.056579	1.1	0.3179
Source	DF	Type III SS	Mean Square	F Value	Pr > F
REP	5	0.24544877	0.04909	0.96	0.4861
SITE	1	0.13090873	0.130909	2.56	0.1409
REP(SITE)	5	0.45726531	0.091453	1.79	0.2034
FILT	1	0.0013293	0.001329	0.03	0.8752
SITE*FILT	1	0.05657871	0.056579	1.1	0.3179

Site 1 = WOCM 0.0 and Site 2 = CRM 21.8

Table A12. (continued)

Test for SITE to SITE Differences					
General Linear Models Procedure					
Dependent Variable: AVGGAM					
Tests of Hypotheses using the	Type III MS for	REP(SITE) as an error term			
Source	DF	Type III SS	Mean Square	F Value	Pr > F
SITE	1	0.13090873	0.130909	1.43	0.2852

Site 1 = WOCM 0.0 and Site 2 = CRM 21.8

Table A13. SAS® Printout for site to site TSP concentration analysis (GFF data only)

Test for SITE to SITE GFF Differences

General Linear Models Procedure

Level of -----TSP-----

SITE	N	Mean	SD
1	6	4.27916667	1.77817791
2	6	5.39166667	2.91493639

Test for SITE to SITE GFF Differences

General Linear Models Procedure

Dependent Variable: TSP

Tests of Hypotheses using the Type III MS for RE(SITE) as an error term

Source	DF	Type III SS	Mean Square	F Value	Pr > F
SITE	1	3.712969	3.71296875	0.64	0.4434

Site 1 = WOCM 0.0 and Site 2 = CRM 21.8

Table A14. SAS® Printout for TSP concentration analysis for CRM 21.8

Analysis of TSP Concentrations for CRM 21.8					
General Linear Models Procedure					
Dependent Variable: TSP					
Source	DF	Sum of Squares	Mean Square	F Value	R > F
Model	1	34.51020833	34.51020833	3.45	0.093
Error	10	100.0780208	10.00780208		
Corrected Total	11	134.58822917			
	R-Square	C.V.	Root MSE		TSP Mean
	0.256413	85.59669	3.16351104		36.9583333
Source	DF	Type I SS	Mean Square	F Value	R > F
FILT	1	34.51020833	34.51020833	3.45	0.093
Source	DF	Type III SS	Mean Square	F Value	R > F
FILT	1	34.51020833	34.51020833	3.45	0.093

Site 1 = WOCM 0.0 and Site 2 = CRM 21.8

Table A15. Differences between laboratory replicate TSP samples for surface water analyses

Collection Date	Control Number	Sample ID	Pan A TSP (mg/L)	Pan B TSP (mg/L)	Difference	Mean +2SD	Mean -2SD	Mean +3SD	Mean - 3SD
10NOV93	1	10112	3.4	2.8	0.6	2.66	-3.37	4.17	-4.88
10NOV93	2	10136	4	4.2	-0.2	2.66	-3.37	4.17	-4.88
17NOV93	3	10200	10	10.4	-0.4	2.66	-3.37	4.17	-4.88
18NOV93	4	10238	52.8	55.8	-3	2.66	-3.37	4.17	-4.88
24JAN94	5	10672	8.2	9	-0.8	2.66	-3.37	4.17	-4.88
27JAN94	6	10858	14.8	16.4	-1.6	2.66	-3.37	4.17	-4.88
01FEB94	7	11038	4.4	4.2	0.2	2.66	-3.37	4.17	-4.88
01FEB94	8	11052	4.2	4.4	-0.2	2.66	-3.37	4.17	-4.88
02FEB94	9	11104	13.2	13	0.2	2.66	-3.37	4.17	-4.88
03FEB94	10	11148	3.4	3.4	0	2.66	-3.37	4.17	-4.88
03FEB94	11	11157	2.2	2	0.2	2.66	-3.37	4.17	-4.88
03FEB94	12	11163	2.2	1.8	0.4	2.66	-3.37	4.17	-4.88
03FEB94	13	11166	2	2.4	-0.4	2.66	-3.37	4.17	-4.88
03FEB94	14	11172	1.2	1.4	-0.2	2.66	-3.37	4.17	-4.88
07FEB94	15	11213	2.88	2.5	0.38	2.66	-3.37	4.17	-4.88
07FEB94	16	11217	3.27	3.08	0.19	2.66	-3.37	4.17	-4.88
07FEB94	1	11219	3.08	3.08	0	2.66	-3.37	4.17	-4.88
07FEB94	2	11221	2.69	3.08	-0.39	2.66	-3.37	4.17	-4.88
07FEB94	3	11225	3.08	3.08	0	2.66	-3.37	4.17	-4.88
07FEB94	4	11227	2.69	2.88	-0.19	2.66	-3.37	4.17	-4.88
08FEB94	5	11240	4.2	4.8	-0.6	2.66	-3.37	4.17	-4.88
08FEB94	6	11243	4.2	5	-0.8	2.66	-3.37	4.17	-4.88

Table A15. (continued)

Collection Date	Control Number	Sample ID	Pan A TSP (mg/L)	Pan B TSP (mg/L)	Difference	Mean +2SD	Mean -2SD	Mean +3SD	Mean -3SD
08FEB94	7	11246	4	3.4	0.6	2.66	-3.37	4.17	-4.88
08FEB94	8	11249	4.8	5.2	-0.4	2.66	-3.37	4.17	-4.88
08FEB94	9	11252	4.8	4.4	0.4	2.66	-3.37	4.17	-4.88
08FEB94	10	11255	4	4.8	-0.8	2.66	-3.37	4.17	-4.88
08FEB94	11	11258	4.8	4.4	0.4	2.66	-3.37	4.17	-4.88
08FEB94	12	11261	5.2	5.4	-0.2	2.66	-3.37	4.17	-4.88
08FEB94	13	11264	5.2	5.4	-0.2	2.66	-3.37	4.17	-4.88
08FEB94	14	11267	5.8	5.4	0.4	2.66	-3.37	4.17	-4.88
14FEB94	15	11423	16	15.2	0.8	2.66	-3.37	4.17	-4.88
15FEB94	1	11474	11.4	12.6	-1.2	2.66	-3.37	4.17	-4.88
15FEB94	2	11488	10.8	12.4	-1.6	2.66	-3.37	4.17	-4.88
16FEB94	3	11533	6	6.6	-0.6	2.66	-3.37	4.17	-4.88
16FEB94	4	11547	6.4	5.4	1	2.66	-3.37	4.17	-4.88
16FEB94	5	11561	5.8	5.8	0	2.66	-3.37	4.17	-4.88
17FEB94	6	11610	10	8.2	1.8	2.66	-3.37	4.17	-4.88
22FEB94	7	11657	32	35.2	-3.2	2.66	-3.37	4.17	-4.88
22FEB94	8	11671	44.8	41.6	3.2	2.66	-3.37	4.17	-4.88
24FEB94	9	11348	21.2	25.2	-4	2.66	-3.37	4.17	-4.88
24FEB94	10	11356	32.4	37.6	-5.2	2.66	-3.37	4.17	-4.88
24FEB94	11	11358	34	31.2	2.8	2.66	-3.37	4.17	-4.88
24FEB94	12	11360	35.2	34.4	0.79	2.66	-3.37	4.17	-4.88
24FEB94	13	11362	35.6	37.2	-1.6	2.66	-3.37	4.17	-4.88
24FEB94	14	11366	32	33.2	-1.2	2.66	-3.37	4.17	-4.88

Table A15. (continued)

Collection Date	Control Number	Sample ID	Pan A TSP (mg/L)	Pan B TSP (mg/L)	Difference	Mean +2SD	Mean -2SD	Mean +3SD	Mean -3SD
24FEB94	15	11368	38	38.4	-0.4	2.66	-3.37	4.17	-4.88
01MAR94	1	11715	4.6	5.2	-0.6	2.66	-3.37	4.17	-4.88
03MAR94	2	11785	21.8	23.2	-1.4	2.66	-3.37	4.17	-4.88
03MAR94	3	11799	18	18.2	-0.2	2.66	-3.37	4.17	-4.88
07MAR94	4	12528	13.2	12.4	0.8	2.66	-3.37	4.17	-4.88
07MAR94	5	12542	9	11	-2	2.66	-3.37	4.17	-4.88
08MAR94	6	11847	9	8.4	0.6	2.66	-3.37	4.17	-4.88
08MAR94	7	11859	4.6	4.8	-0.2	2.66	-3.37	4.17	-4.88
10MAR94	8	11931	26	21.2	4.8	2.66	-3.37	4.17	-4.88
10MAR94	9	11934	19.2	22.4	-3.2	2.66	-3.37	4.17	-4.88
10MAR94	10	11940	20.8	22	-1.2	2.66	-3.37	4.17	-4.88
10MAR94	11	11943	20.8	19.6	1.2	2.66	-3.37	4.17	-4.88
10MAR94	12	11946	22.8	19.6	3.2	2.66	-3.37	4.17	-4.88
10MAR94	13	11949	20.8	20.8	0	2.66	-3.37	4.17	-4.88
10MAR94	14	11952	20.4	17.6	2.8	2.66	-3.37	4.17	-4.88
10MAR94	15	11955	19.6	22.4	-2.8	2.66	-3.37	4.17	-4.88
15MAR94	1	12016	9.6	9.6	0	2.66	-3.37	4.17	-4.88
16MAR94	2	12110	3.2	3.2	0	2.66	-3.37	4.17	-4.88
17MAR94	3	12176	6	6.2	-0.2	2.66	-3.37	4.17	-4.88
17MAR94	4	12190	4	4.2	-0.2	2.66	-3.37	4.17	-4.88
17MAR94	5	12204	7.2	8.4	-1.2	2.66	-3.37	4.17	-4.88
23MAR94	6	12239	6.6	7	-0.4	2.66	-3.37	4.17	-4.88
23MAR94	7	12253	13	12.6	0.4	2.66	-3.37	4.17	-4.88

Table A15. (continued)

Collection Date	Control Number	Sample ID	Pan A TSP (mg/L)	Pan B TSP (mg/L)	Difference	Mean +2SD	Mean -2SD	Mean +3SD	Mean -3SD
29MAR94	8	12338	25.4	21.8	3.6	2.66	-3.37	4.17	-4.88
29MAR94	9	12352	23.4	22.8	0.6	2.66	-3.37	4.17	-4.88
29MAR94	10	12366	22.8	24	-1.2	2.66	-3.37	4.17	-4.88
30MAR94	11	12409	9.6	11.8	-2.2	2.66	-3.37	4.17	-4.88
30MAR94	12	12423	11	12.8	-1.8	2.66	-3.37	4.17	-4.88
30MAR94	13	12437	14	14	0	2.66	-3.37	4.17	-4.88
05APR94	14	12479	17.2	17	0.2	2.66	-3.37	4.17	-4.88
05APR94	15	12493	8.8	8	0.8	2.66	-3.37	4.17	-4.88
12APR94	1	12618	17.43	17.2	0.23	2.66	-3.37	4.17	-4.88
12APR94	2	12632	18.8	18	0.79	2.66	-3.37	4.17	-4.88
13APR94	3	12681	5.8	5.4	0.4	2.66	-3.37	4.17	-4.88
13APR94	4	12695	7.6	7.8	-0.2	2.66	-3.37	4.17	-4.88
18APR94	5	12821	12.4	12.4	0	2.66	-3.37	4.17	-4.88
18APR94	6	12835	10.8	10.4	0.4	2.66	-3.37	4.17	-4.88
19APR94	7	12973	18	19	-1	2.66	-3.37	4.17	-4.88
19APR94	8	12987	12.6	12	0.6	2.66	-3.37	4.17	-4.88
19APR94	9	13001	17.2	17.6	-0.4	2.66	-3.37	4.17	-4.88
19APR94	10	13015	14	14.6	-0.6	2.66	-3.37	4.17	-4.88
19APR94	11	13029	11.6	11.8	-0.2	2.66	-3.37	4.17	-4.88
19APR94	12	13041	32.2	32.4	-0.2	2.66	-3.37	4.17	-4.88
19APR94	13	13055	26.8	26	0.7	2.66	-3.37	4.17	-4.88
19APR94	14	13069	24.4	24.8	-0.4	2.66	-3.37	4.17	-4.88
19APR94	15	13083	21.8	22.2	-0.4	2.66	-3.37	4.17	-4.88

Table A15. (continued)

Collection Date	Control Number	Sample ID	Pan A TSP (mg/L)	Pan B TSP (mg/L)	Difference	Mean +2SD	Mean -2SD	Mean +3SD	Mean -3SD
19APR94	1	13097	19	19.6	-0.601	2.66	-3.37	4.17	-4.88
20APR94	2	13271	7.6	9.2	-1.6	2.66	-3.37	4.17	-4.88
20APR94	3	13299	7.8	8.8	-1	2.66	-3.37	4.17	-4.88
20APR94	4	13313	9.6	8.6	1	2.66	-3.37	4.17	-4.88
27APR94	5	13348	3.4	3.8	-0.4	2.66	-3.37	4.17	-4.88
27APR94	6	13362	3.6	3.8	-0.2	2.66	-3.37	4.17	-4.88
03MAY94	7	13405	9.6	10	-0.4	2.66	-3.37	4.17	-4.88
03MAY94	8	13419	8.8	9.8	-1	2.66	-3.37	4.17	-4.88
03MAY94	9	13433	10.8	12.8	-2	2.66	-3.37	4.17	-4.88
04MAY94	10	13486	5.8	6	-0.2	2.66	-3.37	4.17	-4.88
04MAY94	11	13500	8.4	9	-0.6	2.66	-3.37	4.17	-4.88
10MAY94	12	13533	6.8	5.8	1	2.66	-3.37	4.17	-4.88
31MAY94	13	14135	11	10.4	0.6	2.66	-3.37	4.17	-4.88
31MAY94	14	14149	9.4	9.8	-0.4	2.66	-3.37	4.17	-4.88
31MAY94	15	14163	10.2	11.6	-1.4	2.66	-3.37	4.17	-4.88
06JUN94	1	14242	9.4	10.2	-0.8	2.66	-3.37	4.17	-4.88
06JUN94	2	14256	6.8	7.6	-0.8	2.66	-3.37	4.17	-4.88
06JUN94	3	14270	6.4	6.6	-0.2	2.66	-3.37	4.17	-4.88
08JUN94	4	14322	9.4	8.4	1	2.66	-3.37	4.17	-4.88
08JUN94	5	14336	9	7.8	1.2	2.66	-3.37	4.17	-4.88
08JUN94	6	14350	10.6	10.6	0	2.66	-3.37	4.17	-4.88
09JUN94	7	14405	17.4	19	-1.6	2.66	-3.37	4.17	-4.88
09JUN94	8	14419	7.6	8.8	-1.2	2.66	-3.37	4.17	-4.88

Table A15. (continued)

Collection Date	Control Number	Sample ID	Pan A TSP (mg/L)	Pan B TSP (mg/L)	Difference	Mean +2SD	Mean -2SD	Mean +3SD	Mean -3SD
09JUN94	9	14433	14	14.2	-0.2	2.66	-3.37	4.17	-4.88
09JUN94	10	14447	14.6	17	-2.4	2.66	-3.37	4.17	-4.88
14JUN94	11	14480	15.8	17	-1.2	2.66	-3.37	4.17	-4.88
14JUN94	12	14494	8.4	10	-1.6	2.66	-3.37	4.17	-4.88
16JUN94	13	14578	17.4	18.8	-1.4	2.66	-3.37	4.17	-4.88
16JUN94	14	14592	16	14.4	1.6	2.66	-3.37	4.17	-4.88
21JUN94	15	14646	13	15	-2	2.66	-3.37	4.17	-4.88
21JUN94	1	14660	13.4	15	-1.6	2.66	-3.37	4.17	-4.88
21JUN94	2	14674	16.8	16.8	0	2.66	-3.37	4.17	-4.88
28JUN94	3	14809	59.6	70.4	-10.8	2.66	-3.37	4.17	-4.88
28JUN94	4	14826	74.8	79.2	-4.4	2.66	-3.37	4.17	-4.88
28JUN94	5	14851	53.6	47.6	6	2.66	-3.37	4.17	-4.88
29JUN94	6	14912	25.6	25.2	0.4	2.66	-3.37	4.17	-4.88
29JUN94	7	14926	25.2	25.2	0	2.66	-3.37	4.17	-4.88
12JUL94	8	14978	18.2	19	-0.79	2.66	-3.37	4.17	-4.88
12JUL94	9	14992	6.6	7	-0.4	2.66	-3.37	4.17	-4.88
13JUL94	10	15045	7.4	6.8	0.6	2.66	-3.37	4.17	-4.88
13JUL94	11	15059	6.8	7.2	-0.4	2.66	-3.37	4.17	-4.88
20JUL94	12	15103	4	4.2	-0.2	2.66	-3.37	4.17	-4.88
20JUL94	13	15117	4	4.2	-0.2	2.66	-3.37	4.17	-4.88
20JUL94	14	15131	4.8	4.8	0	2.66	-3.37	4.17	-4.88
25JUL94	15	15222	8.4	9.2	-0.8	2.66	-3.37	4.17	-4.88
25JUL94	1	15236	12.2	13.4	-1.2	2.66	-3.37	4.17	-4.88

Table A15. (continued)

Collection Date	Control Number	Sample ID	Pan A TSP (mg/L)	Pan B TSP (mg/L)	Difference	Mean +2SD	Mean -2SD	Mean +3SD	Mean -3SD
26JUL94	2	15318	8.2	9	-0.8	2.66	-3.37	4.17	-4.88
26JUL94	3	15335	8.2	7.8	0.4	2.66	-3.37	4.17	-4.88
26JUL94	4	15346	6.4	7.4	-1	2.66	-3.37	4.17	-4.88
26JUL94	5	15360	8.6	9	-0.4	2.66	-3.37	4.17	-4.88
28JUL94	6	13713	5	5.6	-0.6	2.66	-3.37	4.17	-4.88
28JUL94	7	13727	3.4	4.4	-1	2.66	-3.37	4.17	-4.88
28JUL94	8	13741	3.8	4.2	-0.4	2.66	-3.37	4.17	-4.88
28JUL94	9	13755	4.6	4.8	-0.2	2.66	-3.37	4.17	-4.88
28JUL94	10	13770	7.2	7.4	-0.2	2.66	-3.37	4.17	-4.88
28JUL94	11	13785	3.8	4.2	-0.4	2.66	-3.37	4.17	-4.88
28JUL94	12	13797	3.8	4.4	-0.6	2.66	-3.37	4.17	-4.88
28JUL94	13	13811	3.4	4	-0.6	2.66	-3.37	4.17	-4.88
28JUL94	14	13842	6.4	7	-0.6	2.66	-3.37	4.17	-4.88
29JUL94	15	13967	4.6	5	-0.4	2.66	-3.37	4.17	-4.88
29JUL94	1	13981	23	27.4	-4.4	2.66	-3.37	4.17	-4.88
29JUL94	2	13995	18.2	18.8	-0.5	2.66	-3.37	4.17	-4.88
29JUL94	3	14009	20.4	22.8	-2.4	2.66	-3.37	4.17	-4.88
29JUL94	4	14023	10.4	11.8	-1.4	2.66	-3.37	4.17	-4.88
29JUL94	5	14037	5.2	5.4	-0.2	2.66	-3.37	4.17	-4.88
29JUL94	6	14051	7.4	6.2	1.2	2.66	-3.37	4.17	-4.88
29JUL94	7	14077	5.6	4.6	1	2.66	-3.37	4.17	-4.88
29JUL94	8	14091	5.8	5.8	0	2.66	-3.37	4.17	-4.88
10AUG94	9	15486	4.25	4.75	-0.5	2.66	-3.37	4.17	-4.88

Table A15. (continued)

Collection Date	Control Number	Sample ID	Pan A TSP (mg/L)	Pan B TSP (mg/L)	Difference	Mean +2SD	Mean -2SD	Mean +3SD	Mean -3SD
10AUG94	10	15500	6.25	6.5	-0.25	2.66	-3.37	4.17	-4.88
11AUG94	11	15556	5.4	6	-0.6	2.66	-3.37	4.17	-4.88
17AUG94	12	15626	18	19.4	-1.4	2.66	-3.37	4.17	-4.88
17AUG94	13	15640	19.6	21.8	-2.2	2.66	-3.37	4.17	-4.88
17AUG94	14	15654	17.8	18.6	-0.8	2.66	-3.37	4.17	-4.88
18AUG94	15	15708	20.4	20.4	0	2.66	-3.37	4.17	-4.88
18AUG94	1	15722	20.6	19.2	1.4	2.66	-3.37	4.17	-4.88
18AUG94	2	15736	16.6	16.2	0.4	2.66	-3.37	4.17	-4.88
23AUG94	3	15805	35.6	36	-0.4	2.66	-3.37	4.17	-4.88
24AUG94	4	15878	20.6	22	-1.4	2.66	-3.37	4.17	-4.88
24AUG94	5	15892	17.6	17.4	0.2	2.66	-3.37	4.17	-4.88
24AUG94	6	15906	13.8	14.2	-0.4	2.66	-3.37	4.17	-4.88
25AUG94	7	15959	17.2	18	-0.7	2.66	-3.37	4.17	-4.88
25AUG94	8	15973	17.4	18.4	-1	2.66	-3.37	4.17	-4.88
29AUG94	9	16090	3	3.6	-0.6	2.66	-3.37	4.17	-4.88
29AUG94	10	16104	3.4	4	-0.6	2.66	-3.37	4.17	-4.88
29AUG94	11	16118	5	4.8	0.2	2.66	-3.37	4.17	-4.88
29AUG94	12	16132	4.6	5.4	-0.8	2.66	-3.37	4.17	-4.88
29AUG94	13	16146	6	6.6	-0.6	2.66	-3.37	4.17	-4.88
29AUG94	14	16160	2.6	3.2	-0.6	2.66	-3.37	4.17	-4.88
29AUG94	15	16174	2.6	3	-0.4	2.66	-3.37	4.17	-4.88
29AUG94	1	16188	2.4	3	-0.6	2.66	-3.37	4.17	-4.88
29AUG94	2	16200	3.4	3.4	0	2.66	-3.37	4.17	-4.88

Table A15. (continued)

Collection Date	Control Number	Sample ID	Pan A TSP (mg/L)	Pan B TSP (mg/L)	Difference	Mean +2SD	Mean -2SD	Mean +3SD	Mean -3SD
29AUG94	3	16214	8	8.8	-0.8	2.66	-3.37	4.17	-4.88
30AUG94	4	16330	4.4	3.4	1	2.66	-3.37	4.17	-4.88
30AUG94	5	16344	12.8	14	-1.2	2.66	-3.37	4.17	-4.88
30AUG94	6	16358	11.6	12	-0.4	2.66	-3.37	4.17	-4.88
30AUG94	7	16370	13.4	13	0.4	2.66	-3.37	4.17	-4.88
30AUG94	8	16384	10.8	10.2	0.6	2.66	-3.37	4.17	-4.88
30AUG94	9	16398	4.2	4.8	-0.6	2.66	-3.37	4.17	-4.88
30AUG94	10	16412	2.8	3.4	-0.6	2.66	-3.37	4.17	-4.88
30AUG94	11	16426	3.4	3.2	0.2	2.66	-3.37	4.17	-4.88
30AUG94	12	16443	3.2	3.2	0	2.66	-3.37	4.17	-4.88
30AUG94	13	16454	6	6	0	2.66	-3.37	4.17	-4.88
07SEP94	14	16496	6	4	2	2.66	-3.37	4.17	-4.88
07SEP94	15	16510	15.4	15.2	0.2	2.66	-3.37	4.17	-4.88
08SEP94	16	16555	7.6	8.6	-1	2.66	-3.37	4.17	-4.88
08SEP94	17	16572	9.2	9.8	-0.6	2.66	-3.37	4.17	-4.88
08SEP94	18	16583	11.4	11.2	0.2	2.66	-3.37	4.17	-4.88
14SEP94	19	16639	6.2	5.6	0.6	2.66	-3.37	4.17	-4.88
Mean difference	-0.35								
SD	1.5								

Table A15. (continued)

Collection Date	Control Number	Sample ID	Pan A TSP (mg/L)	Pan B TSP (mg/L)	Difference	Mean +2SD	Mean -2SD	Mean +3SD	Mean -3SD
Unreliable TSP Data Collected during Phase II									
13JAN94	5	10583	72	.					
13JAN94	6	10598	.	.					
27JAN94	13	10872	18	.					
27JAN94	14	10886	.	17.6					
03FEB94		11175	1.6	.					
03FEB94	7	11169	1	-259					
07FEB94	10	11211	0	2.69					
24FEB94		11364	-2.8	-4					
Relative Percent Differences of greater than 20%									
24JAN94		10644	2.6	3.4	-0.8				
24JAN94		10658	6.6	4	2.6				
26JAN94		10762	2.2	1	1.2				
26JAN94		10776	1.4	2.4	-1				
02FEB94		11118	5	6.4	-1.4				
02FEB94		11132	5.2	7.4	-2.2				
03FEB94		11151	0.8	1.2	-0.4				
03FEB94		11154	0.8	1.2	-0.4				
03FEB94		11160	0.6	1.2	-0.6				
07FEB94		11209	0.77	1.54	-0.77				
07FEB94		11215	2.12	6.35	-4.23				

Table A15. (continued)

Collection Date	Control Number	Sample ID	Pan A TSP (mg/L)	Pan B TSP (mg/L)	Difference	Mean +2SD	Mean -2SD	Mean +3SD	Mean -3SD
07FEB94		11223	2.69	1.92	0.77				
14FEB94		11409	10.2	13.8	-3.6				
17FEB94		11596	4.2	8.6	-4.4				
24FEB94		11350	18	27.2	-9.2				
24FEB94		11352	15.2	43.2	-28				
24FEB94		11354	19.2	28	-8.8				
10MAR94		11937	19.6	24.4	-4.8				
10MAR94		11958	32	9.6	22.4				
15MAR94		12030	4.4	5.6	-1.2				
15MAR94		12044	3.2	32.4	-29.2				
16MAR94		12096	4.2	5.6	-1.4				
16MAR94		12124	4.8	2.6	2.2				
12APR94		12604	23.14	30	-6.86				
12APR94		12646	12	19.71	-7.71				
18APR94		12807	25.67	17	8.67				
20APR94		13201	4	12.6	-8.6				
20APR94		13215	7.2	4.4	2.8				
20APR94		13229	5.4	7	-1.6				
20APR94		13243	8	11	-3				
20APR94		13257	10.4	13.4	-3				
20APR94		13285	9.2	7.4	1.8				
10MAY94		13547	8.8	7	1.8				
11MAY94		13582	7.6	10.8	-3.2				

Table A15. (continued)

Collection Date	Control Number	Sample ID	Pan A TSP (mg/L)	Pan B TSP (mg/L)	Difference	Mean +2SD	Mean -2SD	Mean +3SD	Mean - 3SD
11MAY94		13596	4.4	7.6	-3.2				
15JUN94		14529	3.8	8.6	-4.8				
15JUN94		14543	7	14.2	-7.2				
28JUN94		14837	40.4	55.6	-15.2				
22JUN94		14726	.6	2	4				
22JUN94		14740	6	10	-4				
22JUN94		14754	18	23	-5				
28JUN94		14837	40.4	55.6	-15.2				
29JUN94		14898	16.8	23.2	-6.4				
28JUL94		13828	3.6	4.6	-1				
29JUL94		14063	5.4	7.2	-1.8				
09AUG94		15404	3.6	6.2	-2.6				
09AUG94		15418	3.4	4.8	-1.4				
10AUG94		15472	7	4.75	2.25				
11AUG94		15542	13.8	11	2.8				
23AUG94		15789	28.8	22	6.8				
23AUG94		15819	90.8	14.4	76.4				
23AUG94		15836	19.2	13.2	6				
14 SEP 94		16625	5.6	12.8	-7.2				

**Table A16. Differences between laboratory replicate turbidity samples
for surface water analyses**

Collection Date	Control Number	Sample ID	Dupl A Turb (NTU)	Dupl B Turb (NTU)	Difference	Mean +2SD	Mean -2SD	Mean +3SD	Mean -3SD
11NOV93	1	10134	1.7	2	-0.30	0.88	-0.90	1.32	-1.35
17NOV93	2	10198	9.3	9.6	-0.30	0.88	-0.90	1.32	-1.35
18NOV93	3	10236	56	56	0.00	0.88	-0.90	1.32	-1.35
13JAN94	4	10369	6.9	7.3	-0.40	0.88	-0.90	1.32	-1.35
13JAN94	5	10384	4.6	4.6	0.00	0.88	-0.90	1.32	-1.35
13JAN94	6	10399	1.7	1.7	0.00	0.88	-0.90	1.32	-1.35
13JAN94	7	10429	2.9	2.9	0.00	0.88	-0.90	1.32	-1.35
13JAN94	8	10581	15	14	1.00	0.88	-0.90	1.32	-1.35
13JAN94	9	10596	12	13	-1.00	0.88	-0.90	1.32	-1.35
26JAN94	10	10761	2.7	2.8	-0.10	0.88	-0.90	1.32	-1.35
26JAN94	11	10775	2.6	2.6	0.00	0.88	-0.90	1.32	-1.35
01FEB94	12	11037	5	5	0.00	0.88	-0.90	1.32	-1.35
01FEB94	13	11051	5	5	0.00	0.88	-0.90	1.32	-1.35
02FEB94	14	11103	5.1	5	0.10	0.88	-0.90	1.32	-1.35
02FEB94	15	11117	7.1	7.1	0.00	0.88	-0.90	1.32	-1.35
02FEB94	1	11127	7.2	7.1	0.10	0.88	-0.90	1.32	-1.35
07FEB94	2	11210	2	2	0.00	0.88	-0.90	1.32	-1.35
07FEB94	3	11212	3	3	0.00	0.88	-0.90	1.32	-1.35
07FEB94	4	11214	3.4	3.3	0.10	0.88	-0.90	1.32	-1.35
07FEB94	5	11216	3.5	3.5	0.00	0.88	-0.90	1.32	-1.35
07FEB94	6	11218	4.2	4.5	-0.30	0.88	-0.90	1.32	-1.35
07FEB94	7	11220	3.6	3.9	-0.30	0.88	-0.90	1.32	-1.35
07FEB94	8	11222	4.2	4	0.20	0.88	-0.90	1.32	-1.35
07FEB94	9	11224	4	4.3	-0.30	0.88	-0.90	1.32	-1.35
07FEB94	10	11226	4	4	0.00	0.88	-0.90	1.32	-1.35
07FEB94	11	11228	4.4	4.4	0.00	0.88	-0.90	1.32	-1.35
08FEB94	12	11241	4.1	4.1	0.00	0.88	-0.90	1.32	-1.35
08FEB94	13	11244	4	3.8	0.20	0.88	-0.90	1.32	-1.35
08FEB94	14	11247	4.4	3.9	0.50	0.88	-0.90	1.32	-1.35
08FEB94	15	11250	4.1	4	0.10	0.88	-0.90	1.32	-1.35
08FEB94	1	11253	4	3.7	0.30	0.88	-0.90	1.32	-1.35
08FEB94	2	11256	4.1	4	0.10	0.88	-0.90	1.32	-1.35
08FEB94	3	11259	4.5	4	0.50	0.88	-0.90	1.32	-1.35
08FEB94	4	11262	4.4	4	0.40	0.88	-0.90	1.32	-1.35
08FEB94	5	11265	4.2	4.1	0.10	0.88	-0.90	1.32	-1.35
08FEB94	6	11268	4.6	4.3	0.30	0.88	-0.90	1.32	-1.35
14FEB94	7	11408	9.7	9.6	0.10	0.88	-0.90	1.32	-1.35
14FEB94	8	11422	9.6	9.7	-0.10	0.88	-0.90	1.32	-1.35

Table A16. (continued)

Collection Date	Control Number	Sample ID	Dupl A Turb (NTU)	Dupl B Turb (NTU)	Difference	Mean +2SD	Mean -2SD	Mean +3SD	Mean -3SD
15FEB94	9	11473	7.5	7.4	0.10	0.88	-0.90	1.32	-1.35
15FEB94	10	11487	7.6	7.6	0.00	0.88	-0.90	1.32	-1.35
16FEB94	11	11532	5.9	5.9	0.00	0.88	-0.90	1.32	-1.35
16FEB94	12	11546	5.9	5.9	0.00	0.88	-0.90	1.32	-1.35
16FEB94	13	11556	5.9	5.8	0.10	0.88	-0.90	1.32	-1.35
17FEB94	14	11595	5.5	5.4	0.10	0.88	-0.90	1.32	-1.35
17FEB94	15	11609	9.1	8.9	0.20	0.88	-0.90	1.32	-1.35
22FEB94	1	11656	24	24	0.00	0.88	-0.90	1.32	-1.35
22FEB94	2	11670	26	26	0.00	0.88	-0.90	1.32	-1.35
25FEB94	3	11349	16	16	0.00	0.88	-0.90	1.32	-1.35
25FEB94	4	11351	19	19	0.00	0.88	-0.90	1.32	-1.35
25FEB94	5	11353	21	21	0.00	0.88	-0.90	1.32	-1.35
25FEB94	6	11355	18	18	0.00	0.88	-0.90	1.32	-1.35
25FEB94	7	11357	22	22	0.00	0.88	-0.90	1.32	-1.35
25FEB94	8	11359	17	18	-1.00	0.88	-0.90	1.32	-1.35
25FEB94	9	11361	22	21	1.00	0.88	-0.90	1.32	-1.35
25FEB94	10	11363	26	25	1.00	0.88	-0.90	1.32	-1.35
25FEB94	11	11367	18	18	0.00	0.88	-0.90	1.32	-1.35
25FEB94	12	11369	18	18	0.00	0.88	-0.90	1.32	-1.35
01MAR94	13	11714	4.1	4.2	-0.10	0.88	-0.90	1.32	-1.35
03MAR94	14	11784	22	22	0.00	0.88	-0.90	1.32	-1.35
03MAR94	15	11798	23	23	0.00	0.88	-0.90	1.32	-1.35
08MAR94	1	11846	6.7	6.8	-0.10	0.88	-0.90	1.32	-1.35
08MAR94	2	11858	5	5.2	-0.20	0.88	-0.90	1.32	-1.35
10MAR94	3	11935	21	22	-1.00	0.88	-0.90	1.32	-1.35
10MAR94	4	11938	22	21	1.00	0.88	-0.90	1.32	-1.35
10MAR94	5	11941	23	23	0.00	0.88	-0.90	1.32	-1.35
10MAR94	6	11944	20	22	-2.00	0.88	-0.90	1.32	-1.35
10MAR94	7	11947	21	21	0.00	0.88	-0.90	1.32	-1.35
10MAR94	8	11950	24	24	0.00	0.88	-0.90	1.32	-1.35
10MAR94	9	11953	22	23	-1.00	0.88	-0.90	1.32	-1.35
30MAR94	10	12408	16	15	1.00	0.88	-0.90	1.32	-1.35
30MAR94	11	12418	14	15	-1.00	0.88	-0.90	1.32	-1.35
30MAR94	12	12436	15	15	0.00	0.88	-0.90	1.32	-1.35
05APR94	13	12478	5.9	6	-0.10	0.88	-0.90	1.32	-1.35
05APR94	14	12492	7.5	7.5	0.00	0.88	-0.90	1.32	-1.35
07APR94	15	12527	16	16	0.00	0.88	-0.90	1.32	-1.35
07APR94	1	12541	11	12	-1.00	0.88	-0.90	1.32	-1.35
12APR94	2	12603	17	17	0.00	0.88	-0.90	1.32	-1.35
12APR94	3	12617	16	16	0.00	0.88	-0.90	1.32	-1.35

Table A16. (continued)

Collection Date	Control Number	Sample ID	Dupl A Turb (NTU)	Dupl B Turb (NTU)	Difference	Mean +2SD	Mean -2SD	Mean +3SD	Mean -3SD
12APR94	4	12627	16	15	1.00	0.88	-0.90	1.32	-1.35
12APR94	5	12645	16	16	0.00	0.88	-0.90	1.32	-1.35
13APR94	6	12680	6.8	7	-0.20	0.88	-0.90	1.32	-1.35
13APR94	7	12694	9.8	9.3	0.50	0.88	-0.90	1.32	-1.35
18APR94	8	12806	21	22	-1.00	0.88	-0.90	1.32	-1.35
18APR94	9	12820	15	15	0.00	0.88	-0.90	1.32	-1.35
18APR94	10	12834	12	12	0.00	0.88	-0.90	1.32	-1.35
19APR94	11	12972	5.8	5.5	0.30	0.88	-0.90	1.32	-1.35
19APR94	12	12986	12	12	0.00	0.88	-0.90	1.32	-1.35
19APR94	13	13000	16	15.5	0.50	0.88	-0.90	1.32	-1.35
19APR94	14	13014	16	15.5	0.50	0.88	-0.90	1.32	-1.35
19APR94	15	13028	12	12	0.00	0.88	-0.90	1.32	-1.35
19APR94	1	13040	25	24.5	0.50	0.88	-0.90	1.32	-1.35
19APR94	2	13054	22	22	0.00	0.88	-0.90	1.32	-1.35
19APR94	3	13068	22	22	0.00	0.88	-0.90	1.32	-1.35
19APR94	4	13082	19	19	0.00	0.88	-0.90	1.32	-1.35
19APR94	5	13096	18	17	1.00	0.88	-0.90	1.32	-1.35
20APR94	6	13200	3.3	3.3	0.00	0.88	-0.90	1.32	-1.35
20APR94	7	13214	2.9	2.9	0.00	0.88	-0.90	1.32	-1.35
20APR94	8	13228	3.5	3.5	0.00	0.88	-0.90	1.32	-1.35
20APR94	9	13242	11	11	0.00	0.88	-0.90	1.32	-1.35
20APR94	10	13256	8.2	8	0.20	0.88	-0.90	1.32	-1.35
20APR94	11	13270	-7.4	7.5	-0.10	0.88	-0.90	1.32	-1.35
20APR94	12	13284	7.5	7.3	0.20	0.88	-0.90	1.32	-1.35
20APR94	13	13298	7.3	7.3	0.00	0.88	-0.90	1.32	-1.35
20APR94	14	13312	9.1	9.1	0.00	0.88	-0.90	1.32	-1.35
27APR94	15	13347	4.3	4.3	0.00	0.88	-0.90	1.32	-1.35
27APR94	1	13361	4.5	4.5	0.00	0.88	-0.90	1.32	-1.35
03MAY94	2	13404	2.4	2.4	0.00	0.88	-0.90	1.32	-1.35
03MAY94	3	13418	4.7	4.7	0.00	0.88	-0.90	1.32	-1.35
03MAY94	4	13428	3.6	3.5	0.10	0.88	-0.90	1.32	-1.35
05MAY94	5	13485	2	1.9	0.10	0.88	-0.90	1.32	-1.35
05MAY94	6	13499	2.4	2.7	-0.30	0.88	-0.90	1.32	-1.35
10MAY94	7	13532	7.4	7.4	0.00	0.88	-0.90	1.32	-1.35
10MAY94	8	13546	6.5	6.6	-0.10	0.88	-0.90	1.32	-1.35
11MAY94	9	13581	6.2	6.2	0.00	0.88	-0.90	1.32	-1.35
11MAY94	10	13595	6.6	6.6	0.00	0.88	-0.90	1.32	-1.35
01JUN94	11	14134	3.4	3.4	0.00	0.88	-0.90	1.32	-1.35
01JUN94	12	14148	2.7	2.7	0.00	0.88	-0.90	1.32	-1.35
01JUN94	13	14162	2.6	2.4	0.20	0.88	-0.90	1.32	-1.35

Table A16. (continued)

Collection Date	Control Number	Sample ID	Dupl A Turb (NTU)	Dupl B Turb (NTU)	Difference	Mean +2SD	Mean -2SD	Mean +3SD	Mean -3SD
06JUN94	14	14241	5.8	5.8	0.00	0.88	-0.90	1.32	-1.35
06JUN94	15	14255	4.2	4.1	0.10	0.88	-0.90	1.32	-1.35
06JUN94	1	14269	3.5	3.5	0.00	0.88	-0.90	1.32	-1.35
08JUN94	2	14321	3	2.9	0.10	0.88	-0.90	1.32	-1.35
08JUN94	3	14335	3.4	3.6	-0.20	0.88	-0.90	1.32	-1.35
08JUN94	4	14349	3.4	3.8	-0.40	0.88	-0.90	1.32	-1.35
10JUN94	5	14404	6.6	6.7	-0.10	0.88	-0.90	1.32	-1.35
10JUN94	6	14418	2.6	2.6	0.00	0.88	-0.90	1.32	-1.35
10JUN94	7	14432	2.3	2.8	-0.50	0.88	-0.90	1.32	-1.35
10JUN94	8	14442	2.7	2.8	-0.10	0.88	-0.90	1.32	-1.35
14JUN94	9	14479	11	12	-1.00	0.88	-0.90	1.32	-1.35
14JUN94	10	14493	7.6	7.8	-0.20	0.88	-0.90	1.32	-1.35
15JUN94	11	14528	3.7	3.9	-0.20	0.88	-0.90	1.32	-1.35
15JUN94	12	14542	5.3	5.4	-0.10	0.88	-0.90	1.32	-1.35
16JUN94	13	14577	14	15	-1.00	0.88	-0.90	1.32	-1.35
16JUN94	14	14591	13	14	-1.00	0.88	-0.90	1.32	-1.35
21JUN94	15	14645	7.1	7.3	-0.20	0.88	-0.90	1.32	-1.35
21JUN94	1	14659	7.4	7.4	0.00	0.88	-0.90	1.32	-1.35
21JUN94	2	14673	7.8	7.9	-0.10	0.88	-0.90	1.32	-1.35
22JUN94	3	14725	6.1	6	0.10	0.88	-0.90	1.32	-1.35
22JUN94	4	14739	12	12	0.00	0.88	-0.90	1.32	-1.35
22JUN94	5	14753	14	14	0.00	0.88	-0.90	1.32	-1.35
28JUN94	6	14806	61	62	-1.00	0.88	-0.90	1.32	-1.35
28JUN94	7	14817	61	60	1.00	0.88	-0.90	1.32	-1.35
28JUN94	8	14834	40	40	0.00	0.88	-0.90	1.32	-1.35
28JUN94	9	14848	35	35	0.00	0.88	-0.90	1.32	-1.35
29JUN94	10	14895	21	21	0.00	0.88	-0.90	1.32	-1.35
29JUN94	11	14909	19	22	-3.00	0.88	-0.90	1.32	-1.35
29JUN94	12	14923	23	24	-1.00	0.88	-0.90	1.32	-1.35
12JUL94	13	14975	5.1	4.9	0.20	0.88	-0.90	1.32	-1.35
12JUL94	14	14989	5	5.2	-0.20	0.88	-0.90	1.32	-1.35
13JUL94	15	15042	4.6	4.6	0.00	0.88	-0.90	1.32	-1.35
13JUL94	1	15056	4.1	4.2	-0.10	0.88	-0.90	1.32	-1.35
20JUL94	2	15100	2.7	2.8	-0.10	0.88	-0.90	1.32	-1.35
20JUL94	3	15114	2.6	2.5	0.10	0.88	-0.90	1.32	-1.35
20JUL94	4	15128	3.3	3.3	0.00	0.88	-0.90	1.32	-1.35
25JUL94	5	15219	7.3	7	0.30	0.88	-0.90	1.32	-1.35
25JUL94	6	15233	9.3	9.3	0.00	0.88	-0.90	1.32	-1.35
26JUL94	7	15315	6.75	6.7	0.05	0.88	-0.90	1.32	-1.35
26JUL94	8	15326	7	6.9	0.10	0.88	-0.90	1.32	-1.35

Table A16. (continued)

Collection Date	Control Number	Sample ID	Dupl A Turb (NTU)	Dupl B Turb (NTU)	Difference	Mean +2SD	Mean -2SD	Mean +3SD	Mean -3SD
26JUL94	9	15343	6.1	6.2	-0.10	0.88	-0.90	1.32	-1.35
26JUL94	10	15357	6.5	6.3	0.20	0.88	-0.90	1.32	-1.35
28JUL94	11	13712	2.2	2.1	0.10	0.88	-0.90	1.32	-1.35
28JUL94	12	13726	2.3	2.3	0.00	0.88	-0.90	1.32	-1.35
28JUL94	13	13740	2.4	2.4	0.00	0.88	-0.90	1.32	-1.35
28JUL94	14	13754	2.5	2.45	0.05	0.88	-0.90	1.32	-1.35
28JUL94	15	13769	5	5	0.00	0.88	-0.90	1.32	-1.35
28JUL94	1	13784	2.75	2.75	0.00	0.88	-0.90	1.32	-1.35
28JUL94	2	13796	2.55	2.6	-0.05	0.88	-0.90	1.32	-1.35
28JUL94	3	13810	2.75	2.6	0.15	0.88	-0.90	1.32	-1.35
28JUL94	4	13827	3.1	3.1	0.00	0.88	-0.90	1.32	-1.35
28JUL94	5	13841	4.5	4.5	0.00	0.88	-0.90	1.32	-1.35
29JUL94	6	13966	2.15	2.35	-0.20	0.88	-0.90	1.32	-1.35
29JUL94	7	13980	32	30	2.00	0.88	-0.90	1.32	-1.35
29JUL94	8	13994	23	23	0.00	0.88	-0.90	1.32	-1.35
29JUL94	9	14008	17	17	0.00	0.88	-0.90	1.32	-1.35
29JUL94	10	14022	7.8	8.2	-0.40	0.88	-0.90	1.32	-1.35
29JUL94	11	14036	2.6	2.6	0.00	0.88	-0.90	1.32	-1.35
29JUL94	12	14050	3.25	3.25	0.00	0.88	-0.90	1.32	-1.35
29JUL94	13	14062	3.4	3.6	-0.20	0.88	-0.90	1.32	-1.35
29JUL94	14	14076	3.4	3.2	0.20	0.88	-0.90	1.32	-1.35
29JUL94	15	14086	3.7	3.35	0.35	0.88	-0.90	1.32	-1.35
09AUG94	1	15401	3.5	3.4	0.10	0.88	-0.90	1.32	-1.35
09AUG94	2	15415	3.6	3.9	-0.30	0.88	-0.90	1.32	-1.35
11AUG94	3	15469	3	2.9	0.10	0.88	-0.90	1.32	-1.35
11AUG94	4	15483	2.5	2.4	0.10	0.88	-0.90	1.32	-1.35
11AUG94	5	15497	3.3	3.1	0.20	0.88	-0.90	1.32	-1.35
11AUG94	6	15539	3.5	3.8	-0.30	0.88	-0.90	1.32	-1.35
11AUG94	7	15553	3.3	3.4	-0.10	0.88	-0.90	1.32	-1.35
17AUG94	8	15623	14	14	0.00	0.88	-0.90	1.32	-1.35
17AUG94	9	15637	13	13	0.00	0.88	-0.90	1.32	-1.35
17AUG94	10	15651	12	11	1.00	0.88	-0.90	1.32	-1.35
18AUG94	11	15705	8.9	9.4	-0.50	0.88	-0.90	1.32	-1.35
18AUG94	12	15719	12	12	0.00	0.88	-0.90	1.32	-1.35
18AUG94	13	15733	8.1	8.4	-0.30	0.88	-0.90	1.32	-1.35
23AUG94	14	15786	31	30.5	0.50	0.88	-0.90	1.32	-1.35
23AUG94	15	15800	30	30.5	-0.50	0.88	-0.90	1.32	-1.35
23AUG94	1	15816	23.5	23	0.50	0.88	-0.90	1.32	-1.35
23AUG94	2	15827	24	24	0.00	0.88	-0.90	1.32	-1.35
24AUG94	3	15875	20	20	0.00	0.88	-0.90	1.32	-1.35

Table A16. (continued)

Collection Date	Control Number	Sample ID	Dupl A Turb (NTU)	Dupl B Turb (NTU)	Difference	Mean +2SD	Mean -2SD	Mean +3SD	Mean -3SD
24AUG94	4	15889	14	14	0.00	0.88	-0.90	1.32	-1.35
24AUG94	5	15903	13	12	1.00	0.88	-0.90	1.32	-1.35
25AUG94	6	15956	15	15	0.00	0.88	-0.90	1.32	-1.35
25AUG94	7	15970	17	17	0.00	0.88	-0.90	1.32	-1.35
29AUG94	8	16087	2.2	2.1	0.10	0.88	-0.90	1.32	-1.35
29AUG94	9	16101	2.3	2.3	0.00	0.88	-0.90	1.32	-1.35
29AUG94	10	16115	2.5	2.5	0.00	0.88	-0.90	1.32	-1.35
29AUG94	11	16129	3.3	3.2	0.10	0.88	-0.90	1.32	-1.35
29AUG94	12	16143	4	3.9	0.10	0.88	-0.90	1.32	-1.35
29AUG94	13	16157	1.8	1.9	-0.10	0.88	-0.90	1.32	-1.35
29AUG94	14	16171	1.7	1.8	-0.10	0.88	-0.90	1.32	-1.35
29AUG94	15	16185	2	2	0.00	0.88	-0.90	1.32	-1.35
29AUG94	1	16197	2.2	2.1	0.10	0.88	-0.90	1.32	-1.35
29AUG94	2	16211	4	4	0.00	0.88	-0.90	1.32	-1.35
30AUG94	3	16327	1.6	1.6	0.00	0.88	-0.90	1.32	-1.35
30AUG94	4	16341	4.9	4.5	0.40	0.88	-0.90	1.32	-1.35
30AUG94	5	16355	4.3	4.3	0.00	0.88	-0.90	1.32	-1.35
30AUG94	6	16367	5.4	5.4	0.00	0.88	-0.90	1.32	-1.35
30AUG94	7	16381	5.5	5.5	0.00	0.88	-0.90	1.32	-1.35
30AUG94	8	16395	3.5	3.4	0.10	0.88	-0.90	1.32	-1.35
30AUG94	9	16409	2.6	2.7	-0.10	0.88	-0.90	1.32	-1.35
30AUG94	10	16423	2.4	2.4	0.00	0.88	-0.90	1.32	-1.35
30AUG94	11	16434	2.4	2.5	-0.10	0.88	-0.90	1.32	-1.35
30AUG94	12	16451	3	3	0.00	0.88	-0.90	1.32	-1.35
07SEP94	13	16493	3.8	3.6	0.20	0.88	-0.90	1.32	-1.35
07SEP94	14	16507	5.9	5.7	0.20	0.88	-0.90	1.32	-1.35
08SEP94	15	16552	3.7	3.6	0.10	0.88	-0.90	1.32	-1.35
08SEP94	16	16563	3	3.4	-0.40	0.88	-0.90	1.32	-1.35
08SEP94	17	16580	3.5	3.5	0.00	0.88	-0.90	1.32	-1.35
13SEP94	18	16622	4.6	4.7	-0.10	0.88	-0.90	1.32	-1.35
13SEP94	19	16636	5.8	6	-0.20	0.88	-0.90	1.32	-1.35
Mean	-0.013								
SD	0.4447								

Table A16. (continued)

Collection Date	Control Number	Sample ID	Dupl A Turb (NTU)	Dupl B Turb (NTU)	Difference	Mean +2SD	Mean -2SD	Mean +3SD	Mean -3SD
Unreliable data									
10NOV93		10110	.	.					
10NOV93		10134	.	.					
20DEC93		10292	3.6	.					
12JAN94		10369	.	.					
12JAN94		10384	.	.					
12JAN94		10399	.	.					
12JAN94		10429	.	.					
24JAN94		10643	2.8	.					
24JAN94		10657	3.8	.					
24JAN94		10671	3.15	.					
27JAN94		10857	13	.					
27JAN94		10871	21.5	.					
27JAN94		10881	19.5	.					
03FEB94		11149	9	.					
03FEB94		11153	3.9	.					
03FEB94		11156	3.4	.					
03FEB94		11158	3.9	.					
03FEB94		11161	3.5	.					
03FEB94		11165	3.6	.					
03FEB94		11167	3.5	.					
03FEB94		11170	3.3	.					
03FEB94		11174	3.6	.					
03FEB94		11176	3.8	.					
25FEB94	11	11365	0	0					
10MAR94		11932	.	.					
10MAR94		11956	22	.					
10MAR94		11959	.	.					
Relative percent difference greater than 20%									
11NOV93		10110	1.3	1					

Appendix B

ANALYTICAL QUALITY CONTROL

1. QUALITY CONTROL

1.1 ANALYTICAL QUALITY CONTROL

The laboratory QC Program ensured that all data generated and reported were scientifically valid, consistent with accepted methods, and of known accuracy. Results from QC samples were used to document data quality, verify that the analytical system was functioning for a given matrix/analyte, identify when additional corrections need to be made to the analytical system, and determine the effect of these corrections. The QC data provided an important indication of how well the data quality objectives were met. The types of laboratory QC samples used included laboratory control samples (LCSs), matrix spikes (MS), matrix spike duplicates (MSDs), surrogate spikes, replicates, and performance evaluation (PE) samples.

The quality assurance (QA) objectives for precision and accuracy in the laboratory were defined by control limits established for each method, if available. Acceptance criteria for the radiological analyses were generated by each laboratory.

All laboratories performing chemical analyses participated in PE sample programs during their period of performance for Phase 2. Selected results of these evaluations are included in Appendix D.

Laboratory QC samples can be used to evaluate the contribution of laboratory subsampling error and laboratory analytical error to total measurement error. Method blanks and MS samples may be analyzed to evaluate contributions of bias due to laboratory subsampling and laboratory analysis. Laboratory duplicates may be analyzed to evaluate the contribution of laboratory subsampling error and laboratory analysis error to sampling uncertainty.

Ten laboratories participated in sample analysis for Phase 2. A list of the laboratories that analyzed samples for each SOW is summarized in Table 23. The samples were analyzed for potential contaminants of concern using EPA-approved procedures wherever possible. Each laboratory implemented a QC program to ensure that all data generated and reported were scientifically valid, consistent with accepted methods, and of known accuracy.

1.2 METHOD QUALITY CONTROL

Method quality control consists of those practices common to a group or batch of samples that have been analyzed simultaneously by the same analytical method.

Instrument tuning is evaluated to determine if the instrument was properly configured to maximize analyte identification and sensitivity. This evaluation is part of the gas chromatograph/mass spectrometer (GC/MS) methods, where criteria specify tuning compounds, concentrations, and frequencies.

Calibration is assessed to document the accuracy and sensitivity of the instrument for the target analytes. Method criteria usually specify the number of standards, the concentration levels, the frequency of analysis, and the required response factors and precision criteria.

Blanks assess contamination levels in the overall process, in transport of the samples from the site to the laboratory (trip blanks), and in the analytical process itself [method blanks (MBs)] that may bias the analytical results.

Laboratory control samples (LCSs) contain known concentrations of analytes and are used to assess method bias, precision, and comparability.

Matrix spikes assess the bias of the method for the matrix, as well as the precision of the method when performed in duplicate. Matrix spike recovery (MSR) is calculated as follows:

$$MSR = ((SSR - SR) / SA) \times 100$$

where

MSR = MS recovery (percent),
SSR = spiked sample result,
SR = sample result,
SA = spike added.

Duplicates and MSDs assess the precision of the sampling process and/or the analytical method. The Relative Percent Difference (RPD) and Duplicate Error Ratio (DER) are used to evaluate duplicate control requirements. When evaluating duplicate precision, DER is calculated as follows:

$$DER = \frac{|S - D|}{(2.5\sigma_s + 2.5\sigma_d)}$$

where

S = original sample result,
D = duplicate sample result,
 $2.5\sigma_s$ = original sample uncertainty, and
 $2.5\sigma_d$ = duplicate sample uncertainty.

The DER should be ≤ 1 . When the original and duplicate sample results are less than the MDA, the DER is not calculated. RPD is calculated as follows:

$$RPD = \frac{|D1 + D2|}{(D1 + D2)/2} \times 100$$

where *D1* is the value of the first measurement, and *D2* is the value of the second measurement.

1.3 SAMPLE QUALITY CONTROL

Sample quality control consists of those elements that are applicable to individual samples.

Holding time deviations from method and/or project requirements are noted. Exceeding holding times may result in contaminant loss. For purposes of this document, sample extraction holding time is the time elapsed between when the sample was collected and when the sample was extracted.

Sample analysis holding time for semivolatiles and pesticides/PCBs is the time elapsed between when the sample was extracted and when the sample was analyzed. Sample analysis holding time for metals is the time elapsed between when the sample was collected and when the sample was analyzed.

Internal standards are used to evaluate the stability of the instrumentation between calibration runs.

Analyte identification consists of evaluating the sample spectra against standards and or standard libraries of spectra to ensure that acceptable identifications are made. Retention times or relative retention times are also evaluated against standard criteria.

Surrogates are organic compounds not found in environmental samples that are added to a sample to evaluate the accuracy and bias of the method.

Analyte quantitation must be reviewed in terms of detection limits as well as specificity for the contaminants of concern. Any detection limits that exceed regulatory or action levels must be identified. The laboratory's ability to detect the analyte of concern in the sample matrix at the prescribed threshold must be documented. Increasing variability in the estimate of the concentration will increase the uncertainty of the end product (e.g., risk assessment). The detection limits must reflect dilutions, interferences, and sample volume and/or moisture corrections.

1.4 SUPPORTING QUALITY ASSURANCE

Other QA/QC elements consist of additional documentation necessary to assess the analytical laboratory conduct of operations and sample tracking and general laboratory QC.

Chain-of-custody (COC) records document sample possession from the time of collection to disposal. All discrepancies between the sample identification and the information contained on the COC documents must be addressed. Sample security must be demonstrated as required by the project quality assurance plan (QAP).

Logbooks used to record all information pertinent to the analysis of the samples are reviewed to ensure technical adequacy and legal defensibility.

Internal quality control measures include performance evaluation samples and LCSs that determine analytical accuracy and method performance. Control charts may be evaluated to determine the statistical performance of the laboratory.

Certifications of the laboratory from performance evaluation programs such as the Water Pollution (WP) Studies, Water Supply (WS) Studies, State Drinking Water Programs, Environmental Monitoring Systems Laboratory (EMSL), Contract Laboratory Program (CLP), Environmental Measurements Laboratory (EML), and others will support the performance of the laboratories for those analytes reported.

Standard operating procedures (SOPs) within the laboratory ensure that the samples are analyzed and data reported using approved and documented techniques.

2. GAMMA SPECTROSCOPY ANALYSES

The goal of the Quality Assurance/Quality Control (QA/QC) program for the Low Level Radiological Analysis Laboratory (LLRAL) is to ensure that all data generated for decision making purposes are technically valid, of known quality, and properly documented. This goal is accomplished by using a system of standardized and accepted analytical methods with proper documentation of calibration, standardization, and external check samples. To achieve this goal, the process must be in a state of statistical control. This is accomplished by introducing quality assessment protocols that monitor QC procedures that suggest the need for corrective actions and evaluate the general quality of the data produced.

Quality assessments used for Phase 2 of the Clinch River Environmental Restoration Program (CRERP) were established by quantifiable and qualitative indicators such as accuracy, precision, completeness, minimum detectable activity (MDA), and collaborative testing using externally provided samples. In addition, internal and external audits were performed regularly. The reliability of the reported data is assured when accompanied by quantitative estimates of the appropriate quality assessments.

All sample and QC analyses were performed on a Canberra GeniePC Gamma-ray Spectrometer using Ge(Li) or intrinsic Ge (IG) coaxial detectors (designated as Detectors 1, 2, 3, 6, and 7). Software used for identification and quantitation was the Model S401 GeniePC Spectroscopy System from Canberra, Version 2.0. All standards, background determinations, QC samples, and field samples were identified and quantitated using this set of system components.

The detectors used for this analysis were calibrated according to manufacturers' specifications and guidelines found in EPA Method 901.1 (modified) for gamma spectroscopy. In addition, the Laboratory Quality Assurance Plan (LQAP) and the CRERP SOW-0019 were also instrumental in the determination of operating conditions for the GeniePC spectrometer. Various criteria were used in estimating QC on a daily, batch, or long-term basis.

All QC criteria met requirements set forth in the CRERP Statement of Work 0019 (SOW-0019), the *Requirements for Quality Control of Analytical Data for the Environmental Restoration Program (ES/ER/TM-16)*, and the LQAP.

Holding times, data package turn around time requirements, and sample preservation were also set forth in the CRERP SOW-0019. Holding times were established as six months from date of sample collection and the data package turn around time was set at 45 days from receipt of the last sample in a batch. Aqueous samples were preserved with nitric acid while there was no preservative used for sediment samples or cartridge filter samples.

Samples received by LLRAL were prepared by the sample preparation laboratory in one of three geometries. Each geometry used was efficiency calibrated according to the manufacturer's specifications and guidelines. Soil/sediment samples were contained in 90mL aluminum cans or 0.5L Marinelli beakers, aqueous samples (surface water or pore water) in 0.5L or 1.0L Marinelli beakers, and filters in cylindrical cartridge filter cases. All samples were sealed prior to sample log-in and required no sample preparation by LLRAL. As a result, matrix spikes were not performed on these samples and all results were reported on an as received (i.e., wet weight for the sediments) basis.

Project-specific requirements were designated in the CRERP SOW-0019. Target nuclides were specified as ^{137}Cs and ^{60}Co and the MDA as 15 pCi/L for aqueous samples for both ^{137}Cs and ^{60}Co , 10 pCi/g for solid matrices for ^{137}Cs , and 5 pCi/g for solid matrices for ^{60}Co . In addition, Tentatively Identified Nuclides (TINs) were to be reported with each sample when they could be identified. These results are reported and estimated quantitations are calculated for each sample result based on information contained in a Canberra supplied library and no standards are analyzed for these samples. Therefore, all TIN results are considered as estimated activity of uncertain qualitative identification.

The specific criteria used in assessing QC for samples analyzed by the LLRAL are as follows: instrument tuning, calibration (initial and daily calibration checks), background determinations (including long background counts and 10 minute daily checks), Laboratory Control Samples (LCS), replicate (i.e., duplicate) analyses, MDA, and long term repeated analysis of U. S. Environmental Protection Agency (EPA) sanctioned samples (e.g., EPA spiked clay samples).

2.1. INSTRUMENT QUALITY CONTROL PARAMETERS

2.1.1 Tuning

Tuning of each detector was accomplished by placing a National Institute of Standards and Technology (NIST) certified source on the detector and adjusting the gain and offset settings so that peak resolution was maximized and the photopeak spectrum adjusted so that a known nuclide peak appeared in a pre-designated region of interest. After assuring that all peaks were represented in the spectrum, the initial energy efficiency calibration may be performed.

The standard used for all tuning and calibration analyses was a mixed radionuclide solution obtained from Amersham Corporation and was composed of nine radionuclides chosen to produce well spaced photopeaks. A Certificate of Measurement is supplied with each solution stating the number of gamma-rays produced per second per gram of solution, the relative accuracy of the measurement, the reference time, and the amount of any gamma-ray emitting radioactive impurities detected in the solution. All radionuclides in solution are certified to be within 3% of the applicable NIST measurement.

2.1.2 Initial Calibration

Initial calibration requires that three criteria must be satisfied prior to acceptance of the initial efficiency curve. They are activity, resolution, and channel versus energy placement for each geometry to be analyzed.

Activity coefficients. The activity coefficients derived from the initial efficiency curve(s) for ^{60}Co , ^{137}Cs , and ^{241}Am (high, medium, and low photon energies) are used in the analysis of a known, secondary standard [e.g., a standard reference material (SRM)] produced by a different manufacturer. These initial activity calculations must be within EPA tolerances which are typically $\pm 20\%$ for aqueous samples and $\pm 30\%$ for solid matrixes in order to meet requirements.

Resolution. The resolution of the system is indicated by measuring the Full Width at Half Maximum (FWHM) height of the ^{60}Co 1,332 keV photopeak. The maximum value for this criteria is 2.4 keV.

Channel drift. The 1,332 keV ^{60}Co peak is placed in the desired channel (usually 2,665-2,670 for a 4,000 channel instrument) by the use of the gain setting and pole zero settings. Deviations or shifts of this peak position are monitored to detect any abnormal channel drift. The allowable drift is ± 4 channels. After the initial parameters are known, the daily calibration check is initiated in order to monitor any situation where detector criteria are out of control.

2.1.3 Daily Calibration

After approximately 20 to 30 analyses of the daily calibration standards were acquired, the Upper Control Limit (UCL), Upper Warning Limit (UWL), Lower Warning Limit (LWL), and Lower Control Limit (LCL) were calculated for each monitored nuclide based on the standard deviation. The UCL and LCL are ± 3 standard deviations from the mean and represent the limits of each individual parameter. All applicable criteria are reviewed daily prior to any field sample or QC sample analysis.

2.1.4 Backgrounds

Backgrounds. Backgrounds consist of counting the empty detector (or cave), at least every three months, in order to determine the magnitude of naturally occurring radiation and to minimize the background contribution to the error associated with the total propagated error reported with each analytical result. These background counts are performed over long periods of time typically over a weekend.

Background checks. Background checks are performed on a daily basis and have a duration of 10 minutes. This parameter is tracked on control charts and serves as an indicator of gross contamination from day to day. If any result falls outside of the acceptable ± 3 sigma criteria, analysis is stopped and the anomaly investigated.

2.1.5 Laboratory Control Samples

LCSs were obtained from the National Bureau of Standards (NBS) and the Department of Energy (DOE). All samples had certificates from the NBS showing the radionuclide, the gamma-ray abundance, and the uncertainty of the measurement. Several different matrices and geometries were used for QC purposes during Phase 2. These SRMs are identified by numbers (e.g., SRM 4350, 4353, 4354) or as EPA spiked clay.

The DOE samples are the same as those used in the semi-annual report for the Quality Assessment Program and are designed to examine the quality of contractor environmental measurements. These results are compiled with those of the EML and other participating contractors and a summary of these results made available for use as QC samples.

2.2 SAMPLE QUALITY CONTROL PARAMETERS

A total of 776 non-QC samples were submitted for analysis during Phase 2 of the CRERP. These consisted of 356 aqueous samples or 45.9% (236 surface water samples for 30.4% and 120 pore water samples for 15.5%) of the total. A total of 179 or 23.1% were soil/sediment matrix (4 soil/sediment samples were submitted in 0.5L Marinelli beakers and 6 sludge samples were submitted in 1 L Marinelli beakers) and 241 or 31.1% were cartridge filters. Samples were grouped into batches (after sample log-in) consisting of not more than 20 of the same matrix/geometry. Each sample batch was analyzed on a single detector along with batch specific QC.

2.2.1 Aqueous Samples

Method blanks. A total of 47 MBs were analyzed during the analysis of 25 sample batches. The blanks consisted of distilled water and nitric acid preservative contained in representative Marinelli beakers. Each blank was counted for a time period equivalent to the duration of the associated samples. Absolute results for the target nuclides were less than the associated uncertainty and less than the contract required detection limit (CRDL). All criteria were met for MB parameters. The following table summarizes blank results for all aqueous samples:

Table 1. Aqueous blank summary

Total number of blanks = 47	⁶⁰ Co, pCi/L	¹³⁷ Cs, pCi/L
Maximum Value	10.300	15.200
Minimum Value	-7.790	-4.880
Average Value	1.118	4.034
Standard Deviation	4.240	5.046
CRDL from CRERP SOW-0019	15	15

NOTE: Negative activity values for minimum values were due to background fluctuations.

Laboratory control samples. A total of 50 LCSs were analyzed in 25 batches. LCSs serve as the primary monitor of accuracy for each method. Accuracy is defined as the proximity of an individual calculated result compared to the accepted or certified result for a specific matrix and geometry. It is determined by analyzing a reference material of known activity and expressing the result as a percentage of the accepted value.

There were several different reference materials used during Phase 2 and the percent recovery requirements were identical for all. The project required criteria for all certified nuclides specifies that the per cent recovery be between 80% and 120% for aqueous samples.

The target nuclide's (⁶⁰Co and ¹³⁷Cs) activities were charted on a standard control chart during batch analysis to ensure that criteria were achieved and properly documented. Each batch of aqueous samples contained a minimum of one LCS configured in the same geometry as that of the associated field samples. Each reference material is certified and traceable to NIST. Also, as a further measure to ensure unbiased results, the samples used for preparing LCSs originate from different vendors than standards used for calibration purposes.

The following table summarizes the results for all aqueous LCSs:

Table 2. Aqueous LCS summary

Total LCSs = 50	⁶⁰ Co % Recovery	¹³⁷ Cs % Recovery
Maximum Value	116.92	119.56
Minimum Value	98.35	96.19
Average Value	103.19	106.23
Standard Deviation	3.13	4.62
Required % Recovery	80 - 120	80 - 120

NOTE: Per cent recovery requirements are stipulated in the CRERP SOW-0019

Laboratory replicates. A total of 32 replicate analysis results were generated for the 25 aqueous batches. Laboratory replicate analysis is an indicator of method precision. Precision is defined as the measure of the scatter of results around a mean, under similar conditions and geometry. This parameter is expressed as the DER for intra laboratory sample recounts. The difference of two replicate sample activity results is divided by 2.5 times the sum of the individual uncertainty terms to yield a unitless number. If the resulting number is ≤ 1 , the precision criteria requirement is considered adequate for that batch.

Each target nuclide is calculated in this manner and the DER result documented. The table below lists the summary of results for all aqueous (surface water and pore water) samples:

Table 3. Aqueous DER results

Total replicate pairs = 32	⁶⁰ Co	¹³⁷ Cs
Maximum Value	0.73	0.71
Minimum Value	0.00	0.00
Average Value	0.21	0.29
Standard Deviation	0.15	0.20
Required Criteria	<1.0	<1.0

2.2.4 Soil/Sediment Samples

Method blanks. A total of 28 MBs were analyzed during the analysis of 18 soil/sediment batches. The blanks were made up of 100-200 mesh silica gel sealed in a 90mL aluminum sample can. Each blank was counted for the same amount of time as the associated samples. Sediment blank criteria require that there be no target nuclides detected above the MDA and that the absolute value of the calculated target nuclides be less than the associated uncertainty. The table below lists summary information for soil/sediment blanks:

Table 4. Soil/sediment blank summary

Total number of blanks = 28	⁶⁰ Co, pCi/g	¹³⁷ Cs, pCi/g
Maximum Value	0.093	0.104
Minimum Value	-0.104	-0.025
Average Value	0.009	0.032
Standard Deviation	0.046	0.031
CRDL from SOW-0019	5	10

NOTE: Negative activity values for minimum values were due to background fluctuations.

Laboratory control samples. Thirty-two LCSs were processed during the analysis of 18 soil/sediment batches. There were several different SRMs used as LCSs, however, the percent recovery requirements are the same for all samples. These criteria are specified by the EPA and the target nuclides must be between 70% and 130% recovery for soil/sediment samples.

The recoveries of the target nuclides were charted on standard control charts to ensure that the required criteria were achieved and properly documented. All SRMs used for the preparation of the soil/sediment LCSs are certified and traceable to NIST. The table below lists the soil/sediment LCS summary information:

Table 5. Soil/Sediment LCS summary

Total LCSs = 32	⁶⁰ Co, % Recovery	¹³⁷ Cs, % Recovery
Maximum Value	117.92	122.81
Minimum Value	87.14	76.69
Average Value	108.93	97.38
Standard Deviation	5.47	10.79
Required % Recovery	70% - 130%	70% - 130%

Laboratory replicates. Twenty soil/sediment samples were analyzed in duplicate during the analysis of 18 batches of samples. DERs were calculated and documented in the batch reports. The DER criteria is the same for all matrixes and geometries (i.e., DER < 1). The following table lists the DER summary information:

Table 6. Soil/Sediment DER summary*

Total replicate pairs = 20	⁶⁰ Co	¹³⁷ Cs
Maximum Value	0.78	0.78
Minimum Value	0.00	0.00
Average Value	0.21	0.21
Standard Deviation	0.19	0.19
Required Criteria	<1	<1

* - ⁶⁰Co and ¹³⁷Cs DER results are identical

2.2.3 Cartridge Filters

Method blanks. Thirty-one MBs were analyzed during the processing of 19 separate batches of cartridge filters. All blanks analyzed met the requirement that the target nuclides be less than the CRERP CRDL. Cartridge filter MBs were made up of unused, representative filters that were counted for times equivalent to the associated samples. Criteria for cartridge filters required that there be no detectable target nuclides above the CRERP CRDL and that the absolute value of any calculated target nuclide be less than the associated uncertainty. The following table lists summary information for cartridge filter blanks:

Table 7 Cartridge filter blank summary

Total number of blanks = 31	⁶⁰ Co, pCi/g	¹³⁷ Cs, pCi/g
Maximum Value	7.960	9.410
Minimum Value	-6.600	-3.300
Average Value	0.115	0.523
Standard Deviation	2.705	2.426
CRDL*	5	10

* - Cartridge filters are not specifically addressed in CRERP SOW-0019. The CRDL is the same as for soil/sediment.

Laboratory control samples. Twenty-two LCS pairs were analyzed during the processing of 19 batches of cartridge filters. The cartridge filter LCS was prepared by opening a new, unused cartridge filter and adding a known amount of SRM. The filter was then counted in the normal manner. Since there is no specific reference to cartridge filter protocols or requirements in SOW-0019, it was decided to use the criteria of the soil/sediment samples as filter criteria. Therefore, the required percent recovery of the cartridge filters is $\pm 30\%$ of theoretical. The following table lists all summary information:

Table 8 Cartridge Filter LCS Summary

Total LCSs = 22	⁶⁰ Co, % Recovery	¹³⁷ Cs, % Recovery
Maximum Value	119.37	125.10
Minimum Value	93.78	96.79
Average Value	105.14	109.68
Standard Deviation	3.13	7.63
Required % Recovery	70% - 130%	70% - 130%

Laboratory replicates. Twenty-six pairs of samples were evaluated for the DER in a total of 19 batches of cartridge filter samples. The DER criteria is the same for all matrixes and geometries (i.e., DER < 1). The following table lists the DER Summary information for cartridge filters:

Table 9 Cartridge filter DER summary

Total replicate pairs = 26	⁶⁰ Co	¹³⁷ Cs
Maximum Value	0.73	0.52
Minimum Value	0	0.01
Average Value	0.21	0.2
Standard Deviation	0.15	0.14
Required Criteria	<1	<1

2.3 OTHER QUALITY CONTROL

The long-term stability of each detector was followed by using an EPA spiked clay sample. The sample contained a known ¹³⁷Cs activity that was tracked on a weekly basis. The same sample was run on each detector at least once a week and the results charted on standard QC charts. Figures 1 through 5 show each detector's stability for the time period.

Fig. 1. Detector 1 spiked clay stability.

Fig. 2. Detector 2 spiked clay stability.

Detector 3 Spiked Clay Stability

Fig.3. Detector 3 spiked clay stability.

Detector 6 Spiked Clay Stability

Fig. 4. Detector 6 spiked clay stability.

Fig.5. Detector 7 spiked clay stability.

2.4 CONCLUSIONS

A total of 776 field samples were accepted for analysis by the LLRAL for gamma spectroscopy analysis during Phase 2. These samples were divided into more than 70 batches that contained both sample-specific and batch-specific QC. The target nuclides, ^{60}Co and ^{137}Cs , were reported for each sample analyzed. The required CRDL was achieved for all samples and all sample and batch QC criteria were met.

3. ANALYSES OF SAMPLES

3.1 SEDIMENT ANALYSES

3.1.1 Physical Analyses of Sediment Samples

Physical analyses of sediment samples was conducted at Southwest Research Institute (SWRI). This included, bulk density, moisture content, porosity, particle size/hydrometer, specific gravity, total combustible organics (TCO) and total organic carbon (TOC). The samples were prepared and analyzed in accordance with the protocol outlined in SOW 195. Methods used include ASTM D-4959-moisture content, ASTM D-854-porosity, ASTM D-421 and ASTM D-422-particle

4959-moisture content, ASTM D-854-porosity, ASTM D-421 and ASTM D-422-particle size/hydrometer, ASTM D-854-specific gravity, ASTM D-2974-TCO and "Methods of Soil Analysis," Agronomy No. 9 - TOC. Fifteen sample batches were processed. One hundred and sixty six samples were analyzed for bulk density, moisture content, porosity, particle size/hydrometer and specific gravity. One hundred and sixty five samples were analyzed for TCO and one hundred and twenty nine samples were analyzed for TOC.

Holding times. Three samples (52490, 51690, 51904) were received broken and one sample (52329) was received cracked. In each case, the sample remained in the bag and no leakage occurred. Six samples (51598, 51586, 51848, 51847, 51916, 52061) were received with cracked lids. No leakage occurred and analysis was conducted on all samples. Six samples were received at SWRI at 13.6 degrees C. The samples should have arrived between 4 degrees C and 6 degrees C. The data did not appear to have been affected by these deviations.

Two samples (52594, 52595) were returned to ORNL because levels of radioactivity were too high to perform physical analyses on them. The status of the two samples in the data base was marked as lost.

Calibration. All initial and continuing calibration criteria were met for physical analyses.

Blanks. Blank corrections were not performed on dry bulk density, moisture content, porosity, particle size/hydrometer, specific gravity, TCO, and TOC.

Laboratory duplicates. All duplicate analyses for grain size, porosity and specific gravity had a RPD less than 6.29. The RPD was exceeded in the following analyses: dry density (29.60 max), Hydrometer Diameter (39.04 max), TCO (28.57 max), and TOC (18.6 max).

3.1.2 Metals Analyses of Sediment Samples

Metals analyses of sediment samples were conducted at ThermoAnalytical (TMA)-ARLI. Analysis of uranium was performed by both TMA-ARLI and TMA-Norcal. These analyses included inductively coupled plasma (ICP), graphite furnace atomic absorption (GFAA), and cold vapor (CV) analysis of the target compound list (TCL) metals. The samples were prepared and analyzed in accordance with the protocol outlined in the *USEPA Contract Laboratory Program (CLP) SOW for Inorganic Analysis, Multi-Media, Multi-Concentration, ILM03.0*. Twenty-three sample batches were processed containing 169 samples. All samples exhibited matrix interferences, and most received dilutions before analysis.

Holding times. Nineteen samples (batches A311075, A406068) were received at TMA-ARLI at cooler temperatures $>6^{\circ}\text{C}$. These samples were part of a Friday shipment to the laboratory that was not received until Monday, thus accounting for the increase in cooler temperature. This deviation was noted in the data base as a comment.

One sample (51146, batch A403073) was received with a broken jar bottom. Analysis of the sample proceeded on the direction of the client. The data were comparable to other sample batch data and did not appear to have been compromised as a result of the breakage.

All four samples of batch A403036 were analyzed beyond the mercury-holding time. The associated data were qualified as rejected.

Samples in batches A403073, A406011, and A408017 were analyzed beyond the mercury-holding time. The associated data were qualified as estimated.

Because of a laboratory log-in error (see laboratory CARA-94-01), 40 samples were logged in with EPA SW-846 QC instead of the required CLP QC. As a result, all samples were prepared again and analyzed beyond the Hg analysis holding time. The newly analyzed data exhibited lower levels of Hg, thus indicating loss of Hg as the holding time passed. The data for the original analysis of all samples provide a more accurate level of Hg present in the samples. The re-analyzed Hg data was qualified with a use flag of "No" and also qualified as rejected.

Calibration. All initial and continuing calibration criteria were met. No qualification of the data is necessary based on calibration.

Blanks. No significant contamination was found. A few compounds were reported at levels less than the required detection limit.

Matrix spikes. The percentage of matrix spike (MS) recoveries that failed to meet the established recovery criterion was 23%. Most of these matrix-influenced low %R occurred with antimony, arsenic, cadmium, cobalt, selenium, and silver. The associated data were qualified as estimated.

Laboratory duplicates. The percentage of duplicate analyses that failed to meet the established RPD criterion was 6%. Most of these matrix-influenced deviations occurred with arsenic, boron, cadmium, lead, mercury, potassium, and silver. The associated data was qualified as estimated.

Laboratory control samples. the percentage of LCS analyses that failed to meet the established recovery criterion was <1%. There was no solid source LCS available for boron or uranium. No qualification of the data is necessary.

Other quality control. Post-digestion spikes and method of standard deviations were performed as required by the CLP method when matrix spike recoveries were outside the acceptance limits. The percentage of post-digestion spike analyses that failed to meet the established recovery criterion was 28%. Selenium and antimony had the lowest recoveries. The average recovery for selenium was 67%.

The percentage of method of standard addition (MSA) recoveries and correlation coefficients that failed to meet the established criterion was ~14%. Most of the deviations occurred with arsenic, cadmium, cobalt, and lead. The associated data should be qualified as estimated.

3.1.3 Total Kjeldahl Nitrogen Analyses of Sediment Samples

Total Kjeldahl nitrogen (TKN) analyses of sediment samples were conducted at ThermoAnalytical (TMA)-ARLI. Orion 95-12 instrumentation with the Orion 720A ion selective electrode (ISE) performed analysis of TKN. The samples were prepared and analyzed in accordance with the protocol outlined in the *USEPA Method 351.3*. Twenty-three sample batches containing 169 samples were processed. All samples exhibited matrix interferences.

Holding times. Nineteen samples (batches A311075, A406068) were received at TMA-ARLI at cooler temperatures >6°C. These samples were part of a Friday shipment to the laboratory that was not received until Monday, thus accounting for the increase in cooler temperature. This deviation was noted in the data base as a comment.

Two samples (50929, 50944, batch A402059) were not logged in or analyzed (per the client) because of holding time expiration. These do not appear on the holding time evaluation summary because no results were received.

Twenty-two samples (batches A408017, A409038, A403036) were reanalyzed because of matrix problems, but the data were not reported by the lab since the re-analysis was after holding-time expiration.

Calibration. All initial and continuing calibration criteria were met. No qualification of the data is necessary based on calibration.

Blanks. All MBs were free of contamination. No qualification of the data is necessary.

Matrix spikes. The percentage of MS recoveries that failed to meet the established recovery criterion was 38%. The low recoveries were caused by matrix interferences. The average recovery was 75%. The associated data were qualified as estimated.

Laboratory duplicates. The percentage of duplicate analyses that failed to meet the established RPD criterion was 43%. The high relative percent differences (RPDs) were attributed to matrix interferences. The associated data were qualified as estimated.

Laboratory control samples. All LCS recoveries met the established criterion. No qualification of the data is necessary.

3.1.4 Pesticide/Polychlorinated Biphenyl Analyses of Sediment Samples

Pesticide/PCB analyses of sediment samples were conducted at ThermoAnalytical (TMA)-ARLI. A gas chromatograph (GC), with an electron capture detector (ECD) configured with a dual column autosampler injection system, performed analysis of the target compound list (TCL) of pesticides/PCBs. The Nelson 2700 Turbochrome Data System, which normalizes the largest peak to scale, was used to process the data. The samples were extracted and analyzed in accordance with the protocol outlined in the *USEPA Contract Laboratory Program Statement (CLP) of Work for Organic Analysis, Multi-Media, Multi-Concentration*, OLM01.8. Twenty-three sample batches containing 169 samples were processed. In order to reach the contract-required detection limits (CRDLs), each sample was concentrated to a final volume of 2 mL (instead of the method specified 5 mL) after gel permeation chromatography (GPC) cleanup. However, because of matrix interferences, many of the samples were analyzed at various dilutions. Additional sulfur cleanup did not improve the chromatography.

Holding times. Nine samples (51705, 51718, 51719-batch A405030; 51832, 51913, 51937, 51949-batch A405044; 52392-batch A406051; 52509-batch A406067) were received with discolored water in the plastic bag holding the sample jars. The jar lids were found to be loose and some soil was detected around the mouths of these jars. Approximately 1 to 3 mL of water were lost in each bag. The data from these samples are comparable to data from samples that did not experience any water loss. The data did not appear to have been affected by this deviation.

Twenty-five samples (batches A311074, A406067, and A407034) were received at TMA-ARLI at cooler temperatures $>6^{\circ}\text{C}$. These samples were part of a shipment due at the laboratory on Friday that was not received until Monday, thus accounting for the increase in cooler temperature. This deviation was noted in the data base as a comment.

One sample (50838, batch A402007) was re-extracted outside the extraction holding time. The data from this re-extracted sample was qualified as estimated. One sample (51595, batch A405027) was received broken and no analysis was performed.

Calibration. All initial calibration criteria were met. Three sample batches exhibited a nontarget compound interference peak that caused the continuing calibration (%D) criterion to fail. This violation required qualification of positive results for those compounds in affected samples as estimated. The affected compounds included endosulfan sulfate, methoxychlor, alpha-benzene hexachloride (BHC), endrin, 4,4'-DDT, aldrin, and aroclor-1248. Since these compounds were not detected in any of the affected samples, no qualification of the data is necessary.

Blanks. Alpha-BHC was detected in one MB and methoxychlor was detected in two MBs at levels less than or equal to the quantitation limit (QL). These compounds were not detected in the associated samples; therefore, no qualification of the data is necessary. All instrument blanks were free of contamination.

Surrogate spikes. All samples and associated MBs were spiked at 2.5 times less than the CLP requirement since the samples were concentrated 2.5 times in order to reach the requested QLs. The percentage of tetrachloro-m-xylene (TCX) and decachlorobiphenyl (DCB) surrogate recoveries that failed to meet the established recovery criterion was 6%. Of this 6%, 2% exhibited high TCX and DCB surrogate recoveries and 4% exhibited low TCX and DCB surrogate recoveries. The average recovery for TCX was 87% while the average recovery for DCB was 92%. The low surrogate recoveries were mainly caused by matrix interferences. The data associated with the low surrogate recoveries were qualified as estimated.

Matrix spikes and matrix spike duplicates. The percentage of pesticide MS/MSD recoveries that failed to meet the established recovery was 2% and RPD criterion 5%. Mean recoveries ranged from 70-85 %. No qualification of the data is necessary based on the MS/MSD results.

Laboratory control samples. all LCS recoveries met the established recovery criterion. No qualification of the data is necessary based on LCS results.

Other quality control. Most of the samples exhibited the presence of aroclor-1254 and aroclor-1260. However, because of matrix interference, the %D between the two GC columns exceeded the established limit for some compounds resulting in the "P" laboratory data flag. The affected data was qualified as estimated. In some cases, the aroclors could not be confirmed on the second column and were not reported as detected.

All four samples in batch A402058 exhibited a retention time shift caused by carryover/ column degradation/incorrect temperature ramping/co-eluting peaks. The data for these samples were qualified accordingly.

3.1.5 Semivolatile Analyses of Sediment Samples

Semivolatile analyses of sediment samples were conducted at ThermoAnalytical (TMA)-ARLI. A GC/MS performed analysis of the target compound list (TCL) semivolatiles. The samples were extracted and analyzed in accordance with the protocol outlined in the *USEPA CLP SOW for Organic Analysis, Multi-Media, Multi-Concentration*, OLM01.8. Twenty-three sample batches were processed containing 169 samples. All samples exhibited the presence of phthalates and low levels of polyaromatic hydrocarbons, thus necessitating analysis at varying dilution levels.

Holding times. Nine samples (51705, 51718, 51719-batch A405030; 51832, 51913, 51937, 51949-batch A405044; 52392-batch A406051; 52509-batch A406067) were received with discolored water in the plastic bag holding the sample jars. The jar lids were found to be loose and some soil was detected around the mouths of these jars. Approximately 1 to 3 mL of water were lost in each bag. The data from these samples are comparable to data from samples that did not experience any water loss. The data did not appear to have been affected by this deviation.

Twenty-five samples (batches A311074, A406067, and A407034) were received at TMA-ARLI at cooler temperatures $>6^{\circ}\text{C}$. These samples were part of a shipment due at the laboratory on Friday that was not received until Monday, thus accounting for the increase in cooler temperature. This deviation was noted in the data base as a comment.

Four samples (batch A311074) were re-extracted outside the extraction holding time. The data from these samples were qualified as estimated. One sample (51595, batch A405027) was received broken and no analysis was performed.

Calibration. All initial calibration criteria were met. Several batches exhibited continuing calibration (%D) criterion outside the acceptance limits. This violation required qualification of results for those compounds in affected samples as estimated.

Blanks. Benzoic acid, 1,4-dichlorobenzene, 4-nitrophenol, butylbenzylphthalate, bis (2-ethylhexyl) phthalate, di-n-butylphthalate, diethylphthalate, methoxychlor, pentachlorophenol, pyrene, and alpha-BHC were detected in the MBs that were analyzed with the sediment samples. The data were qualified accordingly.

Internal standards. One sample exhibited an increase in the area counts of perylene- d_{12} beyond the acceptance range. This deviation was caused by matrix interference. No compounds were quantitated against this internal standard and no qualification of the data is necessary. All other internal standard criteria were met.

Surrogate spikes. One sample (50930, batch A402058) exhibited high base neutral (BN) surrogate recoveries. All positive data associated with the high BN surrogate recoveries were qualified as estimated. All other surrogate recoveries were within the limits.

Average recoveries for the surrogates are listed below:

• 2-chlorophenol-d4	76%
• phenol-d5	82%
• 2-fluorophenol	79%
• 2,4,6-tribromophenol	84%
• nitrobenzene-d5	73%
• 2-fluorobiphenyl	83%
• terphenyl-d14	97%
• 1,2-dichlorobenzene-d4	68%

Matrix spikes and matrix spike duplicates. Because of matrix interferences, the percentage of MS/MSD recoveries that failed to meet the established recovery and RPD criterion was close to 100%

for 2,4-dinitro toluene and the acid spikes. Overall, 89% of the spike recoveries were within criteria, while 10% were high. The base-neutral spikes averaged 59-89% recoveries while the acid spikes averaged 60-97% recoveries. Since none of the spike compounds were detected in the original samples and surrogate recoveries were acceptable, no qualification of the data is necessary based on the MS/MSD results.

3.1.6 Total Mercury and Methyl Mercury Analyses of Sediment Samples

As part of the CRERP Phase 2 RI, sediment samples from the Clinch River—Watts Bar Reservoir system were analyzed for total Hg to obtain data for use in site characterization and human health and ecological risk assessment. Analyses of Hg speciation were completed to determine if Hg found in past studies was inorganic Hg (Hg^{+2}) or the more toxic MeHg. These analyses were conducted at Brooks Rand, LTD., Seattle, WA, according to CRERP laboratory SOW-193 dated August 30, 1993.

Sediment samples were prepared by $\text{HNO}_3\text{:H}_2\text{SO}_4$ reflux digestion for 3–4 hours, brought to volume with distilled deionized water and preserved with 1ml BrCL. A rapid method of single stage gold amalgamation with cold vapor atomic fluorescence spectrometry (CVAFS) was used to determine the sample Hg content. The Hg contained in the sediment digestates was isolated by stannous chloride reduction, gas phase stripping, and collection onto a gold trap. The Hg collected on the trap was desorbed under a carrier gas stream and then determined by CVAFS. Fluorescence emission signals were recorded by an integrator. The amount of Hg in a sample analyzed was directly proportional to the integrated signal of fluorescence emission. CRERP required the lowest achievable detection limits for baseline risk assessment. Therefore, the detection limits for this technique of less than 1 pg Hg was acceptable. Relative standard deviations (RSDs) of 2.8%, 1.5%, and 2.2% were obtained for the determination of 500, 1000, and 2000 pg Hg standards, respectively.

Sediment samples for MeHg analyses were prepared by distillation. The MeHg and Hg^{+2} contained in the samples were first ethylated with sodium tetraethylborate and collected by purging onto a column filled with Tenax™. The Hg derivatives were then thermally desorbed and transferred to a GC column held in an oven at 95°C, and the species were chromatographically separated. The organo-Hg compounds were decomposed at 800°C to Hg, which is quantified by cold vapor atomic fluorescence spectrometry (CVAFS). CRERP required the lowest achievable detection limits for baseline risk assessment. Therefore, the detection limits for this technique of about 0.6 pg and 1.3 pg for MeHg and Hg^{+2} , respectively, were acceptable. The method has been demonstrated as being very sensitive, precise, and accurate.

For this project, a total of 81 sediment samples were analyzed for total Hg and MeHg content. Along with these samples, a total of 95 QC samples (i.e., 48 TBs, 13 field blanks, 16 laboratory rinsate blanks, and 18 field rinsate blanks) were analyzed. The sediment sample results are reported in ng/g on a dry basis and were included in 38 individual batches numbered from OR-10 through OR-47.

Holding times and preservation. Conformance to holding time and sample preservation requirements for each batch of samples was reviewed. According to SOW-193, the holding time for sediment total Hg analyses is 28 days and the preservation requirement is cooling to $4\pm 2^\circ\text{C}$ until the time of analysis. Unless otherwise noted, sample shipping, receipt, and integrity problems were noted in Programmatic Exception Reports (PERs). The following nonconformances were identified and are listed by data receipt group (DRG).

DRG OR-14: The samples in this DRG were sent to another laboratory by mistake. Consequently, by the time the samples were received by Brooks Rand, LTD., the cooler

temperature was at 10°C. The results for all nine sediment samples (50489, 50494, 50528, 50541, 50553, 50642, 50655, 50668, and 50680) in this DRG were commented in the data base.

DRG OR-30: The analysis holding time was exceeded for all sediment samples in this DRG. The total Hg results for these samples were qualified as estimated (J) with a qualifier code of A03 (analysis holding time exceeded).

DRG OR-33: The analysis holding time was exceeded for the four sediment samples in this DRG (samples 52001, 52014, 52067, and 52079). The total Hg and methyl Hg results for these samples were qualified as estimated (J) with a qualifier code of A03 (analysis holding time was exceeded).

DRG OR-41: The analysis holding time was exceeded for the three sediment samples in this DRG (samples 52585, 52596, and 52610). The total Hg and methyl Hg results for these samples were qualified as estimated (J) with a qualifier code of A03 (analysis holding time was exceeded).

DRG OR-43: The analysis holding time was exceeded for the four sediment samples in this DRG. The total Hg results for these samples were qualified as estimated (J) with a qualifier code of A03 (analysis holding time was exceeded).

Calibration. The laboratory used a grand average of all standards (excluding minimum detection standards) in the analytical run to calculate the calibration coefficient which is the correction factor for the instrument sensitivity on any given day. To give a calibration coefficient correction factor representative of the complete run, the standard concentrations ranged from 10 to 3000 pg for total Hg and 5 to 200 pg for methyl Hg and were analyzed in various positions throughout the analytical run. Correlation coefficient (r^2) information was also provided on the calculation pages of each DRG. Since the calibration coefficient correction factors multiplied by the peak height or peak area were used to determine the concentration for each sample, r^2 values <0.995 should not be considered as an indicator of questionable instrument calibration. Calibration checks are performed immediately after generating the calibration curve, after every ten samples, and at the end of the analytical batch. The calibration check consists of a mid-point standard, a near detection level standard, and a calibration blank. The mid-point standard must show 80-120% recovery for the analysis to be considered in control. Calibration sequences for all analytical runs in all DRGs were acceptable and, therefore, no qualification of the data is necessary based on this criteria.

Blanks. In each analytical sequence, the laboratory analyzed various blanks to monitor system performance. These were identified as bubbler blanks and reagent or MBs. The bubbler blanks were analyzed to show that the analytical system was not contaminated by carrier gases or carryover between samples. Reagent blanks, consisting of the reagents used in sample preparation, were analyzed to show that contamination was not contributed by the reagents used. No significant blank contamination was observed.

Matrix spikes. Matrix spike recovery for each batch of samples was reviewed. A control limit of 75 to 125% recovery was used in evaluating matrix spike recovery. No deviations were identified that would require qualification of the total Hg data. The following deviations were identified for methyl Hg and are listed by DRG:

DRG OR-12: The laboratory reported matrix spike recoveries for five samples in this DRG. One of the recoveries was 74%. However, the average recovery was 83%. This was considered acceptable by the laboratory. Therefore, no qualifications should be applied because of this deviation.

DRG OR-14: Matrix spike recoveries in this DRG ranged from 66 to 74%. As a result, the MeHg results for the sediment samples in this DRG should be qualified as estimated (J) with a qualifier code of I02 (matrix spike recovery was below the lower control limit).

DRG OR-27: The laboratory reported matrix spike recoveries for three samples in this DRG. All recoveries were less than 75%. As a result, the MeHg results for the sediment samples in this DRG should be qualified as estimated (J) with a qualifier code of I02 (matrix spike recovery was below the lower control limit).

Duplicates/Replicates. As required by SOW-193, duplicate samples are to be analyzed for every matrix in each batch of 20 samples or less. Control limits of 35% RPD or relative standard deviation (RSD) for sediment samples are applied when evaluating duplicate/replicate analyses. Instead of duplicates, the laboratory analyzed samples in replicate. The RSDs observed were of low magnitude, so the first of the replicate results was included in the data base as the customer result. The other replicate results were included as quality control measurements. No deviations were identified.

Laboratory control samples. The laboratory used a NIST Hg in water SRM (1641C) and a Nuclear Regulatory Commission (NRC) trace elements in marine sediment reference material (BEST-1) for QC purposes for total Hg. Results reported for these SRMs were acceptable in all cases and, therefore, no qualification of the data is necessary based on this criteria.

The laboratory used an International Atomic Energy Agency (IAEA) MeHg in marine sediment reference material (IAEA-356) for QC purposes. Another reference material used for LCS purposes was SRM NRCC DORM-2, Hg in dogfish muscle. Results reported for these reference materials were acceptable and, therefore, no qualification of the data is necessary based on this criteria.

Other quality control. Whenever lower than usual matrix spike recoveries or higher than usual laboratory blank results were observed, the laboratory would also present sample results corrected for spike recovery and/or blank subtracted. According to SOW-193, and since sample results are qualified because of these deviations, the sample results that were used are those without these corrections.

During the course of the project, the laboratory changed its method of reporting sample results to include attaching qualifiers to the results. For results below the QL and/or below the method detection limit (MDL), a <QL or <MDL was placed in the results field of the analytical report. The QL was determined as ten times the standard deviation of the MBs analyzed on that day and was incorporated into the data base as a "U" qualifier. The MDL was determined as three times the standard deviation of the MBs analyzed on that day and was incorporated into the data base as a "B" qualifier. The QL and MDL values are available in the analytical reports.

The laboratory occasionally presented the results on a wet weight basis in addition to reporting them on a dry weight basis. The dry weight basis results were included in the data base and used for data analysis purposes.

Several of the DRGs reported results of more than 20 samples. These DRGs include OR-14, OR-23, OR-24, OR-28, OR-29, OR-32, OR-34, OR-38, OR-39, OR-41, OR-42, OR-44, OR-45, OR-46, and OR-47. According to SOW-193, no more than 20 samples should be reported in a batch. Although this deviation was noted, this should have no effect on the data since the laboratory followed procedure and provided sufficient QA/QC data (i.e., blanks, duplicates, matrix spikes, etc.). The samples were prepared and analyzed in small batches (i.e., 20 samples or less). During review, all of the QA/QC information associated with each batch was considered. Additional qualification of the data was not necessary.

Other QC and analysis protocol deviations for each batch of samples were reviewed. The following exceptions were identified and are listed by DRG.

DRG OR-39: Because of laboratory miscommunication, the three sediment samples in this DRG (52478, 52492, and 52506) were analyzed twice. The results for the second set of analyses should not be used since the analysis holding time was exceeded. In the data base, the total Hg results for these samples were qualified with a use flag of "N".

DRG OR-43: To verify correct instrument operation, the laboratory analyzed samples 52682 and 52819 twice and reported both sets of MeHg results. The first of the replicate results was included in the data base as the customer result. The other result was included as a quality control measurement.

3.1.7 Radiological Analyses of Sediment Samples by Eco Tek Laboratory Services, Inc.

As part of the CRERP Phase 2 RI, 221 sediment samples from the Clinch River-Watts Bar Reservoir system were analyzed for various radiological parameters. The analyses were completed by EcoTek Laboratory Services, Inc. in Atlanta, Georgia, according to CRERP laboratory SOW-217. The samples were analyzed for isotopic uranium, ^{99}Tc , and ^{90}Sr activities. Isotopic uranium activities were determined by alpha spectrometry. The ^{99}Tc activities were determined by liquid scintillation counting. The ^{90}Sr activities were determined by gas flow proportional counting.

A total of 137 sediment samples were analyzed for ^{90}Sr and 42 samples were analyzed for ^{99}Tc and isotopic uranium. The results for these samples were reported in 16 separate Sample Delivery Groups (SDGs) (Nos. 31529, 31624, 31656, 31773, 31798, 31832, 31840, 31946, 32072, 32075, 32132, 32177, 32190, 32276, 32372, and 32386). The activities were reported in pCi/g.

Holding times and preservation. Conformance to holding time and sample preservation requirements was reviewed. The samples were collected during the period November 1993 through July 1994. No discrepancies were found in a comparison between the CRERP chain-of-custody (COC) forms and samples received. The shipping packages were sealed and packed properly and all samples arrived in good condition. Upon receipt, the samples were logged in and stored appropriately until the analyses were performed.

A 6-month holding time is applied to sediment samples analyzed for radionuclides. There are no special preservation requirements. No qualification of the data is necessary based on holding time and sample preservation criteria.

Calibration. For the isotopic uranium determinations by alpha spectrometry, the initial instrument calibrations and continuing calibration verification checks were acceptable. In addition, a series of pulser instrument checks were performed on the detectors prior to counting the samples. All pulser checks were found to be acceptable. Weekly calibration checks to monitor energy calibration and a check for the peaks's full-width half-maximum (FWHM) measurement were also found to be acceptable. No qualification of the isotopic uranium data is necessary based on this criteria.

For the ^{90}Sr determinations, two of the instrument performance assessments were not within acceptance criteria. The absorption curve was not generated within one year of the sample analyses. The absorption curve was dated 10/92 through 11/92. In addition, no data to document the cross-talk determination was included in the data packages. As a result, all ^{90}Sr results were qualified as estimated (J). The qualifier codes R06 (absorption curve criteria were not met) and S05 (cross-talk verification criteria were not met) were assigned with the J qualification.

There were no calibration problems noted for the ^{99}Tc determinations.

Blanks. In each analytical sequence, the laboratory analyzed the required MBs to monitor procedural and system performance. The method or reagent blanks for each determination consisted of deionized water prepared as a sample and taken through the separation chemistry, if applicable. The results were qualified as estimated (J) if their results were greater than the MDA. If the results were less than the MDA, the results were qualified as not detected, associated value uncertain (UJ). A qualifier code of F01 (sample data were qualified as a result of the MB) accompanies the qualifier flags.

The ^{238}U MB in SDG No. 32072 had a result greater than the minimal detectable activity (MDA). The results were qualified.

The ^{234}U and ^{238}U MB in SDG No. 32372 had results greater than the MDA. The ^{234}U and ^{238}U results for samples 52354, 52355, 52340, 52341, 52383, 52384, 52398, 52399, 52487, 52488, 52501, 52502, 52515, and 52516 were qualified.

The ^{234}U MB in SDG No. 32386 had results greater than the MDA. The ^{234}U results for samples 52591, 52592, 52605, 52606, 52619, and 52620 were qualified.

The ^{238}U MB in SDG No. 32276 had results greater than the MDA. The ^{238}U results for samples 52226, 52227, 52241, 52242, 52256, and 52257 were qualified.

The ^{90}Sr MB in SDG No. 31832 had results greater than the MDA. The ^{90}Sr results for samples 51013, 51031, and 51034 were qualified.

The ^{90}Sr MB in SDG No. 31529 had results greater than the MDA. The ^{90}Sr results for samples 50116, 50136, 50187, 50189, 50207, 50226, and 50228 were qualified.

The ^{90}Sr MB in SDG No. 32276 had results greater than the MDA. The ^{90}Sr results for samples 52136, 52146, 52148, 52158, 52160, 52222, and 52223 were qualified.

The ^{90}Sr MB in SDG No. 31773 had results greater than the MDA. The ^{90}Sr results for samples 50923, 50924, 50938, and 50939 were qualified.

The ^{99}Tc MBs were reviewed and all determinations were less than the MDA. No qualification of these data is necessary based on this criteria.

Chemical recovery. The ^{90}Sr , ^{99}Tc and isotopic uranium analyses use either carriers or chemical tracers in completing the determinations. According to SOW-217, recoveries of 50 to 110% are considered acceptable.

In SDG No. 32276, the ^{90}Sr carrier recovery for sample 52222 was less than 50%. The ^{90}Sr result for this sample was less than the MDA and was qualified as not detected, associated value uncertain (UJ) with a qualifier code of G02 (radiological chemical recovery was below the lower control limit).

In SDG No. 32276, the ^{90}Sr carrier recoveries for samples 52237 and 52238 were greater than 150%. The ^{90}Sr results were qualified as unusable (R). A qualifier code of G08 (radiological chemical recovery was greater than 150%) accompanies the qualifier flags.

In SDG No. 32177, the ^{90}Sr carrier recoveries for samples 51814, 51816, 51826, 51828, 51838, 51840, 51850, 51907, 51909, 51919, 51931, 51933, and 51943. If the results were greater than the MDA, the results was qualified as estimated (J). If the results were less than the MDA, the results were qualified as not detected, associated value uncertain (UJ) with a qualifier code of G02 (radiological chemical recovery was below the lower control limit).

In SDG No. 32177, the ^{90}Sr carrier recovery for sample 51852 was less than 20%. The ^{90}Sr results were qualified as unusable (R). A qualifier code of G07 (radiological chemical recovery was less than 20%) accompanies the qualifier flags.

In SDG No. 32276, the isotopic uranium tracer recovery for sample 52226 was greater than 110%. The isotopic uranium results for this sample were qualified as estimated (J) if the results were greater than the MDA. If the results were less than the MDA, the results were qualified as not detected, associated value uncertain (UJ) with a qualifier code of G01 (radiological chemical recovery was above the upper control limit).

In SDG No. 31946, the ^{99}Tc tracer recovery for sample 51154 was less than 50%. The ^{99}Tc result for this sample were qualified as estimated (J) if the result was greater than the MDA. If the result was less than the MDA, the result was qualified as not detected, associated value uncertain (UJ) with a qualifier code of G02 (radiological chemical recovery was below the lower control limit).

Matrix spikes. For solid matrices, matrix spike acceptance limits of 70 to 130% recovery are used. The matrix spike recoveries for isotopic uranium and ^{90}Sr in each SDG were reviewed. The following deviations were noted:

In SDG Nos. 32386, 32372, 32276, and 31946 no isotopic uranium matrix spikes were analyzed. The isotopic uranium results for all samples were qualified as estimated (J) if the result was greater than the MDA or as not detected, associated value uncertain (UJ) if the result was less than the MDA. A qualifier code of H09 (matrix spike samples were not analyzed at the required frequency) accompanies the qualifier flags.

All other recoveries were within acceptance limits. No qualification of the data is necessary based on this criteria.

Duplicates. As required by SOW-217, duplicate samples are to be analyzed for every matrix in each batch of 20 samples or less. The laboratory used RPD to evaluate duplicate precision. No deviations were noted and no qualification of the data is necessary based on this criteria.

Laboratory control samples. When evaluating LCS data, one LCS should be analyzed for every matrix in each batch of 20 samples or less. Control limits of 70 to 130% recovery for solid matrices are applied.

The recoveries for all LCSs were within acceptance limits. No qualification of the data is necessary based on this criteria.

Other quality control. Results for all samples are reported in activity per gram (pCi/g), dry basis without blank correction. All aliquots were taken from a dried portion of the original sample, with the exception of the ^{99}Tc analysis. The ^{99}Tc aliquot was from a low temperature leachate of the original wet sample that was subsequently corrected for percent moisture.

Quantitation limits. As a measure of QLs, the laboratory reported actual results obtained, the associated uncertainty, and an MDA value. The CRERP required QL for isotopic uranium was 1 pCi/g. The CRERP required QL for ^{99}Tc was 2 pCi/g. The CRERP required QL for ^{90}Sr was 5 pCi/g. Those results that are less than the MDA were qualified as not detected at the associated level (U). A qualifier code of T01 (detection limits were not met) accompanies the qualifier flag. The following deviations were noted:

In SDG No. 32132, the ^{90}Sr MDAs did not meet MDA acceptance criteria for sample 51699.

In SDG No. 31798, the ^{99}Tc MDAs did not meet MDA acceptance criteria for sample 50925.

In SDG No. 32386, the ^{99}Tc MDAs did not meet MDA acceptance criteria for samples 52605 and 52606.

In SDG No. 31840, the ^{99}Tc MDAs did not meet MDA acceptance criteria for samples 51083, 51084, 51098, and 51099.

3.1.8 Radiological Analyses of Sediment Samples by Oak Ridge Analytical Services

As part of the CRERP Phase 2 RI, 49 sediment samples from the Clinch River--Watts Bar Reservoir system were analyzed for various radiological parameters. Twenty-three samples were analyzed for ^{90}Sr and 26 samples were analyzed for ^{99}Tc and isotopic uranium. The analyses were completed by Oak Ridge Analytical Services (ORAS), Oak Ridge, Tennessee, according to CRERP laboratory SOW-217. The results for these samples were reported in two separate SDGs (Nos. 1101 and 1105).

The ^{90}Sr and ^{99}Tc activities were determined by liquid scintillation counting. The isotopic uranium activities were determined by alpha spectrometry.

Holding times and preservation. Conformance to holding time and sample preservation requirements was reviewed. The samples were collected during the period August 2, 1994 through September 12, 1994, and were submitted to the laboratory on September 13, 1994. No discrepancies were found in a comparison between the CRERP COC forms and samples received. The shipping packages were sealed and packed properly, and all samples arrived in good condition. Upon receipt, the samples were logged in and stored appropriately until the analyses were performed.

A 6-month holding time is applied to sediment samples analyzed for radionuclides. There are no special preservation requirements. No qualification of the data is necessary based on holding time and sample preservation criteria.

Calibration. For the isotopic uranium determinations by alpha spectrometry, the initial instrument calibrations and continuing calibration verification checks were acceptable. In addition, a series of pulser instrument checks were performed on the detectors prior to counting the samples. All pulser checks were found to be acceptable. Weekly calibration checks to monitor energy calibration and a check for the peak's FWHM measurement was also found to be acceptable.

For the ^{90}Sr and ^{99}Tc determinations analyzed by liquid scintillation counting with pulsed-shaped discrimination, one of the instrument performance assessments was above the 3-sigma acceptance limit. These assessments include ^{14}C chi square, ^{14}C efficiency, ^{14}C background, ^3H chi square, ^3H figure of merit, ^3H efficiency, and the ^3H background measured on flame-sealed standards. A ^3H chi square value of 45.8 was recorded on October 12, 1994. The data point was remeasured on the next day and fell within acceptable limits. The liquid scintillation calibration curve included compensation for cross-talk and efficiency. All results were corrected for background, efficiency, cross-talk, and quenching. Based on professional judgement, no qualification of the data is necessary based on this criteria.

Blanks. In each analytical sequence, the laboratory analyzed the required MBs to monitor procedural and system performance. The isotopic uranium reagent blank consisted of deionized water prepared as a sample and traced with ^{232}U tracer for chemical yield. The ^{90}Sr and ^{99}Tc blanks consisted of deionized water prepared as a sample and taken through the separation chemistry. The blanks for

all determinations were less than the MDA and therefore, no qualifications of these data are necessary based on this criteria.

Chemical recovery. The ^{90}Sr and isotopic uranium analyses use either carriers or chemical tracers in completing the determinations. According to SOW-217, recoveries of 50 to 110% are considered acceptable. The result was qualified as estimated (J) if the result was greater than the MDA or as not detected, associated value uncertain (UJ) if the result was less than the MDA. A qualifier code of G02 (radiological chemical recovery was below the lower control limit) accompanies the qualifier flags.

In SDG No. 1101, the chemical tracer recovery for the isotopic uranium analyses was low for sample 52953 (43%) and the results were qualified.

In SDG No. 1101, the ^{90}Sr carrier recoveries were low for samples 52703, 52704, 52968, 52718, 52827, and 52952. The chemical recoveries were 49%, 48%, 47%, 40%, 38%, and 46%, respectively. As a result, the ^{90}Sr results for these samples were qualified.

In SDG No. 1101, the chemical tracer recoveries for the isotopic uranium analyses were low for samples 53102 and 53116. The chemical recoveries were both 45%. As a result, the isotopic uranium results for these samples were qualified.

Matrix spikes. For solid matrices, matrix spike acceptance limits of 70 to 130% recovery are used. The recoveries for each SDG were reviewed. The results was qualified as estimated (J) if the result was greater than the MDA or as not detected, associated value uncertain (UJ) if the result was less than the MDA. A qualifier code of H02 (matrix spike recovery was below the lower control limit) accompanies the qualifier flags. Deviations are listed as follows:

In SDG No. 1101, the ^{99}Tc matrix spike recovery was 56%. The results were qualified.

In SDG No. 1105, the ^{238}U matrix spike recovery was 63% for batch 2190A. The ^{238}U results for samples 52691, 52705, 52706, 52719, 52720, 52733, 52734, 52828, 52829, 52843, and 52844 were qualified.

All other recoveries were within acceptance limits. Therefore, no other qualifications of the data are necessary based on this criteria.

Duplicates. As required by SOW-217, duplicate samples are to be analyzed for every matrix in each batch of 20 samples or less. The DER for all duplicate analyses was within acceptance limits. Therefore, no qualification of the data is necessary based on this criteria.

Laboratory control samples. When evaluating LCS data, one LCS should be analyzed for every matrix in each batch of 20 samples or less. Control limits of 80 to 120% recovery for aqueous matrices and 70 to 130% recovery for solid matrices are applied. The uranium controls were prepared as reagent blanks and spiked with natural uranium. The natural uranium standard was prepared from NIST traceable EPA solution #1843-1. The ^{90}Sr controls consisted of deionized water prepared as a sample, spiked with an EPA standard #2454-2 ^{90}Sr solution and taken through the separation chemistry. The ^{99}Tc control consisted of deionized water prepared as a sample, spiked with an Isotope Products Laboratories (IPL) #389-54-2 technetium-99 solution and taken through the separation chemistry.

In SDG No. 1105, the ^{234}U LCS recovery was 132%. The results for this isotope in samples 53088, 53089, 53102, 53103, and 53116 was qualified as estimated (J) if the result was greater than the MDA or as not detected, associated value uncertain (UJ) if the result was less than the

MDA. A qualifier code of P01 (LCS recovery was above the upper control limit) accompanies the qualifier flags.

The recoveries for all other LCSs were within acceptance limits. Therefore, no other qualification of the data are necessary based on this criteria.

Other quality control. results for all samples are reported in activity per gram, dry basis without blank correction. Total received weights were obtained on all samples. All aliquots were taken from a dried portion of the original sample, with the exception of the ^{99}Tc analysis. The ^{99}Tc aliquot was from a low temperature leachate of the original wet sample that was subsequently corrected for percent moisture.

For the isotopic uranium determinations, the chemical tracer recovery on the duplicate sample for batch 2191A was 42.7%, which was below the specified 50% lower control limit. However, the DER between this duplicate and the original sample (which has an acceptable chemical tracer recovery) was 0.11. This is well within limits. Sample 52953 had a tracer recovery of 43.0%. The isotopic uranium data for this sample was qualified as estimated (J) if the results was greater than the MDA and as not detected, associated value uncertain (UJ), if the result is less than the MDA. A qualifier code of G02 (radiological chemical recovery was below the lower control limit) accompanies the qualifier flags.

Eight ^{90}Sr samples in batch 2196A were reanalyzed due to low chemical yield. Although the original results as well as the reanalysis results from 2196B were reported for comparison purposes, the results from 2196B were included in the CRERP data base.

Those results that require no qualification and are less than the MDA were qualified as not detected (U).

3.2 PORE WATER ANALYSES

3.2.1 Metals Analyses of Pore Water Samples

Metal analyses of pore water samples were conducted at Lockheed. These analyses included ICP, GFAA, and graphite furnace cold vapor (CV) performed analysis of the TCL metals. The samples were prepared and analyzed in accordance with the protocol outlined in the *USEPA CLP SOW for Inorganic Analysis, Multi-Media, Multi-Concentration*, ILM03.0. Twenty-four sample batches containing 129 samples were processed. Because of insufficient pore water sample quantities, 13 batches used associated water samples from SOW-191 as the source of the matrix spike, duplicate, serial dilution, and post-digestion spike samples.

Holding times. All samples were received intact. All preparation and analysis holding times were met except for one sample (52629, batch L2478) that was analyzed beyond the Hg holding time. The associated data were qualified as estimated (detects) or rejected (nondetects).

Calibration. All initial and continuing calibration criteria were met. No qualification of the data is necessary based on initial or continuing calibration.

Blanks. No significant contamination was found. A few compounds were reported at levels less than the required detection limit.

Matrix spikes. The percentage of MS recoveries that failed to meet the established recovery criterion was <1%. Deviations occurred in one MS each with magnesium (high-batch L1490), magnesium (low-batch L2428), selenium (high-batch L2428), and sodium (low-batch L1208). The associated data should be qualified as estimated.

Laboratory duplicates. All of the duplicate analyses met the established RPD criterion, except for boron. No qualification of the data is necessary.

Laboratory control samples. The percentage of LCS analyses that failed to meet the established recovery criterion was <1%. Boron recovery in two LCS (batches L1112, L987) failed the criterion (high) because of the use of borosilicate glassware. The associated data should be qualified as estimated.

Other quality control. The percentage of ICP serial dilution analyses that failed to meet the established criterion was <1%. Potassium and sodium recoveries were low in two samples (batch L1490). The data should be qualified as estimated.

3.2.2 Total Kjeldahl Nitrogen Analyses of Pore Water Samples

Total Kjeldahl nitrogen analyses of pore water samples were conducted at Lockheed. The samples were analyzed in accordance with the protocol outlined in the *USEPA Method 351.2*. Twenty-five sample batches containing 115 samples were processed. Two additional samples were received improperly preserved and, therefore, were not analyzed.

Holding times. All samples were received intact. Analysis holding times were exceeded for 24 samples in batches L805, L1112, L1180, and L1438. The data were qualified as estimated.

Calibration. All initial and continuing calibration criteria were met. No qualification of the data is necessary.

Blanks. All MBs were free of contamination. No qualification of the data is necessary.

Matrix spikes. All MS recoveries met established recovery criterion. No qualification of the data is necessary.

Laboratory duplicates. All duplicate analyses met established RPD criterion. No qualification of the data is necessary.

Laboratory control samples. All LCS recoveries met the established criterion. No qualification of the data is necessary.

Quantitation limits. The CRDL for total Kjeldahl nitrogen was 93 $\mu\text{g/L}$. Four batches (L2921, L2938, L2947, L2689) met the 93 $\mu\text{g/L}$ RDL. The remaining batches reported detection limits of 100 or 200 $\mu\text{g/L}$.

3.2.3 Total Organic Carbon Analyses of Pore Water Samples

Total organic carbon (TOC) analyses of pore water samples were conducted at Lockheed. The samples were analyzed in accordance with the protocol outlined in the *USEPA Method 415.2*. Twenty-

five sample batches containing 111 samples were processed. Two additional samples were received improperly preserved and, therefore, were not analyzed.

Holding times. All samples were received intact. Nineteen samples in batches L1180, L805, and L936 were analyzed after holding time expiration. The data were qualified as estimated. Forty-eight samples (batches L805, L1112, L1401, L1438, L1511, L1936, L2006, L2115, L2136, L2291) were received in clear glass bottles with headspace. For the best analytical results, TOC samples should be collected in amber glass with no headspace.

Calibration. All initial and continuing calibration criteria were met. No qualification of the data is necessary.

Blanks. All reported MBs were free of contamination. No qualification of the data is necessary.

Matrix spikes. All MS recoveries met established recovery criterion. Recoveries ranged from 80-107%, with the average recovery 94%. Fourteen batches (batches L805, L936, L1112, L1180, L1401, L1438, L1511, L1657, L1775, L1862, L1890, L1936, L2006, L2115) did not report any data for MS. Other associated QC were acceptable. No qualification of the data is necessary.

Laboratory duplicates. All duplicate analyses met established RPD criterion. No qualification of the data is necessary.

3.2.4 Pesticide/Polychlorinated Biphenyl Analyses of Pore Water Samples

Pesticide/PCB analyses of pore water samples were conducted at Lockheed. A GC with an ECD configured with a dual column autosampler injection system, performed analysis of the TCL of pesticides/PCBs. The samples were extracted and analyzed in accordance with the protocol outlined in the *USEPA CLP SOW for Organic Analysis, Multi-Media, Multi-Concentration*, OLM01.8. Twenty sample batches were processed containing 75 samples. One sample (50109) exhibited possible detection of aroclor-1254 and two samples (51187, 51735) exhibited possible detection of aldrin at the QL. However, these data could be false positives because of nontarget compound contamination. Because of insufficient pore water sample quantities, 17 batches used associated water samples from SOW-191 as the source of the MS/MSD.

Holding times. One sample (52277, batch L2118) was lost during extraction and no additional sample remained for re-extraction. Field personnel had noticed an oil sheen and tarry odor when taking this original sample. Upon resampling, no oil sheen or tarry odor was detected.

Three samples (batch L2657) were extracted beyond the holding time. The data from these samples were qualified as estimated. Four samples (batch L2911) were analyzed past the holding time. The data from these samples were qualified as estimated. One sample (batch L2038) was received at 10°C. This deviation will be commented in the data base.

Calibration. In <1% of the batches, the initial calibration percent relative standard deviation (% RSD) exceeded the established criteria. Alpha-, delta-, and gamma-(BHC) accounted for the deviations. These compounds were not detected in the associated samples and should be qualified as uncertain.

In <5% of the batches, the continuing calibration RPD for 4,4'-DDD, 4,4'-DDT, and methoxychlor exceeded the established criterion. Since these compounds were not detected in any of the affected samples, no qualification of the data is necessary.

Blanks. All reported instrument blanks were free of contamination. Aldrin was detected in one method blank. No qualification of the data is necessary.

Surrogate spikes. The percentage of batches with surrogate recoveries failing established recovery criterion was 67%. The associated data were qualified as estimated. The average recoveries for TCX and DCB were 48% and 41%, respectively. Three samples (50153, 50074, 51777) exhibited (DCB) recovery of <10%. Associated nondetects were qualified as unusable and detects as estimated.

Matrix spikes and matrix spike duplicates. Because of insufficient pore water sample quantities, 17 batches used associated water samples from SOW-191 as the source of the MS/MSD. The percentage of MS/MSD recoveries that failed to meet the established recovery and RPD criterion was <4%. Heptachlor epoxide, 4,4'-DDE, and endrin accounted for most of the deviations. None of the spike compounds were found in the original samples. The average recoveries ranged from 74-86%. No qualification of the data is necessary based on the MS/MSD results.

Laboratory control samples. All LCS recoveries met the established recovery criterion. No qualification of the data is necessary based on LCS results.

Other quality control. Because of matrix interference, the %D between the two GC columns exceeded the established limit for some compounds resulting in the "P" laboratory data flag. The affected data were qualified as estimated.

3.2.5 Semivolatile Analyses of Pore Water Samples

Semivolatile analyses of pore water samples were conducted at Lockheed. A GC/MS performed analysis of the TCL semivolatiles. The samples were extracted and analyzed in accordance with the protocol outlined in the *USEPA CLP SOW for Organic Analysis, Multi-Media, Multi-Concentration*, OLM01.8. Nineteen sample batches were processed containing 74 samples. Because of insufficient pore water sample quantities, seventeen batches used associated water samples from SOW-191 as the source of the MS/MSD.

Holding times. Three samples in batches L2038 and L2657 were extracted beyond the holding time. One samples in batch L2038 exceeded the analysis holding time. The data from these samples were qualified as estimated.

Calibration. All initial and continuing calibration criteria were met. No qualification of the data is necessary.

Blanks. Benzo(ghi)perylene, bis(2-ethylhexyl)phthalate, di-n-butylphthalate, and diethylphthalate were found in the MBs that were analyzed with the pore water samples. The data were qualified accordingly.

Internal standards. All internal standard criteria were met. No qualification of the data is necessary.

Surrogate spikes. Ninety-three percent of the surrogate recoveries were acceptable.

Average recoveries for the surrogates are listed below:

• phenol-d5	58%
• 2-fluorophenol	64%
• 2,4,6-tribromophenol	75%
• nitrobenzene-d5	75%
• 2-fluorobiphenyl	72%
• terphenyl-d14	52%

Matrix spikes and matrix spike duplicates. Because of insufficient pore water sample quantities, 17 batches used associated water samples from SOW-191 as the source of the MS/MSD. The percentage of MS/MSD recoveries that failed to meet the established recovery and RPD criterion was ~20%. Most of the deviations occurred with the percent recovery (%R) and RPD for 4-chloroaniline (very low), 2,4-dinitro toluene (low), hexachloroethane (high), and diethylphthalate (high). Average recoveries for the base-neutral compounds were 48-88% and for the acid compounds, 67-76%. Since none of the spike compounds were detected in the samples, no qualification of the data is necessary based on the MS/MSD results.

Laboratory control samples. The percentage of LCS recoveries that failed to meet the established recovery criterion was ~10%. Most of the deviations occurred with the %R and RPD for 4-chloroaniline (low), 2,4-dinitro toluene (low), hexachloroethane (high), and diethylphthalate (high). Since none of the spike compounds were detected in the samples, no qualification of the data is necessary based on the LCS results.

3.2.6 Total Mercury and Methyl Mercury Analyses of Pore Water Samples

As part of the CRERP Phase 2 RI, pore water samples were analyzed for total Hg to obtain data for use in site characterization and human health and ecological risk assessment. Analyses of Hg speciation were completed to determine if Hg found in past studies was inorganic Hg (Hg^{+2}) or the more toxic MeHg. The pore water samples were obtained by extracting the interstitial water contained in sediment core samples obtained from various locations at the Clinch River—Watts Bar Reservoir system. These analyses were conducted at Brooks Rand, LTD., Seattle, WA, according to CRERP laboratory SOW-193 dated August 30, 1993.

A rapid method of single stage gold amalgamation with cold vapor atomic fluorescence spectrometry (CVAFS) was used to determine the sample Hg content. Pore water samples for total Hg were prepared by bromine chloride oxidation and ultraviolet light photo oxidation for one hour. The Hg contained in the water samples and sediment digestates was isolated by stannous chloride reduction, gas phase stripping, and collection onto a gold trap. The Hg collected on the trap was desorbed under a carrier gas stream and then determined by CVAFS. Fluorescence emission signals were recorded by an integrator. The amount of Hg in a sample analyzed was directly proportional to the integrated signal of fluorescence emission. CRERP required the lowest achievable detection limits for baseline risk assessment. Therefore, the detection limits for this technique of less than 1 pg Hg was acceptable. Relative standard deviations (RSDs) of 2.8%, 1.5%, and 2.2% were obtained for the determination of 500, 1000, and 2000 pg Hg standards, respectively.

Pore water samples for MeHg analyses were prepared by solvent extraction. A solution of 30% potassium chloride in 1% hydrochloric acid and methylene chloride was added to the sample aliquots

and the samples were agitated for at least one hour. After allowing the separation of the aqueous and solvent phase, the aqueous phase was removed. Distilled water was added to the solvent phase and the sample was vaporized in a water bath at 80°C. The MeHg and Hg⁺² contained in the samples was first ethylated with sodium tetraethylborate and collected by purging onto a column filled with Tenax™. The Hg derivatives were then thermally desorbed and transferred to a GC column held in an oven at 95°C, and the species were chromatographically separated. The organo-Hg compounds were decomposed at 800°C to Hg, which was quantified by cold vapor atomic fluorescence spectrometry (CVAFS). CR-ERP required the lowest achievable detection limits for baseline risk assessment. Therefore, the detection limits for this technique of about 0.6 pg and 1.3 pg for MeHg and Hg⁺², respectively, were acceptable. The method has been demonstrated as being very sensitive, precise, and accurate.

For this project, a total of 45 pore water samples were analyzed for total Hg and MeHg content. Along with these samples, a total of 79 QC samples (i.e., 40 TBs, 11 FBs, 14 laboratory rinsate blanks, and 14 FRBs) were analyzed. The pore water sample results are reported in ng/L and were included in 38 individual batches numbered from OR-10 through OR-47.

Holding times and preservation. Conformance to holding time and sample preservation requirements for each batch of samples was reviewed. According to SOW-193, the holding time for pore water Hg analyses is 28 days and the preservation requirements are acidification to pH <2 with hydrochloric acid and cooling to 4±2°C until the time of analysis. Unless otherwise noted, sample shipping, receipt, and integrity problems were noted in PERs. The following nonconformances were identified and are listed by DRG.

DRG OR-14: The samples in this DRG were sent to another laboratory by mistake. Consequently, by the time the samples were received by Brooks Rand, LTD., the cooler temperature was at 10°C. The total Hg and methyl Hg results for the five pore water and associated QC samples (50463, 50464, 50513, 50519, 50559, 50569, 50583, 50603, 50690, 50699, and 50714) in this DRG have been commented in the data base because of this deviation.

DRG OR-14: The pH of samples 50513 and 50519 was >2 when received at the laboratory. The total Hg and methyl Hg results for these samples were qualified as estimated (J) with a qualifier code of A05 (samples were not preserved properly).

DRG OR-21: Sample 50952 froze during sample storage. This sample was a pore water field rinsate. The laboratory noted that spurious results are obtained from analyzing samples that were frozen and then thawed. The laboratory theorizes that freezing may force the analyte of interest into the pores of the sample container. However, after thawing and holding the sample for about a week, the analyte of interest may reassociate to the matrix. This theory was not supported by documented studies. The Hg and MeHg results for this sample have been commented in the data base because of this deviation.

DRG OR-24: Upon receipt, sample 51192 was partially frozen. The total Hg and methyl Hg results for this sample have been commented in the data base because of this deviation.

DRG OR-30: The analysis holding time was exceeded for the one pore water TB sample (51640) in this DRG. The total Hg results for this sample were qualified as estimated (J) with a qualifier code of A03 (analysis holding time exceeded).

DRG OR-32: The analysis holding time was exceeded for samples 51686, 51689, 51723, 51734, 51756, 51761, and 51787 in this DRG. The total Hg results for these samples were qualified as estimated (J) with a qualifier code of A03 (analysis holding time was exceeded). The MeHg

result for sample 51686 were qualified as estimated (J) with a qualifier code of A03 (analysis holding time was exceeded).

DRG OR-35: The analysis holding time was exceeded for samples 52201, 52260, 52270, and 52280. The MeHg results for these samples were qualified as estimated (J) with a qualifier code of A03 (analysis holding time was exceeded).

DRG OR-39: The analysis holding time was exceeded for samples 52462, 52522, 52530, and 52538 in this DRG. The total Hg and methyl Hg results for these samples were qualified as estimated (J) with a qualifier code of A03 (analysis holding time was exceeded).

DRG OR-43: The cooler temperature was at 14°C and the temperature blank was at 24°C when received at the laboratory. The MeHg results for all four pore water and associated QC samples (52678, 52679, 52736, 52746, 52750, 52758, 52766, 52772, and 52788) in this DRG have been commented in the data base because of this deviation.

DRG OR-44: The samples in this DRG were received with a cooler temperature at 8°C. The total Hg and MeHg results for all pore water and associated QC samples in this DRG have been commented in the data base because of this deviation.

DRG OR-47: The analysis holding time for eight samples in this DRG (53075, 53076, 53119, 53130, 53143, 53149, 53160, and 53169) was exceeded. The results for these samples were qualified as estimated (J) with a qualifier code of A03 (analysis holding time was exceeded).

Calibration. The laboratory used a grand average of all standards (excluding minimum detection standards) in the analytical run to calculate the calibration coefficient, which is the correction factor for the instrument sensitivity on any given day. To give a correction factor representative of the complete run, the standard concentrations ranged from 10 to 3000 pg for total Hg and 5 to 200 pg for methyl Hg and were analyzed in various positions throughout the analytical run. The correction factors multiplied by the peak height or peak area were used to determine the concentration for each sample. Calibration checks were performed immediately after generating the calibration curve, after every ten samples, and at the end of the analytical batch. The calibration check consisted of a mid-point standard, a near detection level standard, and a calibration blank. The mid-point standard had to show 80-120% recovery for the analysis to be considered in control. Calibration sequences for all analytical runs in all DRGs were acceptable and, therefore, no qualification of the data is necessary based on this criteria.

Blanks. In each analytical sequence, the laboratory analyzed various blanks to monitor system performance. These were identified as bubbler blanks and reagent or method blanks. The bubbler blanks were analyzed to show that the analytical system was not contaminated by carrier gases or carryover between samples. Reagent blanks, consisting of the reagents used in sample preparation, were analyzed to show that contamination was not contributed by the reagents used. No significant blank contamination was observed.

Matrix spikes. Matrix spike recovery for each batch of samples was reviewed. A control limit of 75 to 125% recovery was used in evaluating matrix spike recovery. No deviations were identified that would require qualification of the data for total Hg. The following deviations were identified for methyl Hg and are listed by DRG:

DRG OR-12: The laboratory reported matrix spike recoveries for five samples in this DRG. One of the recoveries was 74%. However, the average recovery was 83%. This was considered acceptable by the laboratory. Therefore, no qualifications should be applied because of this deviation.

DRG OR-14: Matrix spike recoveries in this DRG ranged from 66 to 74%. As a result, the MeHg results for all five pore water and associated QC samples in this DRG should be qualified as estimated (J) with a qualifier code of I02 (matrix spike recovery was below the lower control limit).

DRG OR-22: The laboratory reported matrix spike recoveries for four samples in this DRG. One of the recoveries was 70%. However, the average recovery was 82%. This was considered acceptable by the laboratory. Therefore, no qualifications should be applied because of this deviation.

DRG OR-35: The laboratory reported matrix spike recoveries for four samples in this DRG. One of the recoveries was 65%. However, the average recovery was 78%. This was considered acceptable by the laboratory. Therefore, no qualifications should be applied because of this deviation.

Duplicates/Replicates. As required by SOW-193, duplicate samples are to be analyzed for every matrix in each batch of 20 samples or less. Control limits of 20% RPD or RSD for water samples are applied when evaluating duplicate/replicate analyses. Instead of duplicates, the laboratory analyzed samples in replicate. In several of the DRGs, more than one set of replicates were analyzed, but not necessarily according to matrix type (i.e., when a DRG contained both surface water and pore water samples, usually surface water samples were selected for replicate analyses). Because of the similarity of the matrices, this deviation is not considered to affect the quality of the data. The RSDs observed were of low magnitude, so the first of the replicate results was included in the data base as the customer result. The other replicate results were included as QC measurements.

The following deviations were identified for total Hg and are listed by DRG:

DRG OR-44: One of the four replicates analyzed had an RSD of >20%. The results for the samples in this DRG that are associated with this QC sample should be qualified as estimated (J) with a qualifier code of J01 (duplicate/replicate RPD/RSD was outside the control limit).

The following deviations were identified for methyl Hg and are listed by DRG:

DRG OR-39: One of the replicates analyzed in this DRG had an RSD of 23%. The results for the samples in this DRG that are associated with this QC sample should be qualified as estimated (J) with a qualifier code of J01 (duplicate/replicate RPD/RSD was outside the control limit).

DRG OR-44: Two of the four replicates analyzed had RSDs of >20%. The results for the samples in this DRG that are associated with these QC samples should be qualified as estimated (J) with a qualifier code of J01 (duplicate/replicate RPD/RSD was outside the control limit).

Laboratory control samples. The laboratory used a NIST Hg in water SRM (1641C) for QC purposes. Results reported for this SRM were acceptable in all cases and, therefore, no qualification of the data is necessary based on this criteria.

No MeHg in an aqueous matrix was available for use as a LCS. The laboratory did, however, utilize matrix spikes and duplicate/replicate analyses to establish that the analysis was in control. Whenever pore water samples were analyzed along with sediment samples, the laboratory used an IAEA MeHg in marine sediment reference material (IAEA-356) for QC purposes. Another reference material used for LCS purposes was SRM NRCC DORM-2, Hg in dogfish muscle. Results reported for these reference materials were acceptable and, therefore, no qualification of the data is necessary based on this criteria.

Other quality control. Whenever lower than usual MS recoveries or higher than usual laboratory blank results were observed, the laboratory would also present sample results corrected for spike recovery and/or blank subtracted. According to SOW-193, and since sample results are qualified because of these deviations, the sample results that were used are those without these corrections.

During the course of the project, the laboratory changed its method of reporting sample results to include attaching qualifiers to the results. For results below the QL and/or below the MDL, a <QL or <MDL was placed in the results field of the analytical report. The QL was determined as ten times the standard deviation of the MBs analyzed on that day and was incorporated into the data base as a "U" qualifier. The MDL was determined as three times the standard deviation of the MBs analyzed on that day and was incorporated into the data base as a "B" qualifier. The QL and MDL values are available in the analytical reports.

Several of the DRGs reported results of more than 20 samples. These DRGs include OR-14, OR-23, OR-24, OR-28, OR-29, OR-32, OR-34, OR-38, OR-39, OR-41, OR-42, OR-44, OR-45, OR-46, and OR-47. According to SOW-193, no more than 20 samples should be reported in a batch. Although this deviation was noted, this should have no effect on the data since the laboratory followed procedure and provided sufficient QA/QC data (i.e., blanks, duplicates, matrix spikes, etc.). The samples were prepared and analyzed in small batches (i.e., 20 samples or less). During review, all of the QA/QC information associated with each batch was considered. Additional qualification of the data was not necessary.

Other QC and analysis protocol deviations for each batch of samples were reviewed. No exceptions were identified that would require qualification of the data.

3.2.7 Radiological Analyses of Pore Water Samples by Eco Tek Laboratory Services, Inc.

As part of the CRERP Phase 2 RI, 83 pore water samples from the Clinch River-Watts Bar Reservoir system were analyzed for various radiological parameters. The analyses were completed by EcoTek Laboratory Services, Inc. in Atlanta, Georgia, according to CRERP laboratory SOW-217. The samples were analyzed for isotopic uranium, gross alpha, gross beta, and ⁹⁰Sr activities. Isotopic uranium activities were determined by alpha spectrometry. Gross alpha, gross beta, and ⁹⁰Sr activities were determined by gas flow proportional counting.

For this project, a total of 21 pore water samples were analyzed for isotopic uranium activity. Along with these samples, a total of 4 QC samples (i.e., 2 FBs, 1 FRB, and 1 laboratory rinsate blank) were analyzed. A total of 8 pore water samples were analyzed for gross alpha and gross beta activities. Along with these samples, a total of 2 QC samples (i.e., 1 filed blank and 1 laboratory rinsate blank) were analyzed. A total of 54 pore water samples were analyzed for ⁹⁰Sr activities. Along with these samples, a total of 22 QC samples (i.e., 5 FBs, 7 FRBs, and 10 laboratory rinsate blanks) were analyzed. The results for these samples were reported in 14 separate SDGs (Nos. 31556, 31624, 31773, 31798, 31832, 31844, 31893, 32072, 32075, 32132, 32204, 32276, 32372, and 32386). The activities were reported in pCi/L.

Holding times and preservation. Conformance to holding time and sample preservation requirements was reviewed. The samples were collected during the period November 1993 through July 1994. No discrepancies were found in a comparison between the CRERP chain-of-custody (COC) forms and samples received. The shipping packages were sealed and packed properly and all samples arrived in good condition. Upon receipt, the samples were logged in and stored appropriately until the analyses were performed.

A 6-month holding time is applied to surface water samples analyzed for radionuclides. The preservation requirement for pore water samples submitted for gross alpha, gross beta, isotopic uranium and ^{90}Sr analyses is acidification to $\text{pH} < 2$ with nitric acid. The samples were appropriately preserved. No qualification of the data is necessary based on holding time and sample preservation criteria.

Calibration. For the isotopic uranium determinations by alpha spectrometry, the initial instrument calibrations and continuing calibration verification checks were acceptable. In addition, a series of pulser instrument checks were performed on the detectors prior to counting the samples. All pulser checks were found to be acceptable. Weekly calibration checks to monitor energy calibration and a check for the peak's FWHM measurement were also found to be acceptable. No qualification of the isotopic uranium data is necessary based on this criteria.

For the gross alpha, gross beta, and ^{90}Sr determinations, two of the instrument performance assessments were not within acceptance criteria. The absorption curve was not generated within one year of the sample analyses. The absorption curve was dated 10/92 through 11/92. In addition, no data to document the cross-talk determination was included in the data packages. As a result, all gross alpha, gross beta, and ^{90}Sr results were qualified as estimated (J). The qualifier codes R06 (absorption curve criteria were not met) and S05 (cross-talk verification criteria were not met) accompanies the qualifier flags.

Blanks. In each analytical sequence, the laboratory analyzed the required MBs to monitor procedural and system performance. The method or reagent blanks for each determination consisted of deionized water prepared as a sample and taken through the separation chemistry, if applicable. The results were qualified as estimated (J) if their results were greater than the MDA. If the results were less than the MDA, the results were qualified as not detected, associated value uncertain (UJ). A qualifier code of F01 (sample data were qualified as a result of the MB) accompanies the qualifier flags.

The ^{234}U MB in SDG No. 31798 had a result greater than the MDA. The ^{234}U results for samples 51195 and 51213 were qualified.

The ^{234}U MB in SDG No. 31893 had a result greater than the MDA. The ^{234}U results for samples 51195 and 51213 were qualified.

The ^{234}U MB in SDG No. 31840 had a result greater than the MDA. The ^{234}U results for samples 51109 and 51118 were qualified.

The ^{238}U MB in SDG No. 32386 had a result greater than the MDA. The ^{238}U results for samples 52622, 52630, and 52638 were qualified.

The ^{238}U MB in SDG No. 32372 had a result greater than the MDA. The ^{238}U results for samples 52404, 52415, 52424, 52434, 52519, 52527, and 52535 were qualified.

The ^{238}U MB in SDG No. 32276 had a result greater than the MDA. The ^{238}U results for samples 52262, 52272, and 52282 were qualified as estimated.

The gross alpha, gross beta, and strontium MBs were reviewed and all determinations were less than the MDA. No qualification of these data is necessary based on this criteria.

Chemical recovery. The ^{90}Sr and isotopic uranium analyses use either carriers or chemical tracers in completing the determinations. According to SOW-217, recoveries of 50-110% are considered acceptable.

In SDG No. 32204, the ^{90}Sr carrier recoveries for samples 52035, 52043, 52101, and 52107 were less than 50%. The ^{90}Sr results for these samples were less than the MDA and were qualified as not detected, associated value uncertain (UJ) with a qualifier code of G02 (radiological chemical recovery was below the lower control limit).

In SDG No. 31893, the isotopic uranium tracer recovery was low for sample 51213. The isotopic uranium results were qualified as unusable (R). A qualifier code of G07 (radiological chemical recovery was less than 20%) accompanies the qualifier flag.

Matrix spikes. For aqueous matrices, matrix spike acceptance limits of 80 to 120% recovery are used. The matrix spike recoveries for isotopic uranium, gross alpha, gross beta, and ^{90}Sr in each SDG were reviewed. The following deviations were noted:

In SDG No. 31556, the gross alpha matrix spike recovery was greater than 120%. The gross alpha results for samples 50076, 50156, 50431, 50432, 50433, 50434, 50435, 50436, 50437, and 50438 were qualified as estimated (J) if the results were greater than the MDA or as not detected, associated value uncertain (UJ) if the results were less than the MDA. A qualifier code of H01 (matrix spike recovery was above the upper control limit) accompanies the qualifier flags.

In SDG No. 32072, the ^{90}Sr matrix spike recovery was less than 80%. The ^{90}Sr results for samples 51401, 51409, 51414, and 51460 were qualified as estimated (J) if the results were greater than the MDA or as not detected, associated value uncertain (UJ) if the results were less than the MDA. A qualifier code of H02 (matrix spike recovery was below the lower control limit) accompanies the qualifier flags.

In SDG Nos. 31798, 32072, 31893, 32386, 32372, 32276, and 31840, no isotopic uranium matrix spikes were analyzed. The isotopic uranium results for all samples in these SDGs were qualified as estimated (J) if the result was greater than the MDA or as not detected, associated value uncertain (UJ) if the result was less than the MDA. A qualifier code of H09 (matrix spike samples were not analyzed at the required frequency) accompanies the qualifier flags.

All other recoveries were within acceptance limits. No qualification of the data is necessary based on this criteria.

Duplicates. As required by SOW-217, duplicate samples are to be analyzed for every matrix in each batch of 20 samples or less. The laboratory used RPD to evaluate duplicate precision. No deviations were noted and no qualification of the data is necessary based on this criteria.

Laboratory control samples. When evaluating LCS data, one LCS should be analyzed for every matrix in each batch of 20 samples or less. Control limits of 80 to 120% recovery for aqueous matrices are applied. The result was qualified as estimated (J) if the result was greater than the MDA or as not detected, associated value uncertain (UJ) if the result was less than the MDA. A qualifier code of P02 (LCS recovery was below the lower control limit) accompanies the qualifier flags. The following deviations were observed:

In SDG No. 31556, the ^{90}Sr LCS did not meet acceptance limits. The ^{90}Sr results for samples 50395, 50412, and 50429 were qualified as appropriate.

In SDG No. 32204, the ^{90}Sr LCS did not meet acceptance limits. The ^{90}Sr results for samples 51772, 51780, 51785, 51836, 51869, 51875, and 51881 were qualified as appropriate.

The recoveries for all other LCSs were within acceptance limits. Therefore, no other qualification of the data is necessary based on this criteria.

Other quality control. Results for all samples are reported in activity per liter (pCi/L) without blank correction. No dilutions were required in the analysis of any of the samples.

Quantitation limits. As a measure of QLs, the laboratory reported actual results obtained, the associated uncertainty, and an MDA value. The CRERP required QL for isotopic uranium was 1 pCi/L. The CRERP required QL for gross alpha was 3 pCi/L, and gross beta as 5 pCi/L. The CRERP required QL for ^{90}Sr was 5 pCi/L. Those results that are less than the MDA were qualified as not detected at the associated level (U). The results for these samples were qualified as not meeting the DL. A qualifier code of T01 (detection limits were not met) accompanies the qualifier flags.

The following deviations were noted:

In SDG No. 32072, the ^{90}Sr MDAs did not meet MDA acceptance criteria for sample 51358.

In SDG No. 32204, the ^{90}Sr MDAs did not meet MDA acceptance criteria for sample 52101.

In SDG No. 32372, the ^{90}Sr MDAs did not meet MDA acceptance criteria for samples 52537 and 52443.

3.2.8 Radiological Analyses of Pore Water Samples by Oak Ridge Analytical Services

As part of the CRERP Phase 2 RI, pore water samples from the Clinch River–Watts Bar Reservoir system were analyzed for ^{90}Sr , isotopic uranium, and gamma activities. The analyses were completed by Oak Ridge Analytical Services, Oak Ridge, TN, according to CRERP laboratory SOW-217.

The ^{90}Sr activities were determined by liquid scintillation counting and the isotopic uranium activities were determined by alpha spectrometry. The gamma activities were determined by gamma spectroscopy. For this project, a total of 14 pore water samples were analyzed for ^{90}Sr . Along with these samples, a total of 10 QC samples (i.e., 2 FBs, 4 laboratory rinsate blanks, and 4 FRBs) were analyzed. A total of 14 pore water samples were analyzed for isotopic uranium. There were no associated field quality control samples for the isotopic uranium determinations. One pore water FRB was analyzed for gamma activity and is reported in SDG No. 1106. The results are reported in pCi/L and were included in three separate SDGs (Nos. 1095, 1102, and 1106).

Holding times and preservation. Conformance to holding time and sample preservation requirements was reviewed. The samples were collected during the period August 2, 1994 through September 13, 1994, and were submitted to the laboratory on September 13, 1994 and September 20, 1994. No discrepancies were found in a comparison between the CRERP chain-of-custody (COC) forms and samples received. The shipping packages were sealed and packed properly, and all samples arrived in good condition. Upon receipt, the samples were logged in and stored appropriately until the analyses were performed.

A 6-month holding time is applied to surface water samples analyzed for these radionuclides. The preservation requirement for samples submitted for ^{90}Sr , isotopic uranium, and gamma analyses samples is acidification to pH <2 with nitric acid. The samples were appropriately preserved. No qualification of the data is necessary based on holding time and sample preservation criteria.

Calibration. For the ^{90}Sr determinations analyzed by liquid scintillation counting with pulsed-shaped discrimination, one of the instrument performance assessments was above the 3-sigma acceptance limit. These assessments include ^{14}C chi square, ^{14}C efficiency, ^{14}C background, ^3H chi square, ^3H figure of merit, ^3H efficiency, and the ^3H background measured on flame-sealed standards.

A ^3H chi square value of 45.8 was recorded on October 12, 1994. The data point was remeasured on the next day and fell within acceptable limits. The liquid scintillation calibration curve included compensation for cross-talk and efficiency. All results were corrected for background, efficiency, cross-talk, and quenching. Based on professional judgement, no qualification of the ^{90}Sr data is necessary based on this criteria.

For the isotopic uranium determinations by alpha spectrometry, the initial instrument calibrations and continuing calibration verification checks were acceptable. In addition, a series of pulser instrument checks were performed on the detectors prior to counting the samples. All pulser checks were found to be acceptable. Weekly calibration checks to monitor energy calibration and a check for the peak's FWHM measurement were also found to be acceptable. No qualification of the isotopic uranium data is necessary based on this criteria.

For the gamma determinations, the laboratory utilized a high-purity germanium detector to measure the gamma emitting radionuclides. The isotopes of ^{109}Cd , ^{133}Ba , ^{137}Cs , ^{60}Co , ^{54}Mn , and ^{134}Cs contained in an EPA solution were used to calibrate the instrument. Energy calibration and resolution checks including energy, efficiency, and background measurements were found to be acceptable. No qualification of the gamma spectroscopy data is necessary based on this criteria.

Blanks. In each analytical sequence, the laboratory analyzed the required MBs to monitor procedural and system performance. The ^{90}Sr blank consisted of deionized water prepared as a sample and taken through the separation chemistry. The isotopic uranium MB consisted of deionized water prepared as a sample, traced with ^{232}U tracer for chemical yield, and taken through the separation chemistry.

The ^{90}Sr MB in SDG No. 1095, batch 2116A, had a result of 2.09 ± 0.53 pCi/L. Since this result was greater than the MDA of 1.52, the ^{90}Sr results for samples 52677, 52743, 52749, 52757, 52765, 52774, 52781 were qualified as estimated (J) with a qualifier code of F01 (sample data were qualified as a result of the MB).

The blank for the isotopic uranium determinations in SDG No. 1106 exhibited a result greater than the uncertainty and greater than the MDA for the ^{238}U isotope. For samples 53133, 53140, and 53148, the ^{238}U results were qualified as estimated (J) if the results were greater than the MDA or as not detected, associated value uncertain (UJ) if the results were less than the MDA. A qualifier code of F01 (sample data were qualified as a result of the MB) accompanies the qualifier flags.

The blank gamma determinations had results that were less than the MDA and therefore, no qualifications of the gamma data are necessary based on this criteria.

Chemical recovery. The ^{90}Sr and isotopic uranium analyses use either carriers or chemical tracers in completing the determinations. According to SOW-217, recoveries of 50-110% are considered acceptable.

In SDG No. 1095, the carrier recoveries for the ^{90}Sr analyses were low for samples 52677 and 52765. The recoveries were 43% and 47%, respectively. The ^{90}Sr results for these samples were qualified estimated (J) with a qualifier code of G02 (radiological chemical recovery was below the lower control limit).

In SDG No. 1102, the carrier recovery for the ^{90}Sr analysis of sample 53010 was 45%. The ^{90}Sr result for this sample was qualified not detected, associated value uncertain (UJ), with a qualifier code of G02 (radiological chemical recovery was below the lower control limit).

The chemical tracer recoveries for the isotopic uranium determinations were acceptable in all SDGs reviewed. Therefore, no qualification of the isotopic uranium results is necessary based on this criteria.

Matrix spikes. For aqueous matrices, matrix spike acceptance limits of 80-120% recovery are used. The matrix spike recoveries for ^{90}Sr and isotopic uranium in each SDG were reviewed. The following deviation was noted:

In SDG No. 1102, the ^{238}U matrix spike recovery was 63% in batch 2192A. The ^{238}U results for samples 52747, 52755, 52763, 52771, 52876, 52886, 52896, 52906, 52988, 52999, and 53008 were qualified as estimated (J) if the result was greater than the MDA or as not detected, associated value uncertain (UJ) if the result was less than the MDA. A qualifier code of H02 (matrix spike recovery was below the lower control limit) accompanies the qualifier flags.

All other recoveries were within acceptance limits. Therefore, no other qualifications of the data are necessary based on this criteria.

Duplicates. As required by SOW-217, duplicate samples are to be analyzed for every matrix in each batch of 20 samples or less. The DER for all duplicate analyses was within acceptance limits. Therefore, no qualification of the data is necessary based on this criteria.

Laboratory control samples. When evaluating LCS data, one LCS should be analyzed for every matrix in each batch of 20 samples or less. Control limits of 80 to 120% recovery for aqueous matrices are applied. The ^{90}Sr controls consisted of deionized water prepared as a sample, spiked with an EPA standard #2454-2 ^{90}Sr solution and taken through the separation chemistry. The uranium controls were prepared as reagent blanks and spiked with natural uranium. The natural uranium standard was prepared from NIST traceable EPA solution #1843-1. The following deviation was observed:

In SDG No. 1102, the ^{90}Sr LCS recovery did not meet acceptance criteria in batch 2198A. The results for ^{90}Sr in samples 52378, 52878, 52888, 52898, 52908, 52990, 53001, and 53010 were qualified as estimated (J) if the result was greater than the MDA or as not detected, associated value uncertain (UJ) if the result was less than the MDA. A qualifier code of P02 (LCS recovery was below the lower control limit) accompanies the qualifier flags.

The recoveries for all other LCSs were within acceptance limits. Therefore, no other qualification of the data is necessary based on this criteria.

Other quality control. Due to analytical problems, no results were reported for sample 52738, which was a FRB submitted for ^{90}Sr analysis.

Results for all samples are reported in activity per liter (pCi/L) without blank correction. No dilutions were required in the analysis of any of the samples.

Quantitation limits. As a measure of QLs, the laboratory reported actual results obtained, the associated uncertainty, and an MDA value. The CRERP required QL for ^{90}Sr was 5 pCi/L. The CRERP required QL for isotopic uranium was 1 pCi/L. Those results that are less than the MDA were qualified as not detected at the associated level (U). All CRERP required detection limits were met.

3.2.8 Ammonia Analyses of Water and Pore Samples

Ammonia analyses of water and pore samples were conducted at Lockheed. The samples were analyzed in accordance with the protocol outlined in the *USEPA Method 350.1*. Thirty-four sample batches containing 249 water samples and 83 pore water samples were processed.

Holding times. All samples were received intact. The analysis holding time was exceeded on 26 samples. The data were qualified as estimated.

Two samples (50704, 50710, batch L1112) were received incorrectly preserved and were not analyzed.

Calibration All initial and continuing calibration criteria were met. No qualification of the data is necessary.

Blanks. All MBs were free of contamination. No qualification of the data is necessary.

Matrix spikes. All MS recoveries met established recovery criterion except in one batch (low-L805). The associated data should be qualified as estimated.

Laboratory duplicates. All duplicate analyses met established RPD criterion except in two batches (L2057, L1208). The associated data should be qualified as estimated.

Laboratory control samples. All LCS recoveries met the established criterion. No qualification of the data is necessary.

3.3 WATER ANALYSES

3.3.1 Metals Analyses of Water Samples

Metals analyses of water samples were conducted at Lockheed. These analyses included ICP, GFAA, and CV analysis of the TCL metals. The samples were prepared and analyzed in accordance with the protocol outlined in the *USEPA CLP SOW for Inorganic Analysis, Multi-Media, Multi-Concentration*, ILM03.0. Thirty-nine sample batches containing 492 samples were processed. Eight batches contained >20 samples (actual number of included samples were 31, 22, 22, 27, 21, 21, 21, and 21). Each of these batches were analyzed in at least two sample groupings so that the appropriate amount of QC was applied to all samples.

Holding times. All samples were received intact. All preparation and analysis holding times were met except for 7 samples in batch L1771, which were analyzed beyond the Hg holding time. The associated data were qualified as estimated.

Calibration. Two batches (L2395, L2442) were analyzed with no boron initial calibration. Since the associated continuing calibration verification and LCS were within control limits, the client accepted the associated boron analyses. One batch (L2814) exhibited a continuing calibration drift for beryllium, boron, arsenic, selenium, and sodium. The associated samples were bracketed by in-control continuing calibration verifications. No qualification of the data is necessary based on initial or continuing calibration.

Blanks. No significant contamination was found. A few compounds were reported at levels less than the required detection limit.

Matrix spikes. The percentage of MS recoveries that failed to meet the established recovery criterion was <1%. Deviations occurred in two MS samples with boron (low-batches L1111, L2570) and in one MS each with magnesium (high-batch L2442), magnesium (low-batch L2476), manganese (high-batch L1487), and sodium (low-batch L1207). The associated data should be qualified as estimated.

Laboratory duplicates. The percentage of duplicate analyses that failed to meet the established RPD criterion was ~2% for the filtered samples and ~3% for the unfiltered samples.. Boron, copper, aluminum, and zinc accounted for the failures. The associated data were qualified as estimated.

Laboratory control samples. The percentage of LCS analyses that failed to meet the established recovery criterion was <1%. Four boron (batches L986, L806, L718, L2289) recoveries and one selenium (batch L2557) recovery failed the criterion. The associated data should be qualified as estimated.

3.3.2 Anions Analyses of Water Samples

Anion (sulfate, fluoride, bromide, and chloride) analyses of water samples were conducted at Lockheed. The samples were analyzed in accordance with the protocol outlined in the *USEPA Method 300.0*. Thirty-three sample batches containing 226 samples were processed.

Holding times. All samples were received intact. Fifteen samples (batches L986, L1181, L1207) were analyzed for chloride and sulfate after holding time expiration. Seven samples (batch L1111) were analyzed for fluoride after holding time expiration. The data were qualified as estimated.

Calibration. All initial and continuing calibration criteria were met. No qualification of the data is necessary.

Blanks. All reported MBs were free of contamination. One batch (L2687) did not include data from a fluoride MB. The associated data should be qualified as estimated.

Matrix spikes. All MS recoveries met established recovery criterion. One batch (L2687) did not report any data from a sulfate MS. Other associated QC was acceptable. No qualification of the data is necessary.

Laboratory duplicates. All duplicate analyses met established RPD criteria. One batch (L2687) did not report any data from a sulfate duplicate. Other associated QC were acceptable. No qualification of the data is necessary.

Laboratory control samples. All LCS recoveries met the established criterion. No qualification of the data is necessary.

3.3.3 Nitrate-Nitrite Analyses of Water Samples

Nitrate-nitrite analyses of water samples were conducted at Lockheed. Thirty-three sample batches containing 228 samples were processed. There were 210 samples analyzed in accordance with the protocol outlined in the *USEPA Method 353.2*. Eighteen samples were analyzed by *USEPA*

Method 300.0 because instrument problems and holding times (24 h for EPA 353.2 versus 48 h for EPA 300.0) prevented the use of *USEPA Method 353.2*. The analytical detection limit is the same for both of these methods.

Holding times. One sample (11049, batch L1207) was received unpreserved. The sample was preserved by the laboratory upon receipt. The associated data should be qualified as estimated. Thirteen samples exceeded the holding time (batches L1111, L806, L986). The data were qualified as estimated.

Calibration. All initial and continuing calibration criteria were met. No qualification of the data is necessary.

Blanks. All MBs were free of contamination. No qualification of the data is necessary.

Matrix spikes. All MS recoveries met established recovery criterion. No qualification of the data is necessary.

Laboratory duplicates. One duplicate analysis (batch L1207) exhibited a RPD higher than the established RPD criterion. The associated data were qualified as estimated.

Laboratory control samples. All LCS recoveries met the established criterion. No qualification of the data is necessary.

3.3.4 Cyanide Analyses of Water Samples

Cyanide analyses of water samples were conducted at Lockheed. The samples were prepared and analyzed in accordance with the protocol outlined in the *USEPA CLP SOW for Inorganic Analysis, Multi-Media, Multi-Concentration*, ILM03.0. Forty sample batches containing 465 samples were processed. Five batches contained >20 samples (actual number of included samples were 38, 21, 21, 21, and 21). Each of these batches were analyzed in at least two sample groupings so that the appropriate amount of QC was applied to all samples.

Holding times. All samples were received intact, and all analysis holding times were met except for 6 samples (batch L761, L2917) which exceeded the holding time by 1 day. The data were qualified as estimated.

Calibration. All initial and continuing calibration criteria were met. No qualification of the data is necessary.

Blanks. All MBs were free of contamination. No qualification of the data is necessary.

Matrix spikes. All MS recoveries met established recovery criterion. The average recovery was 96%. No qualification of the data is necessary.

Laboratory duplicates. All duplicate analyses met established RPD criterion. No qualification of the data is necessary.

Laboratory control samples. All LCS recoveries met the established criterion. No qualification of the data is necessary.

3.3.5 Pesticide/Polychlorinated Biphenyl Analyses of Water Samples

Pesticide/PCB analyses of water samples were conducted at Lockheed. A GC with an ECD, configured with a dual column autosampler injection system, performed analysis of the TCL pesticides/PCBs. The samples were extracted and analyzed in accordance with the protocol outlined in the *USEPA CLP SOW for Organic Analysis, Multi-Media, Multi-Concentration*, OLM01.8. Forty-five sample batches containing 445 samples were processed. Four batches contained 21 samples and, therefore, received two sets of QC samples.

Holding times. One sample (13833), received broken, was canceled from analysis; all other samples were received intact. All extraction holding times were met. Ten samples in batch L2910 exceeded the analysis holding data. The data were flagged as estimated.

Calibration. In <5% of the batches, the initial calibration, percent relative standard deviation (% RSD), exceeded the established criteria. Aldrin, alpha-, delta-, and gamma-BHC accounted for these deviations. These compounds were not detected in the associated samples and, therefore, should be qualified as uncertain.

In <5% of the batches, the continuing calibration RPD for 4,4'-DDT, gamma-BHC, beta-BHC, alpha-BHC, and endrin exceeded the established criterion. The deviations were caused by co-eluting peaks and should not have any effect on data quality.

Blanks. Aldrin was detected in one MB and an associated sample (12414, batch L1580). The sample data were qualified as not detected. All associated instrument blanks were free of contamination.

Surrogate spikes. The percentage of TCX and DCB surrogate recoveries that met the acceptance limits was 71%. The average percent recovery for TCX and DCB was 63% and 67% respectively. The associated data were qualified as estimated or rejected as applicable.

Matrix spikes and matrix spike duplicates. The percentage of MS/MSD recoveries that failed to meet the established recovery and RPD criterion was <4%. None of the spike compounds were found in the original samples. No qualification of the data is necessary based on the MS/MSD results. The average recoveries ranged from 74-86 %.

Laboratory control samples. All LCS recoveries met the established recovery criterion. No qualification of the data is necessary based on LCS results.

Other quality control. Because of matrix interference, the %D between the two GC columns exceeded the established limit for some compounds resulting in the "P" laboratory data flag. The affected data were qualified as estimated.

3.3.6 Semivolatile Analyses of Water Samples

Semivolatile analyses of water samples were conducted at Lockheed. A GC/MS performed analysis of the TCL semivolatiles. The samples were extracted and analyzed in accordance with the protocol outlined in the *USEPA CLP SOW for Organic Analysis, Multi-Media, Multi-Concentration*, OLM01.8. Forty-five sample batches containing 456 samples were processed. Four batches contained 21 samples and, therefore, received two sets of QC samples.

Holding times. All samples were received intact, and all extraction and analysis holding times were met.

Calibration. All initial and continuing calibration criteria were met. No qualification of the data is necessary.

Blanks. Benzo(ghi)perylene, bis(2-ethylhexyl)phthalate, di-n-butylphthalate, and diethylphthalate were found in the MBs that were analyzed with the pore water samples. The data were qualified accordingly.

Internal standards. One sample exhibited a decrease in the area counts of perylene-d₁₂, and one sample exhibited an increase in the area counts of 1,4-dichlorobenzene-d₄ outside the acceptance range. No compounds were quantitated against this internal standard, and no qualification of the data is necessary. All other internal standard criteria were met.

Surrogate spikes. 98% of the surrogate data were within EPA guidelines.

Average recoveries for the surrogates are listed below:

• phenol-d5	63%
• 2-fluorophenol	71%
• 2,4,6-tribromophenol	85%
• nitrobenzene-d5	78%
• 2-fluorobiphenyl	74%
• terphenyl-d14	82%

Matrix spikes and matrix spike duplicates. The percentage of MS/MSD recoveries that failed to meet the established recovery and RPD criterion was ~20%. Most of the deviations occurred with the % R and RPD for 4-chloroaniline, 2,4-dinitro toluene, hexachloroethane, and diethylphthalate. Since none of the spike compounds were detected in the samples, no qualification of the data is necessary based on the MS/MSD results.

Laboratory control samples. The percentage of LCS recoveries that failed to meet the established recovery criterion was ~10%. Most of the deviations occurred with the %R and RPD for 4-chloroaniline (low), 2,4-dinitro toluene (low), hexachloroethane (high), and diethylphthalate (high). Since none of the spike compounds were detected in the samples, no qualification of the data is necessary based on the LCS results.

3.4 SURFACE WATER ANALYSES

3.4.1 Total Mercury and Methyl Mercury Analyses of Surface Water Samples

As part of the CRERP Phase 2 RI, surface water samples from the Clinch River—Watts Bar Reservoir system were analyzed for total Hg to obtain data for use in site characterization and human health and ecological risk assessment. Analyses of Hg speciation were completed to determine if Hg found in past studies was inorganic Hg (Hg⁺²) or the more toxic MeHg. These analyses were conducted at Brooks Rand, LTD., Seattle, WA, according to CRERP laboratory SOW-193 dated August 30, 1993.

A rapid method of single stage gold amalgamation with cold vapor atomic fluorescence spectrometry (CVAFS) was used to determine the sample Hg content. Surface water samples for total Hg are prepared by bromine chloride oxidation and ultraviolet light photo oxidation for one hour. The Hg contained in the water samples is isolated by stannous chloride reduction, gas phase stripping, and collection onto a gold trap. The Hg collected on the trap is desorbed under a carrier gas stream and then determined by CVAFS. Fluorescence emission signals are recorded by an integrator. The amount of Hg in a sample analyzed is directly proportional to the integrated signal of fluorescence emission. CRERP required the lowest achievable detection limits for baseline risk assessment. Therefore, the detection limit for this technique of less than 1 pg Hg was acceptable. Relative standard deviations (RSDs) of 2.8%, 1.5%, and 2.2% were obtained for the determination of 500, 1000, and 2000 pg Hg standards, respectively.

Surface water samples for MeHg analyses are prepared by solvent extraction. A solution of 30% potassium chloride in 1% hydrochloric acid and methylene chloride is added to the sample aliquots and the samples are agitated for at least one hour. After allowing the separation of the aqueous and solvent phase, the aqueous phase is removed. Distilled water is added to the solvent phase and the sample is vaporized in a water bath at 80°C. The MeHg and Hg⁺² contained in the samples is first ethylated with sodium tetraethylborate and collected by purging onto a column filled with TenaxTM. The Hg derivatives are then thermally desorbed and transferred to a GC column held in an oven at 95°C, and the species are chromatographically separated. The organo-Hg compounds are decomposed at 800°C to Hg, which is quantified by cold vapor atomic fluorescence spectrometry (CVAFS). CR-ERP required the lowest achievable detection limits for baseline risk assessment. Therefore, the detection limits for this technique of about 0.6 pg and 1.3 pg for MeHg and Hg⁺², respectively, were acceptable. The method has been demonstrated as being very sensitive, precise, and accurate.

For this project, a total of 412 surface water samples were analyzed for total Hg and methyl Hg. Along with these samples, a total of 167 QC samples (i.e., 92 TBs, 24 FBs, 24 laboratory rinsate blanks, and 24 FRBs) were analyzed. The surface water sample results are reported in ng/L and were included in 38 individual batches numbered from OR-10 through OR-47.

Holding times and preservation. Conformance to holding time and sample preservation requirements for each batch of samples was reviewed. According to SOW-193, the holding time for surface water Hg analyses is 28 days and the preservation requirements are acidification to pH <2 with hydrochloric acid and cooling to 4±2°C until the time of analysis. Unless otherwise noted, sample shipping, receipt, and integrity problems were noted in PERs. The following nonconformances were identified and are listed by DRG.

DRG OR-10: The nine samples in this DRG were not preserved until they were received at the laboratory. The total Hg and methyl Hg results for all four surface water and associated QC samples (10094, 10095, 10118, 10119, 10142, 10146, 10150, 10163, and 10168) have been commented in the data base because of this deviation.

DRG OR-14: The samples in this DRG were sent to another laboratory by mistake. Consequently, by the time the samples were received by Brooks Rand, LTD., the cooler temperature was at 10°C. The total Hg and methyl Hg results for all six surface water and associated QC samples (10315, 10325, 10334, 10353, 10359, 10447, 10457, 10566, 10571, and 10305) have been commented in the data base because of this deviation.

DRG OR-19: Samples 11374, 11384, and 11450 were received at the laboratory frozen. The laboratory noted that spurious results are obtained from analyzing samples that were frozen and then unthawed. The laboratory theorizes that freezing may force the analyte of interest into the pores of the sample container. However, after thawing and holding the sample for about a week,

the analyte of interest may reassociate to the matrix. This theory was not supported by documented studies. These results have been commented in the data base because of this deviation. Because of insufficient sample volume for samples 11374 and 11450, no MeHg data were reported.

The analysis holding time was exceeded by one day for samples 11373, 11374, 11380, 11384, 11385, 11394, and 11430. The total Hg results for these samples were qualified as estimated (J) with a qualifier code of A03 (analysis holding time was exceeded).

DRG OR-20: Samples 11495, 11496, 11502, 11506, 11516, 11517, 11568, 11569, and 11580 were received at the laboratory either partially or totally frozen. See also the discussion for DRG OR-19. These results have been commented in the data base because of this deviation.

DRG OR-21: Sample 11641 froze during sample storage. See also the discussion for DRG OR-19. These results have been commented in the data base because of this deviation.

DRG OR-28: Sample 12665 was received at the laboratory partially frozen. See also the discussion for DRG OR-19. The Hg and MeHg results have been commented in the data base because of this deviation.

DRG OR-29: The analysis holding time was exceeded for all samples in this DRG. The total Hg results for all samples in this DRG were qualified as estimated (J) with a qualifier code of A03 (analysis holding time was exceeded).

DRG OR-30: The analysis holding time was exceeded for all samples in this DRG. The total Hg results for all samples in this DRG were qualified as estimated (J) with a qualifier code of A03 (analysis holding time was exceeded).

DRG OR-31: The analysis holding time was exceeded for all samples in this DRG by one day. The total Hg results for these samples should be qualified as estimated (J) with a qualifier code of A03 (analysis holding time was exceeded).

DRG OR-32: The analysis holding time was exceeded for samples 13554, 13555, 13561, 13565, and 13566 in this DRG. The total Hg results for these samples were qualified as estimated (J) with a qualifier code of A03 (analysis holding time was exceeded).

DRG OR-37: The analysis holding time was exceeded for samples 14454, 14455, 14461, 14465, and 14466 in this DRG. The total Hg results for these samples were qualified as estimated (J) with a qualifier code of A03 (analysis holding time was exceeded).

DRG OR-39: The analysis holding time was exceeded for samples 14763, 14764, 14773, 14774, 14780, 14784, 14785, 14794, 14795, 14858, 14859, 14865, 14869, 14879, 14879, 14933, and 14880 in this DRG. The total Hg and MeHg results were qualified as estimated (J) with a qualifier code of A03 (analysis holding time was exceeded) as applicable.

DRG OR-41: Sample 15205 was received at the laboratory partially frozen. See also the discussion for DRG OR-19. The Hg and MeHg results have been commented in the data base because of this deviation.

DRG OR-44: The samples in this DRG were received with a cooler temperature at 8°C. The Hg and MeHg results have been commented in the data base because of this deviation.

DRG OR-47: The analysis holding time was exceeded for the samples in this DRG. The total Hg results for these samples were qualified as estimated (J) with a qualifier code of A03 (analysis holding time was exceeded).

Calibration. The laboratory used a grand average of all standards (excluding minimum detection standards) in the analytical run to calculate the calibration coefficient, which is the correction factor for the instrument sensitivity on any given day. To give a correction factor representative of the complete run, the standard concentrations ranged from 10 to 3000 pg for total Hg and 5 to 200 pg for methyl Hg and were analyzed in various positions throughout the analytical run. The correction factors multiplied by the peak height or peak area were used to determine the concentration for each sample. Calibration checks were performed immediately after generating the calibration curve, after every ten samples, and at the end of the analytical batch. The calibration check consisted of a mid-point standard, a near detection level standard, and a calibration blank. The mid-point standard had to show 80-120% recovery for the analysis to be considered in control. Calibration sequences for all analytical runs in all DRGs were acceptable and, therefore, no qualification of the data is necessary based on this criteria.

Blanks. In each analytical sequence, the laboratory analyzed various blanks to monitor system performance. These were identified as bubbler blanks and reagent or MBs. The bubbler blanks were analyzed to show that the analytical system was not contaminated by carrier gases or carryover between samples. Reagent blanks, consisting of the reagents used in sample preparation, were analyzed to show that contamination was not contributed by the reagents used. No significant blank contamination was observed.

Matrix spikes. Matrix spike recovery for each batch of samples was reviewed. A control limit of 75 to 125% recovery was used in evaluating matrix spike recovery. No deviations were identified that would require qualification of the data. The following deviations were identified for methyl mercury and are listed by DRG:

DRG OR-11: The laboratory reported matrix spike recoveries for five samples in this DRG. One of the recoveries was 74%. However, the average recovery was 83%. This was considered acceptable by the laboratory. Therefore, no qualifications should be applied because of this deviation.

DRG OR-14: Matrix spike recoveries ranged from 66 to 74%. As a result, the MeHg results for all six surface water and associated QC samples in this DRG should be qualified as estimated (J) with a qualifier code of I02 (matrix spike recovery was below the lower control limit).

DRG OR-22: The laboratory reported matrix spike recoveries for four samples in this DRG. One of the recoveries was 70%. However, the average recovery was 82%. This was considered acceptable by the laboratory. Therefore, no qualifications should be applied because of this deviation.

DRG OR-25: The laboratory reported matrix spike recoveries for three samples in this DRG. One of the recoveries was 73%. However, the average recovery was 79%. This was considered acceptable by the laboratory. Therefore, no qualifications should be applied because of this deviation.

DRG OR-27: The laboratory reported matrix spike recoveries for three samples in this DRG. All recoveries were less than 75%. As a result, the MeHg results for all surface water and associated QC samples in this DRG should be qualified as estimated (J) with a qualifier code of I02 (matrix spike recovery was below the lower control limit).

DRG OR-40: The laboratory reported matrix spike recoveries for two samples in this DRG. The recoveries were 72% and 71%. As a result, the MeHg results for all surface water samples in this DRG should be qualified as estimated (J) with a qualifier code of I02 (matrix spike recovery was below the lower control limit).

DRG OR-42: The laboratory reported matrix spike recoveries for four samples in this DRG. One of the recoveries was 73%. However, the average recovery was 85%. This was considered acceptable by the laboratory. Therefore, no qualifications should be applied because of this deviation.

DRG OR-45: The laboratory reported matrix spike recoveries for four samples in this DRG. Two of the recoveries were less than 75%. The average recovery was 71%. The MeHg results in this DRG should be qualified as estimated (J) with a qualifier code of I02 (matrix spike recovery was below the lower control limit).

DRG OR-46: The laboratory reported matrix spike recoveries for six samples in this DRG. Five out of the six recoveries were not in the range of 75-125%. One of the five recoveries was >125%. All MeHg results in this DRG should be qualified as estimated (J) with qualifier codes of I02 or I01 (matrix spike recovery was below the lower control limit or above the upper control limit).

DRG OR-47: The laboratory reported matrix spike recoveries for four samples in this DRG. One of the recoveries was 67%. However, the average recovery was 81%. This was considered acceptable by the laboratory. Therefore, no qualifications should be applied because of this deviation.

Duplicates/Replicates. As required by SOW-193, duplicate samples are to be analyzed for every matrix in each batch of 20 samples or less. Control limits of 20% RPD or relative standard deviation (RSD) for water samples are applied when evaluating duplicate/replicate analyses. Instead of duplicates, the laboratory analyzed samples in replicate. In several of the DRGs, more than one set of replicates were analyzed, but not necessarily according to matrix type (i.e., when a DRG contained both surface water and pore water samples, usually surface water samples were selected for replicate analyses). Because of the similarity of the matrices, this deviation is not considered to affect the quality of the data. The RSDs observed were of low magnitude, so the first of the replicate results was included in the data base as the customer result. The other replicate results were included as QC measurements.

The following deviations were identified for total Hg and are listed by DRG:

DRG OR-42: One of the replicates analyzed had an RSD of 24%. The results for the samples in this DRG that are associated with this QC sample should be qualified as estimated (J) with a qualifier code of J01 (duplicate/replicate RPD/RSD was outside the control limit).

DRG OR-44: One of the four replicates analyzed had an RSD of >20%. The results for the samples in this DRG that are associated with this QC sample should be qualified as estimated (J) with a qualifier code of J01 (duplicate/replicate RPD/RSD was outside the control limit).

DRG OR-46: One of six replicates analyzed had an RSD of >20%. The results for the samples in this DRG that are associated with this QC sample should be qualified as estimated (J) with a qualifier code of J01 (duplicate/replicate RPD/RSD was outside the control limit).

The following deviations were identified for MeHg and are listed by DRG:

DRG OR-26: One of the replicates analyzed had an RSD of 48%. The results for the samples in this DRG that are associated with this QC sample should be qualified as estimated (J) with a qualifier code of J01 (duplicate/replicate RPD/RSD was outside the control limit).

DRG OR-39: One of the replicates analyzed in this DRG had an RSD of 23%. The results for the samples in this DRG that are associated with this QC sample should be qualified as estimated (J) with a qualifier code of J01 (duplicate/replicate RPD/RSD was outside the control limit).

DRG OR-41: One of the replicates analyzed had an RSD of 32%. The results for the samples in this DRG that are associated with this QC sample should be qualified as estimated (J) with a qualifier code of J01 (duplicate/replicate RPD/RSD was outside the control limit).

DRG OR-42: One of the replicates analyzed had an RSD of 55%. The results for the samples in this DRG that are associated with this QC sample should be qualified as estimated (J) with a qualifier code of J01 (duplicate/replicate RPD/RSD was outside the control limit).

DRG OR-44: Two of the four replicates analyzed had RSDs of >20%. The results for the samples in this DRG that are associated with these QC samples should be qualified as estimated (J) with a qualifier code of J01 (duplicate/replicate RPD/RSD was outside the control limit).

DRG OR-45: Three of four replicates analyzed had RSDs of >20%. The results for the samples in this DRG that are associated with these QC samples should be qualified as estimated (J) with a qualifier code of J01 (duplicate/replicate RPD/RSD was outside the control limit).

DRG OR-46: One of six replicates analyzed had an RSD of >20%. The results for the samples in this DRG that are associated with this QC sample should be qualified as estimated (J) with a qualifier code of J01 (duplicate/replicate RPD/RSD was outside the control limit).

DRG OR-47: Four of five replicates analyzed had an RSD of >20%. The results for the samples in this DRG that are associated with these QC samples should be qualified as estimated (J) with a qualifier code of J01 (duplicate/replicate RPD/RSD was outside the control limit).

Laboratory control samples. The laboratory used a NIST Hg in water SRM (1641C) for QC purposes. Results reported for this SRM were acceptable in all cases and, therefore, no qualification of the data is necessary based on this criteria.

No MeHg in an aqueous matrix was available for use as a LCS. The laboratory did, however, utilize matrix spikes and duplicate/replicate analyses to establish that the analyses were in control. Whenever surface water samples were analyzed along with sediment samples, the laboratory used an IAEA MeHg in marine sediment reference material (IAEA-356) for QC purposes. Another reference material used for LCS purposes was SRM NRCC DORM-2, Hg in dogfish muscle. Results reported for these reference materials were acceptable and, therefore, no qualification of the data is necessary based on this criteria.

Other quality control. Whenever lower than usual matrix spike recoveries or higher than usual laboratory blank results were observed, the laboratory would also present sample results corrected for spike recovery and/or blank subtracted. According to SOW-193, and since sample results are qualified because of these deviations, the sample results that should be used are those without these corrections.

During the course of the project, the laboratory changed its method of reporting sample results to include attaching qualifiers to the results. For results below the QL and/or below the MDL, a <QL or <MDL was placed in the results field of the analytical report. The QL was determined as ten times the standard deviation of the MBs analyzed on that day and was incorporated into the data base as a "U" qualifier. The MDL was determined as three times the standard deviation of the MBs analyzed on that day and was incorporated into the data base as a "B" qualifier. The QL and MDL values are available in the analytical reports.

Several of the DRGs reported results of more than 20 samples. These DRGs include: OR-14, OR-23, OR-24, OR-28, OR-29, OR-32, OR-34, OR-38, OR-39, OR-41, OR-42, OR-44, OR-45, OR-46, and OR-47. According to SOW-193, no more than 20 samples should be reported in a batch. Although this deviation was noted, this should have no effect on the data since the laboratory followed procedure and provided sufficient QA/QC data (i.e., blanks, duplicates, matrix spikes, etc.). The samples were prepared and analyzed in small batches (i.e., 20 samples or less). During review, all of the QA/QC information associated with each batch was considered. Additional qualification of the data was not necessary.

Other QC and analysis protocol deviations for each batch of samples were reviewed. No exceptions for total Hg were identified that would require qualification of the data. The following exceptions were identified and are listed by DRG.

DRG OR-16: Sample 10813 was prepared by solvent extraction and distillation sample preparation procedures. The result obtained from the solvent extraction sample preparation procedure was 0.101 ng/L and the result obtained from the distillation sample preparation procedure was 0.129 ng/L. To keep the MeHg results consistent throughout the data base, the result from the solvent extraction sample preparation procedure should be used.

3.4.2 Radiological Analyses of Surface Water by Eco Tek Laboratory Services, Inc.

As part of the CRERP Phase 2 RI, 464 surface water samples from the Clinch River–Watts Bar Reservoir system were analyzed for various radiological parameters. The analyses were completed by EcoTek Laboratory Services, Inc. in Atlanta, Georgia, according to CRERP laboratory SOW-217. The samples were analyzed for tritium, gross alpha, gross beta, gamma, and ^{90}Sr activities. Tritium activities were determined by liquid scintillation counting. Gamma activities were determined by gamma spectroscopy. Gross alpha, gross beta, and ^{90}Sr activities were determined by gas flow proportional counting.

For this project, a total of 142 surface water samples were analyzed for tritium activity. Along with these samples, a total of 27 QC samples (i.e., 13 FBs, 11 FRBs, and 3 high-purity water blanks) were analyzed. A total of 171 surface water samples were analyzed for gross alpha and gross beta activities. Along with these samples, a total of 26 QC samples (i.e., 13 FBs, 11 FRBs, and 2 high-purity water blanks) were analyzed. A total of 147 surface water samples were analyzed for ^{90}Sr activities. Along with these samples, a total of 32 QC samples (i.e., 15 FBs, 14 FRBs, and 3 high-purity water blanks) were analyzed. A total of 4 surface water samples were analyzed for gamma activity. There were no field QC samples associated with the gamma analyses. The results for these samples were reported in 15 separate SDGs (Nos. 31556, 31624, 31656, 31684, 31773, 31832, 31893, 31946, 32072, 32075, 32132, 32204, 32276, 32372, and 32386). The activities were reported in pCi/L.

Holding times and preservation. Conformance to holding time and sample preservation requirements was reviewed. The samples were collected during the period November 1993 through July 1994. No discrepancies were found in a comparison between the CRERP COC forms and samples received. The shipping packages were sealed and packed properly and all samples arrived in good condition. Upon receipt, the samples were logged in and stored appropriately until the analyses were performed.

A 6-month holding time is applied to surface water samples analyzed for radionuclides. No preservation is required for samples analyzed for tritium. The preservation requirement for samples submitted for gross alpha, gross beta, gamma, and ^{90}Sr analyses is acidification to pH <2 with nitric

acid. The samples were appropriately preserved. No qualification of the data is necessary based on holding time and sample preservation criteria.

Calibration. For the gross alpha, gross beta, and ^{90}Sr determinations, two of the instrument performance assessments were not within acceptance criteria. The absorption curve was not generated within one year of the sample analyses. The absorption curve was dated 10/92 through 11/92. In addition, no data to document the cross-talk determination were included in the data packages. As a result, all gross alpha, gross beta, and ^{90}Sr results were qualified as estimated (J). The qualifier codes R06 (absorption curve criteria were not met) and S05 (cross-talk verification criteria were not met) accompanies the qualifier flags.

There were no calibration problems noted for the tritium and gamma determinations.

Blanks. In each analytical sequence, the laboratory analyzed the required MBs to monitor procedural and system performance. The method or reagent blanks for each determination consisted of deionized water prepared as a sample and taken through the separation chemistry, if applicable. The results were qualified as estimated (J) if their results were greater than the MDA. If the results were less than the MDA, the results were qualified as not detected, associated value uncertain (UJ). A qualifier code of F01 (sample data were qualified as a result of the MB) accompanies the qualifier flags.

The ^{90}Sr MB in SDG No. 32072 had a result greater than the MDA. The ^{90}Sr results for samples 12468, 12482, 12496, 12531, 12545, and 12621 were qualified.

The ^{90}Sr MB in SDG No. 32075 had a result greater than the MDA. The ^{90}Sr results for samples 13072, 13086, 13100, 13218, 13232, and 13246 were qualified.

The ^{90}Sr MB in SDG No. 32386 had a result greater than the MDA. The ^{90}Sr results for samples 15188, 15132, 15223, 15237, 15320, 15334, and 15347 were qualified.

The tritium, gross alpha, gross beta, and gamma MBs were reviewed and all determinations were less than the MDA. No qualification of this data is necessary based on this criteria.

Chemical recovery. The ^{90}Sr analyses use carriers in completing the determinations. According to SOW-217, recoveries of 50-110% are considered acceptable. Results less than the MDA were qualified as not detected, associated value uncertain (UJ). Results greater than the MDA were qualified as estimated (J). A qualifier code of G02 (radiological chemical recovery was below the lower control limit) accompanies each qualifier flag.

In SDG No. 32132, the ^{90}Sr carrier recoveries for samples 13422, 13503, and 13585 were less than 50% and therefore qualified.

In SDG No. 32386, the ^{90}Sr carrier recovery was low for sample 14993 (48%) and therefore qualified.

In SDG No. 31946, the ^{90}Sr carrier recovery for sample 12440 was 45%. The ^{90}Sr result for this sample was less than the MDA and was qualified.

Matrix spikes. For aqueous matrices, matrix spike acceptance limits of 80 to 120% recovery are used. The matrix spike recoveries for tritium, gross alpha, gross beta, and ^{90}Sr in each SDG were reviewed. The result was qualified as estimated (J), if the result was greater than the MDA, or as not detected, associated value uncertain (UJ), if the result was less than the MDA. A qualifier code of H01

(matrix spike recovery was above the upper control limit) accompanies the qualifier flags. The following deviations were noted:

In SDG No. 31556, the gross alpha matrix spike recovery was greater than 120%. The gross alpha results for samples 10273, 10282, and 10296 were qualified.

In SDG No. 32075, the gross alpha and gross beta matrix spike recoveries were greater than 120%. The gross alpha and gross beta results for all samples in this SDG (except 13301, 13315, 13349, and 13364 for gross beta) were qualified.

In SDG No. 31946, the gross alpha matrix spike recovery was greater than 120%. The gross alpha results for samples 12328, 12339, 12354, 12368, 12411, 12426, and 12439 were qualified.

In SDG No. 32072, the ^{90}Sr matrix spike recovery was less than 80%. The ^{90}Sr results for samples 12468, 12482, 12496, 12531, 12545, 12621, 12810, 12824, and 12838 were qualified.

All other recoveries were within acceptance limits. No qualification of the data is necessary based on this criteria.

Duplicates. As required by SOW-217, duplicate samples are to be analyzed for every matrix in each batch of 20 samples or less. Instead of DERs, the laboratory used RPD to evaluate duplicate precision. No deviations were noted and no qualification of the data is necessary based on this criteria.

Laboratory control samples. When evaluating LCS data, one LCS should be analyzed for every matrix in each batch of 20 samples or less. Control limits of 80 to 120% recovery for aqueous matrices are applied. The result was qualified as estimated (J), if greater than the MDA, or as not detected, associated value uncertain (UJ), if less than the MDA. A qualifier code of P02 (LCS recovery was below the lower control limit) accompanies the qualifier flags.

The following deviations were observed:

In SDG No. 32276, the gross alpha LCS did not meet acceptance limits. All gross alpha results in this SDG were qualified as appropriate.

In SDG No. 31556, the ^{90}Sr LCS did not meet acceptance limits. The ^{90}Sr results for samples 10167, 10202, and 10240 were qualified as appropriate.

The recoveries for all other LCSs were within acceptance limits. No qualification of the data is necessary based on this criteria.

Other quality control. Results for all samples are reported in activity per liter (pCi/L) without blank correction. No dilutions were required in the analysis of any of the samples.

Quantitation limits. As a measure of QLs, the laboratory reported actual results obtained, the associated uncertainty, and an MDA value. The CRERP required QL for tritium was 270 pCi/L. The CRERP required QL for gross alpha was 3 pCi/L and gross beta, 5 pCi/L. The CRERP required QL for ^{90}Sr was 5 pCi/L. The CRERP required QL for gamma was 15 pCi/L. Those results that are less than the MDA were qualified as not detected at the associated level (U). The results for these samples were qualified as not meeting the DL. A qualifier code of T01 (detection limits were not met) accompanies the qualifier flags. The following deviations were noted:

In SDG No. 31832, the tritium MDAs did not meet MDA acceptance criteria for samples 11716, 11786, 11800, 11848, and 11861.

In SDG No. 31893, the tritium MDAs did not meet MDA acceptance criteria for samples 11976, 12004, 12018, 12031, 12063, 12097, 12111, 12125, 12164, 12177, 12191, 12205, 12241, and 12254.

In SDG No. 31773, the tritium MDAs did not meet MDA acceptance criteria for samples 11396, 11410, 11425, 11461, 11475, 11489, 11535, 11548, 11562, 11597, 11611, 11643, 11658, and 11673.

In SDG No. 32372, the ^{90}Sr MDA did not meet MDA acceptance criteria for sample 14811.

3.4.3 Radiological Analyses of Surface Water Samples by Oak Ridge Analytical Services

As part of the CRERP Phase 2 RI, 206 surface water samples from the Clinch River–Watts Bar Reservoir system were analyzed for various radiological parameters. The samples were analyzed for tritium, gross alpha, gross beta, and ^{90}Sr activities. All activities were determined by liquid scintillation counting. The analyses were completed by Oak Ridge Analytical Services, Oak Ridge, TN, according to CRERP laboratory SOW-217.

For this project, a total of 69 surface water samples were analyzed for tritium activity. Along with these samples, a total of 10 QC samples (i.e., 4 FBs, 3 FRBs, and 3 high-purity water blanks) were analyzed. A total of 69 surface water samples were analyzed for gross alpha and gross beta activities. Along with these samples, a total of 10 QC samples (i.e., 4 FBs, 3 FRBs, and 3 high-purity water blanks) were analyzed. A total of 68 surface water samples were analyzed for ^{90}Sr activities. Along with these samples, a total of 10 QC samples (i.e., 4 FBs, 3 FRBs, and 3 high-purity water blanks) were analyzed. The results for these samples were included in four separate SDGs (Nos. 1095, 1102, 1104, and 1106) and were reported in pCi/L.

Holding times and preservation. Conformance to holding time and sample preservation requirements was reviewed. The samples were collected during the period August 2, 1994 through September 13, 1994, and were submitted to the laboratory on September 13, 1994 and September 20, 1994. No discrepancies were found in a comparison between the CRERP COC forms and samples received. The shipping packages were sealed and packed properly, and all samples arrived in good condition with the exception of sample 16569, which was leaking upon arrival. This sample was included in SDG No. 1106 and was submitted for gross alpha and gross beta determinations. This exception is not considered to affect the quality of the data. Upon receipt, the samples were logged in and stored appropriately until the analyses were performed.

A 6-month holding time is applied to surface water samples analyzed for radionuclides. No preservation is required for samples analyzed for tritium. The preservation requirement for samples submitted for gross alpha, gross beta, and ^{90}Sr analyses is acidification to pH <2 with nitric acid. The samples were appropriately preserved. No qualification of the data is necessary based on holding time and sample preservation criteria.

Calibration. For the tritium, gross alpha, gross beta, and ^{90}Sr determinations analyzed by liquid scintillation counting with pulsed-shaped discrimination, one of the instrument performance assessments was above the 3-sigma acceptance limit. These assessments include ^{14}C chi square, ^{14}C efficiency, ^{14}C background, ^3H chi square, ^3H figure of merit, ^3H efficiency, and the ^3H background measured on flame-sealed standards. A ^3H chi square value of 45.8 was recorded on October 12, 1994. The data point was remeasured on the next day and fell within acceptable limits. The liquid scintillation calibration curve included compensation for cross-talk and efficiency. All results were

corrected for background, efficiency, cross-talk, and quenching. Based on professional judgement, no qualification of the data is necessary based on this criteria.

Blanks. In each analytical sequence, the laboratory analyzed the required MBs to monitor procedural and system performance. The method or reagent blanks for each determination consisted of deionized water prepared as a sample and taken through the separation chemistry. If the result was greater than the MDA, the result was qualified as estimated (J). If the result was less than the MDA, the result was qualified as not detected, associated value uncertain. A qualifier code of F01 (sample data were qualified as a result of the MB) accompanies the qualifier flags.

The ^{90}Sr MB in SDG No. 1095, batch 2116A, had a result greater than the MDA. The ^{90}Sr results for samples 13716, 13730, 13744, 13759, 13788, 13800, 13814, 13831, 15382, 15427, 13647, and 13903 were qualified.

The gross beta MBs in SDG No. 1095, batches 2112A and 2113A, had results greater than their respective MDAs. All gross beta results in this SDG were qualified as appropriate.

In SDG No. 1102, the gross alpha MB was greater than the MDA. All gross beta results in this SDG were qualified as appropriate.

The MB for both the gross alpha and gross beta determinations in SDG No. 1106 exhibited a result greater than their respective uncertainties and MDAs. All gross alpha and gross beta results were qualified as appropriate.

Chemical recovery. The ^{90}Sr analyses use carriers in completing the determinations. According to SOW-217, recoveries of 50-110% are considered acceptable.

In SDG No. 1095, the carrier recoveries for samples 13647 and 13903 were 42% and 46%, respectively. The ^{90}Sr results for these samples were qualified estimated (J) with a qualifier code of G02 (radiological chemical recovery was below the lower control limit).

In SDG No. 1102, the ^{90}Sr carrier recoveries were low for samples 15544, 15594, 15663, 15791, 15820, and 15946. The carrier recoveries were 48%, 42%, 40%, 49%, 46%, and 49%, respectively. Because the ^{90}Sr results for these samples were less than the MDA, the results were qualified as not detected, associated value uncertain (UJ). A qualifier code of G02 (radiological chemical recovery was below the lower control limit) accompanies the qualifier flags.

Matrix spikes. For aqueous matrices, matrix spike acceptance limits of 80 to 120% recovery are used. The matrix spike recoveries for tritium, gross alpha, gross beta, and ^{90}Sr in each SDG were reviewed. The following deviation was noted:

In SDG No. 1102, the gross alpha matrix spike recovery was 66%. The gross alpha results for all samples in this SDG were qualified as estimated (J) if the result was greater than the MDA or as not detected, associated value uncertain (UJ) if the result was less than the MDA. A qualifier code of H02 (matrix spike recovery was below the lower control limit) accompanies the qualifier flags.

All other recoveries were within acceptance limits. Therefore, no other qualifications of the data are necessary based on this criteria.

Duplicates. As required by SOW-217, duplicate samples are to be analyzed for every matrix in each batch of 20 samples or less. If the result was greater than the MDA, the result was qualified as estimated (J). If the result was less than the MDA, the result was qualified as not detected, associated

value uncertain (UJ). A qualifier code of J01 (radiological DER was outside the control limit) accompanies the qualifier flags. The following deviations were noted:

In SDG No. 1095, the gross beta DER for the samples analyzed in batch 2113A was 3.2. All gross beta results in this batch were qualified as appropriate.

In SDG No. 1104, the gross alpha DER for the samples analyzed in batch 2206A was 1.6. All gross alpha results in this batch were qualified as appropriate.

In SDG No. 1104, the gross beta DER for the samples analyzed in batch 2206A was 1.1. All gross beta results in this batch were qualified as appropriate.

In SDG No. 1106, the gross alpha DER was 1.1. All gross alpha results in this SDG were qualified as appropriate.

Laboratory control samples. When evaluating LCS data, one LCS should be analyzed for every matrix in each batch of 20 samples or less. Control limits of 80 to 120% recovery for aqueous matrices are applied. The control sample utilized for tritium consisted of deionized water and was spiked with a tritium solution. It was prepared as a sample and taken through the separation chemistry. The tritium solution was diluted from EPA standard #2606-1. The standard utilized for gross alpha and gross beta determinations was diluted from an EPA ^{238}U standard #1843-2. The control consisted of deionized water with ^{238}U added, prepared as a sample and taken through the separation chemistry. The ^{90}Sr controls consisted of deionized water prepared as a sample, spiked with an EPA standard #2454-2 ^{90}Sr solution and taken through the separation chemistry. The result was qualified as estimated (J) if the result was greater than the MDA or as not detected, associated value uncertain (UJ) if the result was less than the MDA. A qualifier code of P02 (LCS recovery was below the lower control limit) accompanies the qualifier flags. The following deviations were observed:

In SDG No. 1102, the gross beta LCS did not meet acceptance limits. All gross beta results in this SDG were qualified as appropriate.

In SDG No. 1102, the ^{90}Sr LCS analyzed in batch 2198A did not meet acceptance limits. The ^{90}Sr results for the samples in this batch were qualified as appropriate.

The recoveries for all other LCSs were within acceptance limits. Therefore, no other qualification of the data are necessary based on this criteria.

Other quality control. Results for all samples are reported in activity per liter (pCi/L) without blank correction. No dilutions were required in the analysis of any of the samples.

Quantitation limits. As a measure of QLs, the laboratory reported actual results obtained, the associated uncertainty, and an MDA value. The CRERP required QL for tritium was 75 pCi/L. The CRERP required QL for gross alpha and gross beta was 2 pCi/L. The CRERP required QL for ^{90}Sr was 5 pCi/L. Those results that are less than the MDA were qualified as not detected at the associated level (U). All CRERP required detection limits were met.

3.5 BIOTA ANALYSES

3.5.1 Polychlorinated Biphenyl Aroclor and Chlordane Isomer Analyses of Fish Tissue Samples—Fall 1991

PCB aroclor and chlordane isomer analyses of fish tissue samples collected in Fall 1991 were conducted at the Tennessee Valley Authority (TVA) Environmental Chemistry Laboratory (ECHEM) according to SOW-0003. A GC with an ECD performed analysis of the TCL PCBs and chlordane isomer. The samples were extracted and analyzed in accordance with the protocol outlined in the *USEPA CLP SOW for Organic Analysis, Multi-Media, Multi-Concentration*, OLM01.8. Ten sample batches containing 137 samples were processed.

Holding times. All samples were received intact. Extraction holding times are not specified for biota samples. All samples remained frozen until extraction. Analysis holding times were met.

Calibration. In all batches, the initial and continuing calibration met the established criteria. No qualification of the data is necessary based on calibration results.

Blanks. All reported method and instrument blanks were free of contamination. No qualification of the data is necessary.

Surrogate spikes. 99% of the surrogate recoveries met the established recovery criterion. The average recovery for TCX was 90%. The average recovery for DCB was 97%.

Matrix spikes and matrix spike duplicates. All MS/MSD recoveries met the established recovery criterion. No qualification of the data is necessary based on MS/MSD results.

Laboratory control samples. All LCS recoveries met the established recovery criterion. No qualification of the data is necessary based on LCS results.

Other quality control. Because of matrix interference, the %D between the two GC columns exceeded the established limit for most compounds resulting in the "P" laboratory data flag. The laboratory was not consistent in assigning the "P" qualifier to corresponding data points between columns 1 and 2. In some cases, the "P" qualifier was reported with the data from only one column. All data from both columns exceeding the %D criteria were qualified by the laboratory. The affected data were qualified as estimated.

3.5.2 Polychlorinated Biphenyl Aroclor and Congener Analyses of Fish Tissue Samples—Fall 1992/Spring 1993

PCB aroclor and congener analyses of fish tissue samples collected in Fall 1992/Spring 1993 were conducted at the TVA ECHM Laboratory according to SOW-0006. A GC with an ECD performed analysis of the TCL PCBs and congeners. The samples were extracted and analyzed in accordance with the protocol outlined in the *USEPA CLP SOW for Organic Analysis, Multi-Media, Multi-Concentration*, OLM01.8. Thirty-one sample batches containing 400 samples were processed.

Holding times. All samples were received intact. Extraction holding times are not specified for biota samples. All samples remained frozen until extraction. Analysis holding times were met.

Calibration. In all batches, the initial calibration percent relative standard deviation (% RSD) exceeded the established criteria. Alpha-chlordene on column 1 (DB-608) and PCB congeners on column 2 (DB-17) accounted for the deviations. While not all PCB congeners exceeded the established limit on column 2, the general trend for this column was high. Therefore, a high bias is evident for all congener data reported for column 2. The associated data should be qualified as estimated.

In all batches, the continuing calibration RPD for PCB congeners on column 2 exceeded the established criterion. The associated data should be qualified as estimated.

Blanks. All reported method and instrument blanks were free of contamination. No qualification of the data is necessary.

Surrogate spikes. Sample C020S21 (batch 18) exhibited low TCX and DCB surrogate recoveries. 98% of the 2359 surrogate recoveries reported were within the limits. The average recoveries for TCX, DCB, and TCBP were 95%, 98%, and 87% respectively.

Matrix spikes and matrix spike duplicates. All MS/MSD recoveries met the established recovery criterion. No qualification of the data is necessary based on MS/MSD results.

Laboratory control samples. All LCS recoveries met the established recovery criterion. No qualification of the data is necessary based on LCS results.

Other quality control. Because of matrix interference, the %D between the two GC columns exceeded the established limit for most compounds resulting in the "P" laboratory data flag. The laboratory was not consistent in assigning the "P" qualifier to corresponding data points between columns 1 and 2. In some cases, the "P" qualifier was reported with the data from only one column. All data from both columns exceeding the %D criteria were qualified by the laboratory. The affected data were qualified as estimated.

3.5.3 Polychlorinated Biphenyl Aroclor and Congener Analyses of Fish Tissue Samples— Fall 1993/Spring 1994

PCB aroclor and congener analyses of fish tissue samples collected in Fall 1993/Spring 1994 were conducted at the TVA ECHM Laboratory according to SOW-0020. A GC with an ECD performed analysis of the TCL PCBs and congeners. The samples were extracted and analyzed in accordance with the protocol outlined in the *USEPA CLP SOW for Organic Analysis, Multi-Media, Multi-Concentration*, OLM01.8. Thirty-one sample batches containing 400 samples were processed.

Holding times. All samples were received intact. Extraction holding times are not specified for biota samples. All samples remained frozen until extraction. Analysis holding times were met.

Calibration. In all batches, the initial calibration percent relative standard deviation (% RSD) exceeded the established criteria. Alpha-chlordene on column 1 (DB-608) and PCB congeners on column 2 (DB-17) accounted for the deviations. While not all PCB congeners exceeded the established limit on column 2, the general trend for this column was high. Therefore, a high bias is evident for all congener data reported for column 2. The associated data should be qualified as estimated.

In all batches, the continuing calibration RPD for PCB congeners on column 2 exceeded the established criterion. The associated data should be qualified as estimated.

Blanks. All reported method and instrument blanks were free of contamination. No qualification of the data is necessary.

Surrogate spikes. 92% of the 1260 surrogate recoveries reported were within criteria. The average recoveries for TCX, DCB, and TCBP were 88%, 76%, and 74% respectively. Sample C001S51 (batch 72) and sample C001S52 (batch 71) exhibited low TCX surrogate recoveries. Batches 78 (all samples), 80 (samples 2439, 2586, 2587, 2588), 81 (all samples), 83 (all samples), and 85 (samples 2620, 4401, 4402, 8227) exhibited low DCB surrogate recoveries. The low surrogate recoveries were mainly caused by matrix interferences. The data associated with the low surrogate recoveries should be qualified as estimated. Four samples in batch 85 (4617, 4683, 4684, 4830) exhibited 0% recovery for DCB. The associated data should be qualified as estimated (detects) or unusable (nondetects).

Matrix spikes and matrix spike duplicates. All MS/MSD recoveries met the established recovery criterion. No qualification of the data is necessary based on MS/MSD results.

Laboratory control samples. All LCS recoveries met the established recovery criterion. No qualification of the data is necessary based on LCS results.

Other quality control. Because of matrix interference, the %D between the two GC columns exceeded the established limit for most compounds resulting in the "P" laboratory data flag. The laboratory was not consistent in assigning the "P" qualifier to corresponding data points between columns 1 and 2. In some cases, the "P" qualifier was reported with the data from only one column. All data from both columns exceeding the %D criteria should be qualified by the laboratory. The affected data were qualified as estimated.

Because of interferences causing overlapping chromatography, the laboratory did not report Form 1 data for oxychlordane or cis-chlordane for several batches. The data should be reported as uncertain nondetects at the QL.

3.5.4 Metals Analyses of Fish Tissue Samples

As part of the CRERP Phase 2 RI, fish tissue samples from several sites in the Tennessee River system were analyzed for selected metals. The analyses were performed to characterize the extent of metals contamination in important fish species (i.e., largemouth bass, bluegill, catfish, and shad) and to determine future sampling sites and analysis activities. The analyses were completed by the TVA ECHEM Laboratory in Chattanooga, Tennessee according to SOW-0008 and SOW-0021.

For this project, 425 fish tissue samples were analyzed for arsenic, beryllium, copper, Hg, and selenium. Along with these samples, 308 QC samples, (131 calibration blank solutions, 44 LCSs, 46 MBs, and 87 MSs) were analyzed. The results were reported in $\mu\text{g/L}$ and included in 44 individual batches numbered 40 through 99. The samples were analyzed according to the CRERP SOW for TVA Biocontaminant Study for Metals Analysis.

After the samples were collected, they were stored in a locked, walk-in freezer in Norris, Tennessee. Later, the samples were transferred to Chattanooga, Tennessee, and stored in a freezer

facility until they were ready for preparation and analysis. Arsenic, beryllium, copper, and selenium were analyzed by GFAA and mercury was analyzed by cold vapor atomic absorption (CVAA).

Holding times and preservation. Conformance to holding time and sample preservation requirements was reviewed. The samples were collected during the spring and fall of 1993 and in the spring of 1994. A six-month holding time is usually applied to solid samples analyzed for metals, and preservation requirements are refrigeration at $4 \pm 2^{\circ}$ C or freezing. These samples were frozen from the time of collection until the time of preparation for analysis. Because there are no regulatory guidelines pertaining to holding times for biota samples, the data should be accepted without qualification based on holding time and sample preservation criteria. There were no sample shipping, receipt, or integrity problems noted in any of the data packages.

Calibration. A calibration curve consisting of a blank and at least three standards was required at the beginning of each regular GFAA and CVAA analytical run. To be acceptable, the calibration curve correlation coefficient should be ≥ 0.995 . Beryllium and copper were analyzed by GFAA using a blank and at least three standards. Mercury was analyzed by CVAA using a blank and at least three standards. The correlation coefficients for each of these elements in every DRG were reviewed. The following deviation was identified:

DRG #77: The correlation coefficient (0.99448) for beryllium did not meet the acceptance criteria. The results for beryllium in this particular analytical run should be qualified as estimated (J) with a qualifier code of D08 (correlation coefficient was < 0.995).

Due to the matrix, the laboratory was required to deviate from normal procedure for the analysis of arsenic and selenium. The laboratory used the Method of Standard Additions (MSA). MSA is used to analyze samples where the sample matrix has a significant effect on the slope of the calibration curve, an effect that is different for each sample. To perform determinations using this method, the sample and sample aliquots to which known amounts of the analyte of interest have been added are analyzed. The absorbance of the sample and of the sample aliquots with standard added are used to determine the slope of the calibration curve. This slope plus the absorbance of the sample allows the concentration of the analyte in the sample to be calculated. MSA criteria require a correlation coefficient of ≥ 0.995 in order to produce accurate results. An examination of the data showed the samples listed in the following table failed to meet the correlation coefficient criteria of ≥ 0.995 . The table also provides a listing of the deviations noted in each DRG.

DRG number	Element	Sample numbers
41	Arsenic	2122, QMSP04101, QMSD04101, 2128, 2129, 2131
42	Arsenic	2088, 2089
43	Arsenic	2036, 2037, 2104
44	Arsenic	2050, 2053
45	Arsenic	QMSP04501
46	Arsenic	2171, 2173, QMSD04601
47	Arsenic	2139
48	Arsenic	2145, 2153, 2154, 2155
50	Arsenic	QMTB05001
51	Arsenic	2006
53	Arsenic	2014
54	Arsenic	QLCS505401
60	Arsenic	QMSP06001
61	Arsenic	2368
77	Arsenic	C001062
86	Arsenic	2653, 2658
86	Selenium	2656, QMSD08601
88	Selenium	2602
91	Arsenic	2400, 2401, 2404, 2588, 2589, QMSP09191
92	Arsenic	2425, QMSP09201
92	Selenium	2407, 2408, 2426, QLCS09201
93	Arsenic	2434
93	Selenium	2435
94	Arsenic	2441, QMSD09401
95	Arsenic	6754
95	Selenium	2478, 2483
96	Arsenic	2501
96	Selenium	2481, 2501, QLCS090601
97	Arsenic	2513, 2519, QMSD09701
97	Selenium	2503, 2504, 2506, 2507
98	Arsenic	2511, 2520, 2523, 2524, QMSD09801
98	Selenium	2511, 2521
99	Selenium	QLCS09901

The samples listed should be qualified estimated. A qualifier code of E05 (correlation coefficient was < 0.995) should accompany the qualifier flags.

Initial calibration verification (ICV). Immediately following instrument calibration, an ICV standard was analyzed to verify that the instrument was properly calibrated. Acceptable recoveries are 90% to 100% for GFAA and 80% to 120% for CVAA analyses. The following deviations were noted and are listed by DRG:

DRG #59: The ICV recovery for beryllium was 64%. The samples associated with this ICV should have their results qualified as estimated, if the results are greater than the MDL. If the results are less than the MDL, the results should be qualified as not detected, associated value uncertain (UJ). A qualifier code of D03 (ICV recovery was below the lower control limit) should accompany the qualifier flags.

DRG #61: The ICV recovery for arsenic was 82%. The samples associated with this ICV should have their results qualified as estimated, if the results are greater than the MDL. If the results are less than the MDL, the results should be qualified as not detected, associated value uncertain (UJ). A qualifier code of D03 (ICV recovery was below the lower control limit) should accompany the qualifier flags.

Continuing calibration verification (CCV). To monitor instrument performance throughout the analytical run, CCV standards are analyzed after every 20 injections or every 2 hours, whichever is more frequent. Acceptable recoveries are 90% to 110% for GFAA and 80% to 120% for CVAA analyses. The following table provides a listing of the deviations noted in each DRG.

DRG number	Element	CCV %R	Qualifier code
40	Arsenic	88	D05
41	Arsenic	124	D04
42	Arsenic	114	D04
43	Arsenic	114	D04
47	Arsenic	114, 120	D04
48	Arsenic	116, 120, 118	D04
49	Arsenic	74, 88, 76	D05
51	Arsenic	84	D05
52	Arsenic	88	D05
53	Arsenic	86	D05
54	Arsenic	88, 86	D05
55	Arsenic	86, 88	D05
60	Selenium	89	D05
62	Arsenic	84	D05
63	Arsenic	82	D05
76	Arsenic	122	D04
87	Arsenic	118	D04
87	Arsenic	86	D05
87	Selenium	88	D05
88	Selenium	82	D05
89	Selenium	114	D04
90	Arsenic	128, 126, 126, 124	D04

DRG number	Element	CCV %R	Qualifier code
91	Arsenic	88	D05
92	Arsenic	116, 118, 118	D04
92	Selenium	114	D04
93	Arsenic	86, 82	D05
93	Beryllium	88	D05
93	Selenium	88	D05
93	Selenium	118	D04
94	Arsenic	114	D04
94	Selenium	78, 88, 88	D05
95	Selenium	118	D04
96	Arsenic	84	D05
96	Selenium	82	D05
97	Arsenic	118	D04
97	Selenium	116	D04
98	Arsenic	86	D05
98	Arsenic	124	D04
98	Selenium	82	D05
99	Selenium	82	D05

The results for these elements in the samples associated with the CCV that showed unacceptable recovery should be qualified as estimated (J), if the result is greater than the MDL. If the result is less than the MDL, the data should be qualified as not detected, associated value uncertain (UJ). The appropriate qualifier codes of D04 (CCV recovery was above the upper control limit) or D05 (CCV was below the lower control limit) should accompany the qualifier flags.

Blanks. MBs as well as instrument blanks were analyzed in each DRG. All blank results were reviewed and found to be below the MDL. No qualification of the data is necessary based on this criterion.

Laboratory Duplicates. The acceptance criteria applied to qualification of the data is 35% RPD. All duplicate RPDs were <35%; therefore, no qualification of the data is necessary based on this criteria.

Matrix spikes. A control limit of 75 to 125% recovery was used in evaluating matrix spike recovery. Matrix spike recovery for each DRG was reviewed. The following table provides a listing of the deviations noted.

DRG number	Element	Matrix spike %R	Qualifier code
41	Arsenic	59	I02
42	Beryllium	130	I01
43	Beryllium	130	I01
44	Arsenic	38	I02
44	Beryllium	160	I01

DRG number	Element	Matrix spike %R	Qualifier code
45	Arsenic	70	I02
45	Beryllium	160	I01
46	Arsenic	140	I01
46	Beryllium	150	I01
47	Arsenic	130	I01
52	Beryllium	145	I01
53	Arsenic	50	I02
53	Beryllium	150	I01
54	Beryllium	130	I01
55	Arsenic	140	I01
56	Beryllium	165	I01
63	Beryllium	60	I02
64	Beryllium	152	I01
76	Arsenic	138	I01
76	Beryllium	148	I01
77	Beryllium	154	I01
86	Arsenic	74	I02
87	Beryllium	190	I01
87	Copper	190	I01
87	Selenium	189	I01
88	Arsenic	158	I01
88	Beryllium	150	I01
88	Selenium	72	I02
89	Selenium	69	I02
90	Beryllium	126	I01
90	Selenium	166	I01
91	Beryllium	128	I01
92	Beryllium	146	I01
93	Arsenic	174	I01
94	Beryllium	182	I01
95	Arsenic	74	I02
95	Beryllium	164	I01
95	Copper	126	I01
96	Beryllium	158	I01
97	Beryllium	156	I01
98	Arsenic	54	I02
99	Beryllium	128	I01

Samples with results greater than the MDL should be qualified as estimated (J). Samples with results less than the MDL should be qualified as not detected, associated value uncertain (UJ). As appropriate, a qualifier code of I01 (matrix spike recovery was above the upper control limit) or I02 (matrix spike recovery was below the lower control limit) should accompany the qualifier flags.

Laboratory control samples. The laboratory used a tissue pool sample for an LCS. One LCS should be analyzed for every matrix in each batch of 20 samples or less. The acceptance criteria used by the laboratory was 75% to 125% recovery. The exceptions are noted in the following table.

DRG number	Element	LCS %R	Qualifier code
56	Selenium	126	P01
67	Selenium	59	P02
77	Selenium	74	P02
86	Hg	127	P01
90	Hg	130	P01
91	Selenium	176	P01
96	Selenium	70	P02
98	Selenium	71	P02
99	Selenium	59	P02

The results associated with the LCSs listed in the table should be qualified as estimated (J), if they are greater than the MDL. If the results are less than the MDL, they should be qualified as not detected, associated value uncertain (UJ). As appropriate, qualifier codes of P01 (LCS recovery was above upper control limit) or P02 (LCS recovery was below lower control limit) should accompany the qualifier flags.

Other quality control. It was noted that the fish tissue samples were to be analyzed for arsenic, beryllium, copper, mercury, and selenium. It was noted that copper was not reported in the following DRGs: 42 through 52, 56 through 59, and 61 through 67.

Results for all samples were reported on a wet weight basis. No corrections or manipulation of the analytical results were made for moisture or any other generic factors.

3.5.5 Semivolatiles Analyses of Fish Tissue Samples

Semivolatiles analyses of 10 fish samples were conducted at Southwest Research Institute by gas chromatography using mass spectrometry detection. The samples were prepared by sonication extraction. The samples were analyzed in accordance with EPA CLP Method OLM01.8 and SOW-0052.

Sample integrity. There are no regulatory holding times for biological samples. The samples were received frozen by the laboratory. The samples were analyzed within 40 days of extraction. Shipping and receipt were acceptable for these samples. No qualification of the data was necessary based on this criteria.

Initial calibration. All initial calibration results were within the control limits of <30% relative standard deviation (RSD). No qualification of the data was necessary based on this criteria.

Calibration checks. All calibration check results were within the control limits of 75 to 125%. No qualification of the data was necessary based on this criteria.

Instrument tuning. Instrument tuning results are all acceptable. No qualification of the data was necessary based on this criteria.

Blanks. Diethylphthalate was detected in the MB at 35 µg/kg and bis(2-Ethylhexyl)phthalate was detected in the MB at 45 µg/kg. There were four positive results in the MB for tentatively identified compounds. All positive results in the samples for the two target compounds detected in the MB were <10× the MB level and were, therefore, qualified as not detected at the associated level (U) and the contract required quantitation limit (CRQL) was reported as appropriate. Qualifier codes of F01 and F06 accompanies the qualifier flags.

Internal standards. All sample chrysene-d12 and perylene-d12 internal standard areas were <50% of the continuing calibration standard areas for chrysene-d12 and perylene-d12. This required all analyte results associated with internal standards chrysene-d12 and perylene-d12 for all samples to be qualified as estimated (J) or not detected, associated value uncertain (UJ). A qualifier code of K01 should accompany the qualifier flags.

Surrogate spikes. Terphenyl-d14 recovery was slightly above the upper control limit for samples PC01C62, PC01C62MS, PC01C63, PC01C64, PC01C65, PC01C66, PC01C68, and PC01C69. Terphenyl-d14 was quantitated using internal standard chrysene-d12, which had areas less than 50% of the continuing calibration standard. Therefore, the terphenyl-d14 results were artificially high. Based on professional judgement, no qualification of the data was necessary based on this criteria.

Matrix spikes. All matrix spike recoveries were acceptable except for the pyrene value for the matrix spike of 179%, which exceeded the upper control limit. As a result, the relative percent difference value for pyrene was 38%, which also exceeded the control limit. Pyrene was also quantitated for the matrix spike sample using internal standard chrysene-d12, which had an area of <50% of the continuing calibration standard. Therefore, the pyrene result for the matrix spike analysis was artificially high. Based on professional judgement, no qualification of the data was necessary based on this criteria.

Laboratory control samples. All laboratory control sample recoveries were within acceptable quality control limits. No qualification of the data was necessary based on this criteria.

3.5.6 Mercury Analyses of Blue Heron and Related Tissue Samples

Mercury analyses of blue heron and related tissue samples (75 liver, 75 muscle, 82 feather, 51 egg, 28 fish, and 9 rinsate) were conducted at Southwest Research Institute by CVAA spectrometry. The samples were prepared by acid digestion. The samples were analyzed by EPA Method 245.5 in accordance with CLP ILM02.0 protocol and SOW-0041, SOW-049, and SOW-196.

Sample integrity. There are no regulatory holding times established for biological samples. Shipping, receipt, and preservation were acceptable for these samples. No qualification of the data was necessary based on this criteria.

Initial calibration. All initial calibration results were within the control limits of 80 to 120%. No qualification of the data was necessary based on this criteria.

Calibration checks. All calibration checks were within the control limits of 80 to 120%. No qualification of the data was necessary based on this criteria.

Blanks. Preparation blanks and instrument blanks were analyzed. For batches KC013L, KC013M, and KC013F, only one preparation blank was analyzed for 27 samples. For batch KE010E, only one preparation blank was analyzed for 25 samples. Since all the required initial and continuing calibration blanks were analyzed and no contamination was detected in the blanks, no qualification of the data based on this criteria is recommended.

Lab duplicates. There are no control limits established for laboratory duplicate RPD for biological samples. The control limit for soil of 35% was used. One laboratory duplicate should be analyzed for each batch of 20 samples or less. For batch 01-5125-006, only one laboratory duplicate sample was analyzed for 24 muscle samples and only one laboratory duplicate sample was analyzed for 30 feather samples. For batches KC013L and KC013M, only one laboratory duplicate sample was analyzed for 27 samples. For batch KE010E only one laboratory duplicate sample was analyzed for 25 samples. No qualification of data is recommended based on these deviations.

For batch 5855, the mercury RPD result of 133.7% required 14 positive feather results to be qualified as estimated (J). For batch 5856, the mercury RPD result of 41.1% required 11 positive feather results to be qualified as estimated (J). Qualifier codes of J01 should accompany these qualifier flags. All other laboratory duplicate results for mercury were acceptable.

Matrix spikes. The matrix spike recovery control limits were 75 to 125%. One matrix spike sample should be analyzed for each batch of 20 samples or less. For batch 01-5125-006, only one matrix spike sample was analyzed for 24 muscle samples and only one matrix spike sample was analyzed for 30 feather samples. For batches KC013L, KC013M, and KC013F, only one matrix spike sample was analyzed for 27 samples. For batch KE010E, only one matrix spike sample was analyzed for 25 samples. No qualification of data is recommended based on these deviations.

For batch 01-5125-006, the matrix spike recovery of 148% required all 30 positive feather results to be qualified as estimated (J). A qualifier code of I01 should accompany the qualifier flags.

For batch KC013M, the matrix spike recovery of 32.2% required all 27 results to be qualified as estimated (J) or not detected, associated value uncertain (UJ). A qualifier code of I02 should accompany the qualifier flags.

For batch KE010E, the matrix spike recovery of 70.0% required all 25 egg results to be qualified as estimated (J) or not detected, associated value uncertain (UJ). A qualifier code of I02 should accompany the qualifier flags.

For batch 5855, the matrix spike recovery of 61.0% required all 6 egg results to be qualified as estimated (J) or not detected, associated value uncertain (UJ). A qualifier code of I02 should accompany the qualifier flags.

For batch 5856, the matrix spike recovery of 150.0% required all 11 positive feather results to be qualified as estimated (J). A qualifier code of I01 should accompany the qualifier flags. All other matrix spike results for Hg were acceptable.

Laboratory control samples. LCS results were not reported for batch 01-5125-006, which consisted of 24 liver, 24 muscle, and 30 feather samples. For batches KC013L and KC013M, only one LCS was analyzed for 27 samples. No qualification of data is recommended for this lack of LCS results. All reported laboratory control sample recoveries for Hg were acceptable. No qualification of the data was necessary based on this criteria.

3.5.7 Metals Analyses of Blue Heron and Related Tissue Samples

Arsenic and chromium analyses of blue heron and related tissue samples (51 liver, 51 muscle, 52 feather, 51 egg, 28 fish, and 9 rinsate) were conducted at Southwest Research Institute by GFAA spectrometry. The samples were prepared by acid digestion. The samples were analyzed by EPA Methods 206.2 and 218.2, respectively, in accordance with EPA CLP ILM02.0 and ILM03.0 protocol.

Sample integrity. There are no regulatory holding times established for biological samples. Shipping, receipt, and preservation are all acceptable for these samples. No qualification of the data was necessary based on this criteria.

Initial calibration. All initial calibration results were within the control limits of 90 to 110% except for one arsenic value of 89.6%. Based on professional judgment, no qualification of the data was necessary based on this criteria.

Calibration checks. All calibration verification checks were within the control limits of 90 to 110%. No qualification of the data is necessary based on this criteria.

Blanks. For batches KC013L, KC013M, and KC013F, only one preparation blank was analyzed for 27 samples. For batch KE010E, only one preparation blank was analyzed for 25 samples. Since the required initial and continuing calibration blanks were analyzed, no qualification of the data is recommended based on this criteria.

For batch KC013L, the highest arsenic concentration was an initial calibration blank value of 1.8 µg/L, which converts to an action level of 225.0 µg/kg. This required four positive liver arsenic results to be qualified as not detected at the associated level (U) for samples KC013L, KC014L, KC015L, and KC016L. A qualifier code of F06 [concentration of the contaminant was detected at a level below the contract required detection limit (CRDL)] should accompany the qualifier flags.

For batch KC013L, the highest chromium concentration was a continuing calibration blank of 2.4 µg/L, which converts to an action level of 300.0 µg/kg. This required all 27 positive liver chromium results from batch KC013L to be qualified as not detected at the associated level (U). A qualifier code of F06 (concentration of the contaminant was detected at a level below the CRDL) should accompany the qualifier flags.

For batch KC013M, the highest arsenic concentration was a continuing calibration blank value of 1.5 µg/L, which converts to an action level of 187.5 µg/kg. This required seven positive arsenic results to be qualified as not detected at the associated level (U) for samples KC013M, KC014M, KC015M, KC016M, LA501M, LC513M, and LC514M. A qualifier code of F06 (concentration of the contaminant was detected at a level below the CRDL) should accompany the qualifier flags.

For batch KC013M, the highest chromium concentration was the preparation blank value of 36.0 µg/kg, which converts to an action level of 180.0 µg/kg. This required 22 chromium results to be qualified as not detected at the associated level (U) for all samples in batch KC013M except KC025M, LC515M, LC516M, LC519M, and LC523M. Qualifier codes of F01 (sample data were qualified as a result of the MB) and F06 (concentration of the contaminant was detected at a level below the CRDL) should accompany the qualifier flags.

For batch KC013F, the highest arsenic concentration was a continuing calibration blank value of 1.3 µg/L, which converts to an action level of 650.0 µg/kg. This required all 20 positive arsenic results in this batch to be qualified as not detected at the associated level (U). A qualifier

code of F06 (concentration of the contaminant was detected at a level below the CRDL) should accompany the qualifier flags.

For batch KC013F, the highest chromium concentration was the preparation blank value of 207.0 $\mu\text{g/kg}$, which converts to an action level of 1035.0 $\mu\text{g/kg}$. This required chromium results in the batch to be qualified as not detected at the associated level (U) for all samples except samples KC018F and LC514F. Qualifier codes of F01 (sample data were qualified as a result of the MB) and F06 (concentration of the contaminant was detected at a level below the CRDL) should accompany the qualifier flags.

For batch KE010E, the highest arsenic concentration was an initial calibration blank value of 1.2 $\mu\text{g/L}$, which converts to an action level of 150.0 $\mu\text{g/kg}$. This required the arsenic result for sample LE515E in this batch to be qualified as not detected at the associated level (U). A qualifier code of F06 (concentration of the contaminant was detected at a level below the CRDL) should accompany the qualifier flags.

For batch KE010E, the highest chromium concentration was the preparation blank value of 80.5 $\mu\text{g/kg}$, which converts to an action level of 400.25 $\mu\text{g/kg}$. This required all 25 positive chromium results in this batch to be qualified as not detected at the associated level (U). Qualifier codes of F01 (sample data were qualified as a result of the MB) and F06 (concentration of the contaminant was detected at a level below the CRDL) should accompany the qualifier flags.

For batch AFSH1, the highest arsenic concentration was an initial calibration blank value of 3.1 $\mu\text{g/L}$, which converts to an action level of 387.5 $\mu\text{g/kg}$. This required all 14 positive arsenic results in this batch to be qualified as not detected at the associated level (U). A qualifier code of F06 (concentration of the contaminant was detected at a level below the CRDL) should accompany the qualifier flags.

For batch AFSH1, the highest chromium concentration was the preparation blank value of 71.75 $\mu\text{g/kg}$, which converts to an action level of 358.75 $\mu\text{g/kg}$. This required all the chromium results for samples in this batch to be qualified as not detected at the associated level (U) except for samples KFSH2, KN004, MFSH1, MN004, and MN020. Qualifier codes of F01 (sample data were qualified as a result of the MB) and F06 (concentration of the contaminant was detected at a level below the CRDL) should accompany the qualifier flags.

Blank results for all other sample batches were acceptable and therefore, no other results require qualification.

Lab duplicates. There are no control limits established for laboratory duplicate RPD for biological samples. The established control limit for soil of 35% RPD was used. For batches KC013L and KC013M, only one laboratory duplicate was analyzed for 27 samples. For batch KE010E, only one laboratory duplicate was analyzed for 25 samples. No qualification of the data is recommended for these less than 5% frequencies for laboratory duplicate analysis.

The hard copy data package for batch KC013M stated there was "insufficient sample for analysis" for sample LC515M. For batch 5849, there was no laboratory duplicate analyzed because of insufficient sample quantity. No qualification of data is recommended for these deviations.

For batch 5855, the chromium laboratory duplicate precision for feather matrix was 42.5%. This required all 14 feather chromium results in this batch to be qualified as estimated (J). A qualifier code of J01 (duplicate RPD was outside the control limit) should accompany the qualifier flag.

For batch 5856, the chromium laboratory duplicate precision for feather matrix was 48.0% and for liver matrix was 75.4%. This required all chromium results for feather and liver samples in

this batch to be qualified as estimated (J). A qualifier code of J01 (duplicate RPD was outside the control limit) should accompany the qualifier flags.

For batch 5858, the chromium laboratory duplicate precision was 62.9%. This required all 20 chromium results in this batch to be qualified as estimated (J). A qualifier code of J01 (duplicate RPD was outside the control limit) should accompany the qualifier flags.

For batch 5859, the chromium laboratory duplicate precision was 190.2%. This required all 19 chromium results in this batch to be qualified as estimated (J). A qualifier code of J01 (duplicate RPD was outside the control limit) should accompany the qualifier flags.

All other laboratory duplicate results for arsenic and chromium were acceptable.

Matrix spikes. The matrix spike recovery control limits were 75 to 125%. For batches KC013L, KC013M, and KC013F, only one matrix spike sample was analyzed for 27 samples. For batch KE010E, only one matrix spike sample was analyzed for 25 samples. No qualification of data is recommended for the lack of proper matrix spike sample analysis frequency for these batches.

For batch KC013L, the arsenic matrix spike recovery was 58.6%. This required all 27 arsenic results in this batch to be qualified as estimated (J) or not detected, associated value uncertain (UJ). A qualifier code of I02 (matrix spike recovery was below the lower control limit) should accompany the qualifier flags.

For batch KC013M, the arsenic matrix spike recovery was 64.0%. This required all 26 arsenic results reported in this batch to be qualified as estimated (J) or not detected, associated value uncertain (UJ). A qualifier code of I02 (matrix spike recovery was below the lower control limit) should accompany the qualifier flags.

For batch KC013F, the arsenic matrix spike recovery was 72.8%. This required all 27 arsenic results in this batch to be qualified as estimated (J) (matrix spike recovery was below the lower control limit) or not detected, associated value uncertain (UJ). A qualifier code of I02 should accompany the qualifier flags.

For batch AFSH1, the arsenic and chromium matrix spike recoveries were 52.6% and 125.6%, respectively. This required all 19 arsenic results and all 19 chromium results in this batch to be qualified as estimated (J) or not detected, associated value uncertain (UJ). As appropriate, qualifier codes of I01 (matrix spike recovery was above the upper control limit) and I02 (matrix spike recovery was below the lower control limit) should accompany the qualifier flags.

For batch 5855, the chromium matrix spike recovery for the feather matrix was 151.0%. This required all 14 chromium results for the feather matrix in this batch to be qualified as estimated (J). A qualifier code of I01 (matrix spike recovery was above the upper control limit) should accompany the qualifier flags.

For batch 5856, the arsenic matrix spike recovery for feather matrix was 143.2%. This did not require qualification of data since all the arsenic results for this batch were non-detects.

For batch 5856, the chromium matrix spike recoveries for muscle and liver were 876.6% and 67.0%, respectively. This required all 7 muscle and all 2 liver chromium results in this batch to be qualified as estimated (J). As appropriate, qualifier codes of I01 (matrix spike recovery was above the upper control limit) and I02 (matrix spike recovery was below the lower control limit) should accompany the qualifier flags.

For batch 5859, the chromium matrix spike recovery was 0%. All 19 chromium results in this batch to be qualified as unusable (R). A qualifier code of I03 (matrix spike recovery was <30%) should accompany the qualifier flags.

All other matrix spike results for arsenic and chromium were acceptable.

Laboratory control samples. LCS recovery control limits have been set by EPA for solid matrices (soil). The EPA control limits for soil matrix were applied to these samples when available. The LCS recovery control limits for aqueous samples is 80 to 120% and have been applied to these samples when solid matrix LCS recovery results were not available for a particular batch.

LCS results were not reported for batch 01-5125-006, which consisted of 24 liver, 24 muscle, and 30 feather samples. No qualification of the data is recommended for this lack of LCS results. For batches KC013L and KC013M, only one LCS was analyzed for 27 samples. No qualification of the data is recommended for the less than 5% frequency of LCS analysis for these batches.

For batch KC013L, the aqueous LCS recoveries for arsenic and chromium were 75.7% and 148.7%, respectively. This required all 27 arsenic results and all 27 chromium results in this batch to be qualified as estimated (J) or not detected, associated value uncertain (UJ). As appropriate, qualifier codes of P02 (LCS recovery was below the lower control limit) or P01 (LCS recovery was above the upper control limit) should accompany the qualifier flags.

For batch KC013M, the aqueous LCS recovery for arsenic was 64.0%. This required all 26 arsenic results reported in this batch to be qualified as estimated (J) or not detected, associated value uncertain (UJ). A qualifier code of P01 (LCS recovery was above the upper control limit) should accompany the qualifier flags.

No other qualification of the data for LCS recovery is required.

3.5.8 PCB Aroclor and Congener Analyses of Blue Heron and Related Tissue Samples

PCB aroclor and congener analyses of blue heron and related tissue samples (67 liver, 76 muscle, 72 fat, 68 egg, 28 fish, and 3 rinsate for PCB aroclors and 50 liver, 52 muscle, 48 fat, 51 egg, 28 fish, and 3 rinsate for PCB congeners) were conducted at Southwest Research Institute by gas chromatography using electron capture detection. The samples were prepared by soxhlet extraction. The samples were analyzed in accordance with EPA Contract Laboratory Protocol (CLP) Method OLM01.8. The PCB aroclor and PCB congener quality control data are discussed together in this section since they were analyzed by the same method and much of the quality control data is commonly applicable.

Sample integrity. There are no regulatory holding times for biological sample matrices. Shipping and receipt are acceptable for these samples. The samples were received frozen by the laboratory. No qualification of the data was necessary based on this criteria.

Initial calibration. All initial calibration results were within the control limits of <20% relative standard deviation (RSD). No qualification of data was necessary based on this criteria.

Calibration checks. All calibration checks were within the control limits of 75 to 125%. No qualification of data was necessary based on this criteria.

Blanks. Both method (preparation) and instrument blank samples were analyzed according to the method quality control requirements. Blank information was not available for batch 01-5125-006. No qualification of data is recommended for this lack of reported blank information. There was no blank contamination reported for these samples. No qualification of data was necessary based on this criteria.

Surrogate recoveries. The advisory control limits for surrogate spike recovery values were 60 to 150%. For surrogate recoveries >150%, a validation qualification code of G01 (surrogate recovery was above the upper control limit) should be assigned. For surrogate recoveries <60%, a validation qualification code of G02 (surrogate recovery was below the lower control limit) should be assigned. For surrogate recoveries <10%, a validation qualification code of G03 (surrogate recovery was <10%) should be assigned. For surrogate recoveries of zero, a validation qualification code of G04 (surrogate recovery was zero) should be assigned.

For batch LIVER, 60 out of 172 surrogate recoveries were less than the lower advisory control limit. This required all results for samples KC013LMS, KC013LMSD, KC014L, KC014LMS, KC014LMSD, KC015L, KC016L, KC018L, KC019L, KC022L, LC512L, LC515L, LC516L, LC517L, LC518L, and LC523L to be qualified as estimated (J) or not detected, associated value uncertain (UJ). For sample KC016L, the tetrachlorometaxylene recoveries were 0%. However based on professional judgement, only the decachlorobiphenyl surrogate recoveries were considered since it is the surrogate most similar to the PCB aroclors. No qualification of the data was necessary because of this deviation. This will hold true for all the results reported in this section.

For batch MUSCLE, 27 out of 172 surrogate recoveries were less than the lower advisory control limit. This required all results for samples KC013M, KC014M, KC015M, KC016M, KC026M, LC513M, LC514M, and LC523M to be qualified as estimated (J) or not detected, associated value uncertain (UJ).

For batch FATS, 58 out of 308 surrogate recoveries were outside the advisory control limits. This required all results for samples KC014AF, KC017AF, KC022AF, LC514AF, and LC521AF to be qualified as estimated (J) or not detected, associated value uncertain (UJ); all positive results for samples KC013AF, KC018AF, KC021AF, KC023AF, KC024AF, KC025AF, KC026AF, LC512AF, LC513AF, LC515AF, LC516AF, LC517AF, LC518AF, LC519AF, LC520AF, LC522AF, and LC523AF to be qualified as estimated (J); and all positive results to be qualified as estimated (J) and all non-detect results to be qualified as unusable (R) for sample KC015AF.

For batch EGG, 130 out of 204 surrogate recoveries were less than the lower advisory control limit. This required all results for samples KE010E, KE016E, KE017E, KE018E, KE019E, KE020E, KE021E, LE519E, and LE520E to be qualified as estimated (J), and all positive results to be qualified as estimated (J) and all non-detect results to be qualified as unusable (R) for samples KE011E, KE012E, KE013E, KE014E, KE015E, KE022E, LE509E, LE510E, LE511E, LE512E, LE513E, LE514E, LE515E, LE516E, LE517E, and LE518E.

For batch FISH, 60 out of 104 surrogate recoveries were less than the lower advisory control limit. This required all results for samples FS501, FS506, FS512, FS513, KFSH1, KFSH2, KN020, LN006, LONG1, LOON1, LOON3, and MN004 to be qualified as estimated (J) or not detected, associated value uncertain (UJ), and all positive results to be qualified as estimated (J) and all non-detects to be qualified as unusable (R) for sample FS012.

For batch RINSA, 4 out of 16 surrogate recoveries were less than the lower advisory control limit. This required all results for samples R#2 and R#3 to be qualified as estimated (J/UJ).

For batch 5838, 73 out of 176 surrogate recoveries were outside advisory control limits. This required all results for samples B0510, B0514, B0516, and B0518 to be qualified as estimated (J) or not detected, associated value uncertain (UJ), and all positive results for samples B0512, B0520, B0522, B0524, B0528, B0536, B0538, B0540, B0544, B0546, and B0548 to be qualified as estimated (J).

For batch 5839, 70 out of 160 surrogate recoveries were outside advisory control limits. This required all results for samples B0550, B0552, B0554, B0556, B0560, and B0595 to be qualified as estimated (J) or not detected, associated value uncertain (UJ); all positive results for samples B0587, B0591, B0592, B0598, B0599, B0600, B0602, B0603, B0606, B0609, B0610, and B0611 to be qualified as estimated (J); and all positive results to be qualified as estimated (J) and all non-detects to be qualified as unusable (R) for sample B0558.

For batch 5842, 32 out of 148 surrogate recoveries were greater the upper advisory limit. This required all positive results for samples B0616, B0617, B0618, B0619, B0620, B0624, B0626, B0627, B0629, B0630, B0633, B0638, and B0639 to be qualified as estimated (J).

For batch 5844, 23 out of 136 surrogate recoveries were outside advisory control limits. This required all positive results for samples B0645, B0649, B0659, B0661, B0674, and B0675 to be qualified as estimated (J), and all positive results to be qualified as estimated (J) and all non-detects to be qualified as unusable (R) for sample B0656.

For batch 5846, 53 out of 148 surrogate recoveries were outside control limits. This required all results for samples B0686 and B0691 to be qualified as estimated (J) or not detected, associated value uncertain (UJ), and all positive results for samples B0676, B0678, B0683, B0684, B0685, B0687, B0690, B0695, B0697, B0700, B0701, B0702, B0706, and B0707 to be qualified as estimated (J).

For batch 5860, 17 out of 52 surrogate recoveries were greater than the upper control limit. This required all positive results for samples B0708, B0709, B0710, B0711, B0712, B0714, and B0716 to be qualified as estimated (J).

Matrix spikes. There are no established control limits for matrix spike recovery or matrix spike/matrix spike duplicate recovery RPD for biological samples. The matrix spike recoveries for these samples varied widely due to matrix interference. The laboratory control sample recoveries were much less variable, thus proving a matrix interference problem. This matrix interference problem also manifested itself in the surrogate spike recoveries, which required extensive qualification of data. Since considerable amounts of data were qualified for surrogate spike recoveries that were outside control limits, matrix spike data were only qualified if a matrix spike recovery was less than 10%. In cases where matrix spike recoveries were less than 10%, the applicable results were qualified as estimated (J) for positive results and as unusable (R) for non-detects, and a validation qualification code of H03 (MS/MSD recovery was <10%) was assigned. This qualification of data was only applied to the original samples which were spiked for the matrix spike analyses.

For batch FATS, the results for congeners #166 and #169 in sample KC017AF were qualified as estimated (J). For batch EGGS, the result for congener #169 in sample KE017E was qualified as unusable (R) and the results for congeners in sample LE512E were qualified as follows: #105 (R), #138 (J), #166 (R), #156 (R), #169 (R), and #189 (R). For batch 5839, the result for congener #105 in sample B0556 was qualified as unusable (R) and the result for congener #156 in sample B0556 was qualified as estimated (J). For batch 5842, the result for congener #105 in sample B0619 was qualified as unusable (R).

Laboratory control samples. There are no established LCS analysis recovery control limits for PCB analysis. The reported LCS recoveries ranged from 70 to 95% for PCB aroclors and from 72 to 168% for PCB congeners. The largest LCS recovery values for PCB congeners were probably due to individual congeners being quantitated in calibration samples from non-coeluting peaks and being quantitated for the LCS sample analyses as a coelution peak with another target PCB congener. No qualification of data was necessary.

3.5.9 Metals Analyses of Mayfly Tissue Samples

Arsenic, lead, mercury, silver, and zinc analyses of nine mayfly samples were conducted at Southwest Research Institute by GFAA spectrometry, CVAA spectrometry, and inductively coupled plasma/atomic emission spectroscopy. The samples were prepared by acid digestion. The samples were analyzed by EPA Methods 206.2, 239.2, 245.5, 272.2, and 200.7, respectively.

Sample integrity. There are no regulatory holding times for biota. Shipping and receipt are acceptable for these samples. The samples were received frozen by the laboratory. No qualification of the data was necessary based on this criteria.

Initial calibration. All initial calibration results were within the control limits of 90 to 110% for metals and 80 to 120% for Hg. No qualification of the data was necessary based on this criteria.

Calibration checks. All calibration check results were within the control limits of 90 to 110% for metals and 80 to 120% for Hg. No qualification of the data was necessary based on this criteria.

Blanks. No contamination was detected for the blanks. No qualification of the data was necessary based on this criteria.

Lab duplicates. There are no established control limits for laboratory duplicate RPD for biota. The control limit for soil of 35% was used. For arsenic, lead, Hg, and silver, the RPDs were 7.6%, 18.6%, 5.2%, and 0.9%, respectively. The RPD for silver was not applicable since both values were non-detects. No qualification of data was necessary based on this criteria.

Matrix spikes. Matrix spike percent recovery ranged from 92.0% to 114.9%, compared to the control limits of 75 to 125%. No qualification of the data was necessary based on this criteria.

Laboratory control samples. LCS percent recovery ranged from 83.1% to 95.0%, compared to the control limits of 80 to 120%. No qualification of the data was necessary based on this criteria.

3.5.10 PCB Aroclor Analyses of Mayfly Tissue Samples

PCB aroclor analyses of nine mayfly samples were conducted at Southwest Research Institute by GC using an ECD. The samples were prepared by soxhlet extraction. The samples were analyzed in accordance with EPA CLP Method OLM01.8.

Sample integrity. There are no regulatory holding times for biological samples. Shipping and receipt are acceptable for these samples. The samples were received frozen by the laboratory. No qualification of the data was necessary based on this criteria.

Initial calibration. All initial calibration results were within the control limits of <20% relative standard deviation (RSD). No qualification of the data was necessary based on this criteria.

Calibration checks. All calibration checks were within the control limits of 75 to 125%. No qualification of the data was necessary based on this criteria.

Blanks. No contamination was detected in the blanks. No qualification of the data was necessary based on this criteria.

Surrogate spikes. Three surrogate spike recovery values were outside the control limits of 60 to 150%. The tetrachlorometaxylene percent recovery on gas chromatography column 1 was 55% for sample B0002, 56% for sample WF001A, and 59% for sample WF001B. Based on professional judgement, no qualification of the data was necessary based on this criteria.

Matrix spikes. No PCB aroclor matrix spike recoveries were reported on a Form 3. The PCB congener matrix spike recoveries ranged from 75% to 125%. No qualification of the data was necessary based on this criteria.

Laboratory control samples. No PCB aroclor laboratory control sample recoveries were reported on a Form 3. PCB congener laboratory control sample percent recoveries ranged from 100% to 115%. No qualification of the data was necessary based on this criteria.

3.5.11 PCB Congener Analyses of Mayfly Tissue Samples

PCB congener analyses of nine mayfly samples were conducted at Southwest Research Institute by GC using an ECD. The samples were prepared by soxhlet extraction. The samples were analyzed in accordance with EPA CLP Method OLM01.8.

Sample integrity. There are no regulatory holding times for biological samples. Shipping and receipt are acceptable for these samples. The samples were received frozen by the laboratory. No qualification of the data was necessary based on this criteria.

Initial calibration. All initial calibration results were within the control limits of < 20% relative standard deviation (RSD). No qualification of data was necessary based on this criteria.

Calibration checks. All calibration checks were within the control limits of 75 to 125%. No qualification of data was necessary based on this criteria.

Blanks. No contamination was detected for the MBs. No qualification of data was necessary based on this criteria.

Surrogate spikes. Three surrogate spike recovery values were slightly outside the control limits of 60 to 150%. The tetrachlorometaxylene percent recovery on gas chromatography column 1 was 55% for sample B0002, 56% for sample WF001A, and 59% for sample WF001B. Based on professional judgement, no qualification of data was necessary based on this criteria.

Matrix spikes. The PCB congener matrix spike recoveries ranged from 75% to 125%. No qualification of data was necessary based on this criteria.

Laboratory control samples. PCB congener laboratory control sample percent recoveries ranged from 100% to 115%. No qualification of data was necessary based on this criteria.

3.5.12 Mercury Analyses of Fish Tissue Samples

Mercury analyses of fish tissue samples were conducted at Southwestern Research Institute (SWRI). The samples were prepared and analyzed in accordance with the protocol outlined in the *USEPA Method 415.2*. Quality control criteria followed *USEPA CLP SOW for Inorganic Analysis, Multi-Media, Multi-Concentration*, ILM03.0. Six sample batches containing 105 samples were processed.

Holding times. All samples were received intact. Preparation holding times are not specified for biota samples. All samples remained frozen until preparation. All samples were analyzed within analysis holding times after preparation.

Calibration. All initial and continuing calibration criteria were met. No qualification of the data is necessary based on initial or continuing calibration.

Blanks. All reported MBs were free of contamination. No qualification of the data is necessary.

Matrix spikes. Two MS recoveries failed to meet the established recovery (high-batch B0291, low-batch B0311). All deviations were caused by matrix interferences. The associated data should be qualified as estimated.

Laboratory duplicates. Three duplicate samples failed to meet the established relative percent difference criterion (batches B0291, B0331, B0351). All deviations were caused by matrix interferences. The associated data should be qualified as estimated.

Laboratory control samples. SRM 1566a (Oyster Tissue) was used as the LCS. All LCS recoveries met the established criterion. No qualification of the data is necessary.

3.5.13 Polychlorinated Biphenyl Aroclor and Congener Analyses of Fish Tissue Samples

PCB aroclor and congener analyses of fish tissue samples were conducted at SWRI. A GC with an ECD performed analysis of the TCL PCBs and congeners. The samples were extracted and analyzed in accordance with the protocol outlined in the *USEPA CLP SOW for Organic Analysis, Multi-Media, Multi-Concentration*, OLM01.8 and SWRI Standard Operating Procedure (SOP) 01-06-26, *PCB Aroclor/Congener Analysis*. Six sample batches containing 105 samples were processed.

Holding times. All samples were received intact. Extraction holding times are not specified for biota samples. All samples remained frozen until extraction. Analysis holding times were met.

Calibration. All initial and continuing calibration criteria were met. No qualification of the data is necessary.

Blanks. All reported method and instrument blanks were free of contamination. No qualification of the data is necessary.

Surrogate spikes. Because of matrix interference, the percentage of TCX and DCB surrogate recoveries that failed to comply with the upper acceptance limit was 30%. The associated data should be qualified as estimated.

congener MS/MSD summary. All other congener MS/MSD recoveries except for batch B0251 exhibited both low and high recoveries. All deviations were caused by matrix interferences. The associated data should be qualified as estimated.

Laboratory control samples. All aroclor LCS recoveries met the established recovery criterion. No qualification of aroclor data is necessary based on LCS results. Batch B0331 did not report congener LCS summary. All other congener LCS recoveries exhibited both low and high recoveries. All deviations were caused by matrix interferences. The associated data should be qualified as estimated.

Other quality control. Because of matrix interference, the %D between the two GC columns exceeded the established limit for some compounds resulting in the "P" laboratory data flag. The affected data should be qualified as estimated.

3.5.14 Mercury Analyses of Mink Tissue Samples

Mercury analyses of mink tissue samples were conducted at SWRI. The samples were prepared and analyzed in accordance with the protocol outlined in the *USEPA Method 415.2*. Quality control criteria followed *USEPA CLP SOW for Inorganic Analysis, Multi-Media, Multi-Concentration, ILM03.0*. The following samples were processed: three sample batches containing 50 hair samples, five sample batches containing 85 kidney samples, three sample batches containing 50 liver samples, two sample batches containing 35 carcass samples.

Holding times. All samples were received intact. Preparation holding times are not specified for biota samples. Batch MC053K was received partially frozen because of evaporation of the dry ice during shipment. The associated data should be qualified as estimated. All other samples remained frozen until preparation. All samples were analyzed within analysis holding times after preparation.

Calibration. All initial and continuing calibration criteria were met. No qualification of the data is necessary based on initial or continuing calibration.

Blanks. All reported MBs were free of contamination. No qualification of the data is necessary.

Matrix spikes. Three MS recoveries failed to meet the established recovery (high-batch MC01H, low-batches MA031K, MC053K). All deviations were caused by matrix interferences. The associated data should be qualified as estimated.

Laboratory duplicates. Two duplicate samples failed to meet the established relative percent difference criterion (batches MC01H, MA01K). All deviations were caused by matrix interferences. The associated data should be qualified as estimated.

Laboratory control samples. SRM 1566a (Oyster Tissue) was used as the LCS. All LCS recoveries met the established criterion. No qualification of the data is necessary.

3.5.15 Polychlorinated Biphenyl Aroclor and Congener Analyses of Mink Tissue Samples

PCB aroclor and congener analyses of mink tissue samples were conducted at SWRI. A GC with an ECD performed analysis of the TCL PCBs and congeners. The samples were extracted and analyzed in accordance with the protocol outlined in the *USEPA CLP SOW for Organic Analysis, Multi-Media, Multi-Concentration, OLM01.8* and SwRI Standard Operating Procedure (SOP) 01-06-26, PCB

in accordance with the protocol outlined in the *USEPA CLP SOW for Organic Analysis, Multi-Media, Multi-Concentration*, OLM01.8 and SWRI Standard Operating Procedure (SOP) 01-06-26, *PCB Aroclor/Congener Analysis*. The following samples were processed: three sample batches containing 49 fat samples, one sample batch containing 20 hair samples, five sample batches containing 85 liver samples, two sample batches containing 35 carcass samples.

Holding times. All samples were received intact. Extraction holding times are not specified for biota samples. All samples remained frozen until extraction. Analysis holding times were met.

Calibration. All initial and continuing calibration criteria were met. No qualification of the data is necessary.

Blanks. All reported method and instrument blanks were free of contamination. No qualification of the data is necessary.

Surrogate spikes. Because of matrix interference, the percentage of TCX and DCB surrogate recoveries that failed to comply with the acceptance limits was >90% for the fat, liver, and carcass samples. The associated data should be qualified as estimated. Surrogate recoveries for the hair samples were acceptable.

Matrix spikes and matrix spike duplicates. All aroclor MS/MSD recoveries met the established recovery criterion. Congener MS/MSD recoveries exhibited low recoveries and/or high MSD RPD in batches MC01A, MA01B, ME02A, ME01L, MA01L, and ME022L. All deviations were caused by matrix interferences. The associated data should be qualified as estimated.

Laboratory control samples. All LCS recoveries met the established recovery criterion. No qualification of the data is necessary based on LCS results.

Other quality control. Because of matrix interference, the %D between the two GC columns exceeded the established limit for some compounds resulting in the "P" laboratory data flag. The affected data should be qualified as estimated.

3.5.16 Radiological Analyses of Waterfowl Tissue Samples

As part of the CRERP Phase 2 RI, 45 waterfowl samples from the Clinch River-Watts bar reservoir system were analyzed for various radiological parameters. Ten Canadian geese and five wood duck bone samples were analyzed for ^{90}Sr . Ten Canadian geese and five wood duck muscle samples were analyzed for ^{99}Tc , isotopic uranium, and isotopic plutonium. In addition, 11 Canadian geese and four wood duck liver samples were analyzed for ^{99}Tc , isotopic uranium, and isotopic plutonium. The analyses were completed by the TMA Eberline Laboratory, Oak Ridge, Tennessee, according to CRERP laboratory SOW-219-A. The results for these samples were reported in five separate sample delivery groups (Nos. 94-02-055, 94-02-056, 94-02-057, 94-02-058, and 94-02-059).

The ^{90}Sr activities were determined by gas flow proportional counting using the modified EML Method SR-02. The ^{99}Tc activities were determined by liquid scintillation counting using the modified EML Method TC-01. The isotopic uranium activities were determined by alpha spectrometry using the modified EML Method U-02. The isotopic plutonium activities were determined by alpha spectrometry using the modified EML Method PU-02. These procedures were not available for review.

through October 13, 1993, and were submitted to the laboratory on February 15, 1994. A 6-month holding time is usually applied to solid samples analyzed for radionuclides and preservation requirements are refrigeration at $4 \pm 2^\circ\text{C}$ or freezing. These samples were frozen from the time of collection until the time of preparation for analysis. Because there is no regulatory holding time limit for biota samples, the data should be accepted without qualification based on holding time and sample preservation criteria. There were no sample shipping, receipt, or integrity problems noted in any of the data packages.

Calibration. As required by SOW-219-A, calibration standard and background control charts were submitted as a single supplemental data package upon completion of the entire work order group rather than being included within each data package. The supplemental data package was not available for review, therefore, it was assumed during the review that the initial instrument calibrations and continuing calibration verification checks were acceptable. Other applicable quality assurance/quality control information included in the data packages indicated that the analyses were in control. No qualification of the data is necessary based on these criteria.

Blanks. In each analytical sequence, the laboratory analyzed the required MBs to monitor procedural and system performance. The blanks for all determinations in all data packages were less than the MDA and therefore, no qualifications of these data are necessary based on these criteria.

Chemical recovery. The ^{90}Sr , isotopic uranium, and isotopic plutonium analyses use either carriers or chemical tracers in completing the determinations. According to SOW-219-A, recoveries of 50-110% are considered acceptable.

In SDG No. 94-02-055, the chemical tracer recovery for the isotopic plutonium analyses was low for samples A0011M, A0041M, A0051M, 2001M, 2011M, 2021M, and 2031M. The chemical recoveries were 45.7%, 45.7%, 44.6%, 26.9%, 43.4%, 46.1%, and 44.6%, respectively. The isotopic plutonium results for these samples should be qualified estimated (J) if the result was greater than the MDA or as not detected, associated value uncertain (UJ) if the result was less than the MDA. A qualifier code of G02 (radiological chemical recovery was below the lower control limit) should accompany the qualifier flags.

In SDG No. 94-02-055, the ^{90}Sr carrier recoveries were high for samples A0011M and 2041M. The chemical recoveries were 111% and 116%, respectively. As a result, the ^{90}Sr results for these samples should be qualified as estimated (J) if the result was greater than the MDA or as not detected, associated value uncertain (UJ) if the result was less than the MDA. A qualifier code of G01 (radiological chemical recovery was above the upper control limit) should accompany the qualifier flags.

In SDG No. 94-02-056, the ^{90}Sr carrier recoveries for samples A002B, 200B, 204B, 1996, 1999, and 2005 were 112%, 116%, 114%, 124%, 119%, and 120%, respectively. The ^{90}Sr results for these samples should be qualified as estimated (J) if the result was greater than the MDA or as not detected, associated value uncertain (UJ) if the result was less than the MDA. A qualifier code of G01 (radiological chemical recovery was above the upper control limit) should accompany the qualifier flags.

In SDG No. 94-02-057, the chemical tracer recovery for the isotopic plutonium analyses was low for samples A0011L, A0021L, A0031L, A0041L, and 2001L. The chemical recoveries were 47.7%, 29.2%, 46.6%, 35.3%, and 36.1%, respectively. The isotopic plutonium results for these samples should be qualified estimated (J) if the result was greater than the MDA or as not detected, associated value uncertain (UJ) if the result was less than the MDA. A qualifier code

of G02 (radiological chemical recovery was below the lower control limit) should accompany the qualifier flags.

In SDG No. 94-02-057, the chemical tracer recovery for ^{99}Tc for sample A0021L was 119%. The ^{99}Tc result for this sample should be qualified as estimated (J) if the result was greater than the MDA or as not detected, associated value uncertain (UJ) if the result was less than the MDA. A qualifier code of G01 (radiological chemical recovery was above the upper control limit) should accompany the qualifier flag.

In SDG No. 94-02-057, the chemical tracer recovery for isotopic uranium for sample A0031L was 41.2%. The isotopic uranium results for this sample should be qualified as estimated (J) if the results were greater than the MDA or as not detected, associated value uncertain (UJ) if the results were less than the MDA. A qualifier code of G01 (radiological chemical recovery was above the upper control limit) should accompany the qualifier flag.

In SDG No. 94-02-058, the isotopic uranium chemical tracer recovery was low for sample 19951 (49.4%). The isotopic uranium results for this sample should be qualified as estimated (J) if the results were greater than the MDA or as not detected, associated value uncertain (UJ) if the results were less than the MDA. A qualifier code of G02 (radiological chemical recovery was below the lower control limit) should accompany the qualifier flags.

In SDG No. 94-02-58, the isotopic plutonium chemical tracer recovery was low for samples 19921, 19951, 19981, 20041, and 20071. The recoveries were 42.3%, 43.4%, 35.3%, 39.4%, and 44.5%, respectively. The isotopic plutonium results for these samples should be qualified estimated (J) if the results were greater than the MDA or as not detected, associated value uncertain (UJ) if the results were less than the MDA. A qualifier code of G02 (radiological chemical recovery was below the lower control limit) should accompany the qualifier flags.

In SDG No. 94-02-59, the chemical tracer yields for all determinations were within control limits. Therefore, no qualification of the data in this SDG is necessary based on these criteria.

Matrix spikes. For solid matrices, matrix spike acceptance limits of 70-130% recovery are used. The recoveries for each SDG were reviewed. Deviations are listed as follows:

In SDG No. 94-02-055, the ^{90}Sr matrix spike recovery was 132%. The ^{90}Sr results should be qualified as estimated (J) if the result was greater than the MDA or as not detected, associated value uncertain (UJ) if the result was less than the MDA. A qualifier code of H01 (matrix spike recovery was above the upper control limit) should accompany the qualifier flags.

In SDG No. 94-02-056, the ^{90}Sr matrix spike recovery was 60%. The ^{90}Sr results should be qualified as estimated (J) if the result was greater than the MDA or as not detected, associated value uncertain (UJ) if the result was less than the MDA. A qualifier code of H02 (matrix spike recovery was below the lower control limit) should accompany the qualifier flags.

In SDG Nos. 94-02-055, 94-02-058, and 94-02-059, the ^{235}U matrix spike recoveries were low. The recoveries were 68%, 27%, and 66%, respectively. However, based on professional judgement, no qualification of the ^{235}U results should be applied because of this deviation.

All other recoveries in all other SDGs were within acceptance limits. Therefore, no other qualifications of the data are necessary based on this criteria.

Duplicates. As required by SOW-219-A, duplicate samples are to be analyzed for every matrix in each batch of 20 samples or less. For analyses with DERs >1, the results should be qualified as

estimated (J) for samples with results greater than the MDA or as not detected, associated value uncertain (UJ) for samples with results less than the MDA. A qualifier code of J01 (radiological DER was outside the control limit) should accompany the qualifier flags. The following analyses had DERs >1:

In SDG No. 94-02-055, the ^{238}Pu , ^{90}Sr , ^{234}U , and ^{238}U results should be qualified.

In SDG No. 94-02-057, the ^{238}Pu and ^{99}Tc results should be qualified

Laboratory control samples. When evaluating LCS data, one LCS should be analyzed for every matrix in each batch of 20 samples or less. Control limits of 80-120% recovery for aqueous matrices and 70-130% recovery for solid matrices are applied.

In SDG Nos. 94-02-058 and 94-02-059, the ^{235}U LCS recoveries were 47% and 152%, respectively. However, based on professional judgement, no qualification of the ^{235}U results should be applied because of this deviation.

The recoveries for all other LCSs in all other SDGs were within acceptance limits. Therefore, no qualification of the data is necessary based on this criteria.

Other quality control. Results for all samples are reported in activity per gram as received. No corrections or manipulation of the analytical results were made for moisture or any other generic factors. It was noted that because of limited sample mass, reanalyses were not possible for samples of these types.

The laboratory was required to deviate from normal procedure for the ^{90}Sr analyses by weighing the bone samples then muffling at 600°C to destroy residual organic matter. After destruction of the organic matter, the samples were digested in mixed acids. The percent recovery for the matrix spike was low. The ^{90}Sr data should be qualified as appropriate. See also the discussion under matrix spikes.

For the isotopic uranium determinations, sample aliquots were weighed and muffled at 600°C to remove organic matter. The residual ash was digested in mixed acids, chromatography column separated, and counted by alpha spectroscopy. No problems were noted during the analytical process. These samples did not contain any significant uranium activity.

For the isotopic plutonium determinations, chemical tracer yields of less than 50% were noted. The isotopic plutonium data should be qualified as appropriate. See also the discussion under chemical recovery. No other problems were noted during the analytical process. These samples did not contain any significant plutonium activity. The results for the ^{239}Pu include ^{240}Pu in that the alpha energy emission is essentially the same and not resolvable by alpha spectroscopy.

For the ^{99}Tc determinations, the laboratory noted that the analyses were difficult because of the organic matrix of the samples. Acceptable matrix spike yields were obtained through strong oxidation of the sample prior to chloroform extraction. Because every sample is analyzed in replicate using a matrix spike to determine yield, a matrix spike was not analyzed for ^{99}Tc . No other problems were noted during the analytical process.

Those results that require no qualification and are less than the MDA should be qualified as not detected (U).

3.5.17 Radiological Analyses of Waterfowl Tissue Samples

As part of the CRERP Phase 2 RI, 20 waterfowl samples (Canadian geese bone and muscle) from the Clinch River—Watts Bar Reservoir system were analyzed for various radiological parameters. The bone samples were analyzed for ^{90}Sr . The muscle samples were analyzed for ^{99}Tc , isotopic uranium, and isotopic plutonium. The analyses were completed by the Y-12 Plant Analytical Services Organization, Oak Ridge, Tennessee, according to CRERP laboratory SOW-048B. The results for these samples were reported in sample delivery group No. 236092.

The ^{90}Sr activities were determined by gas flow proportional counting using Y-12 Plant ASO analytical procedure Y/P65-7196. The ^{99}Tc activities were determined by liquid scintillation counting using Y-12 Plant ASO analytical procedure Y/P65-7154. The isotopic uranium and isotopic plutonium activities were determined by alpha spectrometry using analytical procedure Y/P65-7161.

Samples WF-0017, WF-0019, WF-0021, WF-0023, WF-0025, WF-0001, WF-0004, WF-0007, WF-0010, and WF-0013 were analyzed for isotopic uranium, isotopic plutonium, and technetium-99. Samples WF-0036, WF-0037, WF-0038, WF-0039, WF-0040, WF-0003, WF-0006, WF-0009, WF-0012, and WF-0015 were analyzed for ^{90}Sr .

Holding times and preservation. Conformance to holding time and sample preservation requirements was reviewed. These samples were collected on June 28, 1994 and July 9, 1994. The ^{90}Sr determinations were completed on September 15, 1994 and September 16, 1994. The ^{99}Tc determinations were completed on September 22, 1994. The isotopic uranium determinations were completed on September 6, 1994. The isotopic plutonium determinations were completed on September 2, 1994 and September 12, 1994. A 6-month holding time is usually applied to solid samples analyzed for radionuclides, and preservation requirements are refrigeration at $4 \pm 2^\circ\text{C}$ or freezing. Because these samples were analyzed within six months of collection and because there is no regulatory holding time limit for biota samples, the data should be accepted without qualification based on holding time and sample preservation criteria. There were no sample shipping, receipt, or integrity problems noted in the data package.

Calibration. Control charts and other applicable quality assurance/quality control information included in the data package indicated that the analyses were in control. The ^{90}Sr and ^{99}Tc continuing calibration information was acceptable. No qualification of the data is necessary based on these criteria.

Blanks. In each analytical sequence, the laboratory analyzed the required MBs to monitor procedural and system performance. The blanks for the ^{99}Tc , isotopic uranium, and isotopic plutonium determinations were less than the MDA and therefore, no qualifications of these data are necessary. The ^{90}Sr blank was outside the laboratory's 3-sigma standard deviation control limit. As a result, the ^{90}Sr results for samples WF-0003 and WF-0006 should be qualified as estimated (J) with a qualifier code of F01 (sample data were qualified as a result of the MB). Because the remaining ^{90}Sr sample results were less than the MDA, these should be qualified as not detected, associated value uncertain (UJ) with a qualifier code of F01 (sample data were qualified as a result of the MB).

Chemical recovery. The ^{90}Sr , isotopic uranium, and isotopic plutonium analyses use either carriers or chemical tracers in completing the determinations. Generally, recoveries of 50-100% are considered acceptable. However, lower recoveries may be typical for some matrices and the acceptable lower limit may be lowered in such instances. For these analyses, acceptance limits of 50-100% were used.

For ^{90}Sr samples WF-0036, WF-0037, WF-0039, WF-0003, WF-0006, and WF-0015, the carrier recoveries were 37.5%, 42.5%, 32.5%, 48.3%, 35.4%, and 33.8%, respectively. The results for samples WF-0003 and WF-0006 should be qualified as estimated (J) with a qualifier code of G02 (radiological chemical recovery was below the lower control limit). Because the results for samples WF-0036, WF-0037, WF-0039, and WF-0015 were less than the MDA, these data should be qualified as not detected, associated value uncertain (UJ) with a qualifier code of G02 (radiological chemical recovery was below the lower control limit).

The isotopic uranium chemical tracer recoveries were all within acceptance limits, ranging from 61.8 to 89.4%. Therefore, no qualification of the data is necessary based on these criteria.

For isotopic plutonium samples WF-0019, WF-0021, WF-0023, WF-0004, WF-0007, and WF-0010, the chemical recoveries were 34.8%, 32.3%, 40.9%, 34.3%, 34.2%, and 38.0%, respectively. The ^{238}Pu result for sample WF-0023 should be qualified as estimated (J) with a qualifier code of G02 (radiological chemical recovery was below the lower control limit). Because the ^{238}Pu results for samples WF-0019, WF-0021, WF-0004, WF-0007, and WF-0010 were less than the MDA, these data should be qualified as not detected, associated value uncertain (UJ) with a qualifier code of G02 (radiological chemical recovery was below the lower control limit). The $^{239/240}\text{Pu}$ result for sample WF-0019 should be qualified as estimated (J) with a qualifier code of G02 (radiological chemical recovery was below the lower control limit). Because the results for samples WF-0021, WF-0023, WF-0004, WF-0007, and WF-0010 were less than the MDA, these should be qualified as not detected, associated value uncertain (UJ) with a qualifier code of G02 (radiological chemical recovery was below the lower control limit).

Matrix spikes. Because the ^{90}Sr , isotopic uranium, and isotopic plutonium analyses use either carriers or chemical tracers, no matrix spike recovery checks are employed for these determinations. The matrix spike recovery for the ^{99}Tc analysis was reviewed. For solid matrices, matrix spike acceptance limits of 70-130% recovery are used. The ^{99}Tc matrix spike recovery was 143%. For this reason, and since all ^{99}Tc results were non detects, the results should be qualified as not detected, associated value uncertain (UJ) with a qualifier code of H01 (matrix spike recovery was above the upper control limit).

Duplicates. As required by SOW-048B, duplicate samples are to be analyzed for every matrix in each batch of 20 samples or less. The ^{99}Tc , isotopic plutonium, and ^{90}Sr original and duplicate sample results were less than the MDA. The DER for the detected ^{238}U isotope was within limits. Therefore, no qualification of the data is necessary.

Laboratory control samples. When evaluating LCS data, one LCS should be analyzed for every matrix in each batch of 20 samples or less. Control limits of 80-120% recovery for aqueous matrices and 70-130% recovery for solid matrices are applied.

The recovery for the ^{90}Sr LCS was 66.7%. The ^{90}Sr results for samples WF-0003 and WF-0006 should be qualified as estimated (J) with a qualifier code of P02 (LCS recovery was below the lower control limit). Because the results for samples WF-0036, WF-0037, WF-0038, WF-0039, WF-0040, WF-0009, WF-0012, and WF-0015 were less than the MDA, these data should be qualified as not detected, associated value uncertain (UJ) with a qualified code of P02 (LCS recovery was below the lower control limit).

The recovery for the ^{99}Tc LCS was 78.9%. Therefore, no qualification of the ^{99}Tc data is necessary based on these criteria.

The recovery for the ^{234}U LCS was 111.7%. The recovery for the ^{238}U LCS was 97.6%. Therefore, no qualification of the isotopic uranium data is necessary based on these criteria.

Two ^{239}Pu LCSs were analyzed. The recoveries were 113.9% and 95.9%. Therefore, no qualification of the isotopic plutonium data is necessary based on these criteria.

Other quality control. The laboratory reported that in the analysis of these samples, there were no deviations from procedure, and there were no technical or administrative problems encountered. Copies of the control charts for each determination were included in the data package. These showed that the analytical processes were in control at the time of the analysis of these samples.

The isotopic uranium results require no qualification. Those results that are less than the MDA should be qualified as not detected (U). It was noted that the laboratory reported results for the ^{232}U isotope on the Form 1 results form. The ^{232}U isotope was used for the chemical tracer spiking purposes and should not have been reported on this form. These data were not included in the CR-ERP data base.

3.5.18 Metals Analyses of Waterfowl Tissue Samples

Metals analyses of 55 waterfowl tissue samples (liver and muscle) were conducted at EcoTek Laboratory Services, Incorporated, Atlanta, Georgia. Cadmium, nickel, and selenium were analyzed by ICP, chromium and lead by GFAA, and mercury by CVAA. The samples were analyzed in accordance with the protocol outlined in the *U.S. EPA CLP SOW for Inorganic Analysis*, ILM02.1. The samples were processed and reported in one batch identified as EcoTek SDG No. 31708 under laboratory SOW 219B.

Holding times. The samples in this SDG were collected on the following dates: 06/21/91, 08/20/91, 09/25/93, 09/26/93, 10/02/93, and 10/13/93. The samples were received at the laboratory on 02/15/94. The samples were frozen from the time of collection until the time of preparation for analysis. All samples were received at the laboratory intact and frozen. Because no regulatory holding time for the metals analysis of biota samples exists, no qualification of the data is necessary based on this criteria.

Calibration. The laboratory employed the appropriate calibration sequences (i.e., proper number of standards and frequency). All initial and continuing calibration checks were within acceptance limits. The calibration curve correlation coefficients for chromium and lead by GFAA and Hg by CVAA were all >0.995 . No qualification of the data is necessary based on this criteria.

Blanks. On 04/08/94, the preparation blank analyzed for lead exhibited contamination. The results for lead in samples that were analyzed on this date that were less than the action level and greater than the instrument detection limit (IDL) should be qualified as not detected at the associated level (U). Qualifier codes of F01 (sample data were qualified as a result of the MB) and as appropriate, F06 (concentration of the contaminant was detected at a level below the CRDL) or F07 (concentration of the contaminant was detected at a level less than the action level, but greater than the CRDL) should accompany the qualifier flags.

On all dates that chromium was analyzed, the preparation blank exhibited contamination. The results for chromium in the samples that were less than the action level and greater than the IDL should be qualified as not detected at the associated level (U). Qualifier codes of F01 (sample data

were qualified as a result of the MB) and F06 (concentration of the contaminant was detected at a level below the CRDL) should accompany the qualifier flags.

On 05/13/94, one of the continuing calibration blank (CCB) checks for Hg exhibited contamination. The results for Hg for samples A002L, A004M, 200L, and 200M should be qualified as not detected at the associated level (U) because of this problem. A qualifier code of F06 (concentration of the contaminant was detected at a level below the CRDL) should accompany the qualifier flag.

Matrix spikes. The matrix spike percent recovery did not meet acceptance criteria for Hg and lead. The recoveries were 51.8% and 67.5%, respectively. The results for these elements for samples that were prepared and analyzed on the same date as the matrix spiked samples (002-L, 002-M, 003-L, 003-M, 004-L, 004-M, 006-M, 007-L, 007-M, 008-L, 008-M, 009-L, 009-M, 012-L, 012-M, 013-L, 014-L, and 014-M) should be qualified. If the result was positive, the result should be qualified as estimated (J). If the result was not detected, the result should be qualified as not detected, associated value uncertain (UJ). A qualifier code of I02 (matrix spike recovery was below the lower control limit) should accompany the qualifier flags.

Other quality control. Laboratory duplicate relative percent differences (RPDs) and ICP serial dilution percent differences were all within acceptance limits.

Chromium for sample 204L was determined by the method of standard additions (MSA). Had this sample not been qualified as not detected at the associated level (U) because of preparation blank contamination, the result would have been estimated (J). A qualifier code of E05 (correlation coefficient was <0.995) would accompany the qualifier flag.

Concerning the effect on the data if more than 20 samples are reported in a batch, the following comments are provided. This data package reported the results for 55 tissue samples. This should have no effect on the data since the laboratory followed procedure and provided sufficient QA/QC data (i.e., several preparation blanks, duplicates, matrix spikes, etc.). The samples were prepared and analyzed in small batches (i.e., 20 samples or less). During review, all of the QA/QC information associated with each batch were considered and recommendations as to appropriate qualification of the data were made.

3.5.19 Mercury Analyses of Waterfowl Tissue Samples

Mercury analyses of 10 waterfowl (Canada geese) muscle tissue samples were conducted at Southwest Research Institute, San Antonio, Texas. The samples were analyzed for Hg by CVAA in accordance with the protocol outlined in the *U.S. EPA CLP SOW for Inorganic Analysis*, ILM02.1. The samples were processed and reported in one batch identified as SWRI SDG No. WF0026, CR-ERP SDG No. 5862 under laboratory SOW 048A.

Holding times. The samples in this SDG were collected on 06/28/94 and 07/09/94. The samples were received at the laboratory on 08/25/94. The samples were frozen from the time of collection until the time of preparation for analysis. All samples were received at the laboratory intact and frozen. However, in a laboratory login nonconformance, it was noted that no custody seals were present. This deviation should not affect the integrity of the data. Because no regulatory holding time for the extraction and analysis of biota samples exists, no qualification of the data is necessary based on holding time criteria.

Calibration. The laboratory employed the appropriate calibration sequences (i.e., proper number of standards and frequency). All initial and continuing calibration checks were within acceptance limits. The calibration curve correlation coefficient was >0.995 . No qualification of the data is necessary based on this criteria.

Blanks. All reported method and instrument blanks were free of contamination. No qualification of the data is necessary based on this criteria.

Matrix spikes. The matrix spike percent recovery was in the acceptable range. No qualification of the data is necessary based on this criteria.

Other quality control. The laboratory duplicate RPD LCS recovery were within acceptance limits. No qualification of the data is necessary based on these criteria.

3.5.20 Polychlorinated Biphenyl Aroclors Analyses of Waterfowl Tissue Samples

PCB aroclors analysis of seven waterfowl (wood duck, green-backed heron, and Canada geese) muscle tissue samples were conducted at EcoTek Laboratory Services, Incorporated, Atlanta, Georgia. A GC equipped with an ECD performed analysis of the TCL PCB aroclors. The samples were extracted and analyzed in accordance with the protocol outlined in the *U.S. EPA CLP SOW for Organic Analysis, Multi-Media, Multi-Concentration, 3/90*. The samples were processed and reported in one batch identified as EcoTek SDG No. 1992, Lab Login No. 31708 under laboratory SOW 219B.

Holding times. The samples in this SDG were collected on the following dates: 06/21/91, 08/20/91, 09/25/93, 09/26/93, 10/02/93, and 10/13/93. The samples were received at the laboratory on 02/15/94. The samples were frozen from the time of collection until the time of preparation for analysis. All samples were received at the laboratory intact and frozen. Because no regulatory holding time for the extraction and analysis of biota samples exists, no qualification of the data is necessary based on this criteria.

Calibration. Chromatography was performed on a DB-608 and an RTX-1701 column using a temperature program suitable for resolving the target analytes. Quantitation of sample concentrations was performed using a single-point calibration on both columns. The column check percent difference criteria was exceeded for Aroclor 1260 in sample 1998 and for Aroclor 1254 in samples 2001 and 2003. The results for these compounds should be qualified as estimated (J) with a qualifier code of M08 (the %D between the two pesticide/PCB column checks was $>25\%$).

Blanks. All reported method and instrument blanks were free of contamination. No qualification of the data is necessary based on this criteria.

Surrogate spikes. Sample 2003 exhibited surrogate recovery above acceptance limits. Aroclors 1254 and 1260 in this sample should be qualified as estimated (J) with a qualifier code of G01 (surrogate recovery was above the upper control limit).

Matrix spikes and matrix spike duplicates. The matrix spike/matrix spike duplicate percent recovery was exceeded for Aroclor 1260. This compound was not detected in the unspiked sample, therefore, no qualification of the data is necessary based on this criteria.

Other quality control. All appropriate quality control samples were analyzed with the sample batch.

3.5.21 Pesticide/Polychlorinated Biphenyl Aroclor Analyses of Waterfowl Tissue Samples

Pesticide/PCB aroclors analysis of 10 waterfowl (Canada geese) muscle tissue samples were conducted at Southwest Research Institute, San Antonio, Texas. A GC equipped with an ECD performed analysis of the TCL pesticides/PCB aroclors. The samples were extracted and analyzed in accordance with the protocol outlined in the *U.S. EPA CLP SOW for Organic Analysis, Multi-Media, Multi-Concentration*, OLM01.8. The samples were processed and reported in one batch identified as SWRI SDG No. WF-0002, CRERP SDG No. 5861 under laboratory SOW 048A.

Holding times. The samples in this SDG were collected on 06/28/94 and 07/09/94. The samples were received at the laboratory on 08/25/94. The samples were frozen from the time of collection until the time of preparation for analysis. All samples were received at the laboratory intact and frozen. However, in a laboratory login nonconformance, it was noted that no custody seals were present. This deviation should not affect the integrity of the data. Because no regulatory holding time for the extraction and analysis of biota samples exists, no qualification of the data is necessary based on holding time criteria.

Calibration. Chromatography was performed on a DB-1701 and a DB-17 column using a temperature program suitable for resolving the target analytes. Quantitation of sample concentrations was performed using a single-point calibration on both columns. The initial calibration for the pesticide/PCB analyses reported a relative standard deviation (RSD) >20% for endosulfan II and methoxychlor. Because all sample results for endosulfan II and methoxychlor were non-detects, these results should be qualified as not detected, associated value uncertain (UJ) with a qualifier code of C09 (RSD criteria were not met). The percent difference between calibration factors for the continuing calibration were all within the 25% acceptance criteria limit.

Blanks. All reported method and instrument blanks were free of contamination. No qualification of the data is necessary based on this criteria.

Surrogate spikes. Surrogate recoveries were below the lower control limit for all samples. Low recoveries indicate a possible low bias in the sample results. Because the sample results for all target compounds were non-detects, these should be qualified as not detected, associated value uncertain (UJ) with a qualifier code of G02 (surrogate recovery was below the lower control limit).

Matrix spikes and matrix spike duplicates. Due to inadequate sample volumes, no matrix spike/matrix spike duplicate analyses could be performed. Instead, a preparation blank matrix spike (laboratory control sample) analysis was performed. Four compounds out of six exhibited low recoveries. Gamma-BHC, heptachlor, aldrin, and dieldrin recoveries were below the lower control limit but >10%. Because all sample results for these compounds were non-detects, these should be qualified as not detected, associated value uncertain (UJ) with a qualifier code of P02 (LCS recovery was below the lower control limit).

Other quality control. Instrument performance criteria and GPC and florisil recoveries were within acceptance criteria.

Appendix C

ELECTRONIC QUALITY CONTROL EVALUATIONS

Clinch River Remedial Investigation - Phase II
Data Validation - Holding Times
For Organics - Report 1

12:35 Wednesday, August 16, 199

MATRIX	ANALYTE GROUP	DRG	SAMPLE	SAMPLE DATE	EXTRACT DATE	ANALYZE DATE	EXTRACT HOLD	CPEBT	NODEPEBT	ANALYZE HOLD	CPAHT	NODEAHT	PREVIOUS QUALS	ASSIGNED QUAL
SE	PFCB	A402007	50838	31JAN1994	02MAR94	25FEB94	14	30	16	40	18	.	-[J]	J
FW	PFCB	L2657	52884	08AUG1994	18AUG94	26JUL94	7	10	3	40	22	.	.	J
FW	PFCB	L2657	52894	08AUG1994	18AUG94	24SEP94	7	10	3	40	37	.	.	J
FW	PFCB	L2657	52904	08AUG1994	18AUG94	24SEP94	7	10	3	40	37	.	.	J
WS	PFCB	L2910	16467	07SEP1994	12SEP94	26OCT94	.	.	.	40	44	4	.	J
WS	PFCB	L2910	16488	07SEP1994	12SEP94	26OCT94	.	.	.	40	44	4	.	J
WS	PFCB	L2910	16500	07SEP1994	12SEP94	26OCT94	.	.	.	40	44	4	.	J
WS	PFCB	L2910	16501	07SEP1994	12SEP94	26OCT94	.	.	.	40	44	4	.	J
WS	PFCB	L2910	16514	08SEP1994	12SEP94	26OCT94	.	.	.	40	44	4	.	J
WS	PFCB	L2910	16545	08SEP1994	12SEP94	26OCT94	.	.	.	40	44	4	.	J
WS	PFCB	L2910	16559	08SEP1994	12SEP94	26OCT94	.	.	.	40	44	4	.	J
WS	PFCB	L2910	16560	08SEP1994	12SEP94	26OCT94	.	.	.	40	44	4	.	J
WS	PFCB	L2910	16573	08SEP1994	12SEP94	26OCT94	.	.	.	40	44	4	.	J
WS	PFCB	L2910	16574	08SEP1994	12SEP94	27OCT94	.	.	.	40	45	5	.	J
FW	PFCB	L2911	52995	06SEP1994	12SEP94	27OCT94	.	.	.	40	45	5	.	J
FW	PFCB	L2911	52997	06SEP1994	12SEP94	27OCT94	.	.	.	40	45	5	.	J
FW	PFCB	L2911	53006	06SEP1994	12SEP94	27OCT94	.	.	.	40	45	5	.	J
FW	PFCB	L2911	53015	06SEP1994	12SEP94	27OCT94	.	.	.	40	45	5	.	J
SE	SVOA	A311074	50063	15NOV1993	23NOV93	18JAN94	.	.	.	40	56	16	U[UJ]	UJ
SE	SVOA	A311074	50098	15NOV1993	23NOV93	18JAN94	.	.	.	40	56	16	U[UJ]	UJ
SE	SVOA	A311074	50100	15NOV1993	23NOV93	18JAN94	.	.	.	40	56	16	U[UJ]	UJ
SE	SVOA	A311074	50144	15NOV1993	23NOV93	18JAN94	.	.	.	40	56	16	U[UJ]	UJ
FW	SVOA	L2038	52038	24MAY1994	31MAY94	14JUL94	.	.	.	40	44	4	U[UJ]	UJ
FW	SVOA	L2657	52885	08AUG1994	18AUG94	25AUG94	7	10	3	40	7	.	.	J
FW	SVOA	L2657	52895	08AUG1994	18AUG94	25AUG94	7	10	3	40	7	.	.	J
FW	SVOA	L2657	52905	08AUG1994	18AUG94	25AUG94	7	10	3	40	7	.	.	J

Appendix C, page 1

Clinch River Remedial Investigation - Phase II
Data Validation - Holding Times
For Organics - Report 2a

12:35 Wednesday, August 16, 1995

LAB_CODE	MATRIX_TYP_CODE	LAG_DATA_PROC_GRP	Minimum Extraction Days	Maximum Extraction Days	Average Extraction Days	Minimum Analysis Days	Maximum Analysis Days	Average Analysis Days run
LOCK	PW	PFCB	3	10	6	3	45	19
LOCK	PW	SVOA	3	10	6	3	45	22
LOCK	WQ	PFCB	3	7	5	2	40	16
LOCK	WQ	SVOA	3	7	5	2	40	18
LOCK	WS	PFCB	1	7	5	2	45	15
LOCK	WS	SVOA	2	7	5	2	45	20
THAR	SE	PFCB	3	30	8	4	56	20
THAR	SE	SVOA	3	11	7	4	56	14

Appendix C, page 2

Clinch River Remedial Investigation - Phase II
Data Validation - Holding Times
For Organics - Report 2b

12:35 Wednesday, August 16, 1995

MATRIX	ANALYTE GROUP	Minimum Extraction Days	Maximum Extraction Days	Average Extraction Days	Minimum Analysis Days	Maximum Analysis Days	Average Analysis Days
PW	PFCB	3	10	6	3	45	19
PW	SVOA	3	10	6	3	45	22
SE	PFCB	3	30	8	4	56	20
SE	SVOA	3	11	7	4	56	14
WQ	PFCB	3	7	5	2	40	16
WQ	SVOA	3	7	5	2	40	18
WS	PFCB	1	7	5	2	45	15
WS	SVOA	2	7	5	2	45	20

Appendix C, page 3

Clinch River Remedial Investigation - Phase II
Data Validation - Holding Times
For Organics - Report 3
No soil samples violated the > 90% moisture requirement

12:35 Wednesday, August 16, 1995

Clinch River Remedial Investigation - Phase II
Data Validation - Holding Times
For Organics - Report 4

12:35 Wednesday, August 16, 199

LAB_CODE	MATRIX_TYP_CODE	LAG_DATA_PROC_GRP	Minimum % Moist	Maximum % Moist	Average % Moist
SWRI	BIOTA	PPCB	0	0	0
SWRI	BIOTA	SVOA	0	0	0
THAR	SE	PPCB	18	64	36
THAR	SE	SVOA	18	64	35

Appendix C, page 5

MATRIX	ANALYTE GROUP	DRG	SAMPLE	SAMPLE DATE	ANALYSIS	TYPE	EXTRACT DATE	ANALYZE HOLD	CPEHT	NODEPEHT	QUAL	ASSIGNED QUAL
WS	CN	L2917	16490	07SEP1994	CNC	P	22SEP1994	14	15	1	.	J
WS	CN	L2917	16491	07SEP1994	CNC	P	22SEP1994	14	15	1	.	J
WS	CN	L2917	16504	07SEP1994	CNC	P	22SEP1994	14	15	1	.	J
WS	CN	L2917	16505	07SEP1994	CNC	P	22SEP1994	14	15	1	.	J
WS	CN	L761	10193	17NOV1993	CNC	P	02DEC1993	14	15	1	.	J
WS	CN	L761	10194	17NOV1993	CNC	P	02DEC1993	14	15	1	.	J
SE	MET	A312025	50281	06DEC1993	ADCV	P	04JAN1994	28	29	1	.	J
SE	MET	A312025	50282	06DEC1993	ADCV	P	04JAN1994	28	29	1	.	J
SE	MET	A312025	50298	06DEC1993	ADCV	P	04JAN1994	28	29	1	.	J
SE	MET	A312025	50299	06DEC1993	ADCV	P	04JAN1994	28	29	1	.	J
SE	MET	A312025	50315	06DEC1993	ADCV	P	04JAN1994	28	29	1	.	J
SE	MET	A312025	50316	06DEC1993	ADCV	P	04JAN1994	28	29	1	.	J
SE	MET	A312025	50332	06DEC1993	ADCV	P	04JAN1994	28	29	1	.	J
SE	MET	A312025	50333	06DEC1993	ADCV	P	04JAN1994	28	29	1	.	J
SE	MET	A403036	51074	07MAR1994	ADCV	D	04MAY1994	28	58	30	.	R
SE	MET	A403036	51075	07MAR1994	ADCV	P	04MAY1994	28	58	30	.	R
SE	MET	A403036	51089	07MAR1994	ADCV	P	04MAY1994	28	58	30	.	R
SE	MET	A403036	51090	07MAR1994	ADCV	P	04MAY1994	28	58	30	.	R
SE	MET	A403051	50061	15NOV1993	ADCV	P	04APR1994	28	140	112	.	R
SE	MET	A403051	50061	15NOV1993	ADCV	P	02MAY1994	28	168	140	.	R
SE	MET	A403051	50062	15NOV1993	ADCV	P	04APR1994	28	140	112	.	R
SE	MET	A403051	50062	15NOV1993	ADCV	P	02MAY1994	28	168	140	.	R
SE	MET	A403051	50096	15NOV1993	ADCV	P	04APR1994	28	140	112	.	R
SE	MET	A403051	50096	15NOV1993	ADCV	P	02MAY1994	28	168	140	.	R
SE	MET	A403051	50097	15NOV1993	ADCV	P	04APR1994	28	140	112	.	R
SE	MET	A403051	50097	15NOV1993	ADCV	P	02MAY1994	28	168	140	.	R
SE	MET	A403051	50118	15NOV1993	ADCV	P	04APR1994	28	140	112	.	R
SE	MET	A403051	50118	15NOV1993	ADCV	P	02MAY1994	28	168	140	.	R
SE	MET	A403051	50119	15NOV1993	ADCV	P	04APR1994	28	140	112	.	R
SE	MET	A403051	50119	15NOV1993	ADCV	P	02MAY1994	28	168	140	.	R
SE	MET	A403051	50140	15NOV1993	ADCV	P	04APR1994	28	140	112	.	R
SE	MET	A403051	50140	15NOV1993	ADCV	P	02MAY1994	28	168	140	.	R
SE	MET	A403051	50141	15NOV1993	ADCV	P	04APR1994	28	140	112	.	R
SE	MET	A403051	50141	15NOV1993	ADCV	P	02MAY1994	28	168	140	.	R
SE	MET	A403051	50191	16NOV1993	ADCV	P	04APR1994	28	139	111	.	R
SE	MET	A403051	50191	16NOV1993	ADCV	P	02MAY1994	28	167	139	.	R
SE	MET	A403051	50192	16NOV1993	ADCV	P	04APR1994	28	139	111	.	R
SE	MET	A403051	50192	16NOV1993	ADCV	P	02MAY1994	28	167	139	.	R
SE	MET	A403051	50210	16NOV1993	ADCV	P	04APR1994	28	139	111	.	R
SE	MET	A403051	50210	16NOV1993	ADCV	P	02MAY1994	28	167	139	.	R
SE	MET	A403051	50229	16NOV1993	ADCV	P	04APR1994	28	139	111	.	R
SE	MET	A403051	50229	16NOV1993	ADCV	P	02MAY1994	28	167	139	.	R
SE	MET	A403051	50230	16NOV1993	ADCV	P	04APR1994	28	139	111	.	R
SE	MET	A403051	50230	16NOV1993	ADCV	P	02MAY1994	28	167	139	.	R
SE	MET	A403062	50281	06DEC1993	ADCV	P	28APR1994	28	143	115	.	R
SE	MET	A403062	50282	06DEC1993	ADCV	P	28APR1994	28	143	115	.	R
SE	MET	A403062	50298	06DEC1993	ADCV	P	28APR1994	28	143	115	.	R
SE	MET	A403062	50299	06DEC1993	ADCV	P	28APR1994	28	143	115	.	R
SE	MET	A403062	50315	06DEC1993	ADCV	P	28APR1994	28	143	115	.	R
SE	MET	A403062	50316	06DEC1993	ADCV	P	28APR1994	28	143	115	.	R
SE	MET	A403062	50332	06DEC1993	ADCV	P	28APR1994	28	143	115	.	R
SE	MET	A403062	50333	06DEC1993	ADCV	D	28APR1994	28	143	115	.	R
SE	MET	A403062	50370	07DEC1993	ADCV	P	28APR1994	28	142	114	.	R
SE	MET	A403062	50386	07DEC1993	ADCV	P	28APR1994	28	142	114	.	R
SE	MET	A403062	50387	07DEC1993	ADCV	P	28APR1994	28	142	114	.	R

Clinch River Remedial Investigation - Phase II
Data Validation - Holding Times
For Inorganics - Report 1 - Prep Dates

12:38 Wednesday, August 16, 1995

MATRIX	ANALYTE GROUP	DRG	SAMPLE	SAMPLE DATE	ANALYSIS	TYPE	EXTRACT DATE	ANALYZE HOLD	CPEPT	NODEPEPT	QUAL	ASSIGNED QUAL
SE	MET	A403062	50403	07DEC1993	ADCV	P	28APR1994	28	142	114	.	R
SE	MET	A403062	50404	07DEC1993	ADCV	P	28APR1994	28	142	114	.	R
SE	MET	A403062	50420	07DEC1993	ADCV	P	28APR1994	28	142	114	.	R
SE	MET	A403062	50421	07DEC1993	ADCV	P	28APR1994	28	142	114	.	R
SE	MET	A403073	51145	14MAR1994	ADCV	P	27APR1994	28	44	16	.	J
SE	MET	A403073	51146	14MAR1994	ADCV	P	27APR1994	28	44	16	.	J
SE	MET	A403073	51175	14MAR1994	ADCV	P	27APR1994	28	44	16	.	J
SE	MET	A403073	51176	14MAR1994	ADCV	P	27APR1994	28	44	16	.	J
SE	MET	A404007	50744	25JAN1994	ADCV	P	27APR1994	28	92	64	.	R
SE	MET	A404007	50836	31JAN1994	ADCV	P	27APR1994	28	86	58	.	R
SE	MET	A404007	50837	31JAN1994	ADCV	P	27APR1994	28	86	58	.	R
SE	MET	A404007	50849	31JAN1994	ADCV	P	27APR1994	28	86	58	.	R
SE	MET	A404007	50850	31JAN1994	ADCV	P	27APR1994	28	86	58	.	R
SE	MET	A404024	50487	10JAN1994	ADCV	P	27APR1994	28	107	79	.	R
SE	MET	A404024	50488	10JAN1994	ADCV	P	27APR1994	28	107	79	.	R
SE	MET	A404024	50495	10JAN1994	ADCV	P	27APR1994	28	107	79	.	R
SE	MET	A404024	50496	10JAN1994	ADCV	P	27APR1994	28	107	79	.	R
SE	MET	A404024	50529	10JAN1994	ADCV	P	27APR1994	28	107	79	.	R
SE	MET	A404024	50530	10JAN1994	ADCV	P	27APR1994	28	107	79	.	R
SE	MET	A404024	50542	10JAN1994	ADCV	P	27APR1994	28	107	79	.	R
SE	MET	A404024	50543	10JAN1994	ADCV	P	27APR1994	28	107	79	.	R
SE	MET	A404024	50554	10JAN1994	ADCV	P	27APR1994	28	107	79	.	R
SE	MET	A404024	50555	10JAN1994	ADCV	P	27APR1994	28	107	79	.	R
SE	MET	A404024	50640	11JAN1994	ADCV	P	27APR1994	28	106	78	.	R
SE	MET	A404024	50641	11JAN1994	ADCV	P	27APR1994	28	106	78	.	R
SE	MET	A404024	50653	11JAN1994	ADCV	P	27APR1994	28	106	78	.	R
SE	MET	A404024	50654	11JAN1994	ADCV	P	27APR1994	28	106	78	.	R
SE	MET	A404024	50666	11JAN1994	ADCV	P	27APR1994	28	106	78	.	R
SE	MET	A404024	50667	11JAN1994	ADCV	P	27APR1994	28	106	78	.	R
SE	MET	A404024	50678	11JAN1994	ADCV	P	27APR1994	28	106	78	.	R
SE	MET	A406011	52138	03JUN1994	ADCV	P	06JUL1994	28	33	5	.	J
SE	MET	A406011	52139	03JUN1994	ADCV	P	06JUL1994	28	33	5	.	J
SE	MET	A406011	52150	03JUN1994	ADCV	P	06JUL1994	28	33	5	.	J
SE	MET	A406011	52151	03JUN1994	ADCV	P	06JUL1994	28	33	5	.	J
SE	MET	A406011	52162	03JUN1994	ADCV	P	06JUL1994	28	33	5	.	J
SE	MET	A406011	52163	03JUN1994	ADCV	P	06JUL1994	28	33	5	.	J
SE	MET	A408017	52683	02AUG1994	ADCV	P	01SEP1994	28	30	2	.	J
SE	MET	A408017	52684	02AUG1994	ADCV	P	01SEP1994	28	30	2	.	J
SE	MET	A408017	52697	02AUG1994	ADCV	P	01SEP1994	28	30	2	.	J
SE	MET	A408017	52698	02AUG1994	ADCV	P	01SEP1994	28	30	2	.	J
SE	MET	A408017	52711	02AUG1994	ADCV	P	01SEP1994	28	30	2	.	J
SE	MET	A408017	52712	02AUG1994	ADCV	P	01SEP1994	28	30	2	.	J
SE	MET	A408017	52725	02AUG1994	ADCV	P	01SEP1994	28	30	2	.	J
SE	MET	A408017	52726	02AUG1994	ADCV	P	01SEP1994	28	30	2	.	J
WS	MET	L1771	12764	18APR1994	ADCV	P	17MAY1994	28	29	1	.	J
WS	MET	L1771	12765	18APR1994	ADCV	P	17MAY1994	28	29	1	.	J
WS	MET	L1771	12775	18APR1994	ADCV	P	17MAY1994	28	29	1	.	J
WS	MET	L1771	12776	18APR1994	ADCV	P	17MAY1994	28	29	1	.	J
WO	MET	L1771	12784	18APR1994	ADCV	P	17MAY1994	28	29	1	.	J
WS	MET	L1771	12794	18APR1994	ADCV	P	17MAY1994	28	29	1	.	J
WS	MET	L1771	12795	18APR1994	ADCV	P	17MAY1994	28	29	1	.	J
FW	MET	L2478	52629	18JUL1994	ADCV	P	03OCT1994	28	77	49	.	R

Appendix C Page 7

1 CN 14 days EG 28 Days Other MET 180 days

Clinch River Remedial Investigation - Phase II
Data Validation - Holding Times
For Inorganics - Report 2a - Prep Dates

12:38 Wednesday, August 16, 1995

LAB_CODE	MATRIX_TYP_CODE	LAG_DATA_PROC_GRP	MIN_HOLD	MAX_HOLD	AVG_HOLD
LOCK	PW	MET	7	77	20
LOCK	WQ	CN	6	14	10
LOCK	WQ	MET	5	63	20
LOCK	WS	CN	6	15	10
LOCK	WS	MET	5	61	19
THAR	SE	MET	4	168	41

Clinch River Remedial Investigation - Phase II
Data Validation - Holding Times
For Inorganics - Report 2b - Prep Dates

12:38 Wednesday, August 16, 1995

MATRIX	ANALYTE GROUP	MIN_HOLD	MAX_HOLD	AVG_HOLD
PW	MET	7	77	20
SE	MET	4	168	41
WQ	CN	6	14	10
WQ	MET	5	63	20
WS	CN	6	15	10
WS	MET	5	61	19

Appendix C, page 9

1 CN 14 days HG 28 Days Other MET 180 days

Clinch River Remedial Investigation - Phase II
Data Validation - Holding Times
For Inorganics - Report 1 - Using Prep Dates

16:12 Friday, August 18, 1995

MATRIX	ANALYTE GROUP	DRG	SAMPLE	SAMPLE DATE	ANALYSIS	EXTRACT DATE	ANALYZE HOLD	CPEET	NODEPEET	PRIOR QUALS	ASSIGNED QUAL
WS	AMMON	L1208	10642	24JAN1994	Ammonium	12MAR1994	28	47	19	* H U UJ	UJ
WS	AMMON	L1208	10656	24JAN1994	Ammonium	12MAR1994	28	47	19	* H J	J
WS	AMMON	L1208	10670	24JAN1994	Ammonium	12MAR1994	28	47	19	* H J	J
WQ	AMMON	L1208	10683	24JAN1994	Ammonium	12MAR1994	28	47	19	* H U UJ	UJ
WS	AMMON	L1208	10760	26JAN1994	Ammonium	12MAR1994	28	45	17	* H U UJ	UJ
WS	AMMON	L1208	10774	26JAN1994	Ammonium	12MAR1994	28	45	17	* H U UJ	UJ
WS	AMMON	L1208	10856	27JAN1994	Ammonium	12MAR1994	28	44	16	* H J	J
WS	AMMON	L1208	10870	27JAN1994	Ammonium	12MAR1994	28	44	16	* H J	J
WS	AMMON	L1208	10885	27JAN1994	Ammonium	12MAR1994	28	44	16	* H J	J
WS	AMMON	L1208	11036	01FEB1994	Ammonium	12MAR1994	28	39	11	* H U UJ	UJ
WS	AMMON	L1208	11050	01FEB1994	Ammonium	12MAR1994	28	39	11	* H J	J
WS	AMMON	L1208	11102	02FEB1994	Ammonium	12MAR1994	28	38	10	* H J	J
WS	AMMON	L1208	11116	02FEB1994	Ammonium	12MAR1994	28	38	10	* H U UJ	UJ
WS	AMMON	L1208	11131	02FEB1994	Ammonium	12MAR1994	28	38	10	* H U UJ	UJ
FW	AMMON	L1208	50790	25JAN1994	Ammonium	12MAR1994	28	46	18	* H J	J
FW	AMMON	L1208	50857	31JAN1994	Ammonium	12MAR1994	28	40	12	* H U UJ	UJ
FW	AMMON	L1208	50866	31JAN1994	Ammonium	12MAR1994	28	40	12	* H J	J
FW	AMMON	L961	50288	06DEC1993	Ammonium	05JAN1994	28	30	2	- J	J
FW	AMMON	L961	50305	06DEC1993	Ammonium	05JAN1994	28	30	2	- J	J
FW	AMMON	L961	50322	06DEC1993	Ammonium	05JAN1994	28	30	2	- J	J
FW	AMMON	L961	50339	06DEC1993	Ammonium	05JAN1994	28	30	2	- J	J
FW	AMMON	L961	50376	07DEC1993	Ammonium	05JAN1994	28	29	1	- J	J
FW	AMMON	L961	50393	07DEC1993	Ammonium	05JAN1994	28	29	1	- J	J
FW	AMMON	L961	50410	07DEC1993	Ammonium	05JAN1994	28	29	1	- J	J
FW	AMMON	L961	50427	07DEC1993	Ammonium	05JAN1994	28	29	1	- J	J
WS	AMMON	L987	10291	20DEC1993	Ammonium	25JAN1994	28	36	8	H J	J
WS	ANIONS	L1111	10366	12JAN1994	Fluoride	20FEB1994	28	39	11	U	UJ
WS	ANIONS	L1111	10381	12JAN1994	Fluoride	20FEB1994	28	39	11	U	UJ
WS	ANIONS	L1111	10396	12JAN1994	Fluoride	20FEB1994	28	39	11	U	UJ
WS	ANIONS	L1111	10426	12JAN1994	Fluoride	20FEB1994	28	39	11	U	UJ
WQ	ANIONS	L1111	10438	12JAN1994	Fluoride	20FEB1994	28	39	11	U	UJ
WS	ANIONS	L1111	10578	13JAN1994	Fluoride	20FEB1994	28	38	10	U	UJ
WS	ANIONS	L1111	10593	13JAN1994	Fluoride	20FEB1994	28	38	10	U	UJ
WS	ANIONS	L1181	10640	24JAN1994	Chloride	07MAR1994	28	42	14	H	J
WS	ANIONS	L1181	10640	24JAN1994	Sulfate	07MAR1994	28	42	14	H	J
WS	ANIONS	L1181	10654	24JAN1994	Chloride	07MAR1994	28	42	14	H	J
WS	ANIONS	L1181	10654	24JAN1994	Sulfate	07MAR1994	28	42	14	H	J
WS	ANIONS	L1181	10668	24JAN1994	Chloride	07MAR1994	28	42	14	H	J
WS	ANIONS	L1181	10668	24JAN1994	Sulfate	07MAR1994	28	42	14	H	J
WQ	ANIONS	L1181	10681	24JAN1994	Chloride	07MAR1994	28	42	14	H	J
WQ	ANIONS	L1181	10681	24JAN1994	Sulfate	07MAR1994	28	42	14	H U	UJ
WS	ANIONS	L1181	10758	26JAN1994	Chloride	07MAR1994	28	40	12	H	J
WS	ANIONS	L1181	10758	26JAN1994	Sulfate	07MAR1994	28	40	12	H	J
WS	ANIONS	L1181	10772	26JAN1994	Chloride	07MAR1994	28	40	12	H	J
WS	ANIONS	L1181	10772	26JAN1994	Sulfate	07MAR1994	28	40	12	H	J
WS	ANIONS	L1181	10854	27JAN1994	Chloride	07MAR1994	28	39	11	H	J
WS	ANIONS	L1181	10854	27JAN1994	Sulfate	07MAR1994	28	39	11	H	J
WS	ANIONS	L1181	10868	27JAN1994	Chloride	07MAR1994	28	39	11	H	J
WS	ANIONS	L1181	10868	27JAN1994	Sulfate	07MAR1994	28	39	11	H	J
WS	ANIONS	L1181	10882	27JAN1994	Chloride	07MAR1994	28	39	11	H	J
WS	ANIONS	L1181	10882	27JAN1994	Sulfate	07MAR1994	28	39	11	H	J
WS	ANIONS	L1207	11034	01FEB1994	Chloride	08MAR1994	28	35	7	H	J
WS	ANIONS	L1207	11034	01FEB1994	Sulfate	08MAR1994	28	35	7	H	J
WS	ANIONS	L1207	11048	01FEB1994	Chloride	08MAR1994	28	35	7	H	J
WS	ANIONS	L1207	11048	01FEB1994	Sulfate	08MAR1994	28	35	7	H	J

Metal 180 days* NO3NO4 AMMON ANIONS TKN TOC 28 days* 18496258 7 days

Clinch River Remedial Investigation - Phase II
Data Validation - Holding Times
For Inorganics - Report 1 - Using Prep Dates

16:12 Friday, August 18, 1995

MATRIX	ANALYTE GROUP	DRG	SAMPLE	SAMPLE DATE	ANALYSIS	EXTRACT DATE	ANALYZE HOLD	CPEHT	MODEPEHT	PRIOR QUALS	ASSIGNED QUAL
WS	ANIONS	L1207	11100	02FEB1994	Chloride	08MAR1994	28	34	6	H	J
WS	ANIONS	L1207	11100	02FEB1994	Sulfate	08MAR1994	28	34	6	H	J
WS	ANIONS	L1207	11114	02FEB1994	Chloride	08MAR1994	28	34	6	H	J
WS	ANIONS	L1207	11114	02FEB1994	Sulfate	08MAR1994	28	34	6	H	J
WS	ANIONS	L1207	11128	02FEB1994	Chloride	08MAR1994	28	34	6	H	J
WS	ANIONS	L1207	11128	02FEB1994	Sulfate	08MAR1994	28	34	6	H	J
WS	ANIONS	L986	10289	20DEC1993	Chloride	20JAN1994	28	31	3	H	J
WS	ANIONS	L986	10289	20DEC1993	Sulfate	20JAN1994	28	31	3	H	J
WS	NO3NO4	L1111	10367	12JAN1994	Nitrate/n	11FEB1994	28	30	2	- J	J
WS	NO3NO4	L1111	10382	12JAN1994	Nitrate/n	11FEB1994	28	30	2	- J	J
WS	NO3NO4	L1111	10397	12JAN1994	Nitrate/n	11FEB1994	28	30	2	- J	J
WS	NO3NO4	L1111	10427	12JAN1994	Nitrate/n	11FEB1994	28	30	2	- J	J
WQ	NO3NO4	L1111	10439	12JAN1994	Nitrate/n	11FEB1994	28	30	2	U UJ	UJ
WS	NO3NO4	L1111	10579	13JAN1994	Nitrate/n	11FEB1994	28	29	1	- J	J
WS	NO3NO4	L1111	10594	13JAN1994	Nitrate/n	11FEB1994	28	29	1	- J	J
WS	NO3NO4	L806	10108	10NOV1993	Nitrate/n	20DEC1993	28	40	12	- J	J
WS	NO3NO4	L806	10132	10NOV1993	Nitrate/n	20DEC1993	28	40	12	- J	J
WQ	NO3NO4	L806	10161	10NOV1993	Nitrate/n	20DEC1993	28	40	12	U UJ	UJ
WS	NO3NO4	L806	10196	17NOV1993	Nitrate/n	20DEC1993	28	33	5	- J	J
WS	NO3NO4	L806	10234	18NOV1993	Nitrate/n	20DEC1993	28	32	4	- J	J
WS	NO3NO4	L986	10290	20DEC1993	Nitrate/n	21JAN1994	28	32	4	H J	J
WQ	TKN	L1112	50460	10JAN1994	Kjeldahl	03MAR1994	28	52	24	U UJ	UJ
WQ	TKN	L1112	50510	10JAN1994	Kjeldahl	03MAR1994	28	52	24	U UJ	UJ
PW	TKN	L1112	50561	10JAN1994	Kjeldahl	03MAR1994	28	52	24	U UJ	UJ
PW	TKN	L1112	50574	10JAN1994	Kjeldahl	03MAR1994	28	52	24	U UJ	UJ
PW	TKN	L1112	50580	10JAN1994	Kjeldahl	03MAR1994	28	52	24	- J	J
PW	TKN	L1112	50591	10JAN1994	Kjeldahl	03MAR1994	28	52	24	U UJ	UJ
PW	TKN	L1112	50597	10JAN1994	Kjeldahl	03MAR1994	28	52	24	- J	J
WQ	TKN	L1112	50609	10JAN1994	Kjeldahl	03MAR1994	28	52	24	U UJ	UJ
PW	TKN	L1112	50687	11JAN1994	Kjeldahl	03MAR1994	28	51	23	- J	J
PW	TKN	L1112	50696	11JAN1994	Kjeldahl	03MAR1994	28	51	23	- J	J
PW	TKN	L1180	50793	25JAN1994	Kjeldahl	17MAR1994	28	51	23	- J J	J
PW	TKN	L1180	50858	31JAN1994	Kjeldahl	17MAR1994	28	45	17	- J J	J
PW	TKN	L1180	50867	31JAN1994	Kjeldahl	17MAR1994	28	45	17	- J J	J
PW	TKN	L1438	51105	07MAR1994	Kjeldahl	07APR1994	28	31	3	- J	J
PW	TKN	L1438	51114	07MAR1994	Kjeldahl	07APR1994	28	31	3	- J	J
WQ	TKN	L805	50032	15NOV1993	Kjeldahl	28DEC1993	28	43	15	- J	J
PW	TKN	L805	50070	15NOV1993	Kjeldahl	28DEC1993	28	43	15	- J	J
WQ	TKN	L805	50084	15NOV1993	Kjeldahl	28DEC1993	28	43	15	- J	J
PW	TKN	L805	50105	15NOV1993	Kjeldahl	28DEC1993	28	43	15	- J	J
PW	TKN	L805	50149	15NOV1993	Kjeldahl	28DEC1993	28	43	15	- J	J
WQ	TKN	L805	50163	15NOV1993	Kjeldahl	28DEC1993	28	43	15	- J	J
PW	TKN	L805	50200	16NOV1993	Kjeldahl	28DEC1993	28	42	14	- J	J
PW	TKN	L805	50219	16NOV1993	Kjeldahl	28DEC1993	28	42	14	- J	J
PW	TKN	L805	50238	16NOV1993	Kjeldahl	28DEC1993	28	42	14	- J	J
PW	TOC	L1180	50789	25JAN1994	Total org	10MAR1994	28	44	16	- J J	J
PW	TOC	L1180	50856	31JAN1994	Total org	10MAR1994	28	38	10	- J J	J
PW	TOC	L1180	50865	31JAN1994	Total org	10MAR1994	28	38	10	- J J	J
WQ	TOC	L805	50029	15NOV1993	Total org	06JAN1994	28	52	24	U UJ	UJ
WQ	TOC	L805	50082	15NOV1993	Total org	06JAN1994	28	52	24	U UJ	UJ
PW	TOC	L805	50103	15NOV1993	Total org	06JAN1994	28	52	24	- J	J
PW	TOC	L805	50147	15NOV1993	Total org	06JAN1994	28	52	24	- J	J
WQ	TOC	L805	50161	15NOV1993	Total org	06JAN1994	28	52	24	U UJ	UJ
PW	TOC	L805	50198	16NOV1993	Total org	06JAN1994	28	51	23	- J	J
PW	TOC	L805	50217	16NOV1993	Total org	06JAN1994	28	51	23	- J	J

Metal 180 days* NO3NO4 AMMON ANIONS TKN TOC 28 days* 18496258 7 days

Clinch River Remedial Investigation - Phase II
Data Validation - Holding Times
For Inorganics - Report 1 - Using Prep Dates

16:12 Friday, August 12, 1995

MATRIX	ANALYTE GROUP	DRG	SAMPLE	SAMPLE DATE	ANALYSIS	EXTRACT DATE	ANALYZE HOLD	CPEHT	NODEPEHT	PRIOR QUALS	ASSIGNED QUAL
PW	TOC	L805	50236	16NOV1993	Total org	06JAN1994	28	51	23	- J	J
PW	TOC	L936	50287	06DEC1993	Total org	19JAN1994	28	44	16	H J	J
PW	TOC	L936	50304	06DEC1993	Total org	19JAN1994	28	44	16	H J	J
PW	TOC	L936	50321	06DEC1993	Total org	19JAN1994	28	44	16	H J	J
PW	TOC	L936	50338	06DEC1993	Total org	19JAN1994	28	44	16	H J	J
PW	TOC	L936	50375	07DEC1993	Total org	19JAN1994	28	43	15	H J	J
PW	TOC	L936	50392	07DEC1993	Total org	19JAN1994	28	43	15	H J	J
PW	TOC	L936	50409	07DEC1993	Total org	19JAN1994	28	43	15	H J	J
PW	TOC	L936	50426	07DEC1993	Total org	19JAN1994	28	43	15	H J	J

Appendix C, page 12

Metal 180 days* NO3NO4 AMMON AMIONS TKN TOC 28 days* 18496258 7 days

Clinch River Remedial Investigation - Phase II
 Data Validation - Holding Times
 For Inorganics - Report 2a

16:12 Friday, August 18, 199

LAB	MATRIX	ANALYTE GROUP	MINIMUM EXTRACT HOLDTIME	MAXIMUM EXTRACT HOLDTIME	AVERAGE EXTRACT HOLDTIME
LOCK	PW	AMMON	4	46	19
LOCK	PW	TKN	11	52	27
LOCK	PW	TOC	11	52	23
LOCK	WQ	AMMON	3	47	17
LOCK	WQ	ANIONS	3	42	18
LOCK	WQ	NO3NO4	8	40	21
LOCK	WQ	TKN	11	52	28
LOCK	WQ	TOC	13	52	23
LOCK	WS	AMMON	3	47	17
LOCK	WS	ANIONS	3	42	16
LOCK	WS	NO3NO4	7	40	17

Appendix C, page 13

Metal, 180 days* NO3NO4 AMMON ANIONS TKN TOC 28 days* 18496258 7 days

Clinch River Remedial Investigation - Phase II
 Data Validation - Holding Times
 For Inorganics - Report 2b

16:12 Friday, August 18, 1995

MATRIX	ANALYTE GROUP	MINIMUM EXTRACT HOLDTIME	MAXIMUM EXTRACT HOLDTIME	AVERAGE EXTRACT HOLDTIME
PW	AMMON	4	46	19
PW	TKN	11	52	27
PW	TOC	11	52	23
WQ	AMMON	3	47	17
WQ	ANIONS	3	42	18
WQ	NO3NO4	8	48	21
WQ	TKN	11	52	28
WQ	TOC	13	52	23
WS	AMMON	3	47	17
WS	ANIONS	3	42	16
WS	NO3NO4	7	40	17

Appendix C, page 14

Metal 180 days* NO3NO4 AMMON ANIONS TKN TOC 28 days* 18496258 7 days

Clinch River Remedial Investigation - Phase II
Data Validation - Holding Times
For Inorganics - Report 3

16:12 Friday, August 18, 1995

No samples exceeded the required pH

Clinch River Remedial Investigation - Phase II
Data Validation - Holding Times
For Inorganics - Report 4

No samples have moisture measurements to be summarized

16:12 Friday, August 18, 1995

Clinch River Remedial Investigation - Phase II
Data Validation - Holding Times
For Inorganics - Report 1

07:23 Tuesday, August 22, 1995

MATRIX	ANALYTE GROUP	DRG	SAMPLE	SAMPLE DATE	ANALYSIS	ANALYZE DATE	ANALYZE HOLD	CPAHT	MODEAHT	QUAL	ASSIGNED QUAL
WS	EG	OR19	11373	14FEB1994	Mercury	15MAR1994	28	29	1	NA U UJ	UJ
WS	EG	OR19	11374	14FEB1994	Mercury	15MAR1994	28	29	1	- J NA	J
WS	EG	OR19	11380	14FEB1994	Mercury	15MAR1994	28	29	1	NA	J
WS	EG	OR19	11384	14FEB1994	Mercury	15MAR1994	28	29	1	NA U	UJ
WS	EG	OR19	11385	14FEB1994	Mercury	15MAR1994	28	29	1	- NA	J
WS	EG	OR19	11394	14FEB1994	Mercury	15MAR1994	28	29	1	NA U	UJ
WS	EG	OR19	11430	14FEB1994	Mercury	15MAR1994	28	29	1	NA U	UJ
WS	EG	OR29	12762	18APR1994	Mercury	25MAY1994	28	37	9	NA U	UJ
WS	EG	OR29	12763	18APR1994	Mercury	25MAY1994	28	37	9	- NA	J
WS	EG	OR29	12769	18APR1994	Mercury	25MAY1994	28	37	9	NA	J
WS	EG	OR29	12773	18APR1994	Mercury	25MAY1994	28	37	9	NA U	UJ
WS	EG	OR29	12774	18APR1994	Mercury	25MAY1994	28	37	9	- J NA	J
WS	EG	OR29	12783	18APR1994	Mercury	25MAY1994	28	37	9	NA U	UJ
WS	EG	OR29	12792	18APR1994	Mercury	25MAY1994	28	37	9	NA U	UJ
WS	EG	OR29	12793	18APR1994	Mercury	25MAY1994	28	37	9	- NA	J
WS	EG	OR29	12872	19APR1994	Mercury	25MAY1994	28	36	8	NA U	UJ
WS	EG	OR29	12873	19APR1994	Mercury	25MAY1994	28	36	8	- NA	J
WS	EG	OR29	12879	19APR1994	Mercury	25MAY1994	28	36	8	NA U	UJ
WS	EG	OR29	12883	19APR1994	Mercury	25MAY1994	28	36	8	- NA	J
WS	EG	OR29	12884	19APR1994	Mercury	25MAY1994	28	36	8	NA U	UJ
WS	EG	OR29	12893	19APR1994	Mercury	25MAY1994	28	36	8	- NA	J
WS	EG	OR29	12894	19APR1994	Mercury	25MAY1994	28	36	8	NA U	UJ
WS	EG	OR29	12903	19APR1994	Mercury	25MAY1994	28	36	8	- NA	J
WS	EG	OR29	12913	19APR1994	Mercury	25MAY1994	28	36	8	NA U	UJ
WS	EG	OR29	12914	19APR1994	Mercury	25MAY1994	28	36	8	- NA	J
WS	EG	OR29	13104	20APR1994	Mercury	25MAY1994	28	35	7	NA U	UJ
WS	EG	OR29	13105	20APR1994	Mercury	25MAY1994	28	35	7	- NA	J
WS	EG	OR29	13111	20APR1994	Mercury	25MAY1994	28	35	7	NA U	UJ
WS	EG	OR29	13115	20APR1994	Mercury	25MAY1994	28	35	7	NA	J
WS	EG	OR29	13116	20APR1994	Mercury	25MAY1994	28	35	7	NA U	UJ
WS	EG	OR29	13125	20APR1994	Mercury	25MAY1994	28	35	7	NA U	UJ
WS	EG	OR29	13126	20APR1994	Mercury	25MAY1994	28	35	7	NA U	UJ
WS	EG	OR29	13135	20APR1994	Mercury	25MAY1994	28	35	7	NA U	UJ
WS	EG	OR29	13136	20APR1994	Mercury	25MAY1994	28	35	7	NA U	UJ
WS	EG	OR29	13145	20APR1994	Mercury	25MAY1994	28	35	7	NA U	UJ
WS	EG	OR29	13146	20APR1994	Mercury	25MAY1994	28	35	7	NA U	UJ
WS	EG	OR29	13152	20APR1994	Mercury	25MAY1994	28	35	7	NA U	UJ
WS	EG	OR29	13156	20APR1994	Mercury	25MAY1994	28	35	7	NA	J
WS	EG	OR29	13157	20APR1994	Mercury	25MAY1994	28	35	7	NA U	UJ
WS	EG	OR29	13166	20APR1994	Mercury	25MAY1994	28	35	7	NA U	UJ
WS	EG	OR29	13167	20APR1994	Mercury	25MAY1994	28	35	7	NA U	UJ
WS	EG	OR29	13176	20APR1994	Mercury	25MAY1994	28	35	7	NA U	UJ
WS	EG	OR29	13177	20APR1994	Mercury	25MAY1994	28	35	7	NA U	UJ
WS	EG	OR29	13186	20APR1994	Mercury	25MAY1994	28	35	7	NA U	UJ
WS	EG	OR29	13187	20APR1994	Mercury	25MAY1994	28	35	7	- NA	J
WS	EG	OR30	13322	27APR1994	Mercury	31MAY1994	28	34	6	NA U	UJ
WS	EG	OR30	13323	27APR1994	Mercury	31MAY1994	28	34	6	NA U	UJ
WS	EG	OR30	13329	27APR1994	Mercury	31MAY1994	28	34	6	NA U	UJ
WS	EG	OR30	13333	27APR1994	Mercury	31MAY1994	28	34	6	NA U	UJ
WS	EG	OR30	13334	27APR1994	Mercury	31MAY1994	28	34	6	NA U	UJ
SE	EG	OR30	51519	25APR1994	Mercury	14JUN1994	28	50	22	NA	J
SE	EG	OR30	51532	25APR1994	Mercury	03JUN1994	28	39	11	NA	J
SE	EG	OR30	51544	25APR1994	Mercury	03JUN1994	28	39	11	NA	J

Clinch River Remedial Investigation - Phase II
Data Validation - Holding Times
For Inorganics - Report 1

07:23 Tuesday, August 22, 1995

MATRIX	ANALYTE GROUP	DRG	SAMPLE	SAMPLE DATE	ANALYSIS	ANALYZE DATE	ANALYZE HOLD	CPABT	NODEABT	QUAL	ASSIGNED QUAL
SE	EG	OR30	51592	02MAY1994	Mercury	15JUN1994	28	44	16	NA	J
SE	EG	OR30	51604	02MAY1994	Mercury	03JUN1994	28	32	4	NA	J
SE	EG	OR30	51616	02MAY1994	Mercury	03JUN1994	28	32	4	NA	J
WQ	EG	OR30	51640	02MAY1994	Mercury	31MAY1994	28	29	1	NA	J
WS	EG	OR31	13449	04MAY1994	Mercury	02JUN1994	28	29	1	- NA U	UJ
WS	EG	OR31	13450	04MAY1994	Mercury	02JUN1994	28	29	1	- - NA	J
WQ	EG	OR31	13459	04MAY1994	Mercury	02JUN1994	28	29	1	- - NA	J
WQ	EG	OR31	13465	04MAY1994	Mercury	02JUN1994	28	29	1	- NA	J
WS	EG	OR31	13469	04MAY1994	Mercury	02JUN1994	28	29	1	- NA U	UJ
WS	EG	OR31	13470	04MAY1994	Mercury	02JUN1994	28	29	1	- - NA	J
WS	EG	OR32	13554	11MAY1994	Mercury	13JUN1994	28	33	5	NA U	UJ
WS	EG	OR32	13555	11MAY1994	Mercury	13JUN1994	28	33	5	- J NA	J
WQ	EG	OR32	13561	11MAY1994	Mercury	13JUN1994	28	33	5	NA	J
WS	EG	OR32	13565	11MAY1994	Mercury	13JUN1994	28	33	5	NA U	UJ
WS	EG	OR32	13566	11MAY1994	Mercury	13JUN1994	28	33	5	- NA	J
WQ	EG	OR32	14093	11MAY1994	Mercury	13JUN1994	28	33	5	NA	J
WQ	EG	OR32	51686	09MAY1994	Mercury	13JUN1994	28	35	7	NA U UJ	UJ
WQ	EG	OR32	51686	09MAY1994	Methyl me	09JUN1994	28	31	3	NA U UJ	UJ
WQ	EG	OR32	51689	09MAY1994	Mercury	13JUN1994	28	35	7	NA	J
WQ	EG	OR32	51723	09MAY1994	Mercury	13JUN1994	28	35	7	NA U	UJ
WQ	EG	OR32	51734	09MAY1994	Mercury	13JUN1994	28	35	7	NA U	UJ
FW	EG	OR32	51756	09MAY1994	Mercury	13JUN1994	28	35	7	NA U	UJ
FW	EG	OR32	51761	09MAY1994	Mercury	13JUN1994	28	35	7	- NA	J
WQ	EG	OR32	51787	09MAY1994	Mercury	13JUN1994	28	35	7	NA U	UJ
SE	EG	OR33	52001	24MAY1994	Mercury	30JUN1994	28	37	9	J NA	J
SE	EG	OR33	52001	24MAY1994	Methyl me	11JUL1994	28	48	20	J NA	J
SE	EG	OR33	52014	24MAY1994	Mercury	30JUN1994	28	37	9	J NA	J
SE	EG	OR33	52014	24MAY1994	Methyl me	11JUL1994	28	48	20	J NA	J
SE	EG	OR33	52067	25MAY1994	Mercury	30JUN1994	28	36	8	J NA	J
SE	EG	OR33	52067	25MAY1994	Methyl me	11JUL1994	28	47	19	J NA	J
SE	EG	OR33	52079	25MAY1994	Mercury	30JUN1994	28	36	8	J NA	J
SE	EG	OR33	52079	25MAY1994	Methyl me	11JUL1994	28	47	19	J NA	J
WQ	EG	OR35	52201	07JUN1994	Methyl me	06JUL1994	28	29	1	NA	J
FW	EG	OR35	52260	07JUN1994	Methyl me	06JUL1994	28	29	1	- NA	J
FW	EG	OR35	52270	07JUN1994	Methyl me	06JUL1994	28	29	1	NA U	UJ
FW	EG	OR35	52280	07JUN1994	Methyl me	06JUL1994	28	29	1	NA U	UJ
WS	EG	OR37	14454	14JUN1994	Mercury	13JUL1994	28	29	1	- NA	J
WS	EG	OR37	14455	14JUN1994	Mercury	13JUL1994	28	29	1	NA U	UJ
WQ	EG	OR37	14461	14JUN1994	Mercury	13JUL1994	28	29	1	NA	J
WS	EG	OR37	14465	14JUN1994	Mercury	13JUL1994	28	29	1	NA U	UJ
WS	EG	OR37	14466	14JUN1994	Mercury	13JUL1994	28	29	1	NA U	UJ
WS	EG	OR39	14763	28JUN1994	Mercury	02AUG1994	28	35	7	- - J J	J
WS	EG	OR39	14763	28JUN1994	Methyl me	02AUG1994	28	35	7	- J U U UJ	UJ
WS	EG	OR39	14764	28JUN1994	Mercury	30JUL1994	28	32	4	- - J	J
WS	EG	OR39	14773	28JUN1994	Mercury	02AUG1994	28	35	7	- - J J	J
WS	EG	OR39	14773	28JUN1994	Methyl me	02AUG1994	28	35	7	- J U U UJ	UJ

Clinch River Remedial Investigation - Phase II
Data Validation - Holding Times
For Inorganics - Report 1

07:23 Tuesday, August 22, 1995

MATRIX	ANALYTE GROUP	DEG	SAMPLE	SAMPLE DATE	ANALYSIS	ANALYZE DATE	ANALYZE HOLD	CPART	NODEART	QUAL	ASSIGNED QUAL	
WS	EG	OR39	14774	28JUN1994	Mercury	30JUL1994	28	32	4	-	J	J
WO	EG	OR39	14780	28JUN1994	Mercury	02AUG1994	28	35	7	B	J	UJ
WO	EG	OR39	14780	28JUN1994	Methyl me	02AUG1994	28	35	7	B	J	UJ
WS	EG	OR39	14784	28JUN1994	Mercury	02AUG1994	28	35	7	-	J	J
WS	EG	OR39	14784	28JUN1994	Methyl me	02AUG1994	28	35	7	-	J	UJ
WS	EG	OR39	14785	28JUN1994	Mercury	30JUL1994	28	32	4	-	J	J
WS	EG	OR39	14794	28JUN1994	Mercury	02AUG1994	28	35	7	-	J	UJ
WS	EG	OR39	14794	28JUN1994	Methyl me	02AUG1994	28	35	7	-	J	UJ
WS	EG	OR39	14795	28JUN1994	Mercury	30JUL1994	28	32	4	-	J	UJ
WS	EG	OR39	14858	29JUN1994	Mercury	02AUG1994	28	34	6	-	J	UJ
WS	EG	OR39	14859	29JUN1994	Methyl me	02AUG1994	28	34	6	-	J	UJ
WS	EG	OR39	14865	29JUN1994	Mercury	30JUL1994	28	31	3	-	J	UJ
WO	EG	OR39	14865	29JUN1994	Methyl me	02AUG1994	28	34	6	B	J	UJ
WS	EG	OR39	14869	29JUN1994	Mercury	02AUG1994	28	34	6	-	J	UJ
WS	EG	OR39	14879	29JUN1994	Methyl me	02AUG1994	28	34	6	-	J	J
WS	EG	OR39	14879	29JUN1994	Mercury	30JUL1994	28	31	3	-	J	J
WS	EG	OR39	14880	29JUN1994	Mercury	02AUG1994	28	34	6	-	J	J
WS	EG	OR39	14933	29JUN1994	Methyl me	02AUG1994	28	34	6	-	J	UJ
WO	EG	OR39	52462	27JUN1994	Mercury	02AUG1994	28	36	6	B	J	UJ
WO	EG	OR39	52462	27JUN1994	Methyl me	02AUG1994	28	36	6	B	J	UJ
FW	EG	OR39	52522	27JUN1994	Mercury	02AUG1994	28	36	8	B	J	UJ
FW	EG	OR39	52522	27JUN1994	Methyl me	02AUG1994	28	36	8	-	J	J
FW	EG	OR39	52530	27JUN1994	Mercury	02AUG1994	28	36	8	-	J	J
FW	EG	OR39	52530	27JUN1994	Methyl me	02AUG1994	28	36	8	-	J	UJ
FW	EG	OR39	52538	27JUN1994	Mercury	02AUG1994	28	36	8	-	J	J
FW	EG	OR39	52538	27JUN1994	Methyl me	02AUG1994	28	36	8	-	J	UJ
SE	EG	OR41	52582	18JUL1994	Mercury	02SEP1994	28	46	18	-	J	J
SE	EG	OR41	52582	18JUL1994	Methyl me	02AUG1994	28	37	9	-	J	J
SE	EG	OR41	52596	18JUL1994	Mercury	02SEP1994	28	46	18	-	J	J
SE	EG	OR41	52596	18JUL1994	Methyl me	02AUG1994	28	37	9	-	J	J
SE	EG	OR41	52610	18JUL1994	Mercury	02SEP1994	28	46	18	-	J	J
SE	EG	OR41	52610	18JUL1994	Methyl me	02AUG1994	28	37	9	-	J	J
SE	EG	OR43	52682	02AUG1994	Mercury	02SEP1994	28	31	3	-	J	J
SE	EG	OR43	52696	02AUG1994	Mercury	02SEP1994	28	31	3	-	J	J
SE	EG	OR43	52710	02AUG1994	Mercury	02SEP1994	28	31	3	-	J	J
SE	EG	OR43	52724	02AUG1994	Mercury	02SEP1994	28	31	3	-	J	J
WO	EG	OR46	16461	30AUG1994	Mercury	28SEP1994	28	29	1	MA	U	UJ
WS	EG	OR47	16470	07SEP1994	Mercury	13OCT1994	28	36	8	B	J	UJ
WS	EG	OR47	16471	07SEP1994	Mercury	13OCT1994	28	36	8	-	J	UJ
WS	EG	OR47	16477	07SEP1994	Mercury	13OCT1994	28	36	8	-	J	J
WS	EG	OR47	16481	07SEP1994	Mercury	13OCT1994	28	36	8	-	J	UJ
WS	EG	OR47	16482	07SEP1994	Mercury	13OCT1994	28	36	8	-	J	UJ
WS	EG	OR47	16517	08SEP1994	Mercury	13OCT1994	28	35	7	-	J	UJ

Clinch River Remedial Investigation - Phase II
Data Validation - Holding Times
For Inorganics - Report 1

07:23 Tuesday, August 22, 1995

MATRIX	ANALYTE GROUP	DRG	SAMPLE	SAMPLE DATE	ANALYSIS	ANALYZE DATE	ANALYZE HOLD	CPART	NODEABT	QUAL	ASSIGNED QUAL
WS	EG	OR47	16518	08SEP1994	Mercury	13OCT1994	28	35	7	- U	UJ
WS	EG	OR47	16527	08SEP1994	Mercury	13OCT1994	28	35	7	- U	UJ
WS	EG	OR47	16528	08SEP1994	Mercury	13OCT1994	28	35	7	- U	UJ
WO	EG	OR47	16534	08SEP1994	Mercury	13OCT1994	28	35	7	-	J
WS	EG	OR47	16538	08SEP1994	Mercury	13OCT1994	28	35	7	B U	UJ
WS	EG	OR47	16539	08SEP1994	Mercury	13OCT1994	28	35	7	B U	UJ
WS	EG	OR47	16590	13SEP1994	Mercury	13OCT1994	28	30	2	B U	UJ
WS	EG	OR47	16591	13SEP1994	Mercury	13OCT1994	28	30	2	B U	UJ
WO	EG	OR47	16597	13SEP1994	Mercury	13OCT1994	28	30	2	-	J
WS	EG	OR47	16601	13SEP1994	Mercury	13OCT1994	28	30	2	B U	UJ
WS	EG	OR47	16602	13SEP1994	Mercury	13OCT1994	28	30	2	B U	UJ
WO	EG	OR47	16611	13SEP1994	Mercury	13OCT1994	28	30	2	B U	UJ
WO	EG	OR47	16646	13SEP1994	Mercury	13OCT1994	28	30	2	B U	UJ
WO	EG	OR47	16659	13SEP1994	Mercury	13OCT1994	28	30	2	B U	UJ
WO	EG	OR47	53075	12SEP1994	Mercury	11OCT1994	28	29	1	NA U	UJ
WO	EG	OR47	53076	12SEP1994	Mercury	11OCT1994	28	29	1	NA	J
WO	EG	OR47	53119	12SEP1994	Mercury	11OCT1994	28	29	1	NA U	UJ
WO	EG	OR47	53130	12SEP1994	Mercury	11OCT1994	28	29	1	NA U	UJ
FW	EG	OR47	53143	12SEP1994	Mercury	11OCT1994	28	29	1	NA U	UJ
FW	EG	OR47	53149	12SEP1994	Mercury	11OCT1994	28	29	1	NA U	UJ
WO	EG	OR47	53160	12SEP1994	Mercury	11OCT1994	28	29	1	NA U	UJ
WO	EG	OR47	53169	12SEP1994	Mercury	11OCT1994	28	29	1	NA U	UJ

Clinch River Remedial Investigation - Phase II
Data Validation - Holding Times
For Inorganics - Report 2a

12:32 Wednesday, August 16, 1995

LAB_CODE	MATRIX_TYP_CODE	LAG_DATA_PROC_GRP	MIN_HOLD	MAX_HOLD	AVG_HOLD
BRAN	PW	EG	7	36	21
BRAN	SE	EG	4	50	22
BRAN	WQ	EG	7	37	20
BRAN	WS	EG	7	37	19

Clinch River Remedial Investigation - Phase II
Data Validation - Holding Times
For Inorganics - Report 2b

12:32 Wednesday, August 16, 1995

MATRIX	ANALYTE GROUP	MIN_HOLD	MAX_HOLD	AVG_HOLD
PW	HG	7	36	21
SE	HG	4	50	22
WQ	HG	7	37	20
WS	HG	7	37	19

Clinch River Remedial Investigation - Phase II
Data Validation - Holding Times
For Inorganics - Report 3

12:32 Wednesday, August 16, 1995

No samples met the pH > 2 (MET,EG) or < 12 (CN) requirement

Clinch River Remedial Investigation - Phase II
Data Validation - Holding Times
For Inorganics - Report 4

12:32 Wednesday, August 16, 1995

No samples have moisture measurements to be summarized

Apr 13 11:43

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2

Semivolative Organic Instrument Performance Check

11:43 Thursday, April 13, 19

Laboratory	m/e Ion Abundance Criteria	% Relative Abundance					Number not meeting criteria
		Number	Minimum	Maximum	Mean	Standard Deviation	
LOCK	DFTPP Mass 127 [25.0-75.0% of mass 198]	47.00	37.40	57.30	47.96	4.88	0.00
	DFTPP Mass 197 [Less than 1.0% of mass 198]	47.00	0.00	0.40	0.05	0.10	0.00
	DFTPP Mass 198 [Base Peak, 100% relative abundance]	47.00	100.00	100.00	100.00	0.00	0.00
	DFTPP Mass 199 [5.0-9.0% of mass 198]	47.00	6.20	7.20	6.69	0.22	0.00
	DFTPP Mass 275 [10.0-30.0% of mass 198]	47.00	14.20	26.70	19.25	2.43	0.00
	DFTPP Mass 365 [Greater than 0.75% of mass 198]	47.00	1.45	4.75	2.23	0.64	0.00
	DFTPP Mass 441 [Present, but less than mass 443]	47.00	5.50	74.10	13.25	15.85	3.00
	DFTPP Mass 442 [40.0-110.0% of mass 198]	47.00	40.00	98.90	65.56	13.77	0.00
	DFTPP Mass 443 [15.0-24.0% of mass 442]	47.00	18.25	20.23	19.26	0.47	0.00
	DFTPP Mass 51 [30.0-80.0% of mass 198]	47.00	30.10	73.80	43.17	12.72	0.00
	DFTPP Mass 68 [Less than 2.0% of mass 69]	47.00	0.00	1.27	0.19	0.33	0.00

(CONTINUED)

Apr 13 11:43

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3

Semivolative Organic Instrument Performance Check

11:43 Thursday, April 13, 199

Laboratory	m/e Ion Abundance Criteria	% Relative Abundance					Number not meeting criteria
		Number	Minimum	Maximum	Mean	Standard Deviation	
LOCK	DFTPP Mass 69 [Mass 69 relative abundance]	47.00	46.40	83.90	58.41	8.44	0.00
	DFTPP Mass 70 [Less than 2.0% of mass 69]	47.00	0.00	0.91	0.42	0.17	0.00
	DFTPP Mass 127 [25.0-75.0% of mass 198]	2.00	43.80	46.10	44.95	1.63	0.00
SWRI	DFTPP Mass 197 [Less than 1.0% of mass 198]	2.00	0.00	0.00	0.00	0.00	0.00
	DFTPP Mass 198 [Base Peak, 100% relative abundance]	2.00	100.00	100.00	100.00	0.00	0.00
	DFTPP Mass 199 [5.0-9.0% of mass 198]	2.00	5.50	5.70	5.60	0.14	0.00
	DFTPP Mass 275 [10.0-30.0% of mass 198]	2.00	20.30	20.80	20.55	0.35	0.00
	DFTPP Mass 365 [Greater than 0.75% of mass 198]	2.00	1.20	1.30	1.25	0.07	0.00
	DFTPP Mass 441 [Present, but less than mass 443]	2.00	7.00	7.50	7.25	0.35	0.00
	DFTPP Mass 442 [40.0-110.0% of mass 198]	2.00	57.50	64.60	61.05	5.02	0.00
	DFTPP Mass 443 [15.0-24.0% of mass 442]	2.00	17.60	18.00	17.80	0.28	0.00

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Apr 13 11:43

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4

Semivolatle Organic Instrument Performance Check

11:43 Thursday, April 13, 195

		% Relative Abundance					Number not meeting criteria
		Number	Minimum	Maximum	Mean	Standard Deviation	
Laboratory	m/e Ion Abundance Criteria						
SWRI	DFTPP Mass 51 [30.0-80.0% of mass 198]	2.00	52.00	55.60	53.80	2.55	0.00
	DFTPP Mass 68 [Less than 2.0% of mass 69]	2.00	0.00	0.00	0.00	0.00	0.00
	DFTPP Mass 69 [Mass 69 relative abundance]	2.00	48.90	49.50	49.20	0.42	0.00
	DFTPP Mass 70 [Less than 2.0% of mass 69]	2.00	0.00	0.00	0.00	0.00	0.00
TMAR	DFTPP Mass 127 [25.0-75.0% of mass 198]	43.00	41.80	57.00	49.87	3.95	0.00
	DFTPP Mass 197 [Less than 1.0% of mass 198]	43.00	0.00	0.40	0.06	0.11	0.00
	DFTPP Mass 198 [Base Peak, 100% relative abundance]	43.00	100.00	100.00	100.00	0.00	0.00
	DFTPP Mass 199 [5.0-9.0% of mass 198]	43.00	5.80	7.20	6.58	0.30	0.00
	DFTPP Mass 275 [10.0-30.0% of mass 198]	43.00	18.50	26.30	23.30	1.88	0.00
	DFTPP Mass 365 [Greater than 0.75% of mass 198]	43.00	1.25	3.54	2.50	0.52	0.00
	DFTPP Mass 441 [Present, but less than mass 443]	43.00	6.00	13.40	9.87	1.90	0.00

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Apr 13 11:43

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5

Semivolative Organic Instrument Performance Check

11:43 Thursday, April 13, 1995

Laboratory	m/e Ion Abundance Criteria	% Relative Abundance					Number not meeting criteria
		Number	Minimum	Maximum	Mean	Standard Deviation	
TWAR	DFTPP Mass 442 [40.0-110.0% of mass 198]	43.00	43.60	97.70	73.57	14.58	0.00
	DFTPP Mass 443 [15.0-24.0% of mass 442]	43.00	17.30	20.00	18.67	0.61	0.00
	DFTPP Mass 51 [30.0-80.0% of mass 198]	43.00	34.60	59.90	46.42	6.92	0.00
	DFTPP Mass 68 [Less than 2.0% of mass 69]	43.00	0.00	1.90	0.30	0.44	0.00
	DFTPP Mass 69 [Mass 69 relative abundance]	43.00	42.10	68.20	53.03	6.87	0.00
	DFTPP Mass 70 [Less than 2.0% of mass 69]	43.00	0.00	0.90	0.16	0.27	0.00

Jun 15 15:21

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2

Samples that exceed the maximum difference criteria

15:20 Thursday, June 15, 1995 2

PRM_COD	DRG_NO	SMP_ID	QCR_VAL
4-Nitroaniline	A312016	SSTD050000061	29.1
	A404015	SSTD050000031	29.7
	A406067	SSTD050000039	25.3
	A407034	SSTD050000045	30.2
	A409019	SSTD050000090	35.5
4-Nitrophenol	A312016	SSTD050000063	-25.9
	A401013	SSTD050000019	29
	A401013	SSTD050000020	30.8
	A401013	SSTD050000021	32
	A408018	SSTD050000052	-39.3
4-Methylphenol	A406051	SSTD050000017	31
Bis(2-ethylhexyl)phthalate	A403015	SSTD050000028	-36
	A403035	SSTD050000029	-36
	A403072	SSTD050000030	-31.3
Di-n-octylphthalate	A402058	SSTD050000087	-25.8
	A403015	SSTD050000028	-25.7
	A403035	SSTD050000029	-25.7
	A406051	SSTD050000017	-33.5
2,4,6-Tribromophenol	A406034	SSTD050000037	-34
2-Fluorophenol	A312016	SSTD050000063	-25.3
	A401013	SSTD050000021	30.1
Dibenz(a,h)anthracene	A401013	SSTD050000020	-26.2
	A401013	SSTD050000021	-25.1
N-Nitroso-di-n-propylamine	A408018	SSTD050000051	-26.6
Di-n-butylphthalate	A312016	SSTD050000063	-28.6
	A403072	SSTD050000030	-27.1
Butylbenzylphthalate	A403015	SSTD050000028	-31.5
	A403035	SSTD050000029	-31.5
	A403072	SSTD050000030	-25.2
2-Nitroaniline	A401013	SSTD050000019	29
	A408018	SSTD050000052	-27.4
3,3'-Dichlorobenzidine	A311074	SSTD050000084	31.1
	A409019	SSTD050000090	60.3
1,2-Dichlorobenzene	A406051	SSTD050000017	26.5
3-Nitroaniline	A311074	SSTD050000084	29.7
	A311074	SSTD050000086	27.2
	A409019	SSTD050000090	27.3

Jun 15 15:21

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3

Semivolatile Continuing Calibration Check

15:20 Thursday, June 15, 1995 3

PRIM_PARAM_CODE	QC_RSLT_VAL					Number exceeding limit
	Number	Minimum	Maximum	Mean	Standard Deviation	SUM
4-Nitroaniline	38.00	-23.20	35.50	11.15	14.25	5.00
4-Nitrophenol	38.00	-39.30	32.00	0.36	15.85	5.00
4-Bromophenyl phenyl ether	38.00	-13.80	11.60	-2.98	5.82	0.00
2,4-Dimethylphenol	38.00	-13.60	18.90	0.94	6.86	0.00
4-Methylphenol	38.00	-18.20	31.00	-3.30	8.26	1.00
4-Chlorobenzeneamine	38.00	-10.80	23.50	3.61	7.61	0.00
2,2'-oxybis(1-chloropropane)	38.00	-24.50	23.80	-0.75	10.07	0.00
Phenol	38.00	-15.40	14.30	-3.06	7.63	0.00
Bis(2-chloroethyl) ether	38.00	-19.40	15.20	-5.48	8.04	0.00
Bis(2-chloroethoxy)methane	38.00	-13.80	12.40	-1.69	5.91	0.00
Bis(2-ethylhexyl)phthalate	38.00	-36.00	7.10	-7.28	10.48	3.00
Di-n-octylphthalate	38.00	-33.50	24.60	-4.70	10.91	4.00
Hexachlorobenzene	38.00	-16.10	12.90	-2.58	7.24	0.00
2,4,6-Tribromophenol	38.00	-34.00	24.20	0.57	12.48	1.00
Anthracene	38.00	-21.00	3.20	-6.92	5.62	0.00
1,2,4-Trichlorobenzene	38.00	-13.50	6.60	-3.12	4.43	0.00
2,4-Dichlorophenol	38.00	-11.80	6.30	-1.18	3.90	0.00
2,4-Dinitrotoluene	38.00	-7.10	14.60	-1.21	5.08	0.00
Pyrene	38.00	-22.60	8.30	-5.27	8.04	0.00
Dimethylphthalate	38.00	-13.60	6.60	-2.83	3.83	0.00
Dibenzofuran	38.00	-10.00	2.80	-4.30	3.54	0.00
Benzo(ghi)perylene	38.00	-20.60	23.70	4.63	9.13	0.00
Indeno(1,2,3-cd)pyrene	38.00	-23.60	21.90	3.39	9.51	0.00

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Jun 15 15:21

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Semivolatile Continuing Calibration Check 15:20 Thursday, June 15, 1995 4

Appendix C, page 31

Number exceeding limit	QC_RSLT_VAL					Number	Minimum	Maximum	Mean	Standard Deviation	SUM	PRIN_PARAM_CODE
						38.00	-15.10	11.20	-0.99	5.99	0.00	Benzo(b)fluoranthene
						38.00	-19.70	4.80	-7.24	6.50	0.00	Fluoranthene
						38.00	-23.60	10.20	-4.58	7.06	0.00	Benzo(k)fluoranthene
						38.00	-18.30	0.40	-6.09	3.53	0.00	Acenaphthylene
						38.00	-19.40	4.30	-4.73	5.07	0.00	Chrysene
						38.00	-15.80	2.90	-7.91	5.22	0.00	1,2-Dichlorobenzene-d4
						38.00	-20.90	1.50	-8.44	6.34	0.00	2-Fluoro-1,1'-biphenyl
						38.00	-25.30	30.10	-2.56	11.16	2.00	2-Fluorophenol
						38.00	-23.60	23.90	-6.22	12.13	0.00	Mitrobenzene-d5
						38.00	-16.70	19.50	-2.24	8.53	0.00	Phenol-d5
						38.00	-9.70	7.70	-0.01	4.98	0.00	Benzo(a)pyrene
						38.00	-12.80	19.30	3.17	7.91	0.00	2,4-Dinitrophenol
						38.00	-20.00	18.30	-2.91	8.53	0.00	2-Methyl-4,6-dinitrophenol
						38.00	-26.20	21.00	2.71	9.97	2.00	Dibenz(a,b)anthracene
						38.00	-17.80	4.20	-3.28	4.81	0.00	Benzo(a)anthracene
						38.00	-9.00	12.00	-1.07	5.54	0.00	4-Chloro-3-methylphenol
						38.00	-10.70	8.50	-1.66	4.98	0.00	2,6-Dinitrotoluene
						38.00	-26.60	18.80	-2.32	10.22	1.00	N-Mitroso-dl-n-propylamine
						38.00	-17.70	23.80	-6.09	7.30	0.00	Hexachloroethane
						38.00	-17.50	11.50	-2.31	7.31	0.00	4-Chlorophenylphenyl ether
						38.00	-23.20	11.40	-2.69	7.52	0.00	Hexachlorocyclopentadiene
						38.00	-16.40	19.20	-0.71	7.97	0.00	Isophorone
						38.00	-20.90	0.00	-6.86	3.89	0.00	Acenaphthene

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Jun 15 15:21

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Semivolatile Continuing Calibration Check

15:20 Thursday, June 15, 1995 5

Appendix C, page 32

Number exceeding limit	QC_RSLT_VAL					Number	Minimum	Maximum	Mean	Standard Deviation	SUM	PRIM_PARAM_CODE
						38.00	-13.20	8.70	-4.41	4.99		Methylphthalate
						38.00	-28.60	5.20	-9.72	8.25		DL-n-butylphthalate
						38.00	-16.70	1.80	-5.60	3.76		Phenanthrene
						38.00	-31.50	14.20	-4.56	10.18	3.00	Butylbenzylphthalate
						38.00	-13.60	5.40	-1.50	4.42	0.00	m-Mitroodiphenylamine
						38.00	-13.20	1.50	-5.87	3.86	0.00	Fluorene
						38.00	-16.00	13.60	-2.04	6.58	0.00	Carbazole
						38.00	-21.70	10.90	-3.43	7.07	0.00	Hexachlorobutadiene
						38.00	-19.40	14.10	-0.71	8.47	0.00	Pentachlorophenol
						38.00	-10.80	8.20	0.49	5.11	0.00	2,4,6-Trichlorophenol
						38.00	-27.40	29.00	-0.75	12.01	2.00	2-Mitroaniline
						38.00	-6.40	12.70	0.61	4.05	0.00	2-Mitrophenol
						38.00	-17.50	1.80	-6.34	3.93	0.00	Naphthalene
						38.00	-12.00	3.20	-5.72	3.12	0.00	2-Methylnaphtalene
						38.00	-13.60	1.90	-4.53	3.56	0.00	2-Chloronaphthalene
						38.00	-18.60	60.30	7.43	13.40	2.00	3,3'-Dichlorobenzidine
						38.00	-13.50	8.00	-4.97	5.29	0.00	2-Chlorophenol-d4
						38.00	-16.30	11.70	-2.52	6.36	0.00	2-Methylphenol
						38.00	-16.30	26.50	-5.47	6.57	1.00	1,2-Dichlorobenzene
						38.00	-13.20	8.50	-2.98	4.85	0.00	2-Chlorophenol
						38.00	-25.00	8.70	-2.88	8.61	0.00	2,4,5-Trichlorophenol
						38.00	-22.00	2.20	-8.27	7.67	0.00	Terphenyl-d14
						38.00	-17.00	21.20	-3.31	9.84	0.00	Mitrobenzene

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Jun 15 15:21

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6

Semivolatile Continuing Calibration Check

15:20 Thursday, June 15, 1995 6

	QC_RSLT_VAL					Number exceeding limit
	Number	Minimum	Maximum	Mean	Standard Deviation	SUM
PRIM_PARAM_CODE						
3-Nitroaniline	38.00	-16.90	29.70	7.51	11.64	3.00

ORGANIC SURROGATE QUALITY CONTROL LIMITS

CODE	DESCRIPTION	SOIL	WATER	WATER LOW LEVEL
NBZ	NITROBENZENE-D5	23-120	35-114	40-112
FBP	2-FLUOROBIPHENYL	30-115	43-116	42-110
TPH	TERPHENYL-D14	18-137	33-141	24-140
PHL	PHENOL-D5	24-113	10-110	17-113
2FP	2-FLUOROPHENOL	25-121	21-110	16-108
TBP	2,4,6-TRIBROMOPHENOL	19-122	10-123	18-126
2CP	2-CHLOROPHENOL-D4	20-130	33-110	
2DB	1,2-DICHLOROBENZENE-D4	20-130	16-110	
TCX	TETRACHLORO-M-XYLENE	60-150	60-150	60-150
DCB	DECACHLOROBIPHENYL	60-150	60-150	60-150

ORGANIC MATRIX SPIKE QUALITY CONTROL LIMITS

CODE	DESCRIPTION	SOIL	WATER
PHE	PHENOL	26-90	12-110
CPH	2-CHLOROPHENOL	25-102	27-123
4DB	1,4-DICHLOROBENZENE	28-104	36-97
NNA	N-NITROSO-DI-N-PROPYLAMINE	41-126	41-116
TCB	1,2,4-TRICHLOROBENZENE	38-107	39-98
CMP	4-CHLORO-3-METHYLPHENOL	26-103	23-97
ACE	ACENAPHTHENE	31-137	46-118
NPH	4-NITROPHENOL	11-114	10-80
DNT	2,4-DINITROTOLUENE	28-89	24-96
PPH	PENTACHLOROPHENOL	17-109	9-103
PYR	PYRENE	35-142	26-127
GBH	GAMMA-BHC	46-127	56-123
HEP	HEPTACHLOR	35-130	40-131
ALD	ALDRIN	34-132	40-120
DEL	DIELDRIN	31-134	52-126
END	ENDRIN	42-139	56-121
DDT	4,4'-DDT	23-134	38-127

Surrogate Recoveries

Analyte 2CP (ACID)

		Recovery (%)				
		N	Min	Max	Mean	Std Dev
SOW#	Matrix					
192	SE	174.0	30.0	104.0	75.6	12.9

Analyte 2FP (ACID)

		Recovery (%)				
		N	Min	Max	Mean	Std Dev
SOW#	Matrix					
191	WQ/WS	473.0	0.0	107.0	71.3	13.1
192	SE	174.0	27.0	104.0	79.1	15.0
194	FW	46.0	7.0	97.0	64.5	21.8
	WQ/WS	33.0	37.0	85.0	72.0	8.4

Analyte PHL (ACID)

		Recovery (%)				
		N	Min	Max	Mean	Std Dev
SOW#	Matrix					
191	WQ/WS	473.0	0.0	100.0	63.1	19.0
192	SE	174.0	32.0	117.0	82.3	13.1
194	FW	46.0	0.0	97.0	57.7	25.0
	WQ/WS	33.0	7.0	87.0	63.8	18.0

Surrogate Recoveries

Analyte TBP (ACID)

		Recovery (%)				
		N	Min	Max	Mean	Std Dev
SOW#	Matrix					
191	WQ/WS	471.0	21.0	125.0	84.7	13.8
192	SE	174.0	32.0	128.0	84.0	17.5
194	PW	46.0	3.0	100.0	74.8	28.3
	WQ/WS	33.0	57.0	108.0	85.0	13.2

Analyte 2DB (BASE)

		Recovery (%)				
		N	Min	Max	Mean	Std Dev
SOW#	Matrix					
192	SE	174.0	24.0	104.0	67.6	13.6

Analyte FBP (BASE)

		Recovery (%)				
		N	Min	Max	Mean	Std Dev
SOW#	Matrix					
191	WQ/WS	473.0	17.0	120.0	73.5	12.0
192	SE	174.0	37.0	124.0	83.1	13.0
194	PW	46.0	50.0	94.0	71.6	9.8
	WQ/WS	33.0	60.0	97.0	76.2	8.3

Surrogate Recoveries

Analyte NBZ (BASE)

		Recovery (%)				
		N	Min	Max	Mean	Std Dev
SOW#	Matrix					
191	WQ/WS	473.0	2.0	107.0	77.9	14.3
192	SE	174.0	29.0	103.0	72.7	14.0
194	FW	46.0	52.0	103.0	75.1	10.1
	WQ/WS	33.0	57.0	100.0	76.4	11.5

Analyte TPH (BASE)

		Recovery (%)				
		N	Min	Max	Mean	Std Dev
SOW#	Matrix					
191	WQ/WS	470.0	10.0	127.0	82.0	19.5
192	SE	167.0	45.0	130.0	94.6	18.9
194	FW	46.0	17.0	96.0	51.6	21.6
	WQ/WS	33.0	45.0	115.0	96.0	16.5

Surrogate Recoveries

Analyte TCX (PEST)

		Recovery (%)				
		N	Min	Max	Mean	Std Dev
SOW#	Matrix					
191	WQ/WS	909.0	0.0	125.0	62.4	14.5
192	SE	388.0	0.0	130.0	82.8	17.9
194	PW	86.0	9.0	70.0	47.6	14.8
	WQ/WS	64.0	1.0	90.0	52.9	16.9

Analyte DCB (PEST)

		Recovery (%)				
		N	Min	Max	Mean	Std Dev
SOW#	Matrix					
191	WQ/WS	909.0	0.0	105.0	66.4	15.5
192	SE	375.0	0.0	130.0	85.4	16.5
194	PW	86.0	9.0	70.0	40.6	15.6
	WQ/WS	64.0	1.0	90.0	51.6	20.2

Surrogate Recoveries

Analyte TCX (PEST)

		Recovery (%)				
		N	Min	Max	Mean	Std Dev
SOW#	Matrix					
0003	BIOTA	274.0	47.0	122.0	89.6	10.3
0006	BIOTA	785.0	36.0	130.0	94.7	12.6
0020	BIOTA	428.0	53.0	114.0	88.0	7.4

Analyte DCB (PEST)

		Recovery (%)				
		N	Min	Max	Mean	Std Dev
SOW#	Matrix					
0003	BIOTA	273.0	64.0	127.0	97.0	11.0
0006	BIOTA	786.0	10.9	130.0	98.0	11.8
0020	BIOTA	425.0	36.0	106.0	76.3	14.4

Analyte TCBP (PES)

		Recovery (%)				
		N	Min	Max	Mean	Std Dev
SOW#	Matrix					
0006	BIOTA	773.0	28.0	129.0	85.9	15.1
0020	BIOTA	405.0	13.0	128.0	74.3	13.2

Surrogate Frequencies

SON=191 MATRIX=WQ/WS

TABLE OF ANALYTE BY RELATION

ANALYTE	RELATION				
	Frequency				
	Percent				
	Row Pct				
Col Pct	<10%	LOW	OK	HIGH	Total
2FP (ACID)	2	2	469	0	473
	0.04	0.04	10.08	0.00	10.17
	0.42	0.42	99.15	0.00	
	8.00	0.36	11.53	0.00	
PHL (ACID)	16	8	449	0	473
	0.34	0.17	9.65	0.00	10.17
	3.38	1.69	94.93	0.00	
	64.00	1.44	11.03	0.00	
TBP (ACID)	0	0	471	0	471
	0.00	0.00	10.13	0.00	10.13
	0.00	0.00	100.00	0.00	
	0.00	0.00	11.58	0.00	
FBP (BASE)	0	9	463	1	473
	0.00	0.19	9.95	0.02	10.17
	0.00	1.90	97.89	0.21	
	0.00	1.62	11.38	100.00	
NBZ (BASE)	2	6	465	0	473
	0.04	0.13	10.00	0.00	10.17
	0.42	1.27	98.31	0.00	
	8.00	1.08	11.43	0.00	
TPH (BASE)	0	3	467	0	470
	0.00	0.06	10.04	0.00	10.11
	0.00	0.64	99.36	0.00	
	0.00	0.54	11.48	0.00	
TCX (PEST)	3	324	582	0	909
	0.06	6.97	12.51	0.00	19.54
	0.33	35.64	64.03	0.00	
	12.00	58.27	14.30	0.00	
DCB (PEST)	2	204	703	0	909
	0.04	4.39	15.12	0.00	19.54
	0.22	22.44	77.34	0.00	
	8.00	36.69	17.28	0.00	
Total	25	556	4069	1	4651
	0.54	11.95	87.49	0.02	100.00

Surrogate Frequencies

SOW-192 MATRIX-SE

TABLE OF ANALYTE BY RELATION

ANALYTE	RELATION				
Frequency					
Percent					
Row Pct					
Col Pct	<10%	LOW	OK	HIGH	Total
2CP (ACID)	0	0	174	0	174
	0.00	0.00	8.10	0.00	8.10
	0.00	0.00	100.00	0.00	
	0.00	0.00	8.24	0.00	
2FP (ACID)	0	0	174	0	174
	0.00	0.00	8.10	0.00	8.10
	0.00	0.00	100.00	0.00	
	0.00	0.00	8.24	0.00	
PHL (ACID)	0	0	173	1	174
	0.00	0.00	8.05	0.05	8.10
	0.00	0.00	99.43	0.57	
	0.00	0.00	8.19	20.00	
TBP (ACID)	0	0	171	3	174
	0.00	0.00	7.96	0.14	8.10
	0.00	0.00	98.28	1.72	
	0.00	0.00	8.10	60.00	
2DB (BASE)	0	0	174	0	174
	0.00	0.00	8.10	0.00	8.10
	0.00	0.00	100.00	0.00	
	0.00	0.00	8.24	0.00	
Total	4	27	2112	5	2148
(Continued)	0.19	1.26	98.32	0.23	100.00

Surrogate Frequencies

SOW-192 MATRIX-SF

TABLE OF ANALYTE BY RELATION

ANALYTE	RELATION				
	Frequency				
	Percent				
	Row Pct				
Col Pct	<10%	LOW	OK	HIGH	Total
FBP (BASE)	0	0	173	1	174
	0.00	0.00	8.05	0.05	8.10
	0.00	0.00	99.43	0.57	
	0.00	0.00	8.19	20.00	
NBZ (BASE)	0	0	174	0	174
	0.00	0.00	8.10	0.00	8.10
	0.00	0.00	100.00	0.00	
	0.00	0.00	8.24	0.00	
TPH (BASE)	0	0	167	0	167
	0.00	0.00	7.77	0.00	7.77
	0.00	0.00	100.00	0.00	
	0.00	0.00	7.91	0.00	
TCX (PEST)	2	20	366	0	388
	0.09	0.93	17.04	0.00	18.06
	0.52	5.15	94.33	0.00	
	50.00	74.07	17.33	0.00	
DCB (PEST)	2	7	366	0	375
	0.09	0.33	17.04	0.00	17.46
	0.53	1.87	97.60	0.00	
	50.00	25.93	17.33	0.00	
Total	4	27	2112	5	2148
	0.19	1.26	98.32	0.23	100.00

Surrogate Frequencies

SOW-194 MATRIX-PW

TABLE OF ANALYTE BY RELATION

ANALYTE	RELATION			
	Frequency			
	Percent			
	Row Pct			
Col Pct	<10%	LOW	OK	Total
2FP (ACID)	2	0	44	46
	0.45	0.00	9.82	10.27
	4.35	0.00	95.65	
	18.18	0.00	14.92	
PEL (ACID)	3	1	42	46
	0.67	0.22	9.38	10.27
	6.52	2.17	91.30	
	27.27	0.70	14.24	
TBP (ACID)	4	2	40	46
	0.89	0.45	8.93	10.27
	8.70	4.35	86.96	
	36.36	1.41	13.56	
FBP (BASE)	0	0	46	46
	0.00	0.00	10.27	10.27
	0.00	0.00	100.00	
	0.00	0.00	15.59	
HBZ (BASE)	0	0	46	46
	0.00	0.00	10.27	10.27
	0.00	0.00	100.00	
	0.00	0.00	15.59	
TPH (BASE)	0	6	40	46
	0.00	1.34	8.93	10.27
	0.00	13.04	86.96	
	0.00	4.23	13.56	
TCX (PEST)	1	61	24	86
	0.22	13.62	5.36	19.20
	1.16	70.93	27.91	
	9.09	42.96	8.14	
DCB (PEST)	1	72	13	86
	0.22	16.07	2.90	19.20
	1.16	83.72	15.12	
	9.09	50.70	4.41	
Total	11	142	295	448
	2.46	31.70	65.85	100.00

Surrogate Frequencies

SOW-194 MATRIX-WQ/WS

TABLE OF ANALYTE BY RELATION

ANALYTE	RELATION			
Frequency				
Percent				
Row Pct				
Col Pct	<10%	LOW	OK	Total
2FP (ACID)	0	0	33	33
	0.00	0.00	10.12	10.12
	0.00	0.00	100.00	
	0.00	0.00	12.74	
PHL (ACID)	1	1	31	33
	0.31	0.31	9.51	10.12
	3.03	3.03	93.94	
	20.00	1.61	11.97	
TBP (ACID)	0	0	33	33
	0.00	0.00	10.12	10.12
	0.00	0.00	100.00	
	0.00	0.00	12.74	
FBP (BASE)	0	0	33	33
	0.00	0.00	10.12	10.12
	0.00	0.00	100.00	
	0.00	0.00	12.74	
NBZ (BASE)	0	0	33	33
	0.00	0.00	10.12	10.12
	0.00	0.00	100.00	
	0.00	0.00	12.74	
TPH (BASE)	0	0	33	33
	0.00	0.00	10.12	10.12
	0.00	0.00	100.00	
	0.00	0.00	12.74	
TCX (PEST)	2	30	32	64
	0.61	9.20	9.82	19.63
	3.13	46.88	50.00	
	40.00	48.39	12.36	
DCB (PEST)	2	31	31	64
	0.61	9.51	9.51	19.63
	3.13	48.44	48.44	
	40.00	50.00	11.97	
Total	5	62	259	326
	1.53	19.02	79.45	100.00

Surrogate Frequencies

SOW=0003 MATRIX=BIOTA

TABLE OF ANALYTE BY RELATION

ANALYTE	RELATION		
	Frequency	Percent	Row Pct
Col Pct	LOW	OK	Total
TCX (PEST)	4	270	274
	0.73	49.36	50.09
	1.46	98.54	
	100.00	49.72	
DCB (PEST)	0	273	273
	0.00	49.91	49.91
	0.00	100.00	
	0.00	50.28	
Total	4	543	547
	0.73	99.27	100.00

Surrogate Frequencies

SOW=0006 MATRIX=BIOTA

TABLE OF ANALYTE BY RELATION

ANALYTE	RELATION		
Frequency			
Percent			
Row Pct			
Col Pct	LOW	OK	Total
TCX (PEST)	1	784	785
	0.04	33.45	33.49
	0.13	99.87	
	3.13	33.91	
DCB (PEST)	5	781	786
	0.21	33.32	33.53
	0.64	99.36	
	15.63	33.78	
TCBP (PES)	26	747	773
	1.11	31.87	32.98
	3.36	96.64	
	81.25	32.31	
Total	32	2312	2344
	1.37	98.63	100.00

Surrogate Frequencies

SOW-0020 MATRIX-BIOTA

TABLE OF ANALYTE BY RELATION

ANALYTE		RELATION		
Frequency				
Percent				
Row Pct				
Col Pct	LOW	OK		Total
TCX (PEST)	2	426		428
	0.16	33.86		34.02
	0.47	99.53		
	2.13	36.60		
DCB (PEST)	51	374		425
	4.05	29.73		33.78
	12.00	88.00		
	54.26	32.13		
TCBP (PES)	41	364		405
	3.26	28.93		32.19
	10.12	89.88		
	43.62	31.27		
Total	94	1164		1258
	7.47	92.53		100.00

AS Recoveries

Analyte Type=Inorganics

Analyte Antimony

		Recovery (%)				
		N	Min	Max	Mean	Std Dev
Lab	Matrix					
TMAR	SE	169.0	51.0	110.4	85.0	13.0

Analyte Arsenic

		Recovery (%)				
		N	Min	Max	Mean	Std Dev
Lab	Matrix					
SWRI	WO/WS	7.0	78.5	103.5	95.8	8.3
TMAR	SE	105.0	84.6	117.7	102.2	8.2

Analyte Cadmium

		Recovery (%)				
		N	Min	Max	Mean	Std Dev
Lab	Matrix					
TMAR	SE	153.0	71.9	135.7	97.4	11.6

AS Recoveries

----- Analyte Type=Inorganics -----

Analyte Chromium

		Recovery (%)				
		N	Min	Max	Mean	Std Dev
Lab	Matrix					
SWRI	WO/WS	7.0	68.2	98.0	87.1	11.7

Analyte Cobalt

		Recovery (%)				
		N	Min	Max	Mean	Std Dev
Lab	Matrix					
TMAR	SE	126.0	48.9	114.6	95.0	14.7

Analyte Lead

		Recovery (%)				
		N	Min	Max	Mean	Std Dev
Lab	Matrix					
TMAR	SE	120.0	84.8	267.6	101.1	17.6

AS Recoveries

Analyte Type=Inorganics

Analyte Selenium

		Recovery (%)				
		N	Min	Max	Mean	Std Dev
Lab	Matrix					
TMAR	SE	170.0	22.4	138.6	67.0	17.4

Analyte Silver

		Recovery (%)				
		N	Min	Max	Mean	Std Dev
Lab	Matrix					
TMAR	SE	165.0	81.0	145.8	104.8	10.3

Analyte Thallium

		Recovery (%)				
		N	Min	Max	Mean	Std Dev
Lab	Matrix					
TMAR	SE	169.0	61.7	121.5	93.6	11.2

AS Frequencies

SOW#-192 Analyte Type-Inorganics

TABLE OF ANALYTE BY RELATION

ANALYTE Frequency Percent Row Pct Col Pct	RELATION			Total
	HIGH	LOW	OK	
Antimony	0	73	96	169
	0.00	6.20	8.16	14.36
	0.00	43.20	56.80	
	0.00	26.26	11.27	
Arsenic	2	2	101	105
	0.17	0.17	8.58	8.92
	1.90	1.90	96.19	
	4.26	0.72	11.85	
Cadmium	11	15	127	153
	0.93	1.27	10.79	13.00
	7.19	9.80	83.01	
	23.40	5.40	14.91	
Cobalt	0	11	115	126
	0.00	0.93	9.77	10.71
	0.00	8.73	91.27	
	0.00	3.96	13.50	
Total	47	278	852	1177
	3.99	23.62	72.39	100.00

(Continued)

AS Frequencies

SOW#-192 Analyte Type-Inorganics

TABLE OF ANALYTE BY RELATION

ANALYTE	RELATION			
	HIGH	LOW	OK	Total
Frequency				
Percent				
Row Pct				
Col Pct				
Lead	1 0.08 0.83 2.13	1 0.08 0.83 0.36	118 10.03 98.33 13.85	120 10.20 --
Selenium	3 0.25 1.76 6.38	147 12.49 86.47 52.88	20 1.70 11.76 2.35	170 14.44
Silver	21 1.78 12.73 44.68	3 0.25 1.82 1.08	141 11.98 85.45 16.55	165 14.02
Thallium	9 0.76 5.33 19.15	26 2.21 15.38 9.35	134 11.38 79.29 15.73	169 14.36
Total	47 3.99	278 23.62	852 72.39	1177 100.00

AS Frequencies

SOW#-049 Analyte Type-Inorganics

TABLE OF ANALYTE BY RELATION

ANALYTE	RELATION		Total
	LOW	OK	
Frequency			
Percent			
Row Pct			
Col Pct			
Arsenic	1	6	7
	7.14	42.86	50.00
	14.29	85.71	
	25.00	60.00	
Chromium	3	4	7
	21.43	28.57	50.00
	42.86	57.14	
	75.00	40.00	
Total	4	10	14
	28.57	71.43	100.00

MS/MSD Recoveries

Analyte Type-Inorganics

Analyte Aluminum

		Recovery (%)				
		N	Min	Max	Mean	Std Dev
Lab	Matrix					
LOCK	PW	10.0	92.1	110.8	102.3	5.3
	WQ/WS	40.0	82.4	116.4	97.7	7.8

Analyte Antimony

		Recovery (%)				
		N	Min	Max	Mean	Std Dev
Lab	Matrix					
LOCK	PW	10.0	94.1	108.2	99.1	4.2
	WQ/WS	44.0	85.2	112.5	98.4	4.6
TMAR	SE	22.0	0.0	42.7	15.4	13.5

Analyte Arsenic

		Recovery (%)				
		N	Min	Max	Mean	Std Dev
Lab	Matrix					
LOCK	PW	10.0	92.8	109.4	102.6	5.2
	WQ/WS	44.0	88.3	112.7	100.2	5.1
TMAR	SE	22.0	12.6	120.5	81.2	24.5

MS/MSD Recoveries

Analyte Type-Inorganics

Analyte Barium

		Recovery (%)				
		N	Min	Max	Mean	Std Dev
Lab	Matrix					
LOCK	PW	10.0	94.9	106.6	99.8	4.7
	WQ/WS	44.0	81.3	107.0	96.4	5.3
TMAR	SE	23.0	87.2	109.0	96.3	5.1

Analyte Beryllium

		Recovery (%)				
		N	Min	Max	Mean	Std Dev
Lab	Matrix					
LOCK	PW	10.0	91.5	108.1	98.1	5.1
	WQ/WS	44.0	90.3	111.1	100.1	5.1
TMAR	SE	22.0	75.7	95.5	89.3	5.9

Analyte Boron

		Recovery (%)				
		N	Min	Max	Mean	Std Dev
Lab	Matrix					
LOCK	PW	10.0	95.3	109.8	104.5	4.7
	WQ/WS	43.0	46.9	123.5	93.1	12.6
TMAR	SE	23.0	68.8	96.1	84.1	7.7

MS/MSD Recoveries

Analyte Type=Inorganics

Analyte Bromide

		Recovery (%)				
		N	Min	Max	Mean	Std Dev
Lab	Matrix					
LOCK	WQ/WS	33.0	86.3	113.3	99.9	5.5

Analyte Cadmium

		Recovery (%)				
		N	Min	Max	Mean	Std Dev
Lab	Matrix					
LOCK	PW	10.0	101.5	112.6	105.3	4.0
	WQ/WS	44.0	92.9	112.8	102.8	4.3
TMAR	SE	16.0	40.0	127.1	97.6	27.0

Analyte Calcium

		Recovery (%)				
		N	Min	Max	Mean	Std Dev
Lab	Matrix					
LOCK	PW	9.0	58.4	125.2	103.2	22.4
	WQ/WS	31.0	22.8	127.9	89.6	26.9

MS/MSD Recoveries

----- Analyte Type=Inorganics -----

Analyte Chloride

		Recovery (%)				
		N	Min	Max	Mean	Std Dev
Lab	Matrix					
LOCK	WQ/WS	32.0	89.7	106.9	97.0	3.6

Analyte Chromium

		Recovery (%)				
		N	Min	Max	Mean	Std Dev
Lab	Matrix					
LOCK	PW	10.0	95.4	110.4	101.8	4.4
	WQ/WS	44.0	88.5	109.0	98.8	4.4
TMAR	SE	23.0	73.3	119.8	101.5	12.6

Analyte Cobalt

		Recovery (%)				
		N	Min	Max	Mean	Std Dev
Lab	Matrix					
LOCK	PW	10.0	94.7	106.5	101.2	3.9
	WQ/WS	44.0	88.3	107.6	97.6	4.2
TMAR	SE	18.0	37.6	119.1	73.1	24.0

MS/MSD Recoveries

----- Analyte Type-Inorganics -----

Analyte Copper

		Recovery (%)				
		N	Min	Max	Mean	Std Dev
Lab	Matrix					
LOCK	PW	10.0	79.8	104.6	95.6	7.1
	WQ/WS	44.0	82.0	106.0	95.4	6.3
THAR	SE	22.0	0.5	99.2	88.5	20.2

Analyte Cyanide

		Recovery (%)				
		N	Min	Max	Mean	Std Dev
Lab	Matrix					
LOCK	WQ/WS	46.0	78.8	117.0	96.0	7.3

Analyte Fluoride

		Recovery (%)				
		N	Min	Max	Mean	Std Dev
Lab	Matrix					
LOCK	WQ/WS	32.0	75.0	116.0	102.1	10.0

MS/MSD Recoveries

----- Analyte Type=Inorganics -----

Analyte Iron

		Recovery (%)				
		N	Min	Max	Mean	Std Dev
Lab	Matrix					
LOCK	PW	10.0	94.6	113.4	103.8	6.4
	WQ/WS	44.0	78.4	110.5	96.1	6.0

Analyte Kjeldahl nitrogen

		Recovery (%)				
		N	Min	Max	Mean	Std Dev
Lab	Matrix					
LOCK	PW	19.0	83.2	127.2	98.6	12.3
	WQ/WS	4.0	87.8	105.4	94.2	7.7
THAR	SE	24.0	10.2	119.2	74.6	35.4

Analyte Lead

		Recovery (%)				
		N	Min	Max	Mean	Std Dev
Lab	Matrix					
LOCK	PW	10.0	95.8	105.8	101.0	4.0
	WQ/WS	44.0	86.8	106.9	96.7	4.5
THAR	SE	6.0	31.5	114.3	88.1	29.3

MS/MSD Recoveries

Analyte Type=Inorganics

Analyte Magnesium

		Recovery (%)				
		N	Min	Max	Mean	Std Dev
Lab	Matrix					
LOCK	PW	10.0	64.0	109.9	98.2	14.2
	WQ/WS	34.0	66.7	129.1	101.7	14.4

Analyte Manganese

		Recovery (%)				
		N	Min	Max	Mean	Std Dev
Lab	Matrix					
LOCK	PW	7.0	83.2	113.6	102.0	13.1
	WQ/WS	44.0	86.4	111.3	99.1	5.3
TMAR	SE	14.0	40.4	123.6	89.9	27.0

Analyte Mercury

		Recovery (%)				
		N	Min	Max	Mean	Std Dev
Lab	Matrix					
LOCK	PW	12.0	84.0	115.5	101.8	8.6
	WQ/WS	43.0	78.5	117.0	99.0	8.1
TMAR	SE	17.0	5.2	115.5	76.6	32.5

MS/MSD Recoveries

Analyte Type=Inorganics

Analyte Molybdenum

		Recovery (%)				
		N	Min	Max	Mean	Std Dev
Lab	Matrix					
LOCK	PW	10.0	92.9	109.3	101.8	5.0
	WQ/WS	44.0	89.1	112.3	98.5	4.6
TMAR	SE	23.0	70.9	94.2	85.2	6.4

Analyte Nickel

		Recovery (%)				
		N	Min	Max	Mean	Std Dev
Lab	Matrix					
LOCK	PW	10.0	94.4	106.5	100.0	4.4
	WQ/WS	44.0	90.2	108.4	98.0	4.1
TMAR	SE	22.0	80.7	110.0	97.8	6.4

Analyte Nitrate/nitrite

		Recovery (%)				
		N	Min	Max	Mean	Std Dev
Lab	Matrix					
LOCK	WQ/WS	31.0	92.4	113.2	102.7	4.5

MS/MSD Recoveries

----- Analyte Type=Inorganics -----

Analyte Potassium

		Recovery (%)				
		N	Min	Max	Mean	Std Dev
Lab	Matrix					
LOCK	PW	10.0	90.2	110.3	101.1	7.1
	WQ/WS	36.0	83.5	104.2	95.3	5.4

Analyte Selenium

		Recovery (%)				
		N	Min	Max	Mean	Std Dev
Lab	Matrix					
LOCK	PW	10.0	94.5	116.9	109.5	7.3
	WQ/WS	44.0	94.9	124.1	107.9	6.9
TMAR	SE	22.0	0.0	83.4	29.1	23.8

Analyte Silver

		Recovery (%)				
		N	Min	Max	Mean	Std Dev
Lab	Matrix					
LOCK	PW	10.0	85.8	108.3	99.6	6.8
	WQ/WS	44.0	49.5	106.8	93.0	10.8
TMAR	SE	22.0	32.3	106.4	68.6	22.5

MS/MSD Recoveries

Analyte Type=Inorganics

Analyte Sodium

		Recovery (%)				
		N	Min	Max	Mean	Std Dev
Lab	Matrix					
LOCK	PW	9.0	85.6	109.5	101.5	8.6
	WQ/WS	35.0	68.2	121.7	94.9	10.5

Analyte Sulfate

		Recovery (%)				
		N	Min	Max	Mean	Std Dev
Lab	Matrix					
LOCK	WQ/WS	32.0	88.0	105.2	95.2	3.7

Analyte Thallium

		Recovery (%)				
		N	Min	Max	Mean	Std Dev
Lab	Matrix					
LOCK	PW	10.0	94.6	106.5	100.3	4.5
	WQ/WS	44.0	85.7	106.0	96.8	4.3
TMAR	SE	23.0	71.7	97.0	85.4	7.2

MS/MSD Recoveries

Analyte Type=Inorganics

Analyte Uranium

		Recovery (%)				
		N	Min	Max	Mean	Std Dev
Lab	Matrix					
LOCK	PW	10.0	95.9	105.0	100.5	3.1
	WQ/WS	44.0	85.3	110.3	97.6	5.9
TMAR	SE	24.0	0.0	100.3	85.3	19.1

Analyte Vanadium

		Recovery (%)				
		N	Min	Max	Mean	Std Dev
Lab	Matrix					
LOCK	PW	10.0	95.5	110.1	102.4	4.3
	WQ/WS	44.0	90.4	111.2	100.2	4.5
TMAR	SE	23.0	88.6	109.1	98.8	4.9

Analyte Zinc

		Recovery (%)				
		N	Min	Max	Mean	Std Dev
Lab	Matrix					
LOCK	PW	10.0	94.9	109.3	102.7	5.0
	WQ/WS	44.0	90.5	116.3	102.8	5.6
TMAR	SE	22.0	74.7	104.7	97.2	7.1

MS/MSD Recoveries

----- Analyte Type=Organics -----

Analyte 1,2,4-Trichlorobenzene

		Recovery (%)				
		N	Min	Max	Mean	Std Dev
Lab	Matrix					
LOCK	WATER	112.0	35.0	105.0	62.5	10.0
THAR	SOIL	46.0	56.3	94.4	74.2	10.1

Analyte 1,4-Dichlorobenzene

		Recovery (%)				
		N	Min	Max	Mean	Std Dev
Lab	Matrix					
THAR	SOIL	46.0	46.3	90.7	67.7	10.3

Analyte 2,4,6-Trichlorophenol

		Recovery (%)				
		N	Min	Max	Mean	Std Dev
Lab	Matrix					
LOCK	WATER	112.0	20.0	120.0	75.6	13.3

MS/MSD Recoveries

Analyte Type=Organics

Analyte 2,4-Dinitrotoluene

		Recovery (%)				
		N	Min	Max	Mean	Std Dev
Lab	Matrix					
LOCK	WATER	112.0	30.0	100.0	58.7	13.5
TMAR	SOIL	46.0	53.7	127.4	88.2	14.5

Analyte 2-Chlorophenol

		Recovery (%)				
		N	Min	Max	Mean	Std Dev
Lab	Matrix					
LOCK	WATER	112.0	32.5	117.5	72.6	11.5
TMAR	SOIL	46.0	52.5	95.8	74.4	10.1

Analyte 4,4'-DDE

		Recovery (%)				
		N	Min	Max	Mean	Std Dev
Lab	Matrix					
LOCK	WATER	110.0	25.0	110.0	78.4	16.8

MS/MSD Recoveries

----- Analyte Type=Organics -----

Analyte 4,4'-DDT

		Recovery (%)				
		N	Min	Max	Mean	Std Dev
Lab	Matrix					
TMAR	SOIL	46.0	46.7	123.5	80.6	15.4

Analyte 4-Chloro-3-methylphenol

		Recovery (%)				
		N	Min	Max	Mean	Std Dev
Lab	Matrix					
TMAR	SOIL	45.0	46.0	128.5	96.4	13.6

Analyte 4-Chlorobenzenamine

		Recovery (%)				
		N	Min	Max	Mean	Std Dev
Lab	Matrix					
LOCK	WATER	112.0	0.0	65.0	26.9	16.7

MS/MSD Recoveries

----- Analyte Type=Organics -----

Analyte 4-Nitrophenol

		Recovery (%)				
		N	Min	Max	Mean	Std Dev
Lab	Matrix					
TMAR	SOIL	46.0	9.2	123.9	76.6	25.5

Analyte Acenaphthene

		Recovery (%)				
		N	Min	Max	Mean	Std Dev
Lab	Matrix					
TMAR	SOIL	46.0	63.5	119.0	86.5	11.9

Analyte Aldrin

		Recovery (%)				
		N	Min	Max	Mean	Std Dev
Lab	Matrix					
TMAR	SOIL	46.0	0.0	107.0	69.8	17.4

MS/MSD Recoveries

Analyte Type=Organics

Analyte Benzo(a)pyrene

		Recovery (%)				
		N	Min	Max	Mean	Std Dev
Lab	Matrix					
LOCK	WATER	112.0	0.0	125.0	59.0	22.1

Analyte Bis(2-chloroethyl) ether

		Recovery (%)				
		N	Min	Max	Mean	Std Dev
Lab	Matrix					
LOCK	WATER	112.0	35.0	125.0	75.1	12.7

Analyte Dieldrin

		Recovery (%)				
		N	Min	Max	Mean	Std Dev
Lab	Matrix					
LOCK	WATER	110.0	65.0	105.0	84.5	10.0
THAR	SOIL	46.0	0.0	124.3	79.0	19.6

MS/MSD Recoveries

----- Analyte Type=Organics -----

Analyte Diethylphthalate

		Recovery (%)				
		N	Min	Max	Mean	Std Dev
Lab	Matrix					
LOCK	WATER	111.0	15.0	110.0	87.6	18.3

Analyte Endosulfan sulfate

		Recovery (%)				
		N	Min	Max	Mean	Std Dev
Lab	Matrix					
LOCK	WATER	110.0	0.0	95.0	73.7	17.6

Analyte Endrin

		Recovery (%)				
		N	Min	Max	Mean	Std Dev
Lab	Matrix					
LOCK	WATER	110.0	50.0	110.0	85.4	12.7
TMAR	SOIL	46.0	47.9	125.3	85.0	17.3

MS/MSD Recoveries

Analyte Type=Organics

Analyte Heptachlor

		Recovery (%)				
		N	Min	Max	Mean	Std Dev
Lab	Matrix					
TMAR	SOIL	46.0	44.3	113.2	74.2	14.6

Analyte Heptachlor epoxide

		Recovery (%)				
		N	Min	Max	Mean	Std Dev
Lab	Matrix					
LOCK	WATER	110.0	63.0	100.0	83.9	9.6

Analyte Hexachlorobenzene

		Recovery (%)				
		N	Min	Max	Mean	Std Dev
Lab	Matrix					
LOCK	WATER	111.0	20.0	110.0	83.9	14.5

MS/MSD Recoveries

Analyte Type=Organics

Analyte Hexachloroethane

		Recovery (%)				
		N	Min	Max	Mean	Std Dev
Lab	Matrix					
LOCK	WATER	112.0	25.0	80.0	48.3	9.1

Analyte Isophorone

		Recovery (%)				
		N	Min	Max	Mean	Std Dev
Lab	Matrix					
LOCK	WATER	111.0	35.0	105.0	74.3	12.9

Analyte Lindane

		Recovery (%)				
		N	Min	Max	Mean	Std Dev
Lab	Matrix					
LOCK	WATER	110.0	61.0	110.0	86.1	9.8
TMAR	SOIL	45.0	43.9	123.3	78.5	16.2

MS/MSD Recoveries

----- Analyte Type-Organics -----

Analyte N-Nitroso-di-n-propylamine

		Recovery (%)				
		N	Min	Max	Mean	Std Dev
Lab	Matrix					
LOCK	WATER	110.0	30.0	130.0	73.1	15.1
TMAR	SOIL	46.0	55.9	113.3	78.8	33.1

Analyte N-Nitrosodiphenylamine

		Recovery (%)				
		N	Min	Max	Mean	Std Dev
Lab	Matrix					
LOCK	WATER	111.0	0.0	100.0	57.9	22.5

Analyte Naphthalene

		Recovery (%)				
		N	Min	Max	Mean	Std Dev
Lab	Matrix					
LOCK	WATER	112.0	40.0	125.0	71.2	11.0

MS/MSD Recoveries

Analyte Type=Organics

Analyte Pentachlorophenol

		Recovery (%)				
		N	Min	Max	Mean	Std Dev
Lab	Matrix					
TMAR	SOIL	46.0	6.4	126.7	60.0	28.8

Analyte Phenol

		Recovery (%)				
		N	Min	Max	Mean	Std Dev
Lab	Matrix					
LOCK	WATER	112.0	25.0	117.5	66.9	13.4
TMAR	SOIL	46.0	47.3	101.8	76.2	11.7

Analyte Pyrene

		Recovery (%)				
		N	Min	Max	Mean	Std Dev
Lab	Matrix					
TMAR	SOIL	45.0	52.0	126.8	88.5	19.8

MS/MSD Recoveries

Analyte Type=Organics

Analyte Total organic carbon (TOC)

		Recovery (%)				
		N	Min	Max	Mean	Std Dev
Lab	Matrix					
LOCK	PW	7.0	80.0	100.4	94.4	7.2
	WATER	1.0	106.8	106.8	106.8	.

Analyte gamma-Chlordane

		Recovery (%)				
		N	Min	Max	Mean	Std Dev
Lab	Matrix					
LOCK	WATER	110.0	50.0	120.0	86.8	15.4

MS/MSD Recoveries

----- Analyte Type=Radionuclides -----

Analyte Strontium-90

		Recovery (%)				
		N	Min	Max	Mean	Std Dev
Lab	Matrix					
ORAS	SOIL	2.0	51.8	52.7	52.2	0.6
	WATER	5.0	108.7	123.3	116.8	5.9

Analyte Technetium-99

		Recovery (%)				
		N	Min	Max	Mean	Std Dev
Lab	Matrix					
ORAS	SOIL	3.0	25.2	82.7	48.7	30.1

MS/MSD Recoveries

----- Analyte Type=Inorganics -----

Analyte Arsenic

		Recovery (%)				
		N	Min	Max	Mean	Std Dev
Lab	Matrix					
TVAE	BIOTA	72.0	30.0	130.0	93.3	21.7

Analyte Beryllium

		Recovery (%)				
		N	Min	Max	Mean	Std Dev
Lab	Matrix					
TVAE	BIOTA	53.0	60.0	130.0	111.6	15.9

Analyte Copper

		Recovery (%)				
		N	Min	Max	Mean	Std Dev
Lab	Matrix					
TVAE	BIOTA	22.0	100.0	130.0	114.3	11.3

MS/MSD Recoveries

Analyte Type-Inorganics

Analyte Mercury

		Recovery (%)				
		N	Min	Max	Mean	Std Dev
Lab	Matrix					
TVAE	BIOTA	88.0	76.0	130.0	101.7	9.0

Analyte Selenium

		Recovery (%)				
		N	Min	Max	Mean	Std Dev
Lab	Matrix					
TVAE	BIOTA	82.0	6.0	130.0	83.3	17.9

MS/MSD Frequencies

SOW#-191 Analyte Type-Inorganics

TABLE OF ANALYTE BY RELATION

ANALYTE	RELATION			
	HIGH	LOW	OK	Total
Frequency				
Percent				
Row Pct				
Col Pct				
Aluminum	0	0	40	40
	0.00	0.00	3.12	3.12
	0.00	0.00	100.00	
	0.00	0.00	3.14	
Antimony	0	0	43	43
	0.00	0.00	3.35	3.35
	0.00	0.00	100.00	
	0.00	0.00	3.37	
Arsenic	0	0	43	43
	0.00	0.00	3.35	3.35
	0.00	0.00	100.00	
	0.00	0.00	3.37	
Barium	0	0	43	43
	0.00	0.00	3.35	3.35
	0.00	0.00	100.00	
	0.00	0.00	3.37	
Beryllium	0	0	43	43
	0.00	0.00	3.35	3.35
	0.00	0.00	100.00	
	0.00	0.00	3.37	
Boron	0	3	39	42
	0.00	0.23	3.04	3.27
	0.00	7.14	92.86	
	0.00	37.50	3.06	
Total	1	8	1275	1284
(Continued)	0.08	0.62	99.30	100.00

*Categories LLLL < LOW < OK < HIGH < HHHH, defined with dividing limits (%):
 radionuclides, aqueous matrices: 50, 80, 120, 160; radionuclides, solid
 matrices: 40, 70, 130, 169; inorganics: 30, 75, 125, none; organics: 10, by
 CLP, by CLP, none. Exception for radionuclides and inorganics: if recovery
 > four times spike, then OK.

MS/MSD Frequencies*

SOW#-191 Analyte Type-Inorganics

TABLE OF ANALYTE BY RELATION

ANALYTE Frequency Percent Row Pct Col Pct	RELATION			
	HIGH	LOW	OK	Total
Bromide	0 0.00 0.00 0.00	0 0.00 0.00 0.00	33 2.57 100.00 2.59	33 2.57
Cadmium	0 0.00 0.00 0.00	0 0.00 0.00 0.00	43 3.35 100.00 3.37	43 3.35
Calcium	0 0.00 0.00 0.00	0 0.00 0.00 0.00	31 2.41 100.00 2.43	31 2.41
Chloride	0 0.00 0.00 0.00	0 0.00 0.00 0.00	32 2.49 100.00 2.51	32 2.49
Chromium	0 0.00 0.00 0.00	0 0.00 0.00 0.00	43 3.35 100.00 3.37	43 3.35
Cobalt	0 0.00 0.00 0.00	0 0.00 0.00 0.00	43 3.35 100.00 3.37	43 3.35
Total	1 0.08	8 0.62	1275 99.30	1284 100.00

(Continued)

*Categories LLLL < LOW < OK < HIGH < HHHH, defined with dividing limits (%):
 radionuclides, aqueous matrices: 50, 80, 120, 160; radionuclides, solid
 matrices: 40, 70, 130, 169; inorganics: 30, 75, 125, none; organics: 10, by
 CLP, by CLP, none. Exception for radionuclides and inorganics: if recovery
 > four times spike, then OK.

MS/MSD Frequencies*

SOW#-191 Analyte Type-Inorganics

TABLE OF ANALYTE BY RELATION

ANALYTE	RELATION			
	HIGH	LOW	OK	Total
Frequency				
Percent				
Row Pct				
Col Pct				
Copper	0 0.00 0.00 0.00	0 0.00 0.00 0.00	43 3.35 100.00 3.37	43 3.35 100.00 3.37
Cyanide	0 0.00 0.00 0.00	0 0.00 0.00 0.00	46 3.58 100.00 3.61	46 3.58 100.00 3.61
Fluoride	0 0.00 0.00 0.00	0 0.00 0.00 0.00	32 2.49 100.00 2.51	32 2.49 100.00 2.51
Iron	0 0.00 0.00 0.00	0 0.00 0.00 0.00	43 3.35 100.00 3.37	43 3.35 100.00 3.37
Lead	0 0.00 0.00 0.00	0 0.00 0.00 0.00	43 3.35 100.00 3.37	43 3.35 100.00 3.37
Magnesium	1 0.08 2.94 100.00	1 0.08 2.94 12.50	32 2.49 94.12 2.51	34 2.65 94.12 2.51
Total	1 0.08	8 0.62	1275 99.30	1284 100.00

(Continued)

*Categories LLLL < LOW < OK < HIGH < HHHH, defined with dividing limits (%):
 radionuclides, aqueous matrices: 50, 80, 120, 160; radionuclides, solid
 matrices: 40, 70, 130, 169; inorganics: 30, 75, 125, none; organics: 10, by
 CLP, by CLP, none. Exception for radionuclides and inorganics: if recovery
 > four times spike, then OK.

MS/MSD Frequencies*

SOW#-191 Analyte Type-Inorganics

TABLE OF ANALYTE BY RELATION

ANALYTE Frequency Percent Row Pct Col Pct	RELATION			Total
	HIGH	LOW	OK	
Manganese	0	0	43	43
	0.00	0.00	3.35	3.35
	0.00	0.00	100.00	
	0.00	0.00	3.37	
Mercury	0	0	43	43
	0.00	0.00	3.35	3.35
	0.00	0.00	100.00	
	0.00	0.00	3.37	
Molybdenum	0	0	43	43
	0.00	0.00	3.35	3.35
	0.00	0.00	100.00	
	0.00	0.00	3.37	
Nickel	0	0	43	43
	0.00	0.00	3.35	3.35
	0.00	0.00	100.00	
	0.00	0.00	3.37	
Nitrate/nitrite	0	0	31	31
	0.00	0.00	2.41	2.41
	0.00	0.00	100.00	
	0.00	0.00	2.43	
Potassium	0	0	36	36
	0.00	0.00	2.80	2.80
	0.00	0.00	100.00	
	0.00	0.00	2.82	
Total	1	8	1275	1284
	0.08	0.62	99.30	100.00

(Continued)

*Categories LLLL < LOW < OK < HIGH < HHHH, defined with dividing limits (%):
 radionuclides, aqueous matrices: 50, 80, 120, 160; radionuclides, solid
 matrices: 40, 70, 130, 169; inorganics: 30, 75, 125, none; organics: 10, by
 CLP, by CLP, none. Exception for radionuclides and inorganics: if recovery
 > four times spike, then OK.

MS/MSD Frequencies

SOW#-191 Analyte Type-Inorganics

TABLE OF ANALYTE BY RELATION

ANALYTE	RELATION			
	HIGH	LOW	OK	Total
Frequency				
Percent				
Row Pct				
Col Pct				
Selenium	0	0	43	43
	0.00	0.00	3.35	3.35
	0.00	0.00	100.00	
	0.00	0.00	3.37	
Silver	0	2	41	43
	0.00	0.16	3.19	3.35
	0.00	4.65	95.35	
	0.00	25.00	3.22	
Sodium	0	2	33	35
	0.00	0.16	2.57	2.73
	0.00	5.71	94.29	
	0.00	25.00	2.59	
Sulfate	0	0	32	32
	0.00	0.00	2.49	2.49
	0.00	0.00	100.00	
	0.00	0.00	2.51	
Thallium	0	0	43	43
	0.00	0.00	3.35	3.35
	0.00	0.00	100.00	
	0.00	0.00	3.37	
Uranium	0	0	43	43
	0.00	0.00	3.35	3.35
	0.00	0.00	100.00	
	0.00	0.00	3.37	
Total	1	8	1275	1284
	0.08	0.62	99.30	100.00

(Continued)

*Categories LLLL < LOW < OK < HIGH < HHHH, defined with dividing limits (%):
 radionuclides, aqueous matrices: 50, 80, 120, 160; radionuclides, solid
 matrices: 40, 70, 130, 169; inorganics: 30, 75, 125, none; organics: 10, by
 CLP, by CLP, none. Exception for radionuclides and inorganics: if recovery
 > four times spike, then OK.

MS/MSD Frequencies*

SOW#-191 Analyte Type-Inorganics

TABLE OF ANALYTE BY RELATION

ANALYTE	RELATION			
Frequency				
Percent				
Row Pct				
Col Pct	HIGH	LOW	OK	Total
Vanadium	0	0	43	43
	0.00	0.00	3.35	3.35
	0.00	0.00	100.00	
	0.00	0.00	3.37	
Zinc	0	0	43	43
	0.00	0.00	3.35	3.35
	0.00	0.00	100.00	
	0.00	0.00	3.37	
Total	1	8	1275	1284
	0.08	0.62	99.30	100.00

*Categories LLLL < LOW < OK < HIGH < HHHH, defined with dividing limits (%):
 radionuclides, aqueous matrices: 50, 80, 120, 160; radionuclides, solid
 matrices: 40, 70, 130, 169; inorganics: 30, 75, 125, none; organics: 10, by
 CLP, by CLP, none. Exception for radionuclides and inorganics: if recovery
 > four times spike, then OK.

MS/MSD Frequencies

SOW#-191 Analyte Type-Organics

TABLE OF ANALYTE BY RELATION

ANALYTE	RELATION				
Frequency Percent Row Pct Col Pct	HIGH	LLLL	LOW	OK	Total
2,4,6-Trichlorop	0	0	9	97	106
	0.00	0.00	0.39	4.16	4.55
	0.00	0.00	8.49	91.51	
	0.00	0.00	3.31	4.85	
4,4'-DDE	0	0	3	103	106
	0.00	0.00	0.13	4.42	4.55
	0.00	0.00	2.83	97.17	
	0.00	0.00	1.10	5.15	
4-Chlorobenzenam	0	12	54	40	106
	0.00	0.52	2.32	1.72	4.55
	0.00	11.32	50.94	37.74	
	0.00	66.67	19.85	2.00	
Benzo(a)pyrene	5	1	34	66	106
	0.21	0.04	1.46	2.83	4.55
	4.72	0.94	32.08	62.26	
	12.82	5.56	12.50	3.30	
Bis(2-chloroethy	0	0	15	91	106
	0.00	0.00	0.64	3.91	4.55
	0.00	0.00	14.15	85.85	
	0.00	0.00	5.51	4.55	
CPH	0	0	10	96	106
	0.00	0.00	0.43	4.12	4.55
	0.00	0.00	9.43	90.57	
	0.00	0.00	3.68	4.80	
Total	39	18	272	2001	2330
(Continued)	1.67	0.77	11.67	85.88	100.00

*Categories LLLL < LOW < OK < HIGH < HHHH, defined with dividing limits (%):
 radionuclides, aqueous matrices: 50, 80, 120, 160; radionuclides, solid
 matrices: 40, 70, 130, 169; inorganics: 30, 75, 125, none; organics: 10, by
 CLP, by CLP, none. Exception for radionuclides and inorganics: if recovery
 > four times spike, then OK.

MS/MSD Frequencies

SOW#-191 Analyte Type=Organics

TABLE OF ANALYTE BY RELATION

ANALYTE	RELATION				
	HIGH	LLLL	LOW	OK	Total
Frequency					
Percent					
Row Pct					
Col Pct					
DEL	0	0	0	106	106
	0.00	0.00	0.00	4.55	4.55
	0.00	0.00	0.00	100.00	
	0.00	0.00	0.00	5.30	
DNT	0	0	67	39	106
	0.00	0.00	2.88	1.67	4.55
	0.00	0.00	63.21	36.79	
	0.00	0.00	24.63	1.95	
Diethylphthalate	15	0	18	73	106
	0.64	0.00	0.77	3.13	4.55
	14.15	0.00	16.98	68.87	
	38.46	0.00	6.62	3.65	
END	0	0	3	103	106
	0.00	0.00	0.13	4.42	4.55
	0.00	0.00	2.83	97.17	
	0.00	0.00	1.10	5.15	
Endosulfan sulfa	0	4	1	101	106
	0.00	0.17	0.04	4.33	4.55
	0.00	3.77	0.94	95.28	
	0.00	22.22	0.37	5.05	
Heptachlor epoxi	0	0	16	90	106
	0.00	0.00	0.69	3.86	4.55
	0.00	0.00	15.09	84.91	
	0.00	0.00	5.88	4.50	
Total	39	18	272	2001	2330
	1.67	0.77	11.67	85.88	100.00

(Continued)

*Categories LLLL < LOW < OK < HIGH < HHHH, defined with dividing limits (%):
 radionuclides, aqueous matrices: 50, 80, 120, 160; radionuclides, solid
 matrices: 40, 70, 130, 169; inorganics: 30, 75, 125, none; organics: 10, by
 CLP, by CLP, none. Exception for radionuclides and inorganics: if recovery
 > four times spike, then OK.

MS/MSD Frequencies*

SOW#-191 Analyte Type=Organics

TABLE OF ANALYTE BY RELATION

ANALYTE	RELATION				
	HIGH	LLLL	LOW	OK	Total
Frequency					
Percent					
Row Pct					
Col Pct					
Hexachlorobenzene	19	0	0	87	106
	0.82	0.00	0.00	3.73	4.55
	17.92	0.00	0.00	82.08	
	48.72	0.00	0.00	4.35	
Hexachloroethane	0	0	5	101	106
	0.00	0.00	0.21	4.33	4.55
	0.00	0.00	4.72	95.28	
	0.00	0.00	1.84	5.05	
Isophorone	0	0	2	104	106
	0.00	0.00	0.09	4.46	4.55
	0.00	0.00	1.89	98.11	
	0.00	0.00	0.74	5.20	
Lindane	0	0	0	106	106
	0.00	0.00	0.00	4.55	4.55
	0.00	0.00	0.00	100.00	
	0.00	0.00	0.00	5.30	
N-Nitrosodiphenyl	0	1	14	91	106
	0.00	0.04	0.60	3.91	4.55
	0.00	0.94	13.21	85.85	
	0.00	5.56	5.15	4.55	
NNA	0	0	2	102	104
	0.00	0.00	0.09	4.38	4.46
	0.00	0.00	1.92	98.08	
	0.00	0.00	0.74	5.10	
Total	39	18	272	2001	2330
(Continued)	1.67	0.77	11.67	85.88	100.00

*Categories LLLL < LOW < OK < HIGH < HHHH, defined with dividing limits (%):
 radionuclides, aqueous matrices: 50, 80, 120, 160; radionuclides, solid
 matrices: 40, 70, 130, 169; inorganics: 30, 75, 125, none; organics: 10, by
 CLP, by CLP, none. Exception for radionuclides and inorganics: if recovery
 > four times spike, then OK.

MS/MSD Frequencies*

SOW#-191 Analyte Type-Organics

TABLE OF ANALYTE BY RELATION

ANALYTE	RELATION				
Frequency Percent Row Pct Col Pct	HIGH	LLLL	LOW	OK	Total
Naphthalene	0 0.00 0.00 0.00	0 0.00 0.00 0.00	13 0.56 12.26 4.78	93 3.99 87.74 4.65	106 4.55
PHE	0 0.00 0.00 0.00	0 0.00 0.00 0.00	4 0.17 3.77 1.47	102 4.38 96.23 5.10	106 4.55
TCB	0 0.00 0.00 0.00	0 0.00 0.00 0.00	2 0.09 1.89 0.74	104 4.46 98.11 5.20	106 4.55
gamma-Chlordane	0 0.00 0.00 0.00	0 0.00 0.00 0.00	0 0.00 0.00 0.00	106 4.55 100.00 5.30	106 4.55
Total	39 1.67	18 0.77	272 11.67	2001 85.88	2330 100.00

*Categories LLLL < LOW < OK < HIGH < HHHH, defined with dividing limits (%):
 radionuclides, aqueous matrices: 50, 80, 120, 160; radionuclides, solid
 matrices: 40, 70, 130, 169; inorganics: 30, 75, 125, none; organics: 10, by
 CLP, by CLP, none. Exception for radionuclides and inorganics: if recovery
 > four times spike, then OK.

MS/MSD Frequencies*

SOW#-192 Analyte Type-Inorganics

TABLE OF ANALYTE BY RELATION

ANALYTE	RELATION				
	HIGH	LLLL	LOW	OK	Total
Antimony	0	19	3	0	22
Frequency	0.00	4.39	0.69	0.00	5.08
Percent	0.00	86.36	13.64	0.00	
Row Pct	0.00	57.58	4.69	0.00	
Col Pct					
Arsenic	0	1	6	15	22
Frequency	0.00	0.23	1.39	3.46	5.08
Percent	0.00	4.55	27.27	68.18	
Row Pct	0.00	3.03	9.38	4.48	
Col Pct					
Barium	0	0	0	23	23
Frequency	0.00	0.00	0.00	5.31	5.31
Percent	0.00	0.00	0.00	100.00	
Row Pct	0.00	0.00	0.00	6.87	
Col Pct					
Beryllium	0	0	0	22	22
Frequency	0.00	0.00	0.00	5.08	5.08
Percent	0.00	0.00	0.00	100.00	
Row Pct	0.00	0.00	0.00	6.57	
Col Pct					
Boron	0	0	3	20	23
Frequency	0.00	0.00	0.69	4.62	5.31
Percent	0.00	0.00	13.04	86.96	
Row Pct	0.00	0.00	4.69	5.97	
Col Pct					
Cadmium	1	0	3	12	16
Frequency	0.23	0.00	0.69	2.77	3.70
Percent	6.25	0.00	18.75	75.00	
Row Pct	100.00	0.00	4.69	3.58	
Col Pct					
Total	1	33	64	335	433
(Continued)	0.23	7.62	14.78	77.37	100.00

*Categories LLLL < LOW < OK < HIGH < HHHH, defined with dividing limits (%):
 radionuclides, aqueous matrices: 50, 80, 120, 160; radionuclides, solid
 matrices: 40, 70, 130, 169; inorganics: 30, 75, 125, none; organics: 10, by
 CLP, by CLP, none. Exception for radionuclides and inorganics: if recovery
 > four times spike, then OK.

MS/MSD Frequencies:

SOW#-192 Analyte Type-Inorganics

TABLE OF ANALYTE BY RELATION

ANALYTE	RELATION				
	HIGH	LLLL	LOW	OK	Total
Frequency					
Percent					
Row Pct					
Col Pct					
Chromium	0	0	1	22	23
	0.00	0.00	0.23	5.08	5.31
	0.00	0.00	4.35	95.65	
	0.00	0.00	1.56	6.57	
Cobalt	0	0	9	9	18
	0.00	0.00	2.08	2.08	4.16
	0.00	0.00	50.00	50.00	
	0.00	0.00	14.06	2.69	
Copper	0	1	0	21	22
	0.00	0.23	0.00	4.85	5.08
	0.00	4.55	0.00	95.45	
	0.00	3.03	0.00	6.27	
Kjeldahl nitroge	0	0	9	15	24
	0.00	0.00	2.08	3.46	5.54
	0.00	0.00	37.50	62.50	
	0.00	0.00	14.06	4.48	
Lead	0	0	1	5	6
	0.00	0.00	0.23	1.15	1.39
	0.00	0.00	16.67	83.33	
	0.00	0.00	1.56	1.49	
Manganese	0	0	0	14	14
	0.00	0.00	0.00	3.23	3.23
	0.00	0.00	0.00	100.00	
	0.00	0.00	0.00	4.18	
Total	1	33	64	335	433
	0.23	7.62	14.78	77.37	100.00

(Continued)

*Categories LLLL < LOW < OK < HIGH < HHHH, defined with dividing limits (%):
 radionuclides, aqueous matrices: 50, 80, 120, 160; radionuclides, solid
 matrices: 40, 70, 130, 169; inorganics: 30, 75, 125, none; organics: 10, by
 CLP, by CLP, none. Exception for radionuclides and inorganics: if recovery
 > four times spike, then OK.

MS/MSD Frequencies*

SOW#-192 Analyte Type=Inorganics

TABLE OF ANALYTE BY RELATION

ANALYTE	RELATION				
	HIGH	LLLL	LOW	OK	Total
Mercury	0	0	4	13	17
	0.00	0.00	0.92	3.00	3.93
	0.00	0.00	23.53	76.47	
	0.00	0.00	6.25	3.88	
Molybdenum	0	0	2	21	23
	0.00	0.00	0.46	4.85	5.31
	0.00	0.00	8.70	91.30	
	0.00	0.00	3.13	6.27	
Nickel	0	0	0	22	22
	0.00	0.00	0.00	5.08	5.08
	0.00	0.00	0.00	100.00	
	0.00	0.00	0.00	6.57	
Selenium	0	11	10	1	22
	0.00	2.54	2.31	0.23	5.08
	0.00	50.00	45.45	4.55	
	0.00	33.33	15.63	0.30	
Silver	0	0	11	11	22
	0.00	0.00	2.54	2.54	5.08
	0.00	0.00	50.00	50.00	
	0.00	0.00	17.19	3.28	
Thallium	0	0	1	22	23
	0.00	0.00	0.23	5.08	5.31
	0.00	0.00	4.35	95.65	
	0.00	0.00	1.56	6.57	
Total	1	33	64	335	433
(Continued)	0.23	7.62	14.78	77.37	100.00

*Categories LLLL < LOW < OK < HIGH < HHHH, defined with dividing limits (%):
 radionuclides, aqueous matrices: 50, 80, 120, 160; radionuclides, solid
 matrices: 40, 70, 130, 169; inorganics: 30, 75, 125, none; organics: 10, by
 CLP, by CLP, none. Exception for radionuclides and inorganics: if recovery
 > four times spike, then OK.

MS/MSD Frequencies*

SOW#-192 Analyte Type-Inorganics

TABLE OF ANALYTE BY RELATION

ANALYTE	RELATION				
	HIGH	LLLL	LOW	OK	Total
Frequency					
Percent					
Row Pct					
Col Pct					
Uranium	0	1	0	23	24
	0.00	0.23	0.00	5.31	5.54
	0.00	4.17	0.00	95.83	
	0.00	3.03	0.00	6.87	
Vanadium	0	0	0	23	23
	0.00	0.00	0.00	5.31	5.31
	0.00	0.00	0.00	100.00	
	0.00	0.00	0.00	6.87	
Zinc	0	0	1	21	22
	0.00	0.00	0.23	4.85	5.08
	0.00	0.00	4.55	95.45	
	0.00	0.00	1.56	6.27	
Total	1	33	64	335	433
	0.23	7.62	14.78	77.37	100.00

*Categories LLLL < LOW < OK < HIGH < HHHH, defined with dividing limits (%):
 radionuclides, aqueous matrices: 50, 80, 120, 160; radionuclides, solid
 matrices: 40, 70, 130, 169; inorganics: 30, 75, 125, none; organics: 10, by
 CLP, by CLP, none. Exception for radionuclides and inorganics: if recovery
 > four times spike, then OK.

MS/MSD Frequencies*

SOW#-192 Analyte Type-Organics

TABLE OF ANALYTE BY RELATION

ANALYTE	RELATION				
	HIGH	LLLL	LOW	OK	Total
Frequency					
Percent					
Row Pct					
Col Pct					
4DB	0	0	0	46	46
	0.00	0.00	0.00	5.91	5.91
	0.00	0.00	0.00	100.00	
	0.00	0.00	0.00	6.36	
ACE	0	0	0	46	46
	0.00	0.00	0.00	5.91	5.91
	0.00	0.00	0.00	100.00	
	0.00	0.00	0.00	6.36	
ALD	0	1	0	45	46
	0.00	0.13	0.00	5.78	5.91
	0.00	2.17	0.00	97.83	
	0.00	16.67	0.00	6.22	
CMF	14	0	0	31	45
	1.80	0.00	0.00	3.98	5.78
	31.11	0.00	0.00	68.89	
	29.79	0.00	0.00	4.29	
CFH	0	0	0	46	46
	0.00	0.00	0.00	5.91	5.91
	0.00	0.00	0.00	100.00	
	0.00	0.00	0.00	6.36	
DDT	0	0	0	46	46
	0.00	0.00	0.00	5.91	5.91
	0.00	0.00	0.00	100.00	
	0.00	0.00	0.00	6.36	
Total	47	6	3	723	779
	6.03	0.77	0.39	92.81	100.00

(Continued)

*Categories LLLL < LOW < OK < HIGH < HHHH, defined with dividing limits (%):
 radionuclides, aqueous matrices: 50, 80, 120, 160; radionuclides, solid
 matrices: 40, 70, 130, 169; inorganics: 30, 75, 125, none; organics: 10, by
 CLP, by CLP, none. Exception for radionuclides and inorganics: if recovery
 > four times spike, then OK.

MS/MSD Frequencies*

SOW#-192 Analyte Type=Organics

TABLE OF ANALYTE BY RELATION

ANALYTE	RELATION				
	HIGH	LLLL	LOW	OK	Total
Frequency					
Percent					
Row Pct					
Col Pct					
DEL	0	1	0	45	46
	0.00	0.13	0.00	5.78	5.91
	0.00	2.17	0.00	97.83	
	0.00	16.67	0.00	6.22	
DNT	22	0	0	24	46
	2.82	0.00	0.00	3.08	5.91
	47.83	0.00	0.00	52.17	
	46.81	0.00	0.00	3.32	
END	0	0	0	46	46
	0.00	0.00	0.00	5.91	5.91
	0.00	0.00	0.00	100.00	
	0.00	0.00	0.00	6.36	
HEP	0	0	0	46	46
	0.00	0.00	0.00	5.91	5.91
	0.00	0.00	0.00	100.00	
	0.00	0.00	0.00	6.36	
Lindane	0	0	1	44	45
	0.00	0.00	0.13	5.65	5.78
	0.00	0.00	2.22	97.78	
	0.00	0.00	33.33	6.09	
NHA	0	0	0	46	46
	0.00	0.00	0.00	5.91	5.91
	0.00	0.00	0.00	100.00	
	0.00	0.00	0.00	6.36	
Total	47	6	3	723	779
	6.03	0.77	0.39	92.81	100.00

(Continued)

*Categories LLLL < LOW < OK < HIGH < HHHH, defined with dividing limits (%):
 radionuclides, aqueous matrices: 50, 80, 120, 160; radionuclides, solid
 matrices: 40, 70, 130, 169; inorganics: 30, 75, 125, none; organics: 10, by
 CLP, by CLP, none. Exception for radionuclides and inorganics: if recovery
 > four times spike, then OK.

MS/MSD Frequencies*

SOW#-192 Analyte Type=Organics

TABLE OF ANALYTE BY RELATION

ANALYTE	RELATION				
	HIGH	LLLL	LOW	OK	Total
NPH	4 0.51 8.70 8.51	1 0.13 2.17 16.67	0 0.00 0.00 0.00	41 5.26 89.13 5.67	46 5.91
PHE	5 0.64 10.87 10.64	0 0.00 0.00 0.00	0 0.00 0.00 0.00	41 5.26 89.13 5.67	46 5.91
PPH	2 0.26 4.35 4.26	3 0.39 6.52 50.00	2 0.26 4.35 66.67	39 5.01 84.78 5.39	46 5.91
PYR	0 0.00 0.00 0.00	0 0.00 0.00 0.00	0 0.00 0.00 0.00	45 5.78 100.00 6.22	45 5.78
TCB	0 0.00 0.00 0.00	0 0.00 0.00 0.00	0 0.00 0.00 0.00	46 5.91 100.00 6.36	46 5.91
Total	47 6.03	6 0.77	3 0.39	723 92.81	779 100.00

*Categories LLLL < LOW < OK < HIGH < HHHH, defined with dividing limits (%):
 radionuclides, aqueous matrices: 50, 80, 120, 160; radionuclides, solid
 matrices: 40, 70, 130, 169; inorganics: 30, 75, 125, none; organics: 10, by
 CLP, by CLP, none. Exception for radionuclides and inorganics: if recovery
 > four times spike, then OK.

MS/MSD Frequencies*

SOW#-194 Analyte Type-Inorganics

TABLE OF ANALYTE BY RELATION

ANALYTE	RELATION		
	HIGH	OK	Total
Frequency			
Percent			
Row Pct			
Col Pct			
Aluminum	0	10	10
	0.00	3.33	3.33
	0.00	100.00	
	0.00	3.34	
Antimony	0	11	11
	0.00	3.67	3.67
	0.00	100.00	
	0.00	3.68	
Arsenic	0	11	11
	0.00	3.67	3.67
	0.00	100.00	
	0.00	3.68	
Barium	0	11	11
	0.00	3.67	3.67
	0.00	100.00	
	0.00	3.68	
Beryllium	0	11	11
	0.00	3.67	3.67
	0.00	100.00	
	0.00	3.68	
Boron	0	11	11
	0.00	3.67	3.67
	0.00	100.00	
	0.00	3.68	
Total	1	299	300
	0.33	99.67	100.00

(Continued)

*Categories LLLL < LOW < OK < HIGH < HHHH, defined with dividing limits (%):
 radionuclides, aqueous matrices: 50, 80, 120, 160; radionuclides, solid
 matrices: 40, 70, 130, 169; inorganics: 30, 75, 125, none; organics: 10, by
 CLP, by CLP, none. Exception for radionuclides and inorganics: if recovery
 > four times spike, then OK.

MS/MSD Frequencies*

SON#-194 Analyte Type-Inorganics

TABLE OF ANALYTE BY RELATION

ANALYTE Frequency Percent Row Pct Col Pct	RELATION		
	HIGH	OK	Total
Cadmium	0	11	11
	0.00	3.67	3.67
	0.00	100.00	
	0.00	3.68	
Calcium	0	9	9
	0.00	3.00	3.00
	0.00	100.00	
	0.00	3.01	
Chromium	0	11	11
	0.00	3.67	3.67
	0.00	100.00	
	0.00	3.68	
Cobalt	0	11	11
	0.00	3.67	3.67
	0.00	100.00	
	0.00	3.68	
Copper	0	11	11
	0.00	3.67	3.67
	0.00	100.00	
	0.00	3.68	
Iron	0	11	11
	0.00	3.67	3.67
	0.00	100.00	
	0.00	3.68	
Total	1	299	300
	0.33	99.67	100.00

(Continued)

*Categories LLLL < LOW < OK < HIGH < HHHH, defined with dividing limits (%):
 radionuclides, aqueous matrices: 50, 80, 120, 160; radionuclides, solid
 matrices: 40, 70, 130, 169; inorganics: 30, 75, 125, none; organics: 10, by
 CLP, by CLP, none. Exception for radionuclides and inorganics: if recovery
 > four times spike, then OK.

MS/MSD Frequencies

SOW#-194 Analyte Type-Inorganics

TABLE OF ANALYTE BY RELATION

ANALYTE	RELATION		
	HIGH	OK	Total
Frequency			
Percent			
Row Pct			
Col Pct			
Kjeldahl nitroge	1	22	23
	0.33	7.33	7.67
	4.35	95.65	
	100.00	7.36	
Lead	0	11	11
	0.00	3.67	3.67
	0.00	100.00	
	0.00	3.68	
Magnesium	0	10	10
	0.00	3.33	3.33
	0.00	100.00	
	0.00	3.34	
Manganese	0	8	8
	0.00	2.67	2.67
	0.00	100.00	
	0.00	2.68	
Mercury	0	12	12
	0.00	4.00	4.00
	0.00	100.00	
	0.00	4.01	
Molybdenum	0	11	11
	0.00	3.67	3.67
	0.00	100.00	
	0.00	3.68	
Total	1	299	300
	0.33	99.67	100.00

(Continued)

*Categories LLLL < LOW < OK < HIGH < HHHH, defined with dividing limits (%):
radionuclides, aqueous matrices: 50, 80, 120, 160; radionuclides, solid
matrices: 40, 70, 130, 169; inorganics: 30, 75, 125, none; organics: 10, by
CLP, by CLP, none. Exception for radionuclides and inorganics: if recovery
> four times spike, then OK.

MS/MSD Frequencies*

SOWs-194 Analyte Type-Inorganics

TABLE OF ANALYTE BY RELATION

ANALYTE	RELATION		
	HIGH	OK	Total
Frequency			
Percent			
Row Pct			
Col Pct			
Nickel	0	11	11
	0.00	3.67	3.67
	0.00	100.00	
	0.00	3.68	
Potassium	0	10	10
	0.00	3.33	3.33
	0.00	100.00	
	0.00	3.34	
Selenium	0	11	11
	0.00	3.67	3.67
	0.00	100.00	
	0.00	3.68	
Silver	0	11	11
	0.00	3.67	3.67
	0.00	100.00	
	0.00	3.68	
Sodium	0	9	9
	0.00	3.00	3.00
	0.00	100.00	
	0.00	3.01	
Thallium	0	11	11
	0.00	3.67	3.67
	0.00	100.00	
	0.00	3.68	
Total	1	299	300
	0.33	99.67	100.00

(Continued)

*Categories LLLL < LOW < OK < HIGH < BHHH, defined with dividing limits (%):
 radionuclides, aqueous matrices: 50, 80, 120, 160; radionuclides, solid
 matrices: 40, 70, 130, 169; inorganics: 30, 75, 125, none; organics: 10, by
 CLP, by CLP, none. Exception for radionuclides and inorganics: if recovery
 > four times spike, then OK.

MS/MSD Frequencies

SOW#-194 Analyte Type-Inorganics

TABLE OF ANALYTE BY RELATION

ANALYTE	RELATION		
	HIGH	OK	Total
Frequency			
Percent			
Row Pct			
Col Pct			
Uranium	0	11	11
	0.00	3.67	3.67
	0.00	100.00	
	0.00	3.68	
Vanadium	0	11	11
	0.00	3.67	3.67
	0.00	100.00	
	0.00	3.68	
Zinc	0	11	11
	0.00	3.67	3.67
	0.00	100.00	
	0.00	3.68	
Total	1	299	300
	0.33	99.67	100.00

*Categories LLLL < LOW < OK < HIGH < HHHH, defined with dividing limits (%):
 radionuclides, aqueous matrices: 50, 80, 120, 160; radionuclides, solid
 matrices: 40, 70, 130, 169; inorganics: 30, 75, 125, none; organics: 10, by
 CLP, by CLP, none. Exception for radionuclides and inorganics: if recovery
 > four times spike, then OK.

MS/MSD Frequencies

SOW#-194 Analyte Type=Organics

TABLE OF ANALYTE BY RELATION

ANALYTE	RELATION				
	HIGH	LLLL	LOW	OK	Total
Frequency					
Percent					
Row Pct					
Col Pct					
2,4,6-Trichlorop	1	0	2	3	6
	0.82	0.00	1.64	2.46	4.92
	16.67	0.00	33.33	50.00	
	14.29	0.00	9.09	3.57	
4,4'-DDE	0	0	2	2	4
	0.00	0.00	1.64	1.64	3.28
	0.00	0.00	50.00	50.00	
	0.00	0.00	9.09	2.38	
4-Chlorobenzene	0	5	1	0	6
	0.00	4.10	0.82	0.00	4.92
	0.00	83.33	16.67	0.00	
	0.00	55.56	4.55	0.00	
Benzo(a)pyrene	1	2	2	1	6
	0.82	1.64	1.64	0.82	4.92
	16.67	33.33	33.33	16.67	
	14.29	22.22	9.09	1.19	
Bis(2-chloroethy	1	0	0	5	6
	0.82	0.00	0.00	4.10	4.92
	16.67	0.00	0.00	83.33	
	14.29	0.00	0.00	5.95	
CPH	1	0	2	3	6
	0.82	0.00	1.64	2.46	4.92
	16.67	0.00	33.33	50.00	
	14.29	0.00	9.09	3.57	
Total	7	9	22	84	122
(Continued)	5.74	7.38	18.03	68.85	100.00

*Categories LLLL < LOW < OK < HIGH < HHHH, defined with dividing limits (%):
 radionuclides, aqueous matrices: 50, 80, 120, 160; radionuclides, solid
 matrices: 40, 70, 130, 169; inorganics: 30, 75, 125, none; organics: 10, by
 CLP, by CLP, none. Exception for radionuclides and inorganics: if recovery
 > four times spike, then OK.

MS/MSD Frequencies*

SOW#-194 Analyte Type-Organics

TABLE OF ANALYTE BY RELATION

ANALYTE	RELATION					Total
	HIGH	LLLL	LOW	OK		
Frequency						
Percent						
Row Pct						
Col Pct						
DEL	0	0	0	4		4
	0.00	0.00	0.00	3.28		3.28
	0.00	0.00	0.00	100.00		
	0.00	0.00	0.00	4.76		
DNT	0	0	3	3		6
	0.00	0.00	2.46	2.46		4.92
	0.00	0.00	50.00	50.00		
	0.00	0.00	13.64	3.57		
Diethylphthalate	0	0	2	3		5
	0.00	0.00	1.64	2.46		4.10
	0.00	0.00	40.00	60.00		
	0.00	0.00	9.09	3.57		
END	0	0	0	4		4
	0.00	0.00	0.00	3.28		3.28
	0.00	0.00	0.00	100.00		
	0.00	0.00	0.00	4.76		
Endosulfan sulfa	0	0	0	4		4
	0.00	0.00	0.00	3.28		3.28
	0.00	0.00	0.00	100.00		
	0.00	0.00	0.00	4.76		
Heptachlor epoxi	0	0	3	1		4
	0.00	0.00	2.46	0.82		3.28
	0.00	0.00	75.00	25.00		
	0.00	0.00	13.64	1.19		
Total	7	9	22	84		122
(Continued)	5.74	7.38	18.03	68.85		100.00

*Categories LLLL < LOW < OK < HIGH < HHHH, defined with dividing limits (%):
 radionuclides, aqueous matrices: 50, 80, 120, 160; radionuclides, solid
 matrices: 40, 70, 130, 169; inorganics: 30, 75, 125, none; organics: 10, by
 CLP, by CLP, none. Exception for radionuclides and inorganics: if recovery
 > four times spike, then OK.

MS/MSD Frequencies*

SOW#-194 Analyte Type-Organics

TABLE OF ANALYTE BY RELATION

ANALYTE	RELATION				
	HIGH	LLLL	LOW	OK	Total
Frequency					
Percent					
Row Pct					
Col Pct					
Hexachlorobenzene	0	0	2	3	5
	0.00	0.00	1.64	2.46	4.10
	0.00	0.00	40.00	60.00	
	0.00	0.00	9.09	3.57	
Hexachloroethane	1	0	0	5	6
	0.82	0.00	0.00	4.10	4.92
	16.67	0.00	0.00	83.33	
	14.29	0.00	0.00	5.95	
Isophorone	0	0	0	5	5
	0.00	0.00	0.00	4.10	4.10
	0.00	0.00	0.00	100.00	
	0.00	0.00	0.00	5.95	
Lindane	0	0	0	4	4
	0.00	0.00	0.00	3.28	3.28
	0.00	0.00	0.00	100.00	
	0.00	0.00	0.00	4.76	
N-Nitrosodiphenyl	0	2	0	3	5
	0.00	1.64	0.00	2.46	4.10
	0.00	40.00	0.00	60.00	
	0.00	22.22	0.00	3.57	
NHA	1	0	0	5	6
	0.82	0.00	0.00	4.10	4.92
	16.67	0.00	0.00	83.33	
	14.29	0.00	0.00	5.95	
Total	7	9	22	84	122
(Continued)	5.74	7.38	18.03	68.85	100.00

*Categories LLLL < LOW < OK < HIGH < HHHH, defined with dividing limits (%):
 radionuclides, aqueous matrices: 50, 80, 120, 160; radionuclides, solid
 matrices: 40, 70, 130, 169; inorganics: 30, 75, 125, none; organics: 10, by
 CLP, by CLP, none. Exception for radionuclides and inorganics: if recovery
 > four times spike, then OK.

MS/MSD Frequencies

SOW#-194 Analyte Type-Organics

TABLE OF ANALYTE BY RELATION

ANALYTE	RELATION				
	HIGH	LLLL	LOW	OK	Total
Frequency					
Percent					
Row Pct					
Col Pct					
Naphthalene	0	0	1	5	6
	0.00	0.00	0.82	4.10	4.92
	0.00	0.00	16.67	83.33	
	0.00	0.00	4.55	5.95	
PHE	0	0	2	4	6
	0.00	0.00	1.64	3.28	4.92
	0.00	0.00	33.33	66.67	
	0.00	0.00	9.09	4.76	
TCB	1	0	0	5	6
	0.82	0.00	0.00	4.10	4.92
	16.67	0.00	0.00	83.33	
	14.29	0.00	0.00	5.95	
Total organic ca	0	0	0	8	8
	0.00	0.00	0.00	6.56	6.56
	0.00	0.00	0.00	100.00	
	0.00	0.00	0.00	9.52	
gamma-Chlordane	0	0	0	4	4
	0.00	0.00	0.00	3.28	3.28
	0.00	0.00	0.00	100.00	
	0.00	0.00	0.00	4.76	
Total	7	9	22	84	122
	5.74	7.38	18.03	68.85	100.00

*Categories LLLL < LOW < OK < HIGH < HHHH, defined with dividing limits (%):
 radionuclides, aqueous matrices: 50, 80, 120, 160; radionuclides, solid
 matrices: 40, 70, 130, 169; inorganics: 30, 75, 125, none; organics: 10, by
 CLP, by CLP, none. Exception for radionuclides and inorganics: if recovery
 > four times spike, then OK.

MS/MSD Frequencies*

SOW#-SOW Analyte Type-Radionuclides

TABLE OF ANALYTE BY RELATION

ANALYTE	RELATION				
Frequency					
Percent					
Row Pct					
Col Pct	HIGH	LLLL	LOW	OK	Total
Strontium-90	2	0	2	3	7
	20.00	0.00	20.00	30.00	70.00
	28.57	0.00	28.57	42.86	
	100.00	0.00	100.00	75.00	
Technetium-99	0	2	0	1	3
	0.00	20.00	0.00	10.00	30.00
	0.00	66.67	0.00	33.33	
	0.00	100.00	0.00	25.00	
Total	2	2	2	4	10
	20.00	20.00	20.00	40.00	100.00

*Categories LLLL < LOW < OK < HIGH < HHHH, defined with dividing limits (%):
 radionuclides, aqueous matrices: 50, 80, 120, 160; radionuclides, solid
 matrices: 40, 70, 130, 169; inorganics: 30, 75, 125, none; organics: 10, by
 CLP, by CLP, none. Exception for radionuclides and inorganics: if recovery
 > four times spike, then OK.

MS/MSD Frequencies

SOW#-0008 Analyte Type-Inorganics

TABLE OF ANALYTE BY RELATION

ANALYTE	RELATION			
Frequency				
Percent				
Row Pct				
Col Pct	HIGH	LOW	OK	Total
Arsenic	16	8	36	60
	6.35	3.17	14.29	23.81
	26.67	13.33	60.00	
	32.65	42.11	19.57	
Beryllium	23	2	35	60
	9.13	0.79	13.89	23.81
	38.33	3.33	58.33	
	46.94	10.53	19.02	
Copper	8	0	4	12
	3.17	0.00	1.59	4.76
	66.67	0.00	33.33	
	16.33	0.00	2.17	
Mercury	0	0	60	60
	0.00	0.00	23.81	23.81
	0.00	0.00	100.00	
	0.00	0.00	32.61	
Selenium	2	9	49	60
	0.79	3.57	19.44	23.81
	3.33	15.00	81.67	
	4.08	47.37	26.63	
Total	49	19	184	252
	19.44	7.54	73.02	100.00

*Categories LLLL < LOW < OK < HIGH < HHHH, defined with dividing limits (%):
radionuclides, aqueous matrices: 50, 80, 120, 160; radionuclides, solid
matrices: 40, 70, 130, 169; inorganics: 30, 75, 125, none; organics: 10, by
CLP, by CLP, none. Exception for radionuclides and inorganics: if recovery
> four times spike, then OK.

MS/MSD Frequencies

SOW#-0021 Analyte Type-Inorganics

TABLE OF ANALYTE BY RELATION

ANALYTE	RELATION				
	HIGH	LLLL	LOW	OK	Total
Frequency					
Percent					
Row Pct					
Col Pct					
Arsenic	5 3.62 17.86 11.11	0 0.00 0.00 0.00	5 3.62 17.86 41.67	18 13.04 64.29 22.50	28 20.29
Beryllium	20 14.49 71.43 44.44	0 0.00 0.00 0.00	0 0.00 0.00 0.00	8 5.80 28.57 10.00	28 20.29
Copper	13 9.42 50.00 28.89	0 0.00 0.00 0.00	0 0.00 0.00 0.00	13 9.42 50.00 16.25	26 18.84
Mercury	2 1.45 7.14 4.44	0 0.00 0.00 0.00	0 0.00 0.00 0.00	26 18.84 92.86 32.50	28 20.29
Selenium	5 3.62 17.86 11.11	1 0.72 3.57 100.00	7 5.07 25.00 58.33	15 10.87 53.57 18.75	28 20.29
Total	45 32.61	1 0.72	12 8.70	80 57.97	138 100.00

*Categories LLLL < LOW < OK < HIGH < HHHH, defined with dividing limits (%):
 radionuclides, aqueous matrices: 50, 80, 120, 160; radionuclides, solid
 matrices: 40, 70, 130, 169; inorganics: 30, 75, 125, none; organics: 10, by
 CLP, by CLP, none. Exception for radionuclides and inorganics: if recovery
 > four times spike, then OK.

Relative Percent Difference for Customer Samples and Duplicates

Laboratory Name-> Brooks Rand,
Matrix-> Pore Water,
AND Media-> Pore Water

Parameter Name	Total		Relative Percent Difference					RPD	Difference between Sample/Lab Dup	Difference
	Number of Samples	Exceeds criteria	Number of Samples	Minimum	Maximum	Mean	Standard Deviation	Exceeds criteria	Number of Samples	Exceeds criteria
Mercury	3.00	0.00	0.00	.	.	.	.	0	2.00	0
Methyl mercury	1.00	0.00	0.00	.	.	.	.	0	1.00	0

Laboratory Name-> Brooks Rand,
Matrix-> Sediment,
AND Media-> Sediment Core

Parameter Name	Total		Relative Percent Difference					RPD	Difference between Sample/Lab Dup	Difference
	Number of Samples	Exceeds criteria	Number of Samples	Minimum	Maximum	Mean	Standard Deviation	Exceeds criteria	Number of Samples	Exceeds criteria
Mercury	27.00	0.00	19.00	0.00	14.27	5.60	3.44	0	8.00	0
Methyl mercury	18.00	0.00	0.00	.	.	.	.	0	18.00	0

For results > 5 x CRDL, RPD is calculated.
If RPD > 20% for water or if RPD > 35% for soils, data is flagged.

For results < 5 x CRDL, the absolute value of the difference is calculated.
If the difference > CRDL for water or difference > 2 * CRDL for soils, data is flagged.

If either result is a non-detect, no calculations are done.

Relative Percent Difference for Customer Samples and Duplicates

Laboratory Name-> Brooks Rand,
Matrix-> Sediment,
AND Media-> Sediment Grab

	Total		Relative Percent Difference					RPD	Difference between Sample/Lab Dup	Difference
	Number of Samples	Exceeds criteria	Number of Samples	Minimum	Maximum	Mean	Standard Deviation	Exceeds criteria	Number of Samples	Exceeds criteria
Parameter Name										
Methyl mercury	2.00	0.00	0.00	.	.	.	.	0	2.00	0

Laboratory Name-> Brooks Rand,
Matrix-> Water Quality,
AND Media-> Pore Water

	Total		Relative Percent Difference					RPD	Difference between Sample/Lab Dup	Difference
	Number of Samples	Exceeds criteria	Number of Samples	Minimum	Maximum	Mean	Standard Deviation	Exceeds criteria	Number of Samples	Exceeds criteria
Parameter Name										
Mercury	2.00	0.00	2.00	0.00	1.55	0.77	1.09	0	0.00	0

For results > 5 x CRDL, RPD is calculated.

If RPD > 20% for water or if RPD > 35% for soils, data is flagged.

For results < 5 x CRDL, the absolute value of the difference is calculated.

If the difference > CRDL for water or difference > 2 * CRDL for soils, data is flagged.

If either result is a non-detect, no calculations are done.

Relative Percent Difference for Customer Samples and Duplicates

Laboratory Name-> Brooks Rand,
Matrix-> Water Quality,
AND Media-> Water sample, unfiltered

	Total		Relative Percent Difference					RPD	Difference between Sample/Lab Dup	Difference
	Number of Samples	Exceeds criteria	Number of Samples	Minimum	Maximum	Mean	Standard Deviation	Exceeds criteria	Number of Samples	Exceeds criteria
Parameter Name										
Mercury	1.00	0.00	0.00	.	.	.	.	0	1.00	0

Laboratory Name-> Brooks Rand,
Matrix-> Surface Water,
AND Media-> Water Sample, filtered

	Total		Relative Percent Difference					RPD	Difference between Sample/Lab Dup	Difference
	Number of Samples	Exceeds criteria	Number of Samples	Minimum	Maximum	Mean	Standard Deviation	Exceeds criteria	Number of Samples	Exceeds criteria
Parameter Name										
Mercury	8.00	0.00	0.00	.	.	.	.	0	1.00	0
Methyl mercury	1.00	0.00	0.00	.	.	.	.	0	0.00	0

For results > 5 x CRDL, RPD is calculated.

If RPD > 20% for water or if RPD > 35% for soils, data is flagged.

For results < 5 x CRDL, the absolute value of the difference is calculated.

If the difference > CRDL for water or difference > 2 * CRDL for soils, data is flagged.

If either result is a non-detect, no calculations are done.

Relative Percent Difference for Customer Samples and Duplicates

Laboratory Name-> Brooks Rand,
Matrix-> Surface Water,
AND Media-> Water sample, unfiltered

Parameter Name	Total		Relative Percent Difference					RPD	Difference between Sample/Lab Dup	Difference
	Number of Samples	Exceeds criteria	Number of Samples	Minimum	Maximum	Mean	Standard Deviation	Exceeds criteria	Number of Samples	Exceeds criteria
Mercury	57.00	0.00	4.00	0.96	5.52	3.32	2.14	0	24.00	0
Methyl mercury	14.00	0.00	0.00	.	.	.	.	0	1.00	0

For results > 5 x CRDL, RPD is calculated.

If RPD > 20% for water or if RPD > 35% for soils, data is flagged.

For results < 5 x CRDL, the absolute value of the difference is calculated.

If the difference > CRDL for water or difference > 2 * CRDL for soils, data is flagged.

If either result is a non-detect, no calculations are done.

Relative Percent Difference for Customer Samples and Duplicates

Laboratory Name-> Ecotek Laboratory Services, Inc.,
Matrix-> BIOTA,
AND Media-> WFWL

Parameter Name	Total		Relative Percent Difference					RPD	Difference between Sample/Lab Dup	Difference
	Number of Samples	Exceeds criteria	Number of Samples	Minimum	Maximum	Mean	Standard Deviation	Exceeds criteria	Number of Samples	Exceeds criteria
Cadmium	3.00	0.00	0.00	.	.	.	.	0	1.00	0
Chromium	3.00	0.00	0.00	.	.	.	.	0	0.00	0
Lead	3.00	0.00	0.00	.	.	.	.	0	0.00	0
Mercury	2.00	1.00	1.00	21.41	21.41	21.41	.	1	0.00	0
Nickel	3.00	0.00	0.00	.	.	.	.	0	0.00	0
Selenium	3.00	0.00	0.00	.	.	.	.	0	1.00	0

For wet chemistry results and for inorganic results > 5 x CRDL, RPD is calculated.
For wet chemistry, if RPD > 20% then data is flagged.
For inorganics, if RPD > 20% for water or if RPD > 35% for soils, data is flagged.

For inorganic results < 5 x CRDL, the absolute value of the difference is calculated.
If the difference > CRDL for water or difference > 2 * CRDL for soils, data is flagged.

If either result is a non-detect, no calculations are done.

Relative Percent Difference for Matrix Spike/Matrix Spike Duplicates

Laboratory Name-> Lockheed Engineering
AND Matrix-> WATER

Parameter Name	Upper limit	Exceeds criteria	Relative Percent Difference				
			Number of Samples	Minimum	Maximum	Mean	Standard Deviation
1,2,4-Trichlorobenzene	28.00	2.00	56.00	0.00	54.55	10.36	9.82
2,4,6-Trichlorophenol	50.00	0.00	56.00	0.00	43.04	10.20	8.13
2,4-Dinitrotoluene	38.00	2.00	55.00	0.00	42.42	11.39	9.70
2-Chlorophenol	40.00	0.00	56.00	0.00	35.00	9.69	8.40
4,4'-DDE	18.00	10.00	55.00	0.00	58.16	8.24	11.11
4-Chlorobenzeneamine	50.00	18.00	53.00	0.00	200.00	52.60	51.12
Benzo(a)pyrene	50.00	9.00	55.00	0.00	200.00	29.60	43.59
Bis(2-chloroethyl) ether	50.00	0.00	55.00	0.00	38.10	10.71	9.11
Dieldrin	18.00	4.00	55.00	0.00	27.03	5.49	6.58
Diethylphthalate	50.00	5.00	56.00	0.00	140.00	17.22	30.20
Endosulfan sulfate	18.00	5.00	53.00	0.00	111.69	8.60	16.06
Endrin	21.00	9.00	54.00	0.00	51.85	10.36	11.66
Heptachlor epoxide	18.00	6.00	55.00	0.00	33.77	6.84	8.54
Hexachlorobenzene	50.00	0.00	56.00	0.00	44.90	7.17	8.02
Hexachloroethane	50.00	1.00	56.00	0.00	78.26	11.41	12.55
Isophorone	50.00	0.00	56.00	0.00	38.30	8.80	8.21
Lindane	15.00	9.00	55.00	0.00	42.42	7.22	8.93
N-Nitroso-di-n-propylamine	38.00	3.00	56.00	0.00	73.68	13.11	15.10
N-Nitrosodiphenylamine	50.00	8.00	53.00	0.00	100.00	22.43	28.75
Naphthalene	50.00	0.00	55.00	0.00	43.90	10.26	8.23
Phenol	42.00	0.00	56.00	0.00	41.03	11.31	10.13
gamma-Chlordane	18.00	4.00	54.00	0.00	37.04	5.96	7.39

Relative Percent Difference for Customer Samples and Duplicates

Laboratory Name-> Lockheed Engineering & Science,

Matrix-> Pore Water,

AND Media-> Pore Water

Parameter Name	Total		Relative Percent Difference					RPD	Difference between Sample/Lab Dup	Difference
	Number of Samples	Exceeds criteria	Number of Samples	Minimum	Maximum	Mean	Standard Deviation	Exceeds criteria	Number of Samples	
Aluminum	10.00	0.00	1.00	0.04	0.04	0.04	.	0	4.00	0
Ammonium nitrogen	4.00	0.00	4.00	0.22	3.09	1.47	1.45	0	0.00	0
Antimony	10.00	0.00	0.00	.	.	.	.	0	9.00	0
Arsenic	10.00	0.00	0.00	.	.	.	.	0	4.00	0
Barium	10.00	0.00	1.00	1.67	1.67	1.67	.	0	8.00	0
Beryllium	10.00	0.00	0.00	.	.	.	.	0	0.00	0
Boron	10.00	5.00	6.00	10.34	53.70	25.69	17.30	3	2.00	2
Cadmium	10.00	0.00	0.00	.	.	.	.	0	0.00	0
Calcium	10.00	0.00	9.00	0.02	2.49	0.95	0.94	0	0.00	0
Chromium	10.00	0.00	0.00	.	.	.	.	0	3.00	0
Cobalt	10.00	0.00	1.00	4.10	4.10	4.10	.	0	8.00	0
Copper	10.00	0.00	0.00	.	.	.	.	0	9.00	0
Iron	10.00	0.00	0.00	.	.	.	.	0	10.00	0
Kjeldahl nitrogen	19.00	0.00	19.00	0.00	16.77	3.22	4.05	0	0.00	0
Lead	10.00	0.00	0.00	.	.	.	.	0	1.00	0
Magnesium	10.00	0.00	9.00	0.04	5.65	1.95	1.88	0	0.00	0

(CONTINUED)

For wet chemistry results and for inorganics results > 5 x CRDL, RPD is calculated.

For wet chemistry, if RPD > 20% then data is flagged.

For inorganics, if RPD > 20% for water or if RPD > 35% for soils, data is flagged.

For inorganics results < 5 x CRDL, the absolute value of the difference is calculated.

If the difference > CRDL for water or difference > 2 * CRDL for soils, data is flagged.

If either result is a non-detect, no calculations are done.

Relative Percent Difference for Customer Samples and Duplicates

Laboratory Name-> Lockheed Engineering & Science,
Matrix-> Pore Water,
AND Media-> Pore Water

Parameter Name	Total		Relative Percent Difference						RPD	Difference between Sample/Lab Dup	
	Number of Samples	Exceeds criteria	Number of Samples	Minimum	Maximum	Mean	Standard Deviation	Exceeds criteria		Number of Samples	Exceeds criteria
Manganese	10.00	0.00	9.00	0.03	7.60	2.21	2.54	0	0.00	0	
Mercury	11.00	0.00	0.00	.	.	.	.	0	0.00	0	
Molybdenum	10.00	0.00	0.00	.	.	.	.	0	7.00	0	
Nickel	10.00	0.00	0.00	.	.	.	.	0	10.00	0	
Potassium	10.00	0.00	0.00	.	.	.	.	0	9.00	0	
Selenium	10.00	0.00	0.00	.	.	.	.	0	0.00	0	
Silver	10.00	0.00	0.00	.	.	.	.	0	0.00	0	
Sodium	10.00	0.00	9.00	0.14	2.39	1.14	0.83	0	0.00	0	
Thallium	10.00	0.00	0.00	.	.	.	.	0	0.00	0	
Total organic carbon (TOC)	20.00	0.00	20.00	0.40	7.37	2.73	2.19	0	0.00	0	
Uranium	10.00	0.00	1.00	1.19	1.19	1.19	.	0	4.00	0	
Vanadium	10.00	0.00	0.00	.	.	.	.	0	0.00	0	
Zinc	10.00	0.00	0.00	.	.	.	.	0	9.00	0	

For wet chemistry results and for inorganic results > 5 x CRDL, RPD is calculated.
For wet chemistry, if RPD > 20% then data is flagged.
For inorganics, if RPD > 20% for water or if RPD > 35% for soils, data is flagged.

For inorganic results < 5 x CRDL, the absolute value of the difference is calculated.
If the difference > CRDL for water or difference > 2 x CRDL for soils, data is flagged.

If either result is a non-detect, no calculations are done.

Relative Percent Difference for Customer Samples and Duplicates

Laboratory Name-> Lockheed Engineering & Science,
Matrix-> Water Quality,
AND Media-> Sediment Core

Parameter Name	Total		Relative Percent Difference					RPD	Difference between Sample/Lab Dup	Difference
	Number of Samples	Exceeds criteria	Number of Samples	Minimum	Maximum	Mean	Standard Deviation	Exceeds criteria	Number of Samples	
Aluminum	1.00	0.00	0.00	.	.	.	.	0	1.00	0
Antimony	1.00	0.00	0.00	.	.	.	.	0	0.00	0
Arsenic	1.00	0.00	0.00	.	.	.	.	0	0.00	0
Barium	1.00	0.00	0.00	.	.	.	.	0	0.00	0
Beryllium	1.00	0.00	0.00	.	.	.	.	0	0.00	0
Boron	1.00	1.00	0.00	.	.	.	.	0	1.00	1
Cadmium	1.00	0.00	0.00	.	.	.	.	0	0.00	0
Calcium	1.00	0.00	0.00	.	.	.	.	0	0.00	0
Chromium	1.00	0.00	0.00	.	.	.	.	0	0.00	0
Cobalt	1.00	0.00	0.00	.	.	.	.	0	0.00	0
Copper	1.00	0.00	0.00	.	.	.	.	0	0.00	0
Iron	1.00	0.00	0.00	.	.	.	.	0	1.00	0
Lead	1.00	0.00	0.00	.	.	.	.	0	0.00	0
Magnesium	1.00	0.00	0.00	.	.	.	.	0	0.00	0
Manganese	1.00	0.00	0.00	.	.	.	.	0	0.00	0
Molybdenum	1.00	0.00	0.00	.	.	.	.	0	0.00	0

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For wet chemistry results and for inorganics results > 5 x CRDL, RPD is calculated.
For wet chemistry, if RPD > 20% then data is flagged.
For inorganics, if RPD > 20% for water or if RPD > 35% for soils, data is flagged.

For inorganics results < 5 x CRDL, the absolute value of the difference is calculated.
If the difference > CRDL for water or difference > 2 * CRDL for soils, data is flagged.

If either result is a non-detect, no calculations are done.

Relative Percent Difference for Customer Samples and Duplicates

Laboratory Name-> Lockheed Engineering & Science,
Matrix-> Water Quality,
AMD Media-> Sediment Core

Parameter Name	Total		Relative Percent Difference					RPD	Difference between Sample/Lab Dup	Difference
	Number of Samples	Exceeds criteria	Number of Samples	Minimum	Maximum	Mean	Standard Deviation	Exceeds criteria	Number of Samples	Exceeds criteria
Nickel	1.00	0.00	0.00	.	.	.	.	0	0.00	0
Potassium	1.00	0.00	0.00	.	.	.	.	0	0.00	0
Selenium	1.00	0.00	0.00	.	.	.	.	0	0.00	0
Silver	1.00	0.00	0.00	.	.	.	.	0	0.00	0
Sodium	1.00	0.00	0.00	.	.	.	.	0	0.00	0
Thallium	1.00	0.00	0.00	.	.	.	.	0	0.00	0
Uranium	1.00	0.00	0.00	.	.	.	.	0	0.00	0
Vanadium	1.00	0.00	0.00	.	.	.	.	0	0.00	0
Zinc	1.00	0.00	0.00	.	.	.	.	0	0.00	0

For wet chemistry results and for inorganic results > 5 x CRDL, RPD is calculated.
For wet chemistry, if RPD > 20% then data is flagged.
For inorganics, if RPD > 20% for water or if RPD > 35% for soils, data is flagged.

For inorganic results < 5 x CRDL, the absolute value of the difference is calculated.
If the difference > CRDL for water or difference > 2 * CRDL for soils, data is flagged.

If either result is a non-detect, no calculations are done.

Relative Percent Difference for Customer Samples and Duplicates

Laboratory Name-> Lockheed Engineering & Science,
Matrix-> Water Quality,
AND Media-> Water Sample, filtered

Parameter Name	Total		Relative Percent Difference					RPD	Difference between Sample/Lab 'Dup	Difference
	Number of Samples	Exceeds criteria	Number of Samples	Minimum	Maximum	Mean	Standard Deviation	Exceeds criteria	Number of Samples	Exceeds criteria
Bromide	1.00	0.00	0.00	.	.	.	.	0	0.00	0
Chloride	1.00	0.00	1.00	8.00	8.00	8.00	.	0	0.00	0
Cyanide	1.00	0.00	0.00	.	.	.	.	0	0.00	0
Fluoride	1.00	0.00	0.00	.	.	.	.	0	0.00	0
Sulfate	1.00	0.00	0.00	.	.	.	.	0	1.00	0

For wet chemistry results and for inorganics results > 5 x CRDL, RPD is calculated.
For wet chemistry, if RPD > 20% then data is flagged.
For inorganics, if RPD > 20% for water or if RPD > 35% for soils, data is flagged.

For inorganics results < 5 x CRDL, the absolute value of the difference is calculated.
If the difference > CRDL for water or difference > 2 * CRDL for soils, data is flagged.

If either result is a non-detect, no calculations are done.

Relative Percent Difference for Customer Samples and Duplicates

Laboratory Name-> Lockheed Engineering & Science,
Matrix-> Water Quality,
AMD Media-> Pore Water

Parameter Name	Total		Relative Percent Difference					RPD	Difference between Sample/Lab Dup	Difference
	Number of Samples	Exceeds criteria	Number of Samples	Minimum	Maximum	Mean	Standard Deviation	Exceeds criteria	Number of Samples	Exceeds criteria
Ammonium nitrogen	1.00	0.00	0.00	.	.	.	.	0	0.00	0
Kjeldahl nitrogen	4.00	0.00	0.00	.	.	.	.	0	0.00	0
Total organic carbon (TOC)	3.00	0.00	0.00	.	.	.	.	0	0.00	0

Laboratory Name-> Lockheed Engineering & Science,
Matrix-> Water Quality,
AMD Media-> Water sample, unfiltered

Parameter Name	Total		Relative Percent Difference					RPD	Difference between Sample/Lab Dup	Difference
	Number of Samples	Exceeds criteria	Number of Samples	Minimum	Maximum	Mean	Standard Deviation	Exceeds criteria	Number of Samples	Exceeds criteria
Cyanide	5.00	0.00	0.00	.	.	.	.	0	0.00	0
Nitrate/nitrite	1.00	0.00	0.00	.	.	.	.	0	0.00	0

For wet chemistry results and for inorganic results > 5 x CRDL, RPD is calculated.
For wet chemistry, if RPD > 20% then data is flagged.
For inorganics, if RPD > 20% for water or if RPD > 35% for soils, data is flagged.

For inorganic results < 5 x CRDL, the absolute value of the difference is calculated.
If the difference > CRDL for water or difference > 2 * CRDL for soils, data is flagged.

If either result is a non-detect, no calculations are done.

Relative Percent Difference for Customer Samples and Duplicates

Laboratory Name--> Lockheed Engineering & Science,
Matrix--> Surface Water,
AND Media--> Water Sample, filtered

Parameter Name	Total		Relative Percent Difference					RPD	Difference between Sample/Lab Dup	
	Number of Samples	Exceeds criteria	Minimum	Maximum	Mean	Standard Deviation	Exceeds criteria		Number of Samples	Exceeds criteria
Aluminum	35.00	1.00	2.87	2.87	2.87		0	24.00	1	
Ammonium nitrogen	31.00	2.00	0.00	42.94	14.59	15.81	2	0.00	0	
Antimony	35.00	0.00					0	29.00	0	
Arsenic	35.00	0.00					0	5.00	0	
Barium	35.00	0.00					0	35.00	0	
Beryllium	35.00	0.00					0	0.00	0	
Boron	35.00	16.00	0.68	85.69	29.63	23.43	12	6.00	4	
Bromide	32.00	0.00					0	0.00	0	
Cadmium	35.00	0.00					0	0.00	0	
Calcium	35.00	0.00	0.02	11.27	2.46	2.33	0	0.00	0	
Chloride	32.00	0.00	0.00	9.79	2.36	2.32	0	0.00	0	
Chromium	35.00	0.00					0	21.00	0	
Cobalt	35.00	0.00					0	0.00	0	
Copper	35.00	1.00	78.99	78.99	78.99		1	30.00	0	
Cyanide	37.00	0.00					0	0.00	0	
Fluoride	31.00	0.00					0	15.00	0	

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For wet chemistry results and for inorganic results > 5 x CRDL, RPD is calculated.
For wet chemistry, if RPD > 20% then data is flagged.
For inorganics, if RPD > 20% for water or if RPD > 35% for soils, data is flagged.

For inorganic results < 5 x CRDL, the absolute value of the difference is calculated.
If the difference > CRDL for water or difference > 2 x CRDL for soils, data is flagged.

If either result is a non-detect, no calculations are done.

Relative Percent Difference for Customer Samples and Duplicates

Laboratory Name-> Lockheed Engineering & Science,
Matrix-> Surface Water,
AND Media-> Water Sample, filtered

Parameter Name	Total		Relative Percent Difference						RPD	Difference between Sample/Lab Dup	
	Number of Samples	Exceeds criteria	Number of Samples	Minimum	Maximum	Mean	Standard Deviation	Exceeds criteria		Number of Samples	Exceeds criteria
Iron	35.00	0.00	0.00	.	.	.	.	0	0	23.00	0
Lead	35.00	0.00	0.00	.	.	.	.	0	0	2.00	0
Magnesium	35.00	0.00	35.00	0.25	11.73	2.61	2.42	0	0	0.00	0
Manganese	35.00	0.00	0.00	.	.	.	.	0	0	32.00	0
Mercury	35.00	0.00	0.00	.	.	.	.	0	0	0.00	0
Molybdenum	35.00	0.00	0.00	.	.	.	.	0	0	0.00	0
Nickel	35.00	0.00	0.00	.	.	.	.	0	0	34.00	0
Nitrate/nitrite	30.00	1.00	30.00	0.00	40.60	4.35	7.35	1	0	0.00	0
Potassium	35.00	0.00	0.00	.	.	.	.	0	0	35.00	0
Selenium	35.00	0.00	0.00	.	.	.	.	0	0	2.00	0
Silver	35.00	0.00	0.00	.	.	.	.	0	0	0.00	0
Sodium	35.00	0.00	30.00	0.03	9.71	2.83	2.17	0	0	5.00	0
Sulfate	31.00	0.00	31.00	0.27	2.84	1.20	0.73	0	0	0.00	0
Thallium	35.00	0.00	0.00	.	.	.	.	0	0	0.00	0
Uranium	35.00	0.00	0.00	.	.	.	.	0	0	7.00	0

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For wet chemistry results and for inorganic results > 5 x CRDL, RPD is calculated.
For wet chemistry, if RPD > 20% then data is flagged.
For inorganic, if RPD > 20% for water or if RPD > 35% for soils, data is flagged.
For inorganic results < 5 x CRDL, the absolute value of the difference is calculated.
If the difference > CRDL for water or difference > 2 x CRDL for soils, data is flagged.
If either result is a non-detect, no calculations are done.

Relative Percent Difference for Customer Samples and Duplicates

Laboratory Name-> Lockheed Engineering & Science,
Matrix-> Surface Water,
AND Media-> Water Sample, filtered

Parameter Name	Total		Relative Percent Difference					RPD	Difference between Sample/Lab Dup	Difference
	Number of Samples	Exceeds criteria	Number of Samples	Minimum	Maximum	Mean	Standard Deviation	Exceeds criteria	Number of Samples	Exceeds criteria
Vanadium	35.00	0.00	0.00	.	.	.	.	0	0.00	0
Zinc	35.00	1.00	0.00	.	.	.	.	0	34.00	1

Laboratory Name-> Lockheed Engineering & Science,
Matrix-> Surface Water,
AND Media-> Water sample, unfiltered

Parameter Name	Total		Relative Percent Difference					RPD	Difference between Sample/Lab Dup	Difference
	Number of Samples	Exceeds criteria	Number of Samples	Minimum	Maximum	Mean	Standard Deviation	Exceeds criteria	Number of Samples	Exceeds criteria
Aluminum	8.00	2.00	5.00	3.09	38.90	18.51	15.32	2	3.00	0
Antimony	8.00	0.00	0.00	.	.	.	.	0	0.00	0
Arsenic	8.00	0.00	0.00	.	.	.	.	0	1.00	0
Barium	8.00	0.00	0.00	.	.	.	.	0	8.00	0
Beryllium	8.00	0.00	0.00	.	.	.	.	0	0.00	0
Moron	8.00	5.00	5.00	14.30	118.36	46.14	41.64	4	1.00	1

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For wet chemistry results and for inorganics results > 5 x CRDL, RPD is calculated.
For wet chemistry, if RPD > 20% then data is flagged.
For inorganics, if RPD > 20% for water or if RPD > 35% for soils, data is flagged.

For inorganics results < 5 x CRDL, the absolute value of the difference is calculated.
If the difference > CRDL for water or difference > 2 * CRDL for soils, data is flagged.

If either result is a non-detect, no calculations are done.

Relative Percent Difference for Customer Samples and Duplicates

Laboratory Name-> Lockheed Engineering & Science,
Matrix-> Surface Water,
AND Media-> Water sample, unfiltered

Parameter Name	Total		Relative Percent Difference					RPD	Difference between Sample/Lab Dup	Difference
	Number of Samples	Exceeds criteria	Number of Samples	Minimum	Maximum	Mean	Standard Deviation	Exceeds criteria	Number of Samples	Exceeds criteria
Cadmium	8.00	0.00	0.00	.	.	.	.	0	0.00	0
Calcium	8.00	0.00	8.00	0.23	6.47	1.75	2.13	0	0.00	0
Chromium	8.00	0.00	0.00	.	.	.	.	0	7.00	0
Cobalt	8.00	0.00	0.00	.	.	.	.	0	0.00	0
Copper	8.00	0.00	0.00	.	.	.	.	0	8.00	0
Cyanide	2.00	0.00	0.00	.	.	.	.	0	0.00	0
Iron	8.00	0.00	0.00	.	.	.	.	0	8.00	0
Lead	8.00	0.00	0.00	.	.	.	.	0	5.00	0
Magnesium	8.00	0.00	8.00	0.12	7.25	2.79	2.17	0	0.00	0
Manganese	8.00	0.00	0.00	.	.	.	.	0	8.00	0
Mercury	8.00	0.00	2.00	3.45	12.28	7.86	6.24	0	0.00	0
Molybdenum	8.00	0.00	0.00	.	.	.	.	0	0.00	0
Nickel	8.00	0.00	0.00	.	.	.	.	0	7.00	0
Potassium	8.00	0.00	0.00	.	.	.	.	0	8.00	0
Selenium	8.00	0.00	0.00	.	.	.	.	0	0.00	0

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For wet chemistry results and for inorganic results > 5 x CRDL, RPD is calculated.
For wet chemistry, if RPD > 20% then data is flagged.
For inorganics, if RPD > 20% for water or if RPD > 35% for soils, data is flagged.

For inorganic results < 5 x CRDL, the absolute value of the difference is calculated.
If the difference > CRDL for water or difference > 2 * CRDL for soils, data is flagged.

If either result is a non-detect, no calculations are done.

Relative Percent Difference for Customer Samples and Duplicates

Laboratory Name-> Lockheed Engineering & Science,
Matrix-> Surface Water,
AND Media-> Water sample, unfiltered

Parameter Name	Total		Relative Percent Difference					RPD	Difference between Sample/Lab Dup	
	Number of Samples	Exceeds criteria	Number of Samples	Minimum	Maximum	Mean	Standard Deviation	Exceeds criteria	Number of Samples	Exceeds criteria
Silver	8.00	0.00	0.00	.	.	.	.	0	0.00	0
Sodium	8.00	8.00	8.00	0.01	5.73	2.49	2.09	0	0.00	0
Thallium	8.00	8.00	0.00	.	.	.	.	0	0.00	0
Uranium	8.00	8.00	1.00	3.77	3.77	3.77	.	0	1.00	0
Vanadium	8.00	8.00	0.00	.	.	.	.	0	1.00	0
Zinc	8.00	8.00	0.00	.	.	.	.	0	8.00	0

For wet chemistry results and for inorganic results > 5 x CRDL, RPD is calculated.

For wet chemistry, if RPD > 20% then data is flagged.

For inorganics, if RPD > 20% for water or if RPD > 35% for soils, data is flagged.

For inorganic results < 5 x CRDL, the absolute value of the difference is calculated.

If the difference > CRDL for water or difference > 2 * CRDL for soils, data is flagged.

If either result is a non-detect, no calculations are done.

Duplicate Error Ratio for Customer Samples and Duplicates
Oak Ridge Analytical Services

Laboratory Name-> Oak Ridge Analytical Services,
Matrix-> Pore Water,
AMD Media-> PW

Parameter Name	Total		Duplicate Error Ratio				
	Number of Samples	Exceeds Criteria	Number of Samples	Minimum	Maximum	Mean	Standard Deviation
Uranium-234	2	0	2.00	0.14	0.31	0.23	0.12
Uranium-235	2	0	2.00	0.22	0.55	0.38	0.23
Uranium-238	2	0	2.00	0.16	0.42	0.29	0.19

Duplicate Error Ratio for Customer Samples and Duplicates
Oak Ridge Analytical Services

Laboratory Name-> Oak Ridge Analytical Services,
Matrix-> Sediment,
AND Media-> CORE

Parameter Name	Total		Duplicate Error Ratio				
	Number of Samples	Exceeds criteria	Number of Samples	Minimum	Maximum	Mean	Standard Deviation
Strontium-90	3	0	3.00	0.27	0.49	0.35	0.12
Technetium-99	3	0	3.00	0.04	0.44	0.25	0.20
Uranium-234	3	0	3.00	0.09	0.31	0.16	0.13
Uranium-235	3	0	3.00	0.27	0.45	0.33	0.10
Uranium-238	3	0	3.00	0.05	0.25	0.12	0.11

Duplicate Error Ratio for Customer Samples and Duplicates
Oak Ridge Analytical Services

Laboratory Name-> Oak Ridge Analytical Services,
Matrix-> Water Quality,
AND Media-> WHOL

	Total		Duplicate Error Ratio				
	Number of Samples	Exceeds criteria	Number of Samples	Minimum	Maximum	Mean	Standard Deviation
Parameter Name							
Tritium	1	0	1.00	0.05	0.05	0.05	.

Duplicate Error Ratio for Customer Samples and Duplicates
Oak Ridge Analytical Services

Laboratory Name-> Oak Ridge Analytical Services,
Matrix-> Surface Water,
AND Media-> WHOL

Parameter Name	Total		Duplicate Error Ratio				
	Number of Samples	Exceeds criteria	Number of Samples	Minimum	Maximum	Mean	Standard Deviation
Gross alpha activity	5	0	6.00	0.12	1.27	0.59	0.48
Gross beta activity	5	0	6.00	0.04	2.56	0.81	0.90
Strontium-90	6	0	6.00	0.03	0.82	0.28	0.30
Tritium	5	0	5.00	0.01	0.22	0.07	0.08

**Duplicate Error Ratio for Customer Samples and Duplicates
ORNL ESD/Radiological Analysis Laboratory**

Laboratory Name: ORNL ESD/Radiological Analysis Laboratory,
Matrix Pore Water,
AND MEDIA_TYP_CODE PW

	Total		Duplicate Error Ratio				
	Number of Samples	Exceeds criteria	Number of Samples	Minimum	Maximum	Mean	Standard Deviation
Parameter Name							
Cesium-137	6	0	6.00	0.01	0.62	0.30	0.26
Cobalt-60	6	0	6.00	0.05	0.73	0.24	0.28

Duplicate Error Ratio for Customer Samples and Duplicates
ORNL ESD/Radiological Analysis Laboratory

Laboratory Name: ORNL ESD/Radiological Analysis Laboratory,
Matrix Residue from a filtered sample,
AND MEDIA_TYP_CODE RE

Parameter Name	Total		Duplicate Error Ratio				
	Number of Samples	Exceeds criteria	Number of Samples	Minimum	Maximum	Mean	Standard Deviation
Cesium-137	25	0	25.00	0.01	0.52	0.21	0.15
Cobalt-60	26	0	26.00	0.01	0.54	0.18	0.15

Duplicate Error Ratio for Customer Samples and Duplicates
ORNL ESD/Radiological Analysis Laboratory

Laboratory Name: ORNL ESD/Radiological Analysis Laboratory,
Matrix Sediment,
AND MEDIA_TYF_CODE CORE

	Total		Duplicate Error Ratio				
	Number of Samples	Exceeds criteria	Number of Samples	Minimum	Maximum	Mean	Standard Deviation
Parameter Name							
Cesium-137	21	0	21.00	0.00	0.78	0.21	0.18
Cobalt-60	21	0	21.00	0.00	0.78	0.20	0.19

Duplicate Error Ratio for Customer Samples and Duplicates
ORNL ESD/Radiological Analysis Laboratory

Laboratory Name: ORNL ESD/Radiological Analysis Laboratory,
Matrix Water Quality,
AND MEDIA_TYP_CODE PW

	Total		Duplicate Error Ratio				
	Number of Samples	Exceeds criteria	Number of Samples	Minimum	Maximum	Mean	Standard Deviation
Parameter Name							
Cesium-137	4	0	4.00	0.12	0.37	0.21	0.12
Cobalt-60	4	0	4.00	0.04	0.43	0.21	0.17

Duplicate Error Ratio for Customer Samples and Duplicates
ORNL ESD/Radiological Analysis Laboratory

Laboratory Name: ORNL ESD/Radiological Analysis Laboratory,
Matrix Water Quality,
AND MEDIA_TYP_CODE WHOL

Parameter Name	Total		Duplicate Error Ratio				
	Number of Samples	Exceeds criteria	Number of Samples	Minimum	Maximum	Mean	Standard Deviation
Cesium-137	5	0	5.00	0.00	0.32	0.14	0.15
Cobalt-60	5	0	5.00	0.00	0.28	0.16	0.11

Duplicate Error Ratio for Customer Samples and Duplicates
ORNL ESD/Radiological Analysis Laboratory

Laboratory Name: ORNL ESD/Radiological Analysis Laboratory,
Matrix Surface Water,
AND MEDIA_TYP.CODE FLTR

	Total		Duplicate Error Ratio				
	Number of Samples	Exceeds criteria	Number of Samples	Minimum	Maximum	Mean	Standard Deviation
Parameter Name							
Cesium-137	16	0	16.00	0.07	0.59	0.30	0.18
Cobalt-60	16	0	16.00	0.04	0.39	0.22	0.10

Relative Percent Difference for Customer Samples and Duplicates

Laboratory Name-> Southwest Research Institute,
Matrix-> BIOTA,
AND Media-> WFWL

Parameter Name	Total		Relative Percent Difference					RPD	Difference between Sample/Lab Dup	Difference
	Number of Samples	Exceeds criteria	Number of Samples	Minimum	Maximum	Mean	Standard Deviation	Exceeds criteria	Number of Samples	Exceeds criteria
Arsenic	8.00	1.00	1.00	42.53	42.53	42.53		1	0.00	0
Chromium	8.00	7.00	8.00	1.75	190.20	59.26	57.73	7	0.00	0
Mercury	10.00	4.00	10.00	3.17	133.69	28.90	38.69	4	0.00	0

Laboratory Name-> Southwest Research Institute,
Matrix-> Sediment,
AND Media-> Sediment Core

Parameter Name	Total		Relative Percent Difference					RPD	Difference between Sample/Lab Dup	Difference
	Number of Samples	Exceeds criteria	Number of Samples	Minimum	Maximum	Mean	Standard Deviation	Exceeds criteria	Number of Samples	Exceeds criteria
Density, dry	18.00	0.00	18.00	0.00	13.36	1.12	3.18	0	0.00	0
Grain size, <0.375 inches	18.00	0.00	18.00	0.00	0.00	0.00	0.00	0	0.00	0
Grain size, <0.75 inches	18.00	0.00	18.00	0.00	0.00	0.00	0.00	0	0.00	0
Grain size, <1 inch	18.00	0.00	18.00	0.00	0.00	0.00	0.00	0	0.00	0

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For wet chemistry results and for inorganics results > 5 x CRDL, RPD is calculated.

For wet chemistry, if RPD > 20% then data is flagged.

For inorganics, if RPD > 20% for water or if RPD > 35% for soils, data is flagged.

For inorganics results < 5 x CRDL, the absolute value of the difference is calculated.

If the difference > CRDL for water or difference > 2 * CRDL for soils, data is flagged.

If either result is a non-detect, no calculations are done.

Relative Percent Difference for Customer Samples and Duplicates

Laboratory Name-> Southwest Research Institute,
Matrix-> Sediment,
AND Media-> Sediment Core

Parameter Name	Total		Relative Percent Difference					RPD	Difference between Sample/Lab Dup	Difference
	Number of Samples	Exceeds criteria	Number of Samples	Minimum	Maximum	Mean	Standard Deviation	Exceeds criteria	Number of Samples	
Grain size, <1.5 inches	18.00	0.00	18.00	0.00	0.00	0.00	0.00	0	0.00	0
Grain size, <149 microns (#100)	18.00	0.00	18.00	0.00	6.29	1.02	1.50	0	0.00	0
Grain size, <2 inches	18.00	0.00	18.00	0.00	0.00	0.00	0.00	0	0.00	0
Grain size, <2000 microns (#10)	18.00	0.00	18.00	0.00	0.00	0.00	0.00	0	0.00	0
Grain size, <250 microns (#60)	18.00	0.00	18.00	0.00	2.05	0.28	0.48	0	0.00	0
Grain size, <3 inches	18.00	0.00	18.00	0.00	0.00	0.00	0.00	0	0.00	0
Grain size, <420 microns (#40)	18.00	0.00	18.00	0.00	1.05	0.17	0.23	0	0.00	0
Grain size, <4760 microns (#4)	18.00	0.00	18.00	0.00	0.00	0.00	0.00	0	0.00	0
Grain size, <74 microns (#200)	18.00	0.00	18.00	0.00	2.91	0.82	0.74	0	0.00	0
Grain size, <840 microns (#20)	18.00	0.00	18.00	0.00	0.31	0.10	0.09	0	0.00	0
Hydrometer diameter, 1440 min	18.00	0.00	18.00	0.00	0.00	0.00	0.00	0	0.00	0

(CONTINUED)

For wet chemistry results and for inorganics results > 5 x CRDL, RPD is calculated.

For wet chemistry, if RPD > 20% then data is flagged.

For inorganics, if RPD > 20% for water or if RPD > 35% for soils, data is flagged.

For inorganics results < 5 x CRDL, the absolute value of the difference is calculated.

If the difference > CRDL for water or difference > 2 * CRDL for soils, data is flagged.

If either result is a non-detect, no calculations are done.

Relative Percent Difference for Customer Samples and Duplicates

Laboratory Name-> Southwest Research Institute,
Matrix-> Sediment,
AND Media-> Sediment Core

Parameter Name	Total		Relative Percent Difference					RPD	Difference between Sample/Lab Dup		Exceeds criteria	Number of Samples	Exceeds criteria
	Number of Samples	Exceeds criteria	Number of Samples	Minimum	Maximum	Mean	Standard Deviation						
Hydrometer diameter, 15 min	18.00	0.00	18.00	0.00	0.00	0.00	0.00	0	0.00	0.00	0	0	0
Hydrometer diameter, 2 min.	18.00	0.00	18.00	0.00	3.08	0.66	1.28	0	0.00	0.00	0	0	0
Hydrometer diameter, 250 min	18.00	0.00	18.00	0.00	0.00	0.00	0.00	0	0.00	0.00	0	0	0
Hydrometer diameter, 30 min	18.00	0.00	18.00	0.00	11.76	0.65	2.77	0	0.00	0.00	0	0	0
Hydrometer diameter, 5 min.	18.00	0.00	18.00	0.00	4.26	0.24	1.00	0	0.00	0.00	0	0	0
Hydrometer diameter, 60 min	18.00	0.00	18.00	0.00	15.38	0.85	3.63	0	0.00	0.00	0	0	0
Hydrometer passing, 1440 min	18.00	1.00	18.00	0.02	39.04	4.98	9.87	1	0.00	0.00	1	0	0
Hydrometer passing, 15 min	18.00	0.00	18.00	0.02	15.30	3.33	4.22	0	0.00	0.00	0	0	0
Hydrometer passing, 2 min.	18.00	0.00	18.00	0.02	9.81	2.76	3.06	0	0.00	0.00	0	0	0
Hydrometer passing, 250 min	18.00	0.00	18.00	0.02	21.24	2.64	5.25	0	0.00	0.00	0	0	0

(CONTINUED)

For wet chemistry results and for inorganic results > 5 x CRDL, RPD is calculated.
For wet chemistry, if RPD > 20% then data is flagged.
For inorganics, if RPD > 20% for water or if RPD > 35% for soils, data is flagged.
For inorganic results < 5 x CRDL, the absolute value of the difference is calculated.
If the difference > CRDL for water or difference > 2 x CRDL for soils, data is flagged.
If either result is a non-detect, no calculations are done.

Relative Percent Difference for Customer Samples and Duplicates

Laboratory Name-> Southwest Research Institute,
Matrix-> Sediment,
AND Media-> Sediment Core

Parameter Name	Total		Relative Percent Difference					RPD	Difference between Sample/Lab Dup	Difference
	Number of Samples	Exceeds criteria	Number of Samples	Minimum	Maximum	Mean	Standard Deviation	Exceeds criteria	Number of Samples	Exceeds criteria
Hydrometer passing, 30 min	18.00	0.00	18.00	0.02	9.55	1.98	2.88	0	0.00	0
Hydrometer passing, 5 min.	18.00	0.00	18.00	0.02	17.41	2.06	4.06	0	0.00	0
Hydrometer passing, 60 min	18.00	0.00	18.00	0.04	13.43	2.63	4.09	0	0.00	0
Porosity	17.00	0.00	17.00	0.00	5.64	0.80	1.36	0	0.00	0
Specific gravity	18.00	0.00	18.00	0.00	1.52	0.52	0.41	0	0.00	0
Total combustible organics (TCO)	22.00	0.00	22.00	0.00	28.57	5.14	7.86	0	0.00	0

For wet chemistry results and for inorganic results > 5 x CRDL, RPD is calculated.

For wet chemistry, if RPD > 20% then data is flagged.

For inorganics, if RPD > 20% for water or if RPD > 35% for soils, data is flagged.

For inorganic results < 5 x CRDL, the absolute value of the difference is calculated.

If the difference > CRDL for water or difference > 2 * CRDL for soils, data is flagged.

If either result is a non-detect, no calculations are done.

Relative Percent Difference for Customer Samples and Duplicates

Laboratory Name-> Southwest Research Institute,
Matrix-> Sediment,
AND Media-> Sediment Grab

	Total		Relative Percent Difference				RPD	Difference between Sample/Lab Dup		Difference
	Number of Samples	Exceeds criteria	Number of Samples	Minimum	Maximum	Mean		Exceeds criteria	Number of Samples	Exceeds criteria
Parameter Name										
Density, dry	1.00	0.00	1.00	0.00	0.00	0.00	.	0	0.00	0
Porosity	1.00	0.00	1.00	0.88	0.88	0.88	.	0	0.00	0

For wet chemistry results and for inorganics results > 5 x CRDL, RPD is calculated.
For wet chemistry, if RPD > 20% then data is flagged.
For inorganics, if RPD > 20% for water or if RPD > 35% for soils, data is flagged.

For inorganics results < 5 x CRDL, the absolute value of the difference is calculated.
If the difference > CRDL for water or difference > 2 * CRDL for soils, data is flagged.

If either result is a non-detect, no calculations are done.

Relative Percent Difference for Matrix Spike/Matrix Spike Duplicates							
Laboratory Name-> TMAH/ARLI AND Matrix-> Sediment							
Parameter Name	Upper Limit	Exceeds criteria	Number of Samples	Minimum	Maximum	Mean	Standard Deviation
Kjeldahl nitrogen	30.00	1.00	1.00	0.94	0.94	0.94	
Relative Percent Difference							
Laboratory Name-> TMAH/ARLI AND Matrix-> SOIL							
Parameter Name	Upper Limit	Exceeds criteria	Number of Samples	Minimum	Maximum	Mean	Standard Deviation
1,2,4-Trichlorobenzene	23.00	2.00	23.00	0.76	31.76	8.79	8.24
1,4-Dichlorobenzene	27.00	1.00	23.00	0.10	47.55	11.21	10.02
2,4-Dinitrotoluene	47.00	0.00	22.00	0.80	37.78	7.33	8.39
2-Chlorophenol	50.00	0.00	23.00	0.93	25.47	8.95	6.81
4,4'-DDT	50.00	0.00	23.00	0.89	38.91	10.95	11.54
4-Chloro-3-methylphenol	33.00	1.00	23.00	0.27	71.64	8.06	14.68
4-Nitrophenol	50.00	0.00	23.00	0.08	48.65	9.85	12.14
Acenaphthene	19.00	0.00	22.00	0.17	18.73	6.25	4.01
Aldrin	43.00	1.00	23.00	0.00	200.00	21.66	40.35
Dieldrin	38.00	3.00	23.00	0.05	200.00	20.77	41.27
Endrin	45.00	0.00	23.00	0.36	41.20	13.42	13.27
Heptachlor	31.00	2.00	23.00	0.48	46.96	12.35	12.13
Lindane	50.00	0.00	22.00	0.00	48.94	12.31	13.91
m-Nitroso-di-n-propylamine	38.00	0.00	23.00	0.18	25.57	9.41	7.48
Pentachlorophenol	47.00	1.00	22.00	1.14	61.47	14.20	13.88
Phenol	35.00	0.00	23.00	0.05	21.26	8.01	6.40

(CONTINUED)

Relative Percent Difference for Matrix Spike/Matrix Spike Duplicates

Laboratory Name-> TMAH/ARLI
AND Matrix-> SOIL

Parameter Name	Upper limit	Exceeds criteria	Relative Percent Difference				Standard Deviation
			Number of Samples	Minimum	Maximum	Mean	
Pyrene	36.00	0.00	23.00	0.37	29.23	7.80	7.11

Relative Percent Difference for Customer Samples and Duplicates

Laboratory Name-> TMAH ARLI,
Matrix-> Sediment,
AND Media-> Sediment Core

Parameter Name	Total		Relative Percent Difference					RPD	Difference between Sample/Lab Dup	Difference
	Number of Samples	Exceeds criteria	Number of Samples	Minimum	Maximum	Mean	Standard Deviation	Exceeds criteria	Number of Samples	Exceeds criteria
Aluminum	23.00	0.00	23.00	0.10	33.29	12.91	9.22	0	0.00	0
Antimony	22.00	0.00	0.00	.	.	.	.	0	0.00	0
Arsenic	23.00	4.00	21.00	0.47	86.56	21.12	21.76	4	2.00	0
Barium	23.00	1.00	22.00	0.30	39.11	6.82	8.67	1	1.00	0
Beryllium	23.00	1.00	19.00	2.84	14.58	6.46	4.00	0	4.00	1
Boron	23.00	3.00	2.00	39.76	39.99	39.87	0.16	2	16.00	1
Cadmium	23.00	3.00	10.00	0.05	124.15	33.28	39.50	3	13.00	0
Calcium	23.00	1.00	22.00	0.04	52.55	5.47	11.00	1	1.00	0
Chromium	23.00	1.00	23.00	2.97	55.84	9.91	11.17	1	0.00	0
Cobalt	23.00	1.00	23.00	0.03	48.19	11.77	11.72	1	0.00	0
Copper	23.00	0.00	22.00	0.54	16.46	4.04	3.76	0	1.00	0
Iron	23.00	0.00	23.00	0.11	16.00	5.11	3.91	0	0.00	0
Kjeldahl nitrogen	22.00	9.00	22.00	0.27	126.32	25.83	28.34	9	0.00	0
Lead	23.00	9.00	23.00	1.84	106.51	27.89	24.92	9	0.00	0
Magnesium	23.00	0.00	23.00	0.03	17.05	6.39	4.89	0	0.00	0
Manganese	23.00	1.00	21.00	0.07	47.02	9.54	12.39	1	2.00	0

(CONTINUED)

For wet chemistry results and for inorganic results > 5 x CRDL, RPD is calculated.
For wet chemistry, if RPD > 20% then data is flagged.
For inorganics, if RPD > 20% for water or if RPD > 35% for soils, data is flagged.

For inorganic results < 5 x CRDL, the absolute value of the difference is calculated.
If the difference > CRDL for water or difference > 2 * CRDL for soils, data is flagged.

If either result is a non-detect, no calculations are done.

Relative Percent Difference for Customer Samples and Duplicates

Laboratory Name-> THAR ARLI,
Matrix-> Sediment,
AND Media-> Sediment Core

Parameter Name	Total			Relative Percent Difference				RPD	Difference between Sample/Lab Dup	
	Number of Samples	Exceeds criteria	Number of Samples	Minimum	Maximum	Mean	Standard Deviation		Exceeds criteria	Number of Samples
Mercury	23.00	3.00	14.00	1.04	58.18	16.82	15.36	1	8.00	2
Molybdenum	23.00	0.00	0.00	.	.	.	.	0	0.00	0
Nickel	23.00	0.00	3.00	0.62	4.29	2.84	1.95	0	20.00	0
Potassium	23.00	3.00	19.00	0.49	48.26	17.09	13.84	3	4.00	0
Selenium	22.00	1.00	0.00	.	.	.	.	0	2.00	1
Silver	23.00	4.00	9.00	3.29	50.35	21.13	20.06	3	12.00	1
Sodium	23.00	0.00	0.00	.	.	.	.	0	22.00	0
Thallium	23.00	0.00	0.00	.	.	.	.	0	1.00	0
Vanadium	23.00	0.00	22.00	1.13	26.50	8.97	6.44	0	1.00	0
Zinc	23.00	0.00	21.00	0.06	21.90	4.96	4.87	0	2.00	0

For wet chemistry results and for inorganic results > 5 x CDL, RPD is calculated.
For wet chemistry, if RPD > 20% then data is flagged.
For inorganics, if RPD > 20% for water or if RPD > 35% for soils, data is flagged.
For inorganic results < 5 x CDL, the absolute value of the difference is calculated.
If the difference > CDL for water or difference > 2 x CDL for soils, data is flagged.
If either result is a non-detect, no calculations are done.

Relative Percent Difference for Customer Samples and Duplicates

Laboratory Name-> TMA-EBERLINE,
Matrix-> BIOTA,
AND Media-> WFWL

Parameter Name	Total		Relative Percent Difference					RPD
	Number of Samples	Exceeds criteria	Number of Samples	Minimum	Maximum	Mean	Standard Deviation	Exceeds criteria
Plutonium-238	4.00	0.00	0.00	.	.	.	.	0
Plutonium-239	2.00	0.00	0.00	.	.	.	.	0
Plutonium-239/240	2.00	0.00	0.00	.	.	.	.	0
Strontium-90	2.00	0.00	0.00	.	.	.	.	0
Technetium-99	4.00	0.00	1.00	170.40	170.40	170.40	.	0
Uranium-234	4.00	0.00	0.00	.	.	.	.	0
Uranium-235	4.00	0.00	0.00	.	.	.	.	0
Uranium-238	4.00	0.00	1.00	120.00	120.00	120.00	.	0

If either result is a non-detect, no calculations are done.

Duplicate Error Ratio for Customer Samples and Duplicates
TMA-ESERLINE

Laboratory Name-> TMA-ESERLINE,
Matrix-> BIOTA,
AND Media-> MWL

Parameter Name	Total		Duplicate Error Ratio				
	Number of Samples	Exceeds Criteria	Number of Samples	Minimum	Maximum	Mean	Standard Deviation
Plutonium-238	3	0	4.00	0.40	1.40	0.81	0.47
Plutonium-239	2	0	2.00	0.40	0.80	0.60	0.28
Plutonium-239/240	2	0	2.00	0.00	0.27	0.13	0.19
Strontium-90	2	0	2.00	0.15	0.18	0.16	0.02
Technetium-99	3	0	4.00	0.00	2.27	0.57	1.13
Uranium-234	4	0	4.00	0.27	0.80	0.51	0.23
Uranium-235	4	0	2.00	0.20	0.40	0.30	0.14
Uranium-238	4	0	4.00	0.27	0.59	0.42	0.18

Relative Percent Difference for Customer Samples and Duplicates

Laboratory Name-> TMA-Morcal,
Matrix Sediment,
AND Media-> Sediment Core

Parameter Name	Total		Relative Percent Difference					RPD	Difference between Sample/Lab Dup	Difference
	Number of Samples	Exceeds criteria	Number of Samples	Minimum	Maximum	Mean	Standard Deviation	Exceeds criteria	Number of Samples	Exceeds criteria
Uranium	24.00	3.00	24.00	0.00	111.11	16.63	24.11	3	0.00	0

For results > 5 x CRDL, RPD is calculated.
If RPD > 20% for water or if RPD > 35% for soils, data is flagged.

For results < 5 x CRDL, the absolute value of the difference is calculated.
If the difference > CRDL for water or difference > 2 * CRDL for soils, data is flagged.

If either result is a non-detect, no calculations are done.

Relative Percent Difference for Customer Samples and Duplicates

Laboratory Name-> TVA Environmental Chemistry Lab.,
Matrix-> BIOTA,
AND Media-> FISH

Parameter Name	Total		Relative Percent Difference					RPD	Difference between Sample/Lab Dup	Difference
	Number of Samples	Exceeds criteria	Number of Samples	Minimum	Maximum	Mean	Standard Deviation	Exceeds criteria	Number of Samples	Exceeds criteria
Chlordene	10.00	0.00	0.00	.	.	.	.	0	0.00	0
Lipids	10.00	1.00	10.00	1.83	20.69	9.57	6.03	1	0.00	0
PCB-1016	10.00	0.00	0.00	.	.	.	.	0	0.00	0
PCB-1221	10.00	0.00	0.00	.	.	.	.	0	0.00	0
PCB-1232	10.00	0.00	0.00	.	.	.	.	0	0.00	0
PCB-1242	10.00	0.00	0.00	.	.	.	.	0	0.00	0
PCB-1248	10.00	0.00	0.00	.	.	.	.	0	0.00	0
PCB-1254	9.00	2.00	9.00	0.00	28.57	8.06	12.67	2	0.00	0
PCB-1260	10.00	0.00	10.00	0.00	8.70	0.87	2.75	0	0.00	0
alpha-Chlordene	9.00	0.00	0.00	.	.	.	.	0	0.00	0
cis-Monachlor	4.00	0.00	4.00	0.00	0.00	0.00	0.00	0	0.00	0
gamma-Chlordane	10.00	0.00	9.00	0.00	11.76	1.31	3.92	0	0.00	0
gamma-Chlordene	9.00	0.00	0.00	.	.	.	.	0	0.00	0
trans-Monachlor	10.00	0.00	10.00	0.00	13.33	1.33	4.22	0	0.00	0

For wet chemistry results and for inorganic results > 5 x CRDL, RPD is calculated.
For wet chemistry, if RPD > 20% then data is flagged.
For inorganics, if RPD > 20% for water or if RPD > 35% for soils, data is flagged.

For inorganic results < 5 x CRDL, the absolute value of the difference is calculated.
If the difference > CRDL for water or difference > 2 * CRDL for soils, data is flagged.

If either result is a non-detect, no calculations are done.

Appendix D

PERFORMANCE EVALUATION RESULTS

Table D1. Performance evaluation results provided by Brooks Rand

*—Laboratory performance ratings for standard reference water sample Hg-16
(mercury)*

[MPV, most probable value; ug/L, micrograms per liter; Lab, laboratory number;
V/I, number of reported values of 1 value; RV, reported value; <, less than]

Rating	Absolute Z-value	Rating	Absolute Z-value
4 (Excellent)	0.00-0.50	1 (Questionable)	1.51-2.00
3 (Good)	0.51-1.00	0 (Poor)	greater than 2.00
2 (Satisfactory)	1.01-1.50	NR (Not Rated)	

Analyte = Mercury			
MPV = 1.30 $\mu\text{g/L}$			
F-pseudosigma = 0.222			
Lab	V/I	RV	Rating
1	1.61	2	
3	1.56	2	
7	1.09	3	
11	1.23	4	
12	1.30	4	
13	1.38	4	
15	1.35	4	
16	1.50	3	
18	1.37	4	
24	1.50	3	
29	1.35	4	
32	1.48	3	
→ 34	1.28	4	
36	0.00	0	
39	1.25	4	
42	1.34	4	
45	1.17	3	
46	0.01	0	
50	1.30	4	
51	1.90	0	
52	1.26	4	
55	1.50	3	
58	0.20	0	
59	1.60	2	
61	1.10	3	
63	1.20	4	
68	1.90	0	
69	1.22	4	
70	1.12	3	
74	1.30	4	
76	1.16	3	
78	1.60	2	
79	1.66	1	
81	1.30	4	
85	1.24	4	
90	0.97	2	
96	1.80	0	
97	0.89	1	
108	1.33	4	
109	1.55	2	
113	1.30	4	
118	0.80	0	
119	1.50	3	
120	1.42	3	
122	< 1.0	NR	
124	1.20	4	
127	1.17	3	
128	1.50	3	
133	1.20	4	
134	1.20	4	
138	1.34	4	
139	1.36	4	
141	1.39	4	
142	1.27	4	
145	1.34	4	
146	1.30	3	
149	1.40	4	
179	1.10	3	
182	2.30	0	
184	1.24	4	
189	2.30	0	
194	1.37	4	
198	1.44	3	
202	1.23	4	
207	0.70	0	

Table D2. Performance evaluation results provided by Lockheed

ICP-MS Instrument Detection Limits

Analyte	Mass (amu)	Detection Limit (ug/L)
Aluminum	27	10
Antimony	121	1
Arsenic	75	1
Barium	138	1
Beryllium	9	1
Boron	11	7
Cadmium	114	1
Cadmium	111	1
Calcium	44	65
Chromium	52	1
Cobalt	59	1
Copper	65	1
Iron	56	16
Iron	57	13
Lead	208	1
Magnesium	25	20
Manganese	55	1
Molybdenum	98	1
Molybdenum	97	2
Nickel	60	1
Potassium	39	18
Selenium	78	3
Silver	107	1
Sodium	23	22
Thallium	204	1
Uranium	238	1
Vanadium	51	1
Zinc	66	2

Table D2. (continued)

WS033 ICPMS RESULTS

Analyte	Measured Result (ug/L)	Acceptance Window (ug/L)
Aluminium	1506	1260-1510
Antimony	44.4	34.2-65.6
Arsenic	42.4	33.1-45.1
Barium	1770	1530-2070
Beryllium	9.29	7.71-10.4
Cadmium	52.4	39.2-58.8
Chromium	159	135-183
Copper	2020	1710-2090
Lead	82.0	55.1-102
Manganese	64.8	56.7-67.7
Molybdenum	126	89.2-166
Nickel	501	417-563
Selenium	112	78.6-118
Silver	69.8	57.1-75.6
Thallium	9.52	6.69-12.4
Zinc	2230	1920-2240

WF031 ICPMS RESULTS

Table D2. (continued)

Analyte	Sample	Found (ug/L)	Acceptance Windows (ug/L)
Aluminum	1	687	550-784 107-182
	2	137	
Antimony	3	92.3	56.4-119 108-244
	4	185	
Arsenic	1	489	408-587 56.7-92.9
	2	69.3	
Beryllium	1	441	382-533 198-278
	2	215	
Cadmium	1	168	138-194 50.8-72.0
	2	57	
Calcium	5,6	100874	92200-121000 6230-7910
	7,8	6871	
Chromium	1	693	604-843 17.4-29.0
	2	21.4	
Cobalt	1	879	775-980 45.4-61.9
	2	51.5	
Copper	1	616	524-657 13.6-24.1
	2	18.0	
Iron	1	45.4	43.5-72.5 950-1270
	2	937*	
Magnesium	5,6	966	822-1130 8710-10600
	7,8	10312	
Lead	1	1165	1060-1350 636-833
	2	666	
Potassium	5,6	6288*	6700-8500 35900-44200
	7,8	38983	
Manganese	1	595	536-660 64.0-82.7
	2	69.4	
Molybdenum	3	24.2	18.6-30.6 64.4-95.0
	4	77.6	
Nickel	1	862	766-992 296-383
	2	321	
Sodium	5,6	63078	57600-66300 24200-28500
	7,8	25645	
Selenium	1	250	156-277 268-486
	2	396	
Silver	3	72.7	60.6-86.8 21.1-30.4
	4	25.4	
Strontium	3	19.8	14.4-23.3 62.0-84.5
	4	74.3	
Vanadium	1	879	832-1040 146-188
	2	155	
Thallium	3	60.3	47.0-77.3 421-643
	4	512	
Zinc	1	958	737-947 37.5-56.1
	2	47.7	

* Result outside the acceptance windows.

Table D3. Performance evaluation results provided by Southwest Research Institute

REGION 6
ORGANIC PERFORMANCE EVALUATION SAMPLE
INDIVIDUAL LABORATORY SUMMARY REPORT
FOR Q8 2 FY 93

LABORATORY: Southwest Research (TX)
PERFORMANCE: ACCEPTABLE - No Response Required
RANK: Above = 0 Same = 4 Below = 34

% SCORE: 100
REPORT DATE: 03/17/93
MATRIX: WATER

COMPOUND	PREDICTION INTERVALS				LABORATORY		#LABS MIS-QNT	PROGRAM #LABS NOT-ID	DATA #LABS ID-CPD	TOTAL #LABS
	WARNING		ACTION		DATA	Q				
	LOWER	UPPER	LOWER	UPPER	CONC	Q				
TCL VOLATILE										
CHLOROMETHANE	38	100	28	110	83		2	0	44	44
1,1-DICHLOROETHENE	71	91	68	94	76		6	0	44	44
DIBROMOCHLOROMETHANE	71	89	68	91	79		6	0	44	44
BENZENE	59	72	57	74	69		5	0	44	44
BROMOFORM	NU	NU	NU	NU	9		0	0	44	44
2-PENTANONE, 4-METHYL-	40	64	36	68	60		3	1	43	44
2-HEXANONE	280	460	260	490	480	\$	6	0	44	44
1,1,2,2-TETRACHLOROETHANE	57	76	54	79	57		3	0	44	44
CHLOROBENZENE	30	36	30	37	34		4	0	44	44
STYRENE	170	220	170	220	220		9	0	44	44
XYLENES (TOTAL)	140	180	130	180	150		3	0	44	44
TCL SEMIVOLATILE										
PHENOL	26	37	25	43	34		3	0	44	44
2-CHLOROPHENOL	18	25	17	29	23		1	0	44	44
1,4-DICHLOROBENZENE	19	29	17	34	23		3	0	44	44
2,2'-OXYBIS(1-CHLOROPROPANE)	14	20	13	21	16		5	1	43	44
NAPHTHALENE	11	16	11	18	13		1	0	44	44
ACENAPHTHENE	17	23	16	24	19		1	0	44	44
DIBENZOFURAN	14	19	13	20	15		1	0	44	44
DIETHYLPHTHALATE	20	28	19	29	22		4	0	44	44
FLUORENE	65	100	60	120	94		1	1	43	44
HEXACHLOROBENZENE	18	26	17	31	21		0	0	44	44
PENTACHLOROPHENOL	56	96	50	100	90		3	0	44	44
FLUORANTHENE	12	17	12	18	14		1	0	44	44
PYRENE	29	46	26	56	39		0	0	44	44
DIBENZ(A,H)ANTHRACENE	29	47	26	49	41		3	0	44	44
TCL PESTICIDES										
BETA-BHC	0.12	0.18	0.11	0.18	0.16		4	3	41	44
GAMMA-BHC (LINDANE)	0.53	0.84	0.49	0.89	0.67		4	0	44	44
HEPTACHLOR	0.41	0.63	0.38	0.66	0.57		3	0	44	44
ALDRIN	0.26	0.42	0.23	0.44	0.42		1	0	44	44
DIELDRIN	0.14	0.22	0.13	0.23	0.19		6	1	43	44
4,4'-DDE	0.44	0.59	0.42	0.62	0.54		4	0	44	44
ENDRIN	0.71	1	0.66	1.1	0.86		3	0	44	44
ENDOSULFAM II	0.1	0.13	0.1	0.14	0.11		0	3	41	44
ENDOSULFAM SULFATE	0.4	0.6	0.37	0.63	0.53		4	1	43	44
4,4'-DDT	0.6	0.88	0.56	0.92	0.75		3	0	44	44
METHOXYCHLOR	1.6	2.3	1.5	2.4	2		3	0	44	44
ALPHA-CHLORDANE	0.7	1	0.66	1.1	0.91		2	0	44	44
GAMMA-CHLORDANE	0.42	0.57	0.39	0.66	0.54		1	0	44	44
NON-TCL VOLATILE										
ACETONITRILE					30			31	13	44

Table D3. (continued)

REGION 6
ORGANIC PERFORMANCE EVALUATION SAMPLE
INDIVIDUAL LABORATORY SUMMARY REPORT
FOR Q8 2 FY 93

LABORATORY: Southwest Research (TX)
PERFORMANCE: ACCEPTABLE - No Response Required
RANK: Above = 0 Same = 4 Below = 34

% SCORE: 100
REPORT DATE: 03/17/
MATRIX: WATER

COMPOUND	PREDICTION INTERVALS				LABORATORY		#LABS MIS-QNT	PROGRAM	DATA	TOTAL #LABS
	WARNING		ACTION		DATA			#LABS	#LABS	
	LOWER	UPPER	LOWER	UPPER	CONC	Q		NOT-ID	ID-CPD	
OCTANE,N-					130			11	33	44
NON-TCL SEMIVOLATILE										
ANILINE					0	NR		41	3	44
BENZYL ALCOHOL					27			7	37	44
DIPHENYLHYDRAZINE					36			3	41	44
PARATHION					28			1	43	44
TCL VOLATILE (Contaminants)										
ACETONE					14			29	15	44
TCL SEMIVOLATILE (Contaminants)										
NITROBENZENE					4			0	44	44
DI-N-BUTYLPHTHALATE					4			40	4	44
NON-TCL VOLATILE (Contaminants)										
2-PROPANOL (ACN)					400			41	3	44
NON-TCL SEMIVOLATILE (Contaminants)										
AZOBENZENE (ACN)					37			43	1	44

OF TCL COMPOUNDS NOT-IDENTIFIED: 0
OF TCL COMPOUNDS MIS-QUANTIFIED: 0
OF TCL CONTAMINANTS: 0

OF NON-TCL COMPOUNDS NOT-IDENTIFIED: 0
OF NON-TCL CONTAMINANTS: 0

Table D3. (continued)

REGION 6
ORGANIC PERFORMANCE EVALUATION SAMPLE
INDIVIDUAL LABORATORY SUMMARY REPORT
FOR QB 3 FY 93

LABORATORY: Southwest Research (TX)
PERFORMANCE: ACCEPTABLE - Response Explaining Deficiency(ies) Required
RANK: Above = 24 Same = 2 Below = 7

% SCORE: 85.0
REPORT DATE: 06/09/
MATRIX: WATER

COMPOUND	PREDICTION INTERVALS				LABORATORY DATA		#LABS MIS-QNT	PROGRAM #LABS NOT-ID	DATA #LABS ID-CPO	TOTAL #LABS
	WARNING LOWER	UPPER	ACTION LOWER	UPPER	CONC	Q				
TCL VOLATILE										
BROMOMETHANE	23	38	21	46	39	S	1	0	34	34
VINYL CHLORIDE	46	80	41	99	79		2	0	34	34
ACETONE	46	200	24	220	195		3	1	33	34
CHLOROFORM	10	13	10	13	12		2	0	34	34
CARBON TETRACHLORIDE	56	76	53	80	67		2	0	34	34
BROMODICHLOROMETHANE	120	150	120	150	131		3	0	34	34
DIBROMOCHLOROMETHANE	50	59	49	60	57		5	0	34	34
1,1,2-TRICHLOROETHANE	51	61	50	62	58		1	0	34	34
BROMOFORM	12	15	11	16	15		1	0	34	34
1,1,2,2-TETRACHLOROETHANE	120	150	110	150	131		3	0	34	34
ETHYL BENZENE	NU	NU	NU	NU	11		0	0	34	34
STYRENE	170	220	160	230	193		5	0	34	34
TCL SEMIVOLATILE										
2,2'-OXYBIS(1-CHLOROPROPANE)	38	56	36	66	52		2	0	34	34
NAPHTHALENE	17	26	15	31	22		1	0	34	34
ACENAPHTHENE	44	65	40	76	58		0	0	34	34
HEXACHLOROBENZENE	22	31	21	35	30		2	0	34	34
FLUORANTHENE	17	25	16	26	23		0	0	34	34
PYRENE	53	74	50	86	67		3	0	34	34
DIBENZ(A,H)ANTHRACENE	11	20	10	22	15		1	0	34	34
TCL PESTICIDES										
DELTA-BHC	0.076	0.1	0.073	0.1	0.11	X	3	0	34	34
ALDRIN	0.12	0.2	0.11	0.21	0.19		3	0	34	34
DIELDRIN	0.36	0.43	0.34	0.44	0.48	X	4	0	34	34
ENDRIN	0.67	0.92	0.63	0.96	0.84		3	0	34	34
ENDOSULFAN II	NU	NU	NU	NU	0.11		0	1	33	34
4,4'-DDT	0.26	0.34	0.24	0.35	0.36	X	5	0	34	34
ENDRIN KETONE	0.27	0.36	0.25	0.38	0.37	S	1	0	34	34
ENDRIN ALDEHYDE	0.13	0.26	0.11	0.28	0.25		2	1	33	34
NON-TCL VOLATILE										
BENZENE,N-PROPYL-					36			5	29	34
2-PROPENENITRILE					80			2	32	34
VINYL ACETATE					0	NR		34	0	34
NON-TCL SEMIVOLATILE										
ANILINE					10			20	14	34
BENZYL ALCOHOL					120			4	30	34
TCL VOLATILE (Contaminants)										
2-BUTANONE					13			15	19	34

Table D3. (continued)

REGION 6
ORGANIC PERFORMANCE EVALUATION SAMPLE
INDIVIDUAL LABORATORY SUMMARY REPORT
FOR Q8 3 FY 93

LABORATORY: Southwest Research (TX)

PERFORMANCE: ACCEPTABLE - Response Explaining Deficiency(ies) Required

RANK: Above = 24 Same = 2 Below = 7

% SCORE: 85.0

REPORT DATE: 06/09/93

MATRIX: WATER

COMPOUND	PREDICTION INTERVALS				LABORATORY		#LABS MIS-QNT	PROGRAM #LABS NOT-ID	DATA #LABS ID-CPD	TOTAL #LABS
	WARNING LOWER	INTERVALS UPPER	ACTION LOWER	UPPER	CONC	Q				
TRICHLOROETHENE					7			24	10	34
TCL SEMIVOLATILE (Contaminants)										
PHENOL					3			13	21	34
2,4-DIMETHYLPHENOL					2			20	14	34
BIS(2-CHLOROETHOXY)METHANE					0.9			17	17	34
1,2,4-TRICHLOROBENZENE					1			12	22	34
2,4,6-TRICHLOROPHENOL					2			13	21	34
BIS(2-ETHYLHEXYL)PHTHALATE					1			21	13	34
NON-TCL VOLATILE (Contaminants)										
2-PROPANOL					170			12	22	34
ACETIC ACID, METHYL ESTER					17			25	9	34
PROPANE, 2-METHOXY-					5			32	2	34
NON-TCL SEMIVOLATILE (Contaminants)										
UNKNOWN					8			19	15	34
UNKNOWN					2			25	9	34
UNKNOWN					5			27	7	34

OF TCL COMPOUNDS NOT-IDENTIFIED: 0

OF TCL COMPOUNDS MIS-QUANTIFIED: 3

OF TCL CONTAMINANTS: 0

OF NON-TCL COMPOUNDS NOT-IDENTIFIED: 0

OF NON-TCL CONTAMINANTS: 0

Table D4. Performance results provided by TMA-ARLI

Performance Evaluation Report
USEPA Water Pollution Study #P032

Page: 1
Date: 05AUG94

Participant ID: CA00204		Type: OTHER		Requesting Office: CA		
Sample Number	Reported Value	True Value*	Acceptance Limits	Warning Limits	Performance Evaluation	
TRACE METALS IN MICROGRAMS/LITER						
001-ALUMINUM						
01	1405	1301	1080- 1510	1130- 1450	Accept.	
02	1960	1801	1500- 2080	1570- 2010	Accept.	
002-ARSENIC						
01	210	210	168- 251	179- 241	Accept.	
02	401	350	281- 418	299- 401	Accept.	
003-BERYLLIUM						
01	26.5	28.0	22.2- 33.6	23.6- 32.1	Accept.	
02	85.1	85.2	67.1- 98.2	71- 94.3	Accept.	
004-CADMIUM						
01	82.1	78.0	65.8- 91	69- 87.9	Accept.	
02	31.9	27.9	22.5- 34	24- 32.6	Accept.	
005-COBALT						
01	175.3	170	149- 190	154- 185	Accept.	
02	428.5	410	363- 456	375- 444	Accept.	
006-CHROMIUM						
01	174.1	169	140- 196	147- 189	Accept.	
02	986.9	955	795- 1100	834- 1060	Accept.	
007-COPPER						
01	88.0	98.0	84.7- 111	88- 107	Accept.	
02	316.0	320	280- 358	290- 348	Accept.	
008-IRON						
01	310.1	310	273- 346	282- 337	Accept.	
02	2729	2600	2310- 2890	2380- 2820	Accept.	
009-MERCURY						
01	0.7	0.615	0.321-0.881	0.391-0.811	Accept.	
02	3.9	3.89	2.87- 5.02	3.14- 4.75	Accept.	
010-MANGANESE						
01	482.7	470	420- 518	433- 506	Accept.	
02	985.8	950	851- 1060	877- 1030	Accept.	
011-NICKEL						
01	688.2	660	587- 732	605- 714	Accept.	
02	2976	2800	2500- 3100	2570- 3020	Accept.	
012-LEAD						
01	122	110	92.9- 127	97.2- 123	Accept.	
02	239	220	189- 247	196- 240	Accept.	
013-SELENIUM						
01	78	100	67.2- 123	74.2- 116	Accept.	
02	52	90.2	60.5- 111	66.9- 105	Not Accept.	
014-VANADIUM						
01	1755	1705	1510- 1890	1560- 1840	Accept.	
02	7372	7202	6290- 7870	6490- 7670	Accept.	
015-ZINC						
01	1966	171	150- 194	156- 188	Not Accept.	
02	1866	1710	1500- 1920	1550- 1870	Accept.	

* Based on theoretical calculations, or a reference value when necessary.

Table D4. (continued)

Performance Evaluation Report
US&PA Water Pollution Study WPO32

Page: 2
Date: 05AUG94

Participant ID: CA00204		Type: OTHER		Requesting Office: CA		
Sample Number	Reported Value	True Value*	Acceptance Limits	Warning Limits	Performance Evaluation	
016-ANTIMONY						
03	290.6	320	187- 404	214- 377	Accept.	
04	148.5	159	99.2- 199	112- 187	Accept.	
017-SILVER						
03	49.6	47.8	39- 56.3	41.2- 54.1	Accept.	
04	95.6	93.1	76.1- 109	80.3- 105	Accept.	
018-THALLIUM						
03	256	260	199- 302	212- 289	Accept.	
04	118	110	85.9- 132	91.8- 126	Accept.	
074-MOLYBDENUM						
03	42.7	44.0	31.7- 52	34.2- 49.4	Accept.	
04	131.2	130	101- 157	108- 150	Accept.	
076-TITANIUM						
03	91.4	97.0	80.3- 111	84.3- 107	Accept.	
04	241.8	250	214- 283	223- 274	Accept.	
MINERALS IN MG/LITER (EXCEPT AS NOTED)						
019-PH-UNITS						
03	6.21	6.20	6.05- 6.33	6.08- 6.3	Accept.	
04	8.51	8.40	8.1- 8.71	8.18- 8.63	Accept.	
020-SPEC. COND. (UMHOS/CM AT 25 C)						
01	472.7	475	424- 532	438- 518	Accept.	
02	636.1	646	579- 724	597- 706	Accept.	
021-TDS AT 180 C						
01	296	289	134- 442	173- 403	Accept.	
02	381	376	265- 493	293- 464	Accept.	
022-TOTAL HARDNESS (AS CaCO3)						
01	176.4	175	158- 192	162- 188	Accept.	
02	151.9	149	135- 167	139- 163	Accept.	
023-CALCIUM						
01	40.16	37.0	33- 42.8	34.2- 41.5	Accept.	
02	61.81	57.0	51.6- 65	53.3- 63.3	Accept.	
024-MAGNESIUM						
01	21.95	20.0	16.9- 23.3	17.7- 22.5	Accept.	
02	1.74	1.60	1.31- 1.84	1.37- 1.77	Accept.	
025-SODIUM						
01	10.94	9.98	8.64- 11.4	8.99- 11.1	Accept.	
02	54.71	50.9	46.5- 56.2	47.7- 55	Accept.	
026-POTASSIUM						
01	4.12	3.60	2.85- 4.36	3.04- 4.17	Accept.	
02	29.13	27.0	23.4- 30	24.3- 29.2	Accept.	
027-TOTAL ALKALINITY (AS CaCO3)						
01	16.6	16.1	12.6- 21.4	13.7- 20.3	Accept.	
02	65.6	64.0	53.4- 74.7	56.1- 72	Accept.	
028-CHLORIDE						
01	117.7	124	114- 134	117- 132	Accept.	
02	110.8	106	98.6- 116	101- 114	Accept.	

* Based on theoretical calculations, or a reference value when necessary.

Table D4. (continued)

Performance Evaluation Report
USEPA Water Pollution Study #P032

Page: 3
Date: 05AUG94

Participant ID: CA00204			Type: OTHER		Requesting Office: CA		
Sample Number	Reported Value	True Value*	Acceptance Limits		Warning Limits	Performance Evaluation	
029-FLUORIDE							
01	1.49	1.50	1.28-	1.7	1.33- 1.65	Accept.	
02	0.947	0.980	0.828-	1.12	0.865- 1.08	Accept.	
030-SULFATE							
01	5.37	5.60	3.52-	7.88	4.07- 7.34	Accept.	
02	73.7	75.0	62.7-	84.9	65.5- 82.1	Accept.	
NUTRIENTS IN MILLIGRAMS/LITER							
031-AMMONIA-NITROGEN							
01	14.2	12.0	9.48-	14.3	10.1- 13.7	Ck. for Err.	
02	2.54	2.30	1.74-	2.86	1.88- 2.73	Accept.	
032-NITRATE-NITROGEN							
01	40.12	39.2	31.7-	46.1	33.5- 44.3	Accept.	
02	2.73	2.81	2.23-	3.34	2.37- 3.21	Accept.	
033-ORTHOPHOSPHATE							
01	1.09	1.20	1.01-	1.38	1.05- 1.34	Accept.	
02	0.704	0.749	0.624-	0.868	0.654-0.838	Accept.	
034-KJELDAHL-NITROGEN							
03	31.0	29.1	21.9-	35	23.4- 33.4	Accept.	
04	6.60	6.32	4.37-	8.16	4.82- 7.7	Accept.	
035-TOTAL PHOSPHORUS							
03	1.22	1.30	0.915-	1.58	1.01- 1.49	Accept.	
04	2.591	2.60	1.87-	3.14	2.04- 2.96	Accept.	
DEMANDS IN MILLIGRAMS/LITER							
036-COD							
01	97.1	111	84.7-	128	90.2- 123	Accept.	
02	22.5	24.3	12.6-	35.3	15.5- 32.4	Accept.	
PCB'S IN MICROGRAMS/LITER							
040-PCB-AROCLOX 1016/1242							
01	8.57	12.7	4.33-	16.7	5.88- 15.1	Accept.	
044-PCB-AROCLOX 1248							
02	4.36	5.39	2.71-	7.12	3.26- 6.56	Accept.	
PCB'S IN OIL IN MILLIGRAMS/KILOGRAM							
100-PCB IN OIL- 1254							
01	14.0	18.5	1.31-	33.7	5.49- 29.5	Accept.	
101-PCB IN OIL- 1260							
02	18.38	23.6	4.95-	34.4	8.7- 30.7	Accept.	
PESTICIDES IN MICROGRAMS/LITER							
047-ALDRIN							
01	0.54	0.626	0.145-	0.844	0.234-0.755	Accept.	
02	0.10	0.129	0.0417-	0.176	0.0585-0.159	Accept.	
048-DIELDRI							
01	0.61	0.582	0.305-	0.801	0.368-0.738	Accept.	
02	0.15	0.151	0.0942-	0.212	0.109-0.197	Accept.	

* Based on theoretical calculations, or a reference value when necessary.

Table D4. (continued)

Performance Evaluation Report
USEPA Water Pollution Study #P032

Page: 4
Date: 05AUG94

Participant ID: CA00204				Type: OTHER	Requesting Office: CA	
Sample Number	Reported Value	True Value*	Acceptance Limits	Warning Limits	Performance Evaluation	
049-DDD						
01	0.72	0.752	0.416-0.998	0.489-0.924	Accept.	
02	0.13	0.144	0.0617-0.213	0.0809-0.194	Accept.	
050-DDE						
01	0.58	0.626	0.304-0.848	0.373-0.779	Accept.	
02	0.19	0.216	0.094-0.299	0.12-0.274	Accept.	
051-DDT						
01	1.22	1.14	0.518- 1.57	0.651- 1.44	Accept.	
02	0.22	0.227	0.0945-0.333	0.125-0.303	Accept.	
052-HEPTACHLOR						
01	0.66	0.733	0.266-0.968	0.355-0.879	Accept.	
02	0.19	0.216	0.0742-0.294	0.102-0.267	Accept.	
053-CHLORDANE						
03	1.34	1.53	0.577- 2.33	0.798- 2.11	Accept.	
04	4.60	5.35	2.28- 8.04	3- 7.31	Accept.	
078-HEPTACHLOR EPOXIDE						
01	0.49	0.543	0.255-0.749	0.317-0.687	Accept.	
02	0.17	0.195	0.085- 0.28	0.109-0.256	Accept.	
VOLATILE HALOCARBONS IN MICROGRAMS/LITER						
054-1,2 DICHLOROETHANE						
01	58.8	60.9	41.2- 80.3	46.1- 75.4	Accept.	
02	11.5	11.7	8.65- 15	9.45- 14.2	Accept.	
055-CHLOROFORM						
01	51.91	55.9	36.3- 73.6	41- 68.9	Accept.	
02	15.5	16.3	11.1- 21.1	12.4- 19.9	Accept.	
056-1,1,1 TRICHLOROETHANE						
01	38.39	45.2	27.7- 60.1	31.8- 56	Accept.	
02	10.07	11.5	7.48- 14.7	8.4- 13.8	Accept.	
057-TRICHLOROETHENE						
01	37.86	43.0	29.5- 54.1	32.6- 51	Accept.	
02	10.66	11.8	8.19- 15.2	9.07- 14.3	Accept.	
058-CARBONTETRACHLORIDE						
01	38.55	43.9	28- 60.1	32- 56	Accept.	
02	12.10	14.7	9.81- 19.8	11.1- 18.5	Accept.	
059-TETRACHLOROETHENE						
01	38.57	44.2	29.9- 56.1	33.2- 52.8	Accept.	
02	13.94	15.5	10.7- 19.8	11.9- 18.7	Accept.	
060-BROMODICHLOROMETHANE						
01	53.19	53.6	37.3- 71.2	41.6- 66.9	Accept.	
02	13.54	13.9	9.56- 18.4	10.7- 17.3	Accept.	
061-DIBROMOCHLOROMETHANE						
01	47.07	48.5	33- 64.2	36.9- 60.3	Accept.	
02	8.37	9.67	6.36- 12.3	7.1- 11.5	Accept.	
062-BROMOFORM						
01	68.45	64.1	40.7- 89.3	46.8- 83.2	Accept.	
02	11.42	12.8	7.2- 17.8	8.53- 16.4	Accept.	

Table D4. (continued)

Performance Evaluation Report
USEPA Water Pollution Study #P032

Page: 5
Date: 05AUG94

Participant ID: CA00204			Type: OTHER		Requesting Office: CA	
Sample Number	Reported Value	True Value*	Acceptance Limits	Warning Limits	Performance Evaluation	
063-METHYLENE CHLORIDE						
01	45.27	43.8	25.6- 62.2	30.2- 57.6	Accept.	
02	17.49	15.2	9.04- 21.9	10.7- 20.3	Accept.	
064-CHLOROBENZENE						
01	46.84	51.9	37.4- 65	40.9- 61.5	Accept.	
02	10.97	11.9	8.91- 14.9	9.66- 14.1	Accept.	
VOLATILE AROMATICS IN MICROGRAMS/LITER						
065-BENZENE						
01	13.1	14.2	10- 18.7	11.1- 17.6	Accept.	
02	57.89	62.7	43.0- 83	48.5- 78	Accept.	
066-ETHYLBENZENE						
01	8.82	8.74	6.63- 10.8	7.16- 10.3	Accept.	
02	52.08	54.8	36.5- 72.7	41.1- 68.1	Accept.	
067-TOLUENE						
01	10.93	12.1	8.54- 15.5	9.41- 14.6	Accept.	
02	35.2	39.9	28.6- 50.4	31.3- 47.7	Accept.	
094-1,2-DICHLOROBENZENE						
01	11.75	11.8	8.15- 15.2	9.04- 14.3	Accept.	
02	45.86	46.0	30.7- 59.9	34.4- 56.2	Accept.	
095-1,4-DICHLOROBENZENE						
01	7.92	8.30	5.64- 11.2	6.34- 10.5	Accept.	
02	42.68	42.8	28.2- 56.4	31.8- 52.8	Accept.	
096-1,3-DICHLOROBENZENE						
01	8.52	8.86	6.11- 11.3	6.76- 10.6	Accept.	
02	46.09	48.6	33.4- 62.2	37- 58.6	Accept.	
MISCELLANEOUS PARAMETERS						
071-TOTAL CYANIDE (IN MG/L)						
01	0.066	0.065	0.0362-0.089	0.0429-0.083	Accept.	
02	0.295	0.310	0.203-0.402	0.228-0.377	Accept.	
072-NON-FILTERABLE RESIDUE (IN MG/L)						
01	44.0	50.0	35.5- 53.9	37.8- 51.6	Accept.	
02	21.4	26.0	20- 27.9	21- 26.9	Accept.	
073-OIL AND GREASE (IN MG/L)						
01	13.1	12.7	5.97- 17.3	7.4- 15.9	Accept.	
02	18.6	18.2	11.6- 22.7	13- 21.3	Accept.	
097-TOTAL PHENOLICS (IN MG/L)						
01	0.097	0.0862	0.0431-0.129	0.0541-0.118	Accept.	
02	0.188	0.177	0.0944- 0.26	0.116-0.239	Accept.	
098-TOTAL RESIDUAL CHLORINE (IN MG/L)						
01	0.35	0.320	0.15-0.453	0.19-0.413	Accept.	
02	0.44	0.530	0.302-0.697	0.354-0.645	Accept.	

***** END OF DATA FOR CA00204 *****

NOTE: FOR LIMITS AND TRUE VALUES, ASSUME THREE SIGNIFICANT DIGITS.

***** END OF REPORT FOR CA00204 *****

* Based on theoretical calculations, or a reference value when necessary.

Table D4. (continued)

Performance Evaluation Report
USEPA Water Supply Study #5034

Page: 1
Date: 11 OCT 74

Participant ID: CA00204		Type: OTHER		Requesting Office: CA		
	Sample Number	Reported Value	True Value*	Acceptance Limits		Performance Evaluation
001 - TRACE METALS IN MICROGRAMS PER LITER:						
001-ARSENIC	001	105	140	117-	158	Not Accept.
002-BARIUM	002	830.5	859	730-	988	Accept.
003-CADMIUM	001	17.8	23.0	18.4-	27.6	Not Accept.
004-CHROMIUM	001	14.0	11.6	9.86-	13.3	Not Accept.
005-LEAD	001	2.	27.0	18.9-	35.1	Not Accept.
006-MERCURY	001	4.6	5.09	3.56-	6.62	Accept.
007-SELENIUM	001	41	51.8	41.4-	62.2	Not Accept.
008-SILVER	002	33	38.1	33-	42.4	Accept.
091-COPPER	001	396.4	420	378-	462	Accept.
140-ANTIMONY	002	17.0	23.7	16.6-	30.8	Accept.
141-BERYLLIUM	001	5.3	5.33	4.53-	6.13	Accept.
142-NICKEL	001	286.6	270	230-	311	Accept.
143-THALLIUM	002	7.4	6.19	4.33-	8.05	Accept.
226-BORON	002	241.8	115	43.8-	239	Not Accept.
235-ALUMINUM	001	196.8	151	128-	172	Not Accept.
236-MANGANESE	001	607.5	590	546-	625	Accept.
237-MOLYBDENUM	002	22.9	24.0	17.9-	30.2	Accept.
239-ZINC	001	502	419	385-	452	Not Accept.
002 - NITRATE/NITRITE/FLUORIDE IN MILLIGRAMS PER LITER:						
009-NITRATE AS N	001	0.462	0.460	0.414-0.506		Accept.
010-FLUORIDE	001	1.11	1.10	0.99- 1.21		Accept.
092-NITRITE AS N	001	0.620	0.680	0.578-0.782		Accept.

* based on theoretical calculations, or a reference value when necessary.

Table D4. (continued)

Performance Evaluation Report
USEPA Water Supply Study #S034

Page: 2
Date: 19OCT94

Participant ID: CA00204		Type: OTHER		Requesting Office: CA	
Sample Number	Reported Value	True Value*	Acceptance Limits	Performance Evaluation	
014 - MISCELLANEOUS ANALYTES:					
022-RESIDUAL FREE CHLORINE (MILLIGRAMS PER LITER)					
001	1.35	1.60	1.23- 1.73	Accept.	
023-TURBIDITY (NTU'S)					
001	0.67	0.720	0.446- 1.12	Accept.	
024-TOTAL FILTERABLE RESIDUE (MILLIGRAMS PER LITER)					
001	325	319	216- 536	Accept.	
025-CALCIUM (MG. CaCO3/L)					
001	182	190	169- 193	Accept.	
026-PH-UNITS					
001	9.19	9.12	8.86- 9.27	Accept.	
027-ALKALINITY (MG. CaCO3/L)					
001	34.7	33.0	30.7- 37.2	Accept.	
029-SODIUM (MILLIGRAMS PER LITER)					
001	16.7	15.2	13.7- 16.6	Not Accept.	
145-SULFATE (MILLIGRAMS PER LITER)					
001	405.5	400	364- 435	Accept.	
146-TOTAL CYANIDE (MILLIGRAMS PER LITER)					
001	0.140	0.140	0.105-0.175	Accept.	

***** END OF DATA FOR CA00204 *****

NOTE: FOR LIMITS AND TRUE VALUES, ASSUME THREE SIGNIFICANT DIGITS.

***** END OF REPORT FOR CA00204 *****

* based on theoretical calculations, or a reference value when necessary.

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