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Data Summary Report for the 1997 Semiannual Tritium Survey for Fourmile Branch and the F- and H-Area Seeplines

by
J. W. Koch II
Westinghouse Savannah River Company
Savannah River Site
Aiken, South Carolina 29808

Exploration Resources

MASTER

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THE ENVIRONMENTAL PROTECTION DEPARTMENT WSRC-TR-97-00414
ENVIRONMENTAL MONITORING SECTION

Data Summary Report for the 1997 Semiannual Tritium Survey for Fourmile Branch and the F- and H-Area Seeplines

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Prepared by:

Environmental Protection Department
Environmental Geochemistry Group
Westinghouse Savannah River Company
Aiken, SC

and

Exploration Resources, Inc.
Athens, GA

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List of Acronyms and Abbreviations

The following acronyms and abbreviations may appear in this Data Summary Report:

°C	degrees Celsius
µg	microgram(s)
µL	microliter
µS	microSiemens
AA	atomic absorption
AQ	analysis qualifier
ASTM	American Society for Testing and Materials
BAT	BAT Associates, Inc.
bls	below land surface
BNA	base/neutral/acid extractables
B	bias qualifier
CCB	continuing calibration blank sample
CCV	continuing calibration verification sample
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act (Superfund)
CFR	Code of Federal Regulations
CLP	Contract Laboratory Program
cm	centimeter(s)
COC	chain of custody; chain-of-custody form
CPT	cone penetrometer test
CRDL	contract-required detection limit
CRQL	contract-required quantitation limit
CSDL	contract-specified detection limit
CV	coefficient of variation
CVAA	cold vapor atomic absorption analysis
DI	deionized (water)

DOE	United States Department of Energy
dpm	disintegrations per minute
DPT	direct push technology
DQOs	data quality objectives
EDD	electronic data deliverable
EGG	Environmental Geochemistry Group
Eh	oxidation-reduction potential
EM-PPM	parts per million methane equivalent
EMSL	EPA's Environmental Monitoring and Support Laboratory
EP	Environmental Physics, Inc.
EPA	United States Environmental Protection Agency
EPD/EMS	Environmental Protection Department/Environmental Monitoring Section
EQL	estimated quantitation limit (for non-radiochemistry analyses)
ERA	Environmental Resource Associates
ERD	Environmental Restoration Department
ESC	expedited site characterization
ExR	Exploration Resources, Inc.
FID	flame ionization detector
ft	feet
g	gram(s)
FHSR	F- and H-Area Seeplines, Radionuclides
FHST3	Third sampling event at the F- and H-Area Seeplines (first quarter 1997)
FHST4	Fourth sampling event at the F- and H-Area Seeplines (third quarter 1997)
GC	gas chromatography
GC/MS	gas chromatography/mass spectrometry
GE	General Engineering Laboratories, Inc.
GFAA	graphite furnace atomic absorption (metals analysis)

GIMS	Geochemical Information Management System
GMP	Groundwater Monitoring Program
GPC	gel permeation chromatography
GPR	ground penetrating radar
ICB	initial calibration blank
ICP	inductively coupled plasma (metals analysis)
ICS	interference check sample
ICV	initial calibration verification
ID	identification
IDL	instrument detection limit
ISA	ICP interference check sample – interferents only
ISB	ICP interference check sample – interferents plus analytes
kg	kilogram
km	kilometer
L	liter
LCS	laboratory control sample(s)
LDRR	laboratory data records review
LIMS	laboratory information management system
LPQL	lowest practical quantitation limit
max.	maximum
MCL	maximum contaminant level
MDA	minimum detectable activity
MDL	method detection limit
meq	milliequivalents
mg	milligram(s)
min.	minimum
mL	milliliter(s)
MRD	mean relative difference

MS	matrix spike
MSA	method of standard addition
MSD	matrix spike duplicate
MSL	mean sea level
NA	not applicable
NAPL	non-aqueous phase liquid
ng	nanogram(s)
NIST	National Institute of Standards and Technology
NTU	nephelometric turbidity unit
OVA	organic vapor analyzer
PAH	polynuclear aromatic hydrocarbons
PAL	performance acceptance limit
PCB	polychlorinated biphenyl
pCi	picoCurie
PE	performance evaluation
PHA	pulse-height analysis; e.g., gamma PHA
PID	photoionization detector
ppb	parts per billion
ppm	parts per million
QA/QC	quality assurance/quality control
r	correlation coefficient
RCO	Radiological Control Officer
RCRA	Resource Conservation and Recovery Act
Recra	Recra LabNet Philadelphia (formerly Roy F. Weston, Inc., Analytics Division)
RFI/RI	RCRA Facility Investigation/Remedial Investigation
RPD	relative percent difference
RQ	result qualifier
RRT	relative retention time

RSD	relative standard deviation
RTW	retention time window
SAIC	Science Applications International Corporation
SCDHEC	South Carolina Department of Health and Environmental Control
SGS	Site Geotechnical Services
SMC	sample/method combination
SOP	standard operating procedure
SOW	statement of work
SQL	sample quantitation limit
SRS	Savannah River Site
SRTC	Savannah River Technology Center
SSC	site-specific contaminant
ssEQL	sample-specific estimated quantitation limit
std. dev.	standard deviation
SW-846	EPA's **Test Methods for Evaluating Solid Waste**
TAL	target analyte list
TCL	target compound list
TCLP	toxicity characteristic leaching procedure
TIC	tentatively identified compound
TNU	Thermo Nutech
U	unclassified
USEPA	see EPA
UTM	Universal Transverse Mercator Zone 17 Coordinate System
VOA	volatile organic analyses
VOC	volatile organic compound
WHC	Westinghouse Hanford Company
WSRC	Westinghouse Savannah River Company

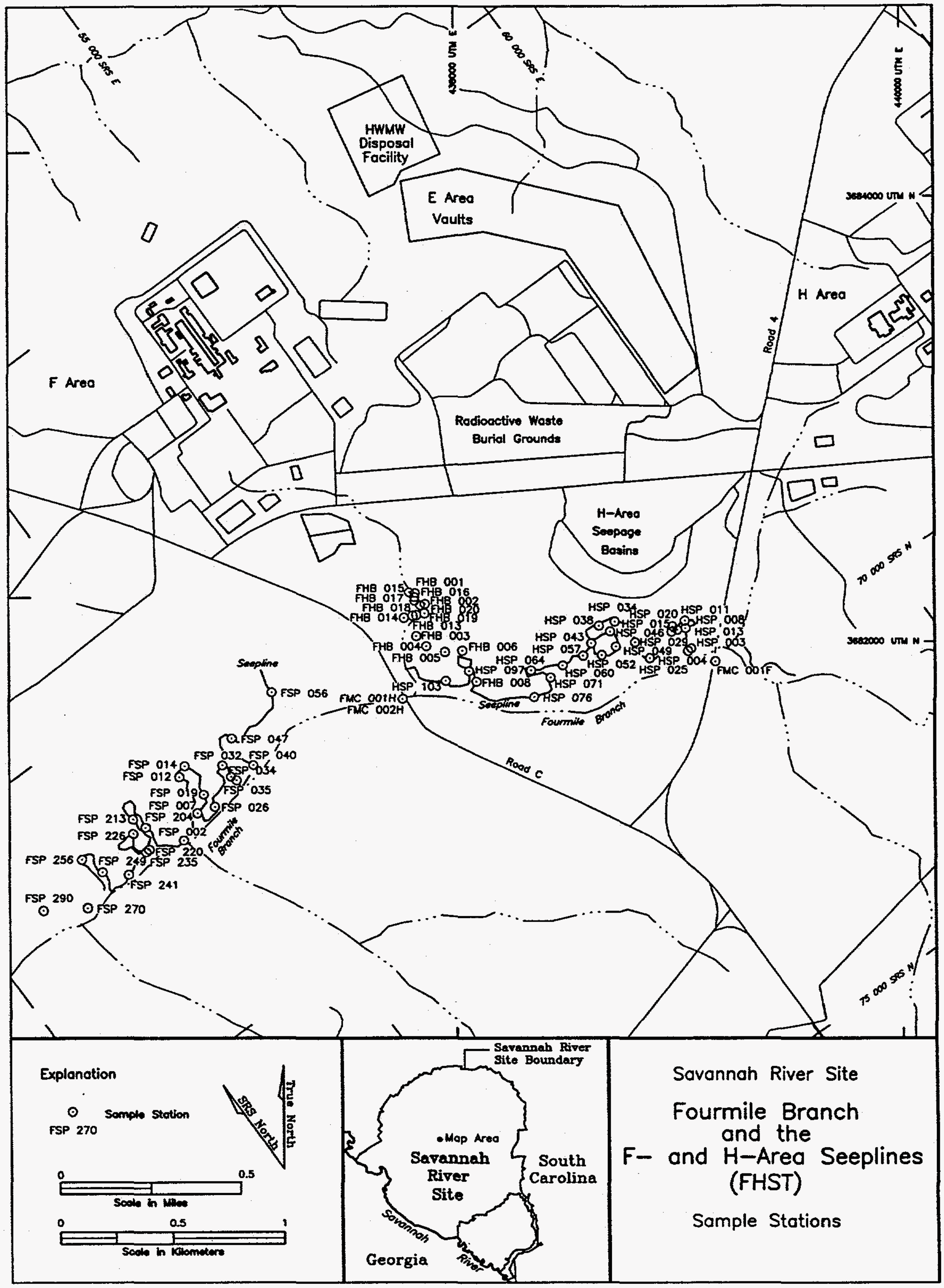

Figure 1. Sampling Locations for Fourmile Branch and the F- and H-Area Seeplines

Executive Summary

Purpose

This report presents a summary of the definitive data validation and verification for the 1997 RFI/RI[1] semiannual tritium survey for Fourmile Branch and the F- and H-Area Seeplines. The RFI/RI was performed under the direction of WSRC ESS/Ecology. This report was prepared under the direction of EPD/EMS.

Scope of the Project

ExR of Athens, GA, validated and verified sample collection, shipping, and laboratory information compiled for this project. The information compiled, reviewed, and maintained includes the following:

- sample documentation
- COC forms
- sample holding times
- initial and continuing instrument calibration
- analyte identification
- analyte quantitation
- analytical error
- analysis of blanks
- laboratory performance evaluations
- quantitation limits

The validation process began with project mobilization and continued through the delivery of EDDs and this report.

Process and Documentation

Sample documentation and maintenance of COC were examined by reviewing the field logs and COC forms. See section 3.1.2, *Production of Chain-of-Custody Forms,* of this report for more information about the COC forms.

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[1] All acronyms and abbreviations used in this report are defined in the *List of Acronyms and Abbreviations* (pp. vii-xi).

Sample holding times were checked by comparing the time between sample collection and analysis with a look-up table of maximum holding times. Analytical instrument calibration was reviewed as part of the LDRR. See section 3.4.2, *Laboratory Data Records Review,* of this report for more information about the LDRR.

Analyte identification and analyte quantitation were verified as part of the computerized checking of the EDDs, during review of the analytical narratives, and as part of the LDRR. Anomalies were clarified with the laboratories wherever possible, and records not meeting criteria were qualified. See section 3.4, *Verification and Validation Issues,* of this report for further information.

In evaluating analytical error, percent recoveries for QC samples were reviewed, and the QC sample and associated project sample data were qualified where necessary. Relative percent differences between duplicate sample analyses were calculated. The criteria for qualification are described in section 3.4.3, *Qualification of the Data,* of this report.

Field-generated blanks (i.e., field blanks, rinsate blanks, and trip blanks) and laboratory-generated blanks (i.e., method blanks) were examined if included in the sampling plan. See section 3.1, *Planning,* of this report for an overview of the sampling plan. Laboratory-generated blanks were analyzed in ratios of more than one for every 20 samples.

Laboratory performance evaluations are detailed in *Appendix B* of this report.

1997 Semiannual Tritium Survey for Fourmile Branch and the F- and H-Area Seeplines Affiliates

The project was completed by the following persons and/or organizations:

- Jim Koch, WSRC-ESS/Ecology, Aiken, SC, was the project manager.
- C. Dan Rogers, WSRC-EPD/EMS, Aiken, SC, was the project technical lead.
- Jim Koch, WSRC-ESS/Ecology, Aiken, SC, collected the water samples.
- GE of Charleston, SC, and WSRC's EM Laboratory of Aiken, SC, prepared the definitive-level analytical data.
- ExR of Athens, GA, validated the data and prepared this report.

1.0 Summary of the Project

1.1 Objective

The objective of this project is to provide validated data for the semiannual tritium sampling events in Fourmile Branch and the F- and H-Area Seeplines.

1.2 Overview

Seepage basins in the F and H Areas received low-level radioactive waste effluent from the chemical separation processes in the General Separations Area. The basins retained the effluent to delay its release to the environment. The waste effluent consisted principally of sodium hydroxide, nitric acid, low levels of various radionuclides, and some metals. Discharges of tritiated water to the seepage basins account for most of the radioactivity.

In 1988 and 1989, the Savannah River Laboratory (now the Savannah River Technology Center) conducted an extensive study aimed at characterizing the shallow groundwater outcropping into Fourmile Branch and its associated seeplines. Researchers measured low pH values, elevated conductivity, and tritium along the seeplines and determined that contaminants leaching from the F- and H-Area seepage basins were impacting the area.

Discharges to the seepage basins were stopped in 1988, and the basins were capped and sealed in 1990 to minimize the release of contaminants to the environment. Scientists hypothesized that after eliminating the contaminant source, annual rainfall amounts and natural groundwater flow would, over time, dilute and flush the remaining contaminant plume out of the shallow groundwater, which would allow recovery of the wetland systems below the basins.

Quarterly sampling of Fourmile Branch and the F- and H-Area seeplines began in May 1992. Results from the quarterly tritium surveys, in which pH, specific conductance, and tritium are measured, have shown a significant decrease in tritium activities and specific conductance values, and pH values have increased to more natural ranges (pH 5–6) when compared with 1989.

Prior to 1996, the tritium analyses were conducted by the EMS laboratory. Data validation was required, so the tritium analyses began to be performed by an independent outside laboratory on a semiannual basis.

1.3 Planning

Sampling events took place on March 5, 6, and 11, 1997, and on September 8, 10, 11, and 17, 1997. One hundred six samples were collected, including duplicates and splits. Concurrent with the sample collection, pH, specific conductance, and water temperatures were measured in the field and recorded in the sample logbooks.

1.4 Field Sampling

During the first sampling event, a total of 63 samples, duplicates, and splits were collected. Forty-three samples were collected during the second sampling event, including duplicates and splits. Tritium results for two additional samples, part of the FHSR project collected on March 10 and 18, 1997, are also reported here.

1.5 Analysis

The samples were analyzed for tritium to meet the requirements for definitive-level data.

1.6 Validation

Validation and verification activities, using definitive data requirements (EPA, 1993), assessed the quality of the definitive level data for the following issues:

- sample documentation
- maintenance of chain of custody
- adherence to sample holding time requirements
- achievement of contract-required quantitation limits
- analytical instrument calibration
- analyte identification
- analyte quantitation

Evaluation of each laboratory's performance in analyte identification and quantitation included examination of the following:

- analytical error
- contamination of blanks
- laboratory performance evaluation samples
- quantitation limit determination, if applicable

2.0 Data Quality Issues Overview

This section provides a summary of the major points affecting the quality of the data for this project.

2.1 Vital Statistics

Of the 138 COCs generated for this project, 108 were used. Twenty-five of the 30 unused COCs were for routine samples that were not utilized, and five were for QC samples (splits or duplicates).

For the FHST3 sampling event, 63 COCs were received from GE. COC forms were not returned for the two split samples sent to the EMS laboratory. Three samples were not taken because the locations were dry, and one sample was voided.

For the FHST4 sampling event, 40 COCs were received from GE. COC forms were not returned for the three split samples sent to the EMS laboratory. Twenty-five samples were not taken because the locations were dry.

Tables 2.1 and 2.2 list the number of sample and QC records that were assigned *U, J,* or *UJ* result qualifiers after verification and validation were performed.

Table 2.1 Number of Records With Result Qualifiers for FHST3

Data Validation Records	Sample Records	QC Records	Total
Total Number of Analytical Records	65	17	82
Qualified Data			
Rejected Analytical Records	0	1	1
Result Qualifier *U*	0	7	7
Result Qualifier *J*	0	0	0
Result Qualifier *UJ*	0	0	0

Table 2.2 Number of Records With Result Qualifiers for FHST4

Data Validation Records	Sample Records	QC Records	Total
Total Number of Analytical Records	43	22	65
Qualified Data			
Rejected Analytical Records	0	1	1
Result Qualifier *U*	0	8	8
Result Qualifier *J*	1	0	1
Result Qualifier *UJ*	0	0	0

2.2 Program Description

This section discusses the validation of the data and gives a brief overview of the laboratories.

2.2.1 Verification and Validation Objectives

Data Quality Objectives

Definitive data (EPA, 1993), have been determined as most appropriate to meet the DQOs of this investigation. Validation and verification activities assessed the data in relation to these standards, especially with regard to the following issues:

- sample documentation
- maintenance of COC
- adherence to sample holding time and preservation requirements
- achievement of contract-required detection limits
- analytical instrument calibration
- analyte identification
- analyte quantitation

Evaluation of each laboratory's performance for analyte identification and quantitation included examination of analytical error, blank contamination, and laboratory performance in the analysis of independent standards.

Each analytical record in the computer data files contains three qualifier fields: result qualifier, analysis qualifier, and bias qualifier. The result qualifier describes the analytical result. The analysis qualifier describes issues arising during the analytical process. The bias qualifier describes whether the result is biased high or low. The laboratories use these fields in reporting the data. During validation and verification of the analytical data, additional qualifiers may be applied to provide additional information about data quality.

Data Quality Levels

Definitive-level data are used for data collection activities that require a high degree of qualitative and quantitative accuracy for all findings. Rigorous methods of analysis and quality assurance are used for those samples considered essential in making a decision. This data level is intended to give the decision maker a level of confidence to make decisions regarding the following:

- treatment
- disposal
- site remediation and/or removal of pollutants
- health risk or environmental impact
- cleanup verification, pollutant source identification, delineation of contaminants
- other significant decisions where an action level is of concern

Only analyte-specific methods can be used for definitive-level data.

2.2.2 Verification and Validation Functions

The data verification process confirms that the required samples were collected and documented, the required analyses were performed on the samples, and the analytical results were reported correctly. The information evaluated during this process includes the sampling plan, delivery order, sample lists, analyte/compound lists, field logbooks, COC forms, and analytical results files.

Data reviewers use computer programs and look-up tables to review the computer data files of sample collection, shipping, and analytical data. The data were examined as follows:

- The following fields were checked to ensure that they were not blank: WSRC sample identification number, sample collection date, laboratory receipt date, analysis date, analysis time, analytical method, laboratory code, laboratory sample identification number, analyte code, result units, nominal concentration, number of dilutions, dilution factor, instrument, instrument batch, and analyst's initials.
- The following fields were checked to ensure that the data were within an acceptable range of values: WSRC sample identification number, sample collection date, laboratory receipt date, analysis date, analysis time, analytical result, accuracy, residual weight, number of dilutions, nominal concentration, and bottle number.
- The following fields were checked against a look-up table or a list of valid codes: laboratory code, laboratory duplicate code, analyte code (test name), analytical method, result qualifier, analysis qualifier, analysis bias, result unit, and sample fraction.

The data validation process determines the usefulness of each analytical result based on QC and method requirements. The information evaluated during this process includes COC forms, analytical narrative summaries, analytical result data files, and raw result and calibration data.

Data validation involves evaluating requirements in the following QC categories: holding times, sample preservation, instrument calibration, analyte identification/quantitation, blanks (trip, method, and field), laboratory control samples, duplicates (field and laboratory), matrix spikes, surrogates, and internal standards.

Data validation and qualification policies were developed from the following sources: EPA, 1986; EPA, 1988a; EPA, 1988b; EPA, 1990; EPA, 1991b; contract-specific WSRC requirements; and discussions with laboratory personnel.

Data Qualifiers

When analytical data are validated, the analytical results and the associated QC information are reviewed using criteria specific to the analysis performed. Data qualifiers are used during the data validation process to classify sample data as conforming to QC requirements.

The qualifiers used for data associated with this project are defined in *Appendix D*.

Precision

Precision measures the reproducibility of measurements under a given set of conditions. It is a quantitative measure of the variability of a group of measurements compared to its average value. Precision is reported in terms of the relative percent difference. The analytical results from the field replicate samples provide data on overall measurement precision; analytical results from the laboratory duplicates provide data on analytical precision.

Accuracy

Accuracy measures the bias in a measurement system; it is difficult to measure for the entire data collection activity. Sources of error are the sampling process, field contamination, preservation, handling, sample matrix, sample preparation, and sample analysis techniques. Sampling accuracy may be assessed by evaluating the results of field blanks and trip blanks. Analytical accuracy may be assessed through the use of known and unknown QC samples, matrix spikes, and method blanks.

Representativeness

Representativeness expresses the degree to which sample data accurately and precisely represent a characteristic of a population, parameter variations at a sampling point, or an environmental condition. Representativeness is a qualitative parameter that is most concerned with the proper design of the sampling program and is best satisfied by making certain that sampling locations are selected properly and that a sufficient number of samples are collected.

The project support request form states that 63 locations were to be sampled for each event, including six QC samples. For the first event 60 locations were sampled, and an additional five QC samples were taken. Three locations were dry. During the second event, samples were taken from 38 locations plus five QC samples. There were 25 dry locations. Tritium results for two samples from the FHSR project are also reported here.

Completeness

Completeness is defined as the percentage of measurements made that are judged to be valid measurements. It is important that critical samples are identified and that plans are made to achieve valid data for them. Completeness was not determined for this report.

Comparability

Comparability is a qualitative parameter expressing the confidence with which one data set can be compared with another. Sample data should be comparable with other measurement data for similar samples and sample conditions. This goal is achieved through using standard techniques to collect and analyze representative samples and through reporting analytical results in appropriate units.

2.2.3 Laboratories

The following laboratories generated the analytical data for this project:

- GE of Charleston, SC, the primary laboratory, provided definitive-level radiological analyses under contract AA07208N.
- EMS/SRS of Aiken, SC, the QC laboratory, provided definitive-level radiological analyses.

2.3 Data Quality Issues Summary

This section provides a summary of the major data quality issues identified during the verification and validation process.

2.3.1 Missing Data

All planned data for environmental samples were collected and received except from the dry locations. The dry stations for each event are listed below:

FHST3
FHB-015
HSP-038
HSP-034

FHST4
FSP-235
FSP-014
FSP-032
FSP-034
FHB-002
FHB-015
FHB-016
FHB-019
FHB-004
FHB-003
FHB-005
FHB-001
FHB-006
FHB-008
HSP-060
HSP-064
HSP-043
HSP-046
HSP-011
HSP-034
HSP-038
HSP-020
HSP-003
HSP-004
HSP-057

2.3.2 Extra Data

Tritium results for two samples from the FHSR project (FMC 001H02 and FMC 002H02) are also reported here, at the project manager's request.

2.3.3 Sample Documentation

COCs were not available for the two split samples sent to the EMS laboratory during the first sampling event nor for the three split samples sent to the EMS laboratory during the second sampling event.

2.3.4 Holding Times and Preservation

No holding times were exceeded for this project.

No cooler temperatures exceeded standards.

2.3.5 Analytical Issues

No significant analytical issues were encountered during verification and validation of the analytical data.

2.3.6 Rejected Data

No environmental sample records associated with this project were rejected. One matrix spike was rejected from each sampling event due to high analyte concentration in the environmental samples. See Table 3.8. No environmental sample records required qualification on the basis of these rejected QC samples.

3.0 Validation

3.1 Planning

SAIC generated the COCs for this project according to a memo from Jim Koch to Dan Rogers dated December 9, 1996.

3.1.1 Planned Work

Samples were to be collected from 63 sampling locations during each of two sampling events, one conducted during first quarter 1997 (FHST3) and one during third quarter 1997 (FHST4).

Sample splits were planned at a frequency of approximately one per 10 samples, to be analyzed for the same parameter as the associated sample.

Samples were to be analyzed for tritium only. The data were validated as definitive-level data.

3.1.2 Production of Chain-of-Custody Forms

COC forms containing the list of requested analyses for each planned sample were printed on waterproof paper. A tear-off stub attached to the COC form stipulated the sample collection location. Information completed on the COC forms included the following:

- EMS sample identification number from the logbook page for that sample
- laboratory sample identification number (to be completed by the laboratory)
- sample collection date
- shipping information (including the signature of each person handling the sample and the date it was handled)
- cooler number and temperature upon arrival at the analytical laboratory

Sixty-nine COC forms were generated for each sampling event of this project (FHST3 and FHST4).

3.1.3 Sample Sets

The following tables list the sample identifiers, sample type, and sample date and time for samples sent to the laboratories. Tritium was the only analysis requested. *A* in the Station ID indicates a duplicate, and *D* indicates a split sample.

Table 3.1 Sample Set for FHST3

Survey Station ID	Sample ID	Laboratory ID	Sample Type	Sample Date and Time
FSP 29003	110500	9703471-01	Water	03/05/97, 09:00
FSP 29003A	110501	9703471-45	Duplicate	03/05/97, 09:05
FSP 27003	110502	9703471-03	Water	03/05/07, 09:10

Table 3.1 Sample Set for FHST3 (cont.)

Survey Station ID	Sample ID	Laboratory ID	Sample Type	Sample Date and Time
FSP 24103	110503	9703471-04	Water	03/05/97, 09:45
FSP 24903	110504	9703471-05	Water	03/05/97, 09:55
FSP 25603	110505	9703471-13	Water	03/05/97, 10:05
FSP 21303	110506	9703471-06	Water	03/05/97, 10:45
FSP 22603	110507	9703471-07	Water	03/05/97, 10:50
FSP 23503	110508	9703471-08	Water	03/05/97, 11:00
FSP 20403	110509	9704590-08	Water	03/05/97, 12:05
FSP 00203	110510	9703471-09	Water	03/05/97, 12:10
FSP 00703	110511	9704590-02	Water	03/05/97, 12:15
FSP 01203	110512	9703471-10	Water	03/05/97, 12:30
FSP 01403	110513	9703471-11	Water	03/05/97, 12:45
FSP 01903	110514	9704590-09	Water	03/05/97, 12:55
FSP 02603	110515	9704590-10	Water	03/05/97, 13:05
FSP 03203	110516	9703471-12	Water	03/05/97, 13:10
FSP 03403	110518	9704590-11	Water	03/05/97, 13:15
FSP 04003	110519	9704590-12	Water	03/05/97, 13:35
FSP 03503	110520	9704590-13	Water	03/05/97, 13:35
FSP 04703	110521	9703471-14	Water	03/05/97, 14:00
HSP 07603	110522	9703471-15	Water	03/06/97, 09:00
HSP 07603D	110523	9708776202	Split	03/06/97, 09:01
HSP 07103	110524	9703471-16	Water	03/06/97, 09:05
HSP 06003	110525	9704590-03	Water	03/06/97, 09:15
HSP 05703	110526	9703471-17	Water	03/06/97, 09:25
HSP 04303	110529	9704590-04	Water	03/06/97, 10:10
HSP 05203	110530	9704590-05	Water	03/06/97, 10:15
FSP 22003	110531	9703471-18	Water	03/05/97, 11:05
HSP 04903	110532	9704590-06	Water	03/06/97, 10:25
HSP 04603	110533	9703471-19	Water	03/06/97, 10:30
HSP 02503	110534	9703471-20	Water	03/06/97, 10:50
HSP 02903	110535	9703471-21	Water	03/06/97, 12:05
HSP 02003	110536	9703471-22	Water	03/06/97, 12:15
HSP 01503	110537	9703471-23	Water	03/06/97, 12:30
HSP 01303	110538	9703471-24	Water	03/06/97, 12:40
HSP 00803	110540	9703471-44	Water	03/06/97, 12:45
HSP 01103	110541	9703471-25	Water	03/06/97, 12:50
HSP 00303	110542	9703471-26	Water	03/06/97, 13:00
HSP 00403	110543	9703471-27	Water	03/06/97, 13:05
HSP 10303	110544	9703471-28	Water	03/06/97, 13:35
HSP 09703	110545	9704590-07	Water	03/06/97, 13:40
FHB 00203	110546	9703471-29	Water	03/11/97, 08:06

Table 3.1 Sample Set for FHST3 (cont.)

Survey Station ID	Sample ID	Laboratory ID	Sample Type	Sample Date and Time
FHB 00103	110547	9703471-30	Water	03/11/97, 08:14
FHB 01603	110548	9703471-31	Water	03/11/97, 08:23
FHB 01703	110550	9704590-15	Water	03/11/97, 08:32
FHB 01803	110551	9704590-14	Water	03/11/97, 08:39
FHB 02003	110552	9703471-32	Water	03/11/97, 08:42
FHB 01903	110553	9704590-16	Water	03/11/97, 08:47
FHB 01303	110554	9704590-17	Water	03/11/97, 08:51
FHB 01403	110555	9703471-33	Water	03/11/97, 08:58
FHB 01203	110556	9704590-18	Water	03/11/97, 09:00
FHB 00403	110557	9703471-34	Water	03/11/97, 09:10
FHB 00303	110558	9703471-35	Water	03/11/97, 09:21
FHB 00303D	110559	9708776302	Split	03/11/97, 09:23
FHB 00603	110560	9703471-36	Water	03/11/97, 09:50
FHB 00503	110561	9703471-37	Water	03/11/97, 09:55
FHB 00803	110562	9703471-38	Water	03/11/97, 10:08
FMC 001F03	110563	9703471-39	Water	03/11/97, 10:59
FSP 05603	110574	9703471-40	Water	03/06/97, 08:20
FSP 05603A	110575	9703471-46	Duplicate	03/06/97, 08:40
HSP 06403	110576	9703471-43	Water	03/06/97, 08:45
HSP 06403A	110577	9703471-47	Duplicate	03/11/97, 08:46
FMC 001H02	110609	9703289-02	Water	03/10/97, 14:15
FMC 002H02	110613	9703474-01	Water	03/18/97, 15:00

Table 3.2 Sample Set for FHST4

Survey Station ID	Sample ID	Laboratory ID	Sample Type	Sample Date and Time
FSP 29004	111700	9710234-01	Water	09/08/97, 08:56
FSP 29004A	111701	9780867502	Split	09/08/97, 09:00
FSP 27004	111702	9710234-02	Water	09/08/97, 09:21
FSP 25604	111703	9710234-03	Water	09/08/97, 10:05
FSP 24904	111704	9710234-04	Water	09/08/97, 10:24
FSP 24104	111705	9710234-05	Water	09/08/97, 10:40
FSP 22004	111707	9710234-06	Water	09/08/97, 11:04
FSP 22604	111708	9710234-07	Water	09/08/97, 11:20
FSP 21304	111709	9710880-01	Water	09/08/97, 11:25
FSP 20404	111710	9710880-02	Water	09/08/97, 12:03
FSP 00204	111711	9710234-08	Water	09/08/97, 12:15
FSP 00704	111712	9710234-09	Water	09/08/97, 12:25
FSP 01204	111713	9710234-10	Water	09/08/97, 12:42
FSP 01904	111715	9710880-03	Water	09/08/97, 13:07

Table 3.2 Sample Set for FHST4 (cont.)

Survey Station ID	Sample ID	Laboratory ID	Sample Type	Sample Date and Time
FSP 02604	111716	9710880-04	Water	09/08/97, 13:26
FSP 03504	111719	9710880-05	Water	09/08/97, 14:07
FSP 04004	111720	9710880-06	Water	09/08/97, 14:15
FSP 04704A	111721	9710234-11	Duplicate	09/10/97, 11:26
FSP 04704	111722	9780876802	Split	09/10/97, 11:25
FSP 05604	111723	9710234-12	Water	09/10/97, 11:40
FHB 02004	111724	9710234-13	Water	09/10/97, 12:10
FHB 01804	111726	9710880-07	Water	09/10/97, 12:25
FHB 01704	111727	9710880-08	Water	09/10/97, 12:31
FHB 01304	111730	9710880-09	Water	09/10/97, 12:59
FHB 01204	111731	9710880-10	Water	09/10/97, 13:03
HSP 10304	111735	9710234-14	Water	09/11/97, 09:00
HSP 07604	111740	9710234-15	Water	09/11/97, 10:19
HSP 07104	111741	9710234-16	Water	09/11/97, 10:34
HSP 05204	111743	9710880-11	Water	09/11/97, 11:06
HSP 04904	111744	9710399-02	Water	09/11/97, 11:15
FMC 00104	111746	9710234-19	Water	09/11/97, 12:18
HSP 00804	111747	9710399-03	Water	09/11/97, 12:40
HSP 01504	111749	9710234-17	Water	09/11/97, 12:56
HSP 01304	111750	9710234-18	Water	09/11/97, 13:07
HSP 09704	111751	9710234-20	Water	09/17/97, 09:00
HSP 09704A	111752	9710399-01	Duplicate	09/17/97, 09:02
HSP 02504	111756	9710234-21	Water	09/17/97, 10:02
HSP 02904	111757	9710234-22	Water	09/17/97, 10:10
FMC 00204	111759	9710234-23	Water	09/17/97, 11:20
FMC 001F04	111760	9710234-24	Water	09/17/97, 12:17
FHB 01404	111762	9710234-25	Water	09/17/97, 13:35
HSP 10304A	111763	9780867602	Split	09/11/97, 09:00
FMC 001F04A	111764	9710234-26	Duplicate	09/17/97, 12:18

3.2 Field Data Quality Issues

3.2.1 Discrepancies from the Planned Work

FHST3

Samples were not taken for sample IDs 110527, 110528, and 110549 (sampling locations HSP-034, HSP-038, and FHB-015, respectively) during the first sampling event because the holes were dry. Samples 110501, 110575, and 110577 were scheduled to be sent to the EMS laboratory to be analyzed as splits but instead were sent to GE and analyzed as duplicates. Sample 110523 was scheduled to be analyzed at GE as a duplicate but instead was sent to the EMS laboratory as a split.

During the first sampling event, samples 110501, 110559, 110575, and 100577 were taken from locations other than those planned, as shown in Table 3.3.

Table 3.3. Planned vs. Actual Stations for FHST3

Sample ID	Planned Station	Actual Station
110501	FSP-002D	FSP-290A
110559	FMC-002	FHB-003D
110575	FSP-204D	FSP-056A
110577	FHB-001D	HSP-064A

FHST4

Samples were not taken for sample IDs 111706 (FSP-235), 111714 (FSP-014), 111717 (FSP-032), 111718 (FSP-034), 111725 (FHB-002), 111728 (FHB-015 and FHB-016), 111729 (FHB-019), 111732 (FHB-004 and FHB-003), 111733 (FHB-005), 111734 (FHB-001), 111736 (FHB-006), 111737 (FHB-008), 111738 (HSP-060), 111739 (HSP-064), 111742 (HSP-043), 111745 (HSP-046), 111748 (HSP-011), 111753 (HSP-034), 111754 (HSP-038), 111755 (HSP-020), 111758 (HSP-003 and HSP-004), and 111761 (HSP-057) because the holes were dry.

For sample ID 111744, the actual station was written incorrectly in the field logbook as FSP-049; it should have been HSP-049. Samples 111752 and 111763 were taken from locations other than those planned, as shown in Table 3.4.

Table 3.4. Planned vs. Actual Stations for FHST4

Sample ID	Planned Station	Actual Station
111752	HSP-008A	HSP-097A
111763	FHB-034A	HSP-103A

3.2.2 Field Data Sets

The following tables list the sample identifiers, sample date and time, and the pH, turbidity, and conductivity readings taken at the time of sampling. *A* in the Station ID indicates a duplicate, and *D* indicates a split sample.

Table 3.5 Field Data for FHST3

Survey Station ID	Sample ID	Sample Date and Time	pH	Conductivity (μmhos)	Water Temperature (°C)
FSP 29003	110500	03/05/97, 09:00	4.19	52	14
FSP 29003A	110501	03/05/97, 09:05	4.19	52	14
FSP 27003	110502	03/05/07, 09:10	4.34	137	14.1
FSP 24103	110503	03/05/97, 09:45	5.52	128	15.1
FSP 24903	110504	03/05/97, 09:55	5.20	64	14.6
FSP 25603	110505	03/05/97, 10:05	5.42	48	14.8

Table 3.5 Field Data for FHST3 (cont.)

Survey Station ID	Sample ID	Sample Date and Time	pH	Conductivity (µmhos)	Water Temperature (°C)
FSP 21303	110506	03/05/97, 10:45	5.42	39	14.4
FSP 22603	110507	03/05/97, 10:50	5.46	210	15.7
FSP 23503	110508	03/05/97, 11:00	5.73	62	14.7
FSP 20403	110509	03/05/97, 12:05	4.55	443	19.4
FSP 00203	110510	03/05/97, 12:10	6.39	81	19.1
FSP 00703	110511	03/05/97, 12:15	6.28	236	22.3
FSP 01203	110512	03/05/97, 12:30	5.74	42	15.5
FSP 01403	110513	03/05/97, 12:45	5.24	21	16.9
FSP 01903	110514	03/05/97, 12:55	4.26	901	16.0
FSP 02603	110515	03/05/97, 13:05	4.53	1350	14.7
FSP 03203	110516	03/05/97, 13:10	5.36	31	15.7
FSP 03403	110518	03/05/97, 13:15	4.40	416	15.1
FSP 04003	110519	03/05/97, 13:35	4.54	1137	14.9
FSP 03503	110520	03/05/97, 13:35	4.42	842	16.4
FSP 04703	110521	03/05/97, 14:00	5.22	46	16.3
HSP 07603	110522	03/06/97, 09:00	6.26	110	15.2
HSP 07603D	110523	03/06/97, 09:01	NR[a]	NR	NR
HSP 07103	110524	03/06/97, 09:05	6.45	92	13.6
HSP 06003	110525	03/06/97, 09:15	6.01	164	13.4
HSP 05703	110526	03/06/97, 09:25	6.08	99	14.2
HSP 04303	110529	03/06/97, 10:10	6.49	104	13.1
HSP 05203	110530	03/06/97, 10:15	5.87	308	13.7
FSP 22003	110531	03/05/97, 11:05	5.03	180	14.6
HSP 04903	110532	03/06/97, 10:25	6.00	100	14.2
HSP 04603	110533	03/06/97, 10:30	6.10	136	13.4
HSP 02503	110534	03/06/97, 10:50	5.41	43	14.0
HSP 02903	110535	03/06/97, 12:05	5.39	45	13.7
HSP 02003	110536	03/06/97, 12:15	5.69	63	14.7
HSP 01503	110537	03/06/97, 12:30	5.69	91	14.3
HSP 01303	110538	03/06/97, 12:40	6.38	119	13.9
HSP 00803	110540	03/06/97, 12:45	6.56	125	13.8
HSP 01103	110541	03/06/97, 12:50	5.65	33	14.2
HSP 00303	110542	03/06/97, 13:00	6.64	184	15.1
HSP 00403	110543	03/06/97, 13:05	6.57	96	14.7
HSP 10303	110544	03/06/97, 13:35	5.45	68	14.8
HSP 09703	110545	03/06/97, 13:40	6.10	87	16.3
FHB 00203	110546	03/11/97, 08:06	4.98	32	14.5

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[a] NR - not recorded. Data should be identical to that of parent sample.

Table 3.5 Field Data for FHST3 (cont.)

Survey Station ID	Sample ID	Sample Date and Time	pH	Conductivity (μmhos)	Water Temperature (°C)
FHB 00103	110547	03/11/97, 08:14	5.63	38	14.3
FHB 01603	110548	03/11/97, 08:23	5.72	53	13.7
FHB 01703	110550	03/11/97, 08:32	5.35	42	13.7
FHB 01803	110551	03/11/97, 08:39	6.12	73	14.3
FHB 02003	110552	03/11/97, 08:42	6.13	26	14.6
FHB 01903	110553	03/11/97, 08:47	4.86	41	14.1
FHB 01303	110554	03/11/97, 08:51	4.98	27	14.4
FHB 01403	110555	03/11/97, 08:58	4.98	31	15.9
FHB 01203	110556	03/11/97, 09:00	4.75	32	15.7
FHB 00403	110557	03/11/97, 09:10	5.11	31	14.5
FHB 00303	110558	03/11/97, 09:21	5.15	27	14.2
FHB 00303D	110559	03/11/97, 09:23	5.15	27	14.2
FHB 00603	110560	03/11/97, 09:50	5.58	34	14.5
FHB 00503	110561	03/11/97, 09:55	5.47	37	13.7
FHB 00803	110562	03/11/97, 10:08	5.27	20	14.6
FMC 001F03	110563	03/11/97, 10:59	6.57	55	19.2
FSP 05603	110574	03/06/97, 08:20	5.47	71	14.1
FSP 05603A	110575	03/06/97, 08:40	5.47	71	14.1
HSP 06403	110576	03/06/97, 08:45	5.12	28	14.2
HSP 06403A	110577	03/06/97, 08:46	NR	NR	NR
FMC 001H	110609	03/10/97, 14:15	7.73	34	70.3° F
FMC 002H	110613	03/18/97, 15:00	6.5	53	73.8° F

Table 3.6 Field Data for FHST4

Survey Station ID	Sample ID	Sample Date and Time	pH	Conductivity (μmhos)	Water Temperature (°C)
FSP 29004	111700	09/08/97, 08:56	4.94	29	19.4
FSP 29004A	111701	09/08/97, 09:00	NR[b]	NR	NR
FSP 27004	111702	09/08/97, 09:21	4.98	35	17.4
FSP 25604	111703	09/08/97, 10:05	6.13	156	18.7
FSP 24904	111704	09/08/97, 10:24	5.42	39	23.6
FSP 24104	111705	09/08/97, 10:40	5.91	254	21.7
FSP 22004	111707	09/08/97, 11:04	5.91	146	21.7
FSP 22604	111708	09/08/97, 11:20	5.85	79	22.8
FSP 21304	111709	09/08/97, 11:25	4.02	477	21.5
FSP 20404	111710	09/08/97, 12:03	4.49	138	22.6

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[b] NR - not recorded. Data should be identical to that of parent sample.

Table 3.6 Field Data for FHST4 (cont.)

Survey Station ID	Sample ID	Sample Date and Time	pH	Conductivity (µmhos)	Water Temperature (°C)
FSP 00204	111711	09/08/97, 12:15	6.8	78.3	22.9
FSP 00704	111712	09/08/97, 12:25	6.13	535	20.1
FSP 01204	111713	09/08/97, 12:42	5.6	36	24.7
FSP 01904	111715	09/08/97, 13:07	4.02	816	22.2
FSP 02604	111716	09/08/97, 13:26	6.44	686	23.4
FSP 03504	111719	09/08/97, 14:07	3.99	1261	22.6
FSP 04004	111720	09/08/97, 14:15	4.16	716	24.5
FSP 04704A	111721	09/10/97, 11:26	5.28	39.3	22.4
FSP 04704	111722	09/10/97, 11:25	NR	NR	NR
FSP 05604	111723	09/10/97, 11:40	3.1	45	22.1
FHB 02004	111724	09/10/97, 12:10	5.29	43	22.2
FHB 01804	111726	09/10/97, 12:25	4.99	34	21.1
FHB 01704	111727	09/10/97, 12:31	5.05	42	22.4
FHB 01304	111730	09/10/97, 12:59	4.58	51	22.3
FHB 01204	111731	09/10/97, 13:03	5.31	42	20.5
HSP 10304	111735	09/11/97, 09:00	5.01	119	21.4
HSP 07604	111740	09/11/97, 10:19	6.20	65	20.4
HSP 07104	111741	09/11/97, 10:34	6.42	151	21.2
HSP 05204	111743	09/11/97, 11:06	6.24	380	21.6
HSP 04904	111744	09/11/97, 11:15	5.75	84	22.0
FMC 00104	111746	09/11/97, 12:18	6.53	64	25.3
HSP 00804	111747	09/11/97, 12:40	5.96	93	21.9
HSP 01504	111749	09/11/97, 12:56	5.73	147	22.8
HSP 01304	111750	09/11/97, 13:07	5.98	79	22.7
HSP 09704	111751	09/17/97, 09:00	6.09	137	20.7
HSP 09704A	111752	09/17/97, 09:02	NR	NR	NR
HSP 02504	111756	09/17/97, 10:02	6.27	117	22.6
HSP 02904	111757	09/17/97, 10:10	6.27	47	22.4
FMC 00204	111759	09/17/97, 11:20	6.10	66	24.1
FMC 001F04	111760	09/17/97, 12:17	6.84	62	24.4
FHB 01404	111762	09/17/97, 13:35	3.48	33	20.7
HSP 10304A	111763	09/11/97, 09:00	NR	NR	NR
FMC 001F04A	111764	09/17/97, 12:18	NR	NR	NR

3.2.3 Sample Logbook Observations

FHST3

During the first sampling event, no entry was made for sampling location FMC-002. Sample ID 110517 was not used; the field logbook pages were crossed out as omitted. Pages in the field logbook for sample ID 110539 (station HSP-011) were voided, and that station was sampled as sample ID 110541. Sample logbook pages for sample ID 110573 were used to record calibration of pH and conductivity meters.

Sample logbook entries for sample IDs 110500, 110501, and 110506 note that the sample was taken by dipping with the sample bottle. The entry for sample 110556 (FHB-012) notes that it is a stream location.

There were no sample logbook observations that affected data quality.

FHST4

For sample ID 111708, the sampler noted that it was not very wet in the seepline, much dryer than usual.

The sampler noted for sample ID 111710 that a bucket was present.

The observations that the bucket and seepline were dry were made for sample ID 111717.

For sample ID 111755, the sampler noted that the sampling location was damp, but no water was seeping into the augered hole.

For sample ID 111727, the sampler noted that the first location where an attempt was made to obtain field measurements was dry. The location was moved 20 ft, and field measurements were obtained.

The sampler noted for sample ID 111735 that there was lots of water in the bucket.

For sample ID 111761, the sampler noted that the sampling location was moist.

There were no sample logbook observations that affected data quality.

3.2.4 Chain-of-Custody Observations

FHST3

Chains of custody for samples 110523 and 110559, split samples from the first sampling event that were sent to EMS, were not returned from the laboratory.

FHST4

Chains of custody for samples 111701, 111722, and 111763, split samples from the second sampling event that were sent to EMS, were not returned from the laboratory.

3.3 Analytical Data Quality Issues

3.3.1 The Laboratories

The samples were analyzed by GE under contract AA07208N. The laboratory has been certified by SCDHEC. The splits were analyzed by the EMS laboratory.

3.3.2 Laboratory Quality Control

The laboratories follow their own QA/QC plans, which are designed to measure and document the accuracy and precision for the various sample control and analytical methods it performs. The laboratories are guided by published method-specific QC requirements as well as other regulatory and contract-required QC procedures.

3.3.3 List of Analytical Suites

Tritium was the only analyte requested in both sampling events. See *Appendix A* for a listing of the analytical methods and the lab's reporting of MDAs.

3.3.4 Analytical Data Observations

The data are final and complete except as noted in this subsection. Data validation is also complete.

Some of the data did not meet all the criteria listed in EPA, 1993, as noted below:

- Field measurements are designed to meet the criteria for screening-level data and they are not analyte specific. Therefore, definitive data criteria are not applicable.
- Analytical error determination (a measurement of method precision) was not calculated; however, precision can be evaluated by referring to the tables in section 3.5, *Precision and Accuracy*, of this report.
- Total measurement error determination (measurement of overall precision from sample acquisition through analysis) was not performed because it requires independently collected samples from the same location, and this practice does not fit into the scope of the project work plan.
- No adjustments to sample values were made for bias or precision.
- Using the criteria defined in EPA, 1993, matrix spike recoveries for an entire project are averaged, and all associated sample data are qualified on the basis of this average. Matrix spike-based qualification for this project, however, was done on a sample-by-sample basis, using the criteria in subsection 3.4.3, *Qualification of the Data.*
- Two of four matrix spikes could not be evaluated due to high concentration of the analyte in the sample.
- No matrix spikes were provided for the split samples from the first event.

3.4 Verification and Validation Issues

3.4.1 Analytical Narrative Review

The EDDs and analytical narratives arrive from the laboratories and are logged in together. If the analytical narrative is missing, it is requested from the analytical laboratory. The narratives are reviewed and used as a reference throughout the data validation process. Discrepancies between the narratives and the analytical data must be resolved by the analytical laboratory. The analytical narratives contain summaries of the following problems encountered by the laboratory:

- QC samples that do not meet the criteria specified by the analytical method
- matrix interference problems
- sample-specific adjustments to the method caused by high concentration of some analytes
- sample preservation and holding time problems
- instrument calibration problems
- contaminated blanks
- other laboratory QC issues

Additional information about the chain-of-custody data and analytical data is often found in the analytical narratives. Copies of the COC forms attached to the analytical narratives are used for data review.

3.4.2 Laboratory Data Records Review

On May 19–21, 1997, laboratory data records were reviewed at EP for selected analyses associated with this project. Tom Coffey of ExR conducted the review.

The purpose of the review is to investigate technical validation issues discussed in EPA, 1993, that are not adequately addressed by computer checking of the EDDs, by review of the analytical narratives, or by review of the COC forms. These technical issues include instrument calibration, analyte identification, and analyte quantitation. The issues are addressed by comparing the instrument printouts associated with particular analyses against validation checklists and the reviewer's professional judgment. The checklist for tritium contains 8 questions and was prepared from four sources: EPA, 1993; WHC (not dated), EP's standard operating procedures, and discussions with laboratory personnel.

Eight samples, approximately 10% of the total, were chosen for review. Samples identified as critical to the investigation were included in the review. Eight worksheets were completed, each representing one sample reviewed for one analyte for one analytical method, EPA 906.0, tritium by liquid scintillation spectrometry.

Scoring

The analysis date and time for one sample did not match the WSRC database.

Qualification of Analyses

No qualification was required. The analysis date and time are correct in the data provided with this report.

No LDRR was performed for the second sampling event.

3.4.3 Qualification of the Data

Each sample was evaluated on the following issues during validation:

- holding time
- sample preservation

- instrument calibration
- analyte identification and quantitation
- method blanks
- laboratory control samples
- rinsates, field blanks, and field duplicates
- laboratory duplicates
- matrix spikes
- instrument readings
- additional information

Holding Time

Criteria

Each analysis was evaluated according to the 6-month holding time limit for radionuclides.

Action

When holding times were exceeded, the following qualifiers were applied:

Analysis Qualifier: *Q*

Result Qualifier: *J*—for detects *UJ*—for nondetects

Findings

No environmental sample records from either sampling event were qualified based on holding times.

Discussion

Most methods specify limits on the time that can pass between sample collection and extraction or analysis. When holding times are exceeded, sample integrity may be compromised due to chemical and/or physical effects that can bias sample results either positively or negatively.

Sample Preservation

Criteria

Sample preservation requirements are determined by regulatory guidance, method specifications, and laboratory protocols.

Findings

No environmental sample records from either sampling event were qualified based on sample preservation.

Instrument Calibration

Criteria

The calibration criteria specific to each method was used to evaluate instrument calibration during the LDRR.

Action

When calibration criteria were not met, the following qualifiers were assigned:

Analysis Qualifier: *L*

Result Qualifiers: *J* or *R*—detects *UJ*—for nondetects

Findings

No environmental sample records from either sampling event were qualified based on instrument calibration.

Discussion

Instrument calibration ensures that the instrument is capable of producing acceptable quantitative results. Initial calibration demonstrates that the instrument is capable of acceptable performance at the beginning of the analysis run. Continuing calibration verification documents that the initial calibration is still valid. After initial calibration, a continuing calibration standard and blank should be analyzed after every ten samples.

Analyte Identification and Quantitation

This issue was examined during the LDRR. The findings are presented in section 3.4.2, *Laboratory Data Records Review*.

Trip Blanks

Criteria

Trip blanks are used to determine the existence and magnitude of contamination from shipping activities.

Action

When an analyte is detected in a trip blank, an analysis qualifier is assigned to that analyte in the blank and to all samples that are shipped in the same cooler as the trip blank having positive results. If the analyte concentration in a sample is less than five times that in the blank (less than 10 times for the common laboratory contaminants acetone, dichloromethane [methylene chloride], and methyl ethyl ketone), assign a result qualifier to that analyte in the sample.

The following qualifiers may be assigned:

Analysis Qualifier: *8*

Result Qualifier: *U*

Findings

There were no trip blanks associated with this project.

Discussion

Volatile organic contamination can be introduced into a trip blank in three ways: during blank preparation at the laboratory; during storage of the trip blank in the cooler; or by cross-contamination from other samples. The contamination can cause false positives in the trip blank and in the samples exposed to contamination.

Method Blanks

Criteria

Method blanks are used to determine the existence and magnitude of contamination from laboratory activities. Method blanks with analytical results greater than zero are considered to be contaminated. The CLP 5×/10× rule is used for data qualification.

Action

When an analyte is detected in a method blank, an analysis qualifier is assigned to that analyte in the blank and to every sample of the preparation batch having positive results. If the analyte concentration in a sample is less than five times that in the blank (less than 10 times for common laboratory contaminants), assign a result qualifier to that analyte in the sample. A bias qualifier should be used only if the laboratory believes the sample is contaminated and has assigned the qualifier.

The following qualifiers may be assigned:

Analysis Qualifier:	*V*
Result Qualifier:	*U*
Bias Qualifier:	*H*

Findings

No environmental sample records from either sampling event were qualified based on method blank contamination.

Discussion

Laboratory contamination of samples during preparation and/or analysis is monitored through the method blank. Laboratory procedures may cause false positive results in the method blanks for common laboratory contaminants.

Laboratory Control Samples

Criteria

- Dioxins/furans: 40–120% recovery (EPA, 1986)

- Inorganics: 80–120% recovery except EPA6020 and EPA6020A, which have 70–130% recovery
- Pesticides: Page D-61 PEST (EPA, 1991b)
- Radiologicals: 80–120% (WHC, not dated)
- Semivolatiles: Table 7, page D-59 SV (EPA, 1991b)
- Volatiles: Table 7, page D-55 VOA (EPA, 1991b)

Action

When the percent recovery for an analyte in the LCS was outside the QC limits, that analyte in the LCS was qualified with an analysis qualifier. That analyte in each sample of the preparation batch was qualified. If an LCS was not included in the preparation batch, all spike compounds for the associated samples were qualified with an analysis and a results qualifier.

LCS recovery below lower QC limit:

Analysis Qualifier: *C*

Result Qualifiers: *J*—for detects *UJ*—for nondetects

LCS recovery above upper QC limit:

Analysis Qualifier: *C*

Result Qualifiers: *J*—for detects

Findings

For first quarter samples, none of the 65 environmental sample records was qualified. For third quarter samples, one of 43 environmental sample records was qualified because one of six LCSs was out of range. The preparation batch was used to correlate the samples with the spikes.

Discussion

LCS percent recoveries that exceed the upper QC limit could indicate a high bias for samples with positive results. Percent recoveries that are less than the lower QC limit could indicate a low bias for samples with positive results, and nondetect results should be considered questionable.

Rinsates, Field Blanks, and Field Duplicates

No qualification is performed based on rinsates, field blanks, and field duplicates.

Laboratory Duplicates

Criteria

- Inorganics: Page 10 (EPA, 1988a)
- Organics: No qualification is done on this basis.

- Radiologicals: (WHC, not dated)

Findings

No environmental sample records from either sampling event were qualified based on RPDs.

Matrix Spikes

Criteria

- Dioxins: 40–120% (EPA, 1986)
- Inorganics: Page 11 (EPA, 1988a)
- Pesticides: Page D-61 PEST (EPA, 1991b)
- Semivolatiles: Table 7, page D-59 SV (EPA, 1991b)
- Volatiles: Table 7, page D-55 VOA (EPA, 1991b)

Action

1. MS recovery limits do not apply when the spike concentration is less than 25% of the sample concentration. When this occurred, the MS record only was qualified as follows:

Analysis Qualifier: *5*

Result Qualifier: *R*

2. If the laboratory did not perform matrix spikes for nonradiological analyses, the following qualifier was used:

Analysis Qualifier: *I*

Findings

For first quarter, two of 65 environmental sample records were qualified with AQ *I* because no matrix spike analyses were performed. For third quarter, 0 of 43 environmental sample records were qualified. The following table lists the frequency with which matrix spikes were rejected because the sample concentration was 4 times higher than the nominal concentration.

Table 3.7 Matrix Spikes With Sample Concentrations 4 Times Higher Than Nominal Concentration for Samples by EP

Quarter	Analyte	Rejection Frequency
1Q97	Tritium	1/2
3Q97	Tritium	1/2

Discussion

When the matrix spike percent recovery for an analyte is high, the results for associated data may be biased positively. When the matrix spike percent recovery for an analyte is low, the results for associated data may be biased negatively, and the nondetected results should be considered questionable.

Instrument Readings

Criteria

For radiologicals, nondetected parameters reported from an instrument reading require a result qualifier.

Action

The result qualifier was as follows:

Result Qualifier: *UI*—for nondetects

Findings

No environmental sample records from either sampling event were qualified.

Discussion

For radiological analyses, the laboratory instrumentation and data management software calculate the MDA, result, and accuracy. If the reported result was less than the MDA and/or the accuracy, a *UI* result qualifier was assigned.

3.5 Precision and Accuracy

This section discusses the analytical data in terms of the precision and accuracy indicators of data quality. Precision is determined from the field and laboratory duplicate analyses and indicates the consistency of field and laboratory techniques. Accuracy is determined from the laboratory control samples, matrix spikes, and the results of the method, field, trip, and equipment blanks or rinsates and indicates the ability of the laboratory to generate correct results.

3.5.1 Precision

Precision is a measure of the repeatability of a measurement and is evaluated from the results of field and laboratory duplicate samples. Field duplicates measure the repeatability for the sampling and analytical techniques, and laboratory duplicates measure the ability of the laboratory to reproduce a result. Low precision can be caused by poor instrument performance, poor operator technique, inconsistent application of method protocols, laboratory environment, time between analyses, or by a difficult, heterogeneous sample matrix. Precision is especially important when the action limit approaches the quantitation limit. At least 5% of the samples are collected in duplicate. The laboratory performs duplicate analyses on at least 10% of the samples received.

Precision is expressed in terms of the relative percent difference as follows:

$$\mathrm{RPD} = \frac{|x - y|}{\left(\frac{x + y}{2}\right)} \times 100,$$

where x is the original sample result and y is the duplicate sample result. When one result of a duplicate pair is below the MDL, the ssEQL is used for that result in the calculation. When both results are below the MDL, the RPD cannot be calculated.

The RPD should be less than 20% for water samples and less than 35% for soil samples when results are above the ssEQL. In the case where results are between the ssEQL and the MDL, the RPD should be less than 100% for water samples and less than 200% for soil samples.

The RPDs for the laboratory and field duplicates are listed in the following tables. The frequency out of range is the number of duplicates that had RPDs greater than the acceptance limit compared to the total number analyzed; the other columns provide the mean RPD, standard deviation, and the minimum and maximum RPDs.

Table 3.8 Relative Percent Differences of Field Duplicates for Water Samples by EP

Quarter	Analyte	Frequency Out of Range	Mean RPD (%)	Std. Dev.	Minimum RPD (%)	Maximum RPD (%)
Radionuclides						
1Q97	Tritium	0/3	6.64	0.567	6.23	7.29
3Q97	Tritium	0/2	3.82	3.62	1.26	6.38

3.5.2 Accuracy

Accuracy is defined as the closeness of agreement between an observed value and an accepted reference value. Accuracy is especially important when the concentration of concern approaches the quantitation limit and/or the action limit. When the concentration is underestimated near the quantitation limit, the analyte may be present but reported as not detected. When the concentration is underestimated near the action limit, the analyte may be at a concentration that would require remediation, but the remediation would not be performed. When the concentration is overestimated near the quantitation limit, the analyte may not be present but reported as detected. When the concentration is overestimated near the action limit, the analyte may not be at a concentration that would require remediation, but the remediation would be performed. The sample types used to evaluate accuracy are performance evaluation studies (see *Appendix B)*, LCS/BSs, surrogate spikes, and matrix spikes.

Laboratory Control Samples

LCSs monitor the performance of all steps in the analysis process, including sample preparation, and are used to identify problems with the analytical procedure. LCSs for inorganic analyses are DI water that is spiked with the target analyte, digested, and analyzed with the regular samples. LCSs for organic analyses are DI water that is spiked with selected target analytes, extracted, and analyzed with the regular samples. The LCS spiking solutions or solid LCSs are obtained from EPA or a third-party supplier or are prepared in the laboratory from chemicals from a different source than the calibration standards. The QC limits for radionuclide LCS are 80-120%.

The following table lists the statistical information for the percent recovery for LCSs by analyte. The frequency out of range is the number of LCSs that had percent recoveries outside the acceptance limits compared to the total number analyzed; the other columns provide the mean percent recovery, standard deviation, and the minimum and maximum percent recoveries.

The percent recovery is calculated as

$$\%R = \frac{SR}{SA} \times 100,$$

where %R = percent recovery

SR = LCS sample result

SA = spike-added result

Table 3.9 Laboratory Control Sample Recoveries for Tritium in Water Samples

Laboratory	Quarter	Frequency Out of Range	Mean Recovery (%)	Std. Dev.	Minimum Recovery (%)	Maximum Recovery (%)
Radionuclides						
EP	1Q97	0/5	98.3	4.76	93.2	103
EP	3Q97	1/6	92.7	8.27	77.2	99.9
EM	3Q97	0/2	94.9	0.636	94.4	95.3

Matrix Spikes

Matrix spikes are used to evaluate the effect of the sample matrix on the analytical procedure. Matrix spikes for at least 5% of the samples are prepared by adding a known quantity of the target analyte to the samples prior to sample preparation. All target analytes are spiked for the inorganic analyses. Selected target analytes are used in the spiking solution for the organic analyses. Results from the matrix spikes are used to evaluate the extent of matrix interference.

The QC limits for matrix spikes are the same as those for LCSs except for inorganics, which have limits of 75–125%. Matrix spikes are rejected if the concentration of the analyte in the sample is more than four times the amount of the spike.

The following tables list the percent recovery for the matrix spikes. The frequency out of range is the number of matrix spikes that had percent recoveries outside the acceptance limits compared to the total number analyzed; the other columns provide the mean percent recovery, standard deviation, and the minimum and maximum percent recoveries.

Table 3.10 Matrix Spike Recoveries for Tritium in Water Samples

Laboratory	Quarter	Frequency Out of Range	Mean Recovery (%)	Std. Dev.	Minimum Recovery (%)	Maximum Recovery (%)
EP	1Q97	0/1	91.7	–	91.7	91.7
EP	3Q97	0/3	94.8	1.85	93.6	96.9
EM	3Q97	0/1	97	–	96.96	96.96

3.5.3 Contamination in Quality Control Samples

Field Blanks

Field blanks are used to identify possible sources of contamination from the processing and shipping of samples. Field blanks consist of DI water or dry quartz sand sealed in sample bottles prior to sampling, opened in the field during sampling, resealed, and shipped to the laboratory with the samples. Positive results from field blanks can result from contaminated sample bottles, contaminated DI water or quartz sand, vapors in the air during sampling, contamination during shipping or analysis, or analytical bias. The results from all samples in the sample delivery group are evaluated to determine the cause of the contamination and the corrective action to be taken.

No field blanks were associated with this project.

Method Blanks

Method blanks are used to determine the existence and magnitude of contamination resulting from the analytical process. Method blanks are analyte-free matrices (DI water for aqueous samples and sodium sulfate for solid samples) that are prepared in the same manner and at the same time as the samples. When method blanks have detectable concentrations of analytes, the laboratory must determine the cause and take corrective action to eliminate the contamination.

The following tables list the statistical information for the method blanks. The frequency detected column gives the number of method blanks analyzed for each analyte that had detectable concentrations compared to the total number analyzed. The other columns list the mean result, standard deviation, minimum and maximum results, and reporting unit. When the the analyte is not detected, the mean and minimum and maximum results are the ssEQLs for the method blanks.

Table 3.11 Frequency of Detection in Method Blanks for Water Samples by EP

Analyte	Quarter	Frequency Detected	Mean Result	Std. Dev.	Min./Max. Result	Unit
Tritium	1Q97	0/5	0.0012	0.095	-0.125/0.131	pCi/mL
Tritium	3Q97	0/6	-0.0652	0.167	-0.267/0.216	pCi/mL

Table 3.12 Frequency of Detection in Method Blanks for Water Samples by EM

Analyte	Quarter	Frequency Detected	Mean Result	Std. Dev.	Min./Max. Result	Unit
Tritium	1Q97	0/2	0	0.566	-0.4/0.4	pCi/mL
Tritium	3Q97	0/2	-0.0005	0.216	-0.153/0.152	pCi/mL

Trip Blanks

Trip blanks are used to detect contamination by volatile substances during shipping, primarily due to the breaking of the seal on the vial caused by depressurization during air transport. Trip blanks are analyzed for VOAs only. Trip blanks are prepared by the EPD/EMS laboratory for groundwater studies and by the analytical laboratory for other studies. If prepared by the analytical laboratory, trip blanks are shipped to EPD/EMS with the sample containers. The blanks are prepared by adding preservative to a 40-mL vial, filling it completely with DI water (no air bubbles), and sealing the top with a Teflon-lined septum cap. If a trip blank is found to be contaminated, the results from all samples shipped in the same cooler are evaluated to determine the extent of the contamination and the corrective action to be taken.

No trip blanks were associated with this project.

Rinsates

Rinsates are used to determine if sampling equipment that has been cleaned in the field is contaminated. Prior to sampling, DI water is poured over or pumped through portions of the sampling equipment that come in contact with the sample. If the rinsate is contaminated, the field cleaning procedure must be evaluated to determine the cause of the contamination. Results for all samples collected with equipment cleaned in the field must be evaluated to determine if the contamination is isolated or generalized.

No rinsates were associated with this project.

3.5.4 Comparability

The comparability of the data from the laboratories is based on the results of the split samples. For at least 10% of the sample locations, a split sample is collected and sent to the designated QC laboratory. The following table lists the RPDs, sample IDs, results that are greater than the quantitation limit for each analyte, and reporting units.

Table 3.13 Split Sample Results for Water Samples

Quarter	RPD	EP Sample ID	EP Result	EM Sample ID	EM Result	Unit
1Q97	21.4	110522	202	110523	163	pCi/mL
1Q97	13.8	110558	101	110559	116	pCi/mL
3Q97	0.244	111700	41	111701	40.9	pCi/mL
3Q97	4.29	111721	114	111722	119	pCi/mL
3Q97	1.03	111735	1940	111763	1960	pCi/mL

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4.0 References

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Appendix A: Analytical Methods and Quantitation Limits

In the following table of radiological analytical methods and quantitation limits, the mean minimum detectable activity (MDA) column reports the minimum activity for each radionuclide/method combination that was reported by each laboratory for this project. Only environmental sample records were used to develop the mean for the primary laboratory (GE, using method EPA906.0); field and laboratory QC samples were not used. Split sample records (only) were used to develop the mean for the QC laboratory (EM, using method).

Table A.1 Analytical Methods and Mean Quantitation Limits

Analyte	Method	Unit	Mean MDA
Tritium	EPA906.0	pCi/mL	5.78
Tritium	WSRC3Q161410	pCi/mL	1.50

Appendix B: Laboratory Performance Evaluation Results

This appendix contains recent performance evaluation results for the laboratories that report data for soils and groundwater samples. Not all laboratories report data for each project.

B.1 EPA Performance Evaluation Study Results

EPA conducts the water pollution (WP) and water supply (WS) performance evaluation studies biannually to certify laboratories for specific analyses. EPA's Environmental Monitoring Systems Laboratory (EMSL) of Cincinnati, OH, distributes water samples spiked with known concentrations of constituents found in polluted waters and potable water and submits them to laboratories seeking certification to analyze wastewater and potable water. EMSL evaluates the results, using limits statistically based on the performance of approximately 100 top-rated laboratories that analyze each constituent by the same procedure as the laboratory being evaluated.

All laboratories reported results for WP036, and EMAX, QST, and Recra reported results for WP037.

For study WP036, the results from EMAX were outside the acceptance limits for chloride, potassium, and sodium. The results for dibromochloro-methane and nonfilterable residue were acceptable but near the acceptance limits; EMAX was instructed to check for error. The results from GE were outside the acceptance limits for fluoride, magnesium, potassium, and total phosphorus. In addition, the results for benzene and methylene chloride were acceptable but near the acceptance limits; GE was instructed to check for error. The results from QST were outside the acceptance limits for chloroform and methylene chloride. In addition, the results for 5-day biochemical oxygen demand, bromodichloromethane, 1,3-dichlorobenzene, and tetrachloroethylene were acceptable but near the acceptance limits; QST was instructed to check for error. The results from Recra for all analytes were within acceptance limits.

For study WP037, the results for EMAX were outside the acceptance limits for fluoride, total phosphorus, and total phenolics. The results for QST were outside the acceptance limits for total beryllium, and total phenolics. The result for carbonaceous biochemical oxygen demand was acceptable but near the acceptance limits; QST was instructed to check for error. The results for Recra were outside the acceptance limits for calcium, total organic carbon, and nonfilterable residue. The results for magnesium and sodium were acceptable but near the acceptance limits; Recra was instructed to check for error.

EMAX and QST reported results for WS037, and EMAX, GE, and QST reported results for WS038.

For WS037, the results for EMAX were outside the acceptance limits for dieldrin, endrin, nitrite, orthophosphate, propachlor, total organic carbon, toxaphene, and trifluralin. The results for QST were outside the acceptance limits for 2,4-D, hardness, nitrate, pentachlorophenol, total organic carbon, and 2,4,5-TP (Silvex).

For WS038, the results for EMAX were outside the acceptance limits for 2,4-D, propachlor, tetrachloroethylene, and total organic carbon. The results for GE were outside the acceptance limits for dicamba and zinc. The results for QST were outside the acceptance limits for 2,4-D, cis-1,2-dichloroethylene, and orthophosphate.

B.2 EMS Quality Control Standards Results

During second quarter 1997, EPD/EMS conducted quality assessments of the laboratories. Each laboratory received a set of certified environmental quality control standards from Environmental Resource Associates (ERA) of Arvada, CO (lot numbers 573, 3218, 3418, 8915, and 9973). Each laboratory's results were compared with the ERA-certified values and performance acceptance limits (PALs). The PALs are listed as guidelines for acceptable analytical results given the limitations of the EPA methods used to determine these parameters. The PALs closely approximate the 95% confidence interval.

Of the 100 analyses reported by GE, 96 (or 96%), were within the PALs. Of 99 analyses reported by Recra, 94 (or 95%), were within the PALs. Of the 100 analyses reported by QST, 97 (or 97%) were within the PALs. Of the 98 analyses reported by EMAX, 91 (or 93%) were within the PALs.

B.3 Mixed Analyte Performance Evaluation Program

The Department of Energy mixed analyte performance evaluation program provides proficiency samples containing metals, pesticides, and radionuclides. The results from the June 1996 MAPEP-96-S3 study were reported in December 1996. GE and Recra reported only chemical analyses, and EP and TNU reported only radionuclide analyes.

For GE, copper was not acceptable and nickel was reported at 23.4 mg/kg although it was not included in the original sample. Five of the eight pesticides had a negative bias and were not acceptable; 4,4′-DDE and methoxychlor were not reported. For Recra, all the metals were within the acceptance limits. Four of the eight pesticides were not acceptable, three were acceptable, and methoxychlor was not reported.

For Environmental Physics, Inc. (EP), all eight radionuclides were acceptable, but plutonium-238 was close to the upper acceptance limit and given a warning flag. For Thermo NUtech (TNU), seven of eight radionuclides were within the acceptance limits; however the result for strontium-90 was not acceptable. The results for EP and TNU are reported in table B.1.

The results for MAPEP-96-W4 were reported in April 1997. For QST, the results for 4-methylphenol and phenol were outside the acceptance limits.

Table B.1 Mixed Analyte Performance Evaluation Program Results for MAPEP-96-S3 for EP and TNU

Analyte	EP Result	TNU Result	Reference Value	Acceptance Limits
Radionuclides (Bq/kg)				
Americium-241	29.0	28.7	28.7	20.09–37.31
Cesium-137	1770	1359	1531	1071.7–1990.3
Cobalt-60	931	727	812	568.4–1055.6
Plutonium-238	***20.5***[a]	17.3	15.9	11.13–20.67
Plutonium-239/240	22.6	18.9	19.7	13.79–25.61
Strontium-90	540	**347**[b]	536.0	375.2–696.8
Uranium-233/234	56.6	59.7	63.9	44.73–83.07
Uranium-238	52.9	59.7	64.0	44.80–83.20

B.4 EPA Radiological Performance Evaluation Studies

EP and QR participated in the EPA radiological performance evaluation studies administered by the Characterization Research Division-Las Vegas. The studies included in this order are the following:

- Tritium in Water, August 9, 1996
- Blind-A, October 15, 1996
- Blind B, October 15, 1996
- Gamma in Water, November 8, 1996
- Strontium in Water, January 17, 1997
- Gross Alpha-Beta in Water, January 31, 1997
- Iodine in Water, February 7, 1997
- Uranium-Radium in Water, February 14, 1997

For tritium in water (8/9/96), the results were 9,613 pCi/L for EP and 10,707 pCi/L for QR. The EPA reference value was 10,879 pCi/L and the acceptance limits were 8,991–12,767 pCi/L.

For iodine in water (2/7/97), both EP and QR reported results of 88.00 pCi/L. The EPA reference value was 86.0 pCi/L and the acceptance limits were 70.4–101.6 pCi/L.

In the following tables, all results are reported in pCi/L.

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[a] In cases where a warning was given, the reported values appear in ***bold italic***.

[b] Reported values that were outside the acceptance limits appear in **bold**.

Table B.2 Blind-A Results for EP and QR (10/15/96)

Analyte	EP Result	QR Result	Reference Value	Acceptance Limits
Gross Alpha	65.27	48.87	59.1	33.4–84.8
Radium-226	9.40	9.60	9.9	7.3–12.5
Radium-228	4.67	4.57	5.1	2.8–7.4
Uranium (natural)	37.33	40.10	40.9	33.8–48.0

Table B.3 Blind-B Results for EP and QR (10/15/96)

Analyte	EP Result	QR Result	Reference Value	Acceptance Limits
Cesium-134	18.00	18.00	20.0	11.3–28.7
Cesium-137	31.33	30.67	30.0	21.3–38.7
Cobalt-60	15.33	15.33	15.0	6.3–23.7
Gross Beta	**43.43**[c]	119.67	111.8	82.7–140.9
Strontium-89	11.67	16.67	10.0	1.3–18.7
Strontium-90	24.67	21.33	25.0	16.3–33.7

Table B.4 Gamma in Water Results for EP and QR (11/8/96)

Analyte	EP Result	QR Result	Reference Value	Acceptance Limits
Cobalt-60	45.67	43.33	44.0	35.3–52.7
Zinc-65	39.33	36.67	35.0	26.3–43.7
Cesium-134	10.67	9.33	11.0	2.3–19.7
Cesium-137	22.67	20.33	19.0	10.3–27.7
Barium-133	64.67	61.00	64.0	53.6–74.4

Table B.5 Strontium in Water Results for EP and QR (1/17/97)

Analyte	EP Result	QR Result	Reference Value	Acceptance Limits
Strontium-89	8.67	11.00	12.0	3.3–20.7
Strontium-90	26.33	24.33	25.0	16.3–33.7

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[c] Reported values that were out of range appear in **bold**.

Table B.6 Gross Alpha-Beta in Water Results for EP and QR (1/31/97)

Analyte	EP Result	QR Result	Reference Value	Acceptance Limits
Gross alpha	4.83	4.60	5.2	0.0–13.9
Gross beta	14.23	17.40	14.7	6.0–23.4

Table B.7 Uranium-Radium in Water Results for EP and QR (2/14/97)

Analyte	EP Result	QR Result	Reference Value	Acceptance Limits
Radium-226	5.17	5.90	5.9	4.3–7.5
Radium-228	7.30	8.33	8.2	4.6–11.8
Uranium (natural)	32.07	27.8	27.0	21.8–32.2

Appendix C: Formats of the Data Files

The formats presented in this appendix have been established by WSRC-EPD/EMS. When entering data in any of the formats, the following conventions are to be used:

- Alpha and alphanumeric entries must be left justified in the records.
- Numeric entries must be right justified in the records.
- There will be no leading zeros except in dates and times.

Table C.1 describes the sample data format, SAM93, which is used for coding and transmitting sampling data records.

Table C.1 Sample Data Format SAM93

Name	Columns	Type	Description
Record format	1–8	Alphanumeric	SAM93 (the format of the data record)
Sample identification number	9–14	Integer	Number of the sample printed on the page of the sample logbook
Sample collection date	15–20	Numeric	Sample collection date recorded using the MMDDYY format
Sample collection time	21–24	Integer	Sample collection time recorded as military time
Sample type	25	Numeric	Sample type coded as 1 = normal 2 = trip blank 3 = field blank 4 = split 5 = rinsate 6 = duplicate 7 = other
Sample matrix	26	Numeric	Sample matrix coded as 1 = soil 2 = rock 3 = sludge 4 = water 5 = sediment 6 = other
Delay check	27	Alpha	Enter a *Y* if there was an unusual delay in bottling samples
Sampler's initials	28–30	Alpha	Sampler's initials
Associated sample	31–36	Integer	Sample identification of associated sample if this sample is a duplicate, split, rinsate, etc.

Table C.1 Sample Data Format SAM93 (cont.)

Name	**Columns**	**Type**	**Description**
Planned sample name	37–46	Alphanumeric	Identification of the sample as it appears in the site work plan
Sample name	47–56	Alphanumeric	Identification of the actual sample (includes any modification made in the field)
Planned top of interval	57–62	Numeric	Depth from the ground to the top of the planned sampling interval to the nearest 0.01 ft
Top of interval	63–68	Numeric	Depth from the ground to the top of the actual sampling interval to the nearest 0.01 ft
Planned bottom of interval	69–74	Numeric	Depth from the ground to the bottom of the planned sampling interval to the nearest 0.01 ft
Bottom of interval	75–80	Numeric	Depth from the ground to the bottom of the actual sampling interval to the nearest 0.01 ft
Soil moisture[a]	81	Numeric	Soil moisture coded as 1 = dry 2 = damp 3 = wet 4 = sludge 5 = liquid
Munsell color[a]	82–91	Alphanumeric	Munsell color
Soil classification[a]	92–93	Alphanumeric	Unified Soil Classification
Number of bottles	94–96	Integer	Number of bottle label numbers used during collection
Insufficient recovery check	97	Alpha	Enter an *R* if insufficient material was recovered to perform all analyses
Improper procedure check	98	Alpha	Enter a *P* if an improper sampling procedure was followed

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[a] No datum is reported for this field.

Table C.2 is a description of the sample bottle data format, SAM93A, which is used for coding and transmitting sample bottle data records.

Table C.2 Sample Bottle Data Format SAM93A

Name	Columns	Type	Description
Record format	1–8	Alphanumeric	SAM93A (the format of the data record)
Sample identification number	9–14	Integer	Number of the sample printed on the page of the sample logbook
Bottle label number	15–23	Integer	Number of the bottle label attached to the bottle

Table C.3 is a description of the survey station data format, STA93, which is used for coding and transmitting station data records.

Table C.3 Survey Station Data Format STA93

Name	Columns	Type	Description
Record format	1–8	Alphanumeric	STA93 (the format of the data record)
Station	9–18	Alphanumeric	Identification of the station (the facility identification and sampling point)
SRS north coordinate	20–27	Numeric	SRS grid north coordinate of the station reported in feet
SRS east coordinate	29–36	Numeric	SRS grid east coordinate of the station reported in feet
Ground elevation	43–48	Numeric	Ground elevation reported in feet above median sea level

Table C.4 is a description of the chain-of-custody data format, COC93, which is used for coding and transmitting chain-of-custody data records.

Table C.4 Chain-of-Custody Data Format COC93

Name	Columns	Type	Description
Record format	1–8	Alphanumeric	COC93 (the format of the data record)
Sample identification number	9–18	Integer	Number of the sample printed on the page of the sample logbook
Laboratory sample identification	19–33	Alphanumeric	Identifier used for the sample by the analytical laboratory
Sample collection date	34–39	Numeric	Sample collection date recorded using the MMDDYY format
Shipping date	40–45	Numeric	Sample shipping date recorded using the MMDDYY format
Cooler identification	46–53	Alphanumeric	Number assigned to the cooler in which the samples are shipped to the analytical laboratory
Sample temperature upon receipt	54–57	Numeric	Temperature of the samples upon receipt at the analytical laboratory in °C

Table C.5 is a description of the analytical data format, AN95, which is used for coding and transmitting analytical data records.

Table C.5 Analytical Data Format AN95

Name	Columns	Type	Description
WSRC identifier[b]	1–12	Alphanumeric	WSRC identifier for the sample
COC number	13–17	Alphanumeric	Identifier of the sample's chain-of-custody form (Required field for groundwater samples; not used for soil samples)
Sample collection date[b]	18–23	Numeric	Date the sample was collected. Enter the preparation date for laboratory blanks and QC samples; enter the date of completion of TCLP sample generation for TCLP samples
Sample collection time	24–27	Numeric	Time of sample collection or generation
Lab receipt date[b]	28–33	Numeric	Date the sample was received by the laboratory; blank for laboratory blanks and QC samples
Extraction date	34–39	Numeric	Date the sample was extracted; blank unless the holding time is dependent upon the extraction time

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[b] This field must have an entry for every record.

Table C.5 Analytical Data Format AN95 (cont.)

Name	Columns	Type	Description
Extraction time	40–43	Numeric	Time the sample extraction was started; blank unless the holding time is dependent upon the extraction time
Extraction/digestion method	44–56	Alphanumeric	Coded identifier for the method used to perform the extraction or digestion (e.g., EPA###.#)
Analysis date[a]	57–62	Numeric	Date the analyte concentration was determined
Analysis time[a]	63–66	Numeric	Time the analyte concentration was determined
Analytical method[a]	67–79	Alphanumeric	Coded identifier for the method used to perform the analysis (e.g., EPA###.#)
Preparation batch	80–87	Alphanumeric	Identification of the sample preparation batch
Laboratory[a]	88–89	Alphanumeric	Code assigned by EPD/EMS to identify the laboratory performing the analysis
Laboratory sample identification[a]	90–104	Alphanumeric	Identifier used for the sample by the analytical laboratory
Laboratory replicate	105–107	Alphanumeric	Indicates that the sample is a non-blind replicate analysis (see table C.8)
Analyte[a]	108–117	Alphanumeric	EPD/EMS identifier for the analyte
Quantitation limit	118–125	Numeric	GE and WA report the ssEQL for non-radiochemistry analyses; all labs report the MDA for radiochemistry analyses
Result qualifier	126–128	Alphanumeric	Coded field used to qualify the analytical result (see table D.1)
Analysis qualifier	129–131	Alphanumeric	Coded field used to qualify the analytical result (see table D.2)
Bias of analysis	132	Alphanumeric	Coded field for specifying the expected bias (see table D.3)
Analytical result	133–142	Numeric	Concentration of the analyte. For non-detects, the ssEQL is reported. Results are reported on a dry weight basis for all analyses reported in per mass units
Result unit[a]	143–146	Alpha	Unit in which the analytical result is expressed
Accuracy	147–154	Numeric	Statistically determined value, 95% confidence level, representing a plus or minus value for the result and reported in the same units as the analytical result. Required for all radiochemical analyses above the detection limit, but not generally reported for non-radiochemical analyses. Do not report more figures than are significant

Table C.5 Analytical Data Format AN95 (cont.)

Name	Columns	Type	Description
Residual weight	155–160	Numeric	Weight of material in milligrams on the planchet after evaporation; used for radionuclide determinations
Nominal concentration[a]	161–168	Numeric	Concentration of analyte added to the sample prior to analysis; reported in the same units as the analytical result. Zero must be entered if the sample was not spiked
Percent recovery	169–174	Numeric	Recovery of the spiked constituent reported as a percentage
Number of dilutions[a]	175	Numeric	Number of steps required to reach the final dilution factor. Zero must be entered if the sample was not diluted
Dilution factor[a]	176–181	Numeric	Dilution used in the analysis; a value of one indicates the sample was not diluted
Instrument[a]	182–189	Alphanumeric	Coded identifier for the instrument used to perform the analysis; each laboratory develops its own codes and provides them to EPD/EMS
Instrument batch[a]	190–197	Alphanumeric	Number assigned by the analytical laboratory to the analysis batch (group of samples analyzed together in a single instrument run along with the associated QC samples)
Analyst's initials[a]	198–200	Alpha	Initials of the analyst
Percent solids	201–205	Numeric	Percentage of the sample that is dry solids; required field if result is reported in per mass units; not applicable for water samples
Bottle label number	206–215	Integer	Number on the bottle label; required field if bottle label is numbered
Sample fraction	216–219	Alphanumeric	EPD/EMS identifier for the fraction of the sample analyzed (see table C.9)
Validation status	220–221	Alphanumeric	0 = Unvalidated (used by laboratory) 3 = Validated definitive data
EPD/EMS receipt date	222–227	Numeric	Date that the analytical data are received by EPD/EMS from the laboratory. The laboratory leaves this blank
ESH-EMS number	228–234	Alphanumeric	Document number assigned to the project report

Table C.6 is a description of the analytical data format, AN95–R1.B which is used for coding and transmitting a subset of the AN95 analytical data records.

Table C.6 Analytical Data Format AN95–R1.B

Name	Columns	Type	Description
WSRC identifier	1–12	Numeric	WSRC identifier for the sample
Station identifier	13–23	Alphanumeric	Identification of the actual sample (includes any modification made in the field)
Top of interval	24–29	Numeric	Depth from the ground to the top of the actual sampling interval to the nearest 0.01 ft
Bottom of interval	30–35	Numeric	Depth from the ground to the bottom of the actual sampling interval to the nearest 0.01 ft
Sample collection date	36–42	Numeric	Date sample was collected. Enter the preparation date for laboratory blanks and QC samples; enter the date of completion of TCLP sample generation for TCLP samples
Laboratory replicate	43–45	Alphanumeric	Indicates that the sample is a non-blind replicate analysis (see table C.8)
Analyte name	46–95	Alphanumeric	Full analyte name
Analytical method	96–108	Alphanumeric	Coded identifier for the method used to perform the analysis (e.g., EPA###.#)
Quantitation limit	109–116	Numeric	GE and WA report the ssEQL for non-radiochemistry analyses; all labs report the MDA for radiochemistry analyses
Result qualifier	117–119	Alphanumeric	Coded field used to qualify the analytical result (see table D.1)
Result	120–129	Numeric	Concentration of the analyte. For non-detects, the ssEQL is reported. Results were reported on a dry weight basis for all analyses reported in per mass units
Analysis qualifier	130–132	Alphanumeric	Coded field used to qualify the analytical result (see table D.2)
Bias of analysis	133–134	Alpha	Coded field for specifying the expected bias (see table D.3)
Result unit	135–140	Alpha	Unit in which the analytical result is reported
Validation status	141–142	Alphanumeric	0 = Unvalidated (used by laboratory) 3 = Validated definitive data
ESH-EMS document number	143–149	Alphanumeric	Document number assigned to the project report

Table C.7 is a description of the analytical data format, AN95–R2.B which is used for coding and transmitting a subset of the AN95 analytical data records.

Table C.7 Analytical Data Format AN95–R2.B

Name	Columns	Type	Description
Station identifier	1–11	Alphanumeric	Identification of the actual sample (includes any modification made in the field)
Top of interval	12–17	Numeric	Depth from the ground to the top of the actual sampling interval to the nearest 0.01 ft
Bottom of interval	18–23	Numeric	Depth from the ground to the bottom of the actual sampling interval to the nearest 0.01 ft
Sample collection date	24–30	Numeric	Date sample was collected. Enter the preparation date for laboratory blanks and QC samples; enter the date of completion of TCLP sample generation for TCLP samples
Laboratory replicate	31–43	Alphanumeric	Indicates that the sample is a non-blind replicate analysis (see table C.8)
Analyte name	44–83	Alphanumeric	Full analyte name
Analysis type	84–93	Alphanumeric	Analytical suite
Quantitation limit	95–102	Numeric	GE and WA report the ssEQL for non-radiochemistry analyses; all labs report the MDA for radiochemistry analyses
Result qualifier	103–105	Alphanumeric	Coded field used to qualify the analytical result (see table D.1)
Result	106–115	Numeric	Concentration of the analyte. For non-detects, the ssEQL is reported. Results are reported on a dry weight basis for all analyses reported in per mass units
Result unit	116–121	Alpha	Unit in which the analytical result is reported
Validation status	122–123	Alphanumeric	0 = Unvalidated (used by laboratory) 3 = Validated definitive data
ESH-EMS document number	124–130	Alphanumeric	Document number assigned to the project report

When making entries in the laboratory replicate field of the data files, only the codes listed in table C.8 are used.

Table C.8 Codes for Laboratory Replicates

Remark	**Definition**
(blank)	Data not remarked; the result is a routine analysis of a sample
1	Laboratory replicate
2A	Matrix spike
2B	Matrix spike duplicate
2C	Surrogate spike
2D	Blank spike
2E	Blank spike duplicate
3	Laboratory blank
4	Re-analysis of a sample at the request of EPD/EMS
CCB	Continuing calibration blank
CCV	Continuing calibration verification sample
ICB	Initial calibration blank
ICS	Interference check sample
ICV	Initial calibration verification sample

When making entries in the sample fraction field of the data files, only the codes listed in table C.9 are used.

Table C.9 Codes for Fractions

Code	**Description**
(blank)	Sample was not fractionated prior to analysis
A	Ashed fraction
D	Dried fraction of a soil or sludge sample; not used with water samples
F	Liquid fraction passing through a filter was analyzed
SL	Liquid fraction of a sample separated from the solid fraction
SS	Suspended soils
T	TCLP extraction

When entering the identifiers for groundwater samples, the format listed in table C.10 is used for the WSRC identifier entered in the AN95 data file.

Table C.10 WSRC Identifier for Groundwater Samples

Name	Columns	Type	Description
Well name			
Series name	1–3	Alpha	Name of the well series (except 241-H) from which the sample was collected; QC laboratory deionized water samples have LB (the first character is blank) as well series designation
Cluster number	4–6	Numeric	Number of the cluster (except 241-H)
Well within cluster	7–8	Alphanumeric	Blank, if not applicable
	9–10	Blank	Unused
Duplicate identification	11	Alphanumeric	Assigned by field personnel to identify different sampling events occurring in one day
Secondary identifier	12	Alphanumeric	Used as an alternate identifier by the Groundwater Monitoring group of EPD/EMS

Appendix D: Data Tables

D.1 Qualifiers

The following qualifiers were applied to the analytical results during data validation.

Table D.1 Result Qualifiers

Qualifier	Description
(blank)	Data are not remarked. Value should be interpreted exactly as reported.
C[a]	Calculated. Analytical result reported was not measured directly but was calculated from other data available. This does not apply to conversions, nor does it apply to calculations made as part of an analytical procedure.
D[a]	Field measurement
I	The value in the result field is the instrument reading, not the sample quantitation limit. Always used with the result qualifier *U*.
J[b]	The analytical result is an estimated quantity.
L[a]	Off-scale high. The actual value is not known but is known to be greater than value shown.
R[a]	Result was rejected because performance requirements in the sample or associated quality control analysis were not met. The analyte may or may not be present.
U[b]	Material analyzed for but not detected. The analyte concentration is less than the ssEQL. NOTE: When both the result qualifier *U* and the result qualifier *I* are reported, the numerical value in the result field is the instrument reading rather than the ssEQL.

Table D.2 Analysis Qualifiers

Qualifier	Description
A	**GC/MS Compound Identification** Relative retention time or mass spectra criteria were not met. **Compound Identification** All anomalies
B	The result is below the sample quantitation limit and above or equal to the instrument detection limit.
C	**Laboratory Control Sample** Criteria were not met.
D	**ICP Serial Dilution** Criteria were not met.
E	The detected result is between the ssEQL and the method detection limit. Report the actual result detected.

[a] This code is based on the STORET codes from the U.S. EPA.
[b] This code is based on the CLP Laboratory Data Qualifiers from the U.S. EPA.

Table D.2 Analysis Qualifiers (cont.)

Qualifier	Description
F	**Pesticides Compound Identification** Pesticide result has been confirmed by gas chromatography/mass spectrometry.
G	**Pesticides Instrument Performance** Use for all conditions outside criteria other than those flagged *N* (see code *N* below).
H	**Internal Standards Performance** Criteria not met
I	**Matrix Spike/Matrix Spike Duplicate** **Matrix Spike Sample Analysis** Spike recovery was not within control limits.
K	**Tentatively Identified Compounds** A tentatively identified compound is a suspected aldol-condensation product.
L	**Calibration Criteria Not Met** Calibration criteria (initial or continuing) were not met. See also *Z* for inorganics.
M	**GC/MS Tuning** Mass calibration criteria not met.
N	**Tentatively Identified Compounds** All TIC results
O	**Surrogate Recovery** Surrogate spike recovery results are not within control limits.
P	**Furnace Atomic Absorption QC** Duplicate injection precision criteria were not met, or post-digestion spike recovery was not within control limits, but sample absorbance is greater than 50% of post-digestion spike absorbance.
Q	**Holding Time** Sample held beyond normal holding time.
R	**ICP Interference Check Sample** Criteria not met
S	The reported value was determined by the method of standard additions.
V	**Method Blank Contamination** Indicates the analyte was detected in both the sample and associated method blank.
W	**Furnace Atomic Absorption QC** Post-digestion spike recovery for furnace atomic absorption analysis is not within control limits while sample absorbance is less than 50% of spike absorbance.
X	**Matrix Spike/Matrix Spike Duplicates** **Laboratory Duplicate Sample Analysis** Duplicate analysis relative percent difference is not within control limits.
Y	Result obtained from unpreserved or improperly preserved sample.
Z	**Calibration** **Furnace Atomic Absorption QC** Correlation coefficient was less than 0.995.
4	Matrix interference; value cannot be determined.
5	The analytical value was four times higher than the standard concentration, and percent recovery cannot be determined.

Table D.2 Analysis Qualifiers (cont.)

Qualifier	Description
6	The analyte was detected in both the sample and associated field blank.
7	The analyte was detected in both the sample and associated rinsate or equipment blank.
8	The analyte was detected in both the sample and associated trip blank.
9	**Field Duplicate Sample Analysis** Duplicate analysis relative percent difference is not within control limits.

Table D.3 Bias Qualifiers

Qualifier	Description
L	Analytical factor causing bias. The associated result may underestimate the true value.
H	Analytical factor causing bias. The associated result may overestimate the true value.

D.2 Number of Qualified Samples

Tables D.4 and D.5 present the samples requested, received, and qualified for each analyte. Analytical results for both the primary laboratory and the laboratory receiving QC samples are included in the tables. Surrogates, matrix spikes, and other laboratory QC results are not included in the tables.

- The **Samples Requested** column contains the number of times the laboratory received a COC form and its associated sample (environmental samples, field-generated duplicates, field blanks, and trip blanks) requesting that a particular analysis be performed.
- The **Samples Received** column contains the total number of samples for which at least one analytical record was reported. Missing analyses are discussed in section 2.3.1, *Missing Data,* of this report.
- The **Analyses Reported** column contains the total number of reported results for the analyte. This number includes laboratory-initiated duplicate analyses and re-analysis results; it does not include analyses of associated laboratory blanks.

The remaining columns in the tables list the number of analyses that were qualified for meeting specified conditions.

- The column labeled **Records Rejected** contains the number of records for which the RQ was *R*. Samples having a rejected result also may have an acceptables reanalysis result.
- The column labeled **Out of Holding** contains the number of records for which the time between sample collection and analysis exceeded the maximum allowed by the analytical method. These records have an AQ of *Q*. All laboratory pH measurements exceed holding time, regardless of the laboratory's efficiency.
- The column labeled **QC Problems** contains the number of records having an AQ of *C*, *H*, *I*, *O*, *V*, or *X* because at least one associated laboratory QC sample did not meet the required standards.
- The column labeled **Preservation** contains the number of records with preservation problems. These records have an AQ of *Y*.
- The column labeled **Calibration** contains the number of records with identified calibration problems. These records have an AQ of *L*.

Table D.4 Number of Qualified Samples for FHST3

Analyte	Samples Requested	Samples Received	Analyses Reported	Records Rejected[a]	Out of Holding[b]	QC Problems[c]	Preservation[d]	Calibration[e]
Radionuclides								
Tritium	65	65	68	0	0	3	0	0

Table D.5 Number of Qualified Samples for FHST4

Analyte	Samples Requested	Samples Received	Analyses Reported	Records Rejected	Out of Holding	QC Problems	Preservation	Calibration
Radionuclides								
Tritium	43	43	47	0	0	1	0	0

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[a] RQ = *R*
[b] AQ = *Q*
[c] AQ = *C, H, I, O, V, or X*
[d] AQ = *Y*
[e] AQ = *L*

The numbers of analytical records sorted by analytical method and type of record are given in tables D.6 and D.7.

Table D.6 Number of Analytical Records by Method and Type of Record for FHST3

Analytical Method	Sample Records	Laboratory Duplicates	Laboratory Blanks	Matrix Spikes	Calibration Checks	Totals
3Q161410	2	1	2	0	0	5
EPA906.0	63	2	10	2	0	77

Table D.7 Number of Analytical Records by Method and Type of Record for FHST4

Analytical Method	Sample Records	Laboratory Duplicates	Laboratory Blanks	Matrix Spikes	Calibration Checks	Totals
EPA906.0	40	2	12	2	0	56
WSRC3Q161410	3	1	4	1	0	9

Tables D.8 and D.9 list the minimum and maximum results for tritium, which was detected in all the routine environmental samples. These tables do not include field QC samples.

Table D.8 Analytes Detected in Environmental Samples for FHST3

Analyte	Average Result	Minimum/Maximum MDA	Units
Tritium	1.53E+06	6.29E+03/1.73E+07	pCi/L

Table D.9 Analytes Detected in Environmental Samples for FHST4

Analyte	Average Result	Minimum/Maximum MDA	Units
Tritium	2.57E+06	2.94E+03/2.13E+07	pCi/L

D.3 Results Sorted by Sample

Table D.10 Results Sorted by Sample for FHST3

SURVEY ID: FHB 00103 **Sample ID:** 110547

Survey location: 54075E 73758N (SRS coordinates)
Sample type: Normal Sample matrix: Water

Constituent	RQ	AQ	B	Result	Unit	ssEQL	Method
Radionuclides							
Tritium				4.19E+04±4.37E+03	pCi/L	5.62E+03	EPA906.0

SURVEY ID: FHB 00203 **Sample ID:** 110546

Survey location: 54095E 73540N (SRS coordinates)
Sample type: Normal Sample matrix: Water

Constituent	RQ	AQ	B	Result	Unit	ssEQL	Method
Radionuclides							
Tritium				1.23E+04±9.29E+02	pCi/L	9.48E+02	EPA906.0

SURVEY ID: FHB 00303 **Sample ID:** 110558

Survey location: 53712E 73236N (SRS coordinates)
Sample type: Normal Sample matrix: Water

Constituent	RQ	AQ	B	Result	Unit	ssEQL	Method
Radionuclides							
Tritium				1.01E+05±2.58E+03	pCi/L	1.26E+03	EPA906.0

SURVEY ID: FHB 00303D **Sample ID:** 110559
Sample type: Split Associated sample: 110558

Constituent	RQ	AQ	B	Result	Unit	ssEQL	Method
3Q161410							
Tritium		I		1.16E+05±3.68E+03	pCi/L	1.50E+06	3Q161410
Tritium		I		1.14E+05±3.64E+03	pCi/L	1.50E+06	3Q161410

SURVEY ID: FHB 00403 **Sample ID:** 110557

Survey location: 53741E 73029N (SRS coordinates)
Sample type: Normal Sample matrix: Water

Constituent	RQ	AQ	B	Result	Unit	ssEQL	Method
Radionuclides							
Tritium				1.58E+05±3.63E+03	pCi/L	1.62E+03	EPA906.0

SURVEY ID: FHB 00503 **Sample ID:** 110561

Survey location: 53910E 72800N (SRS coordinates)
Sample type: Normal Sample matrix: Water

Constituent	RQ	AQ	B	Result	Unit	ssEQL	Method
Radionuclides							
Tritium				4.35E+05±8.58E+03	pCi/L	1.97E+03	EPA906.0

SURVEY ID: FHB 00603 **Sample ID:** 110560

Survey location: 54129E 72672N (SRS coordinates)
Sample type: Normal Sample matrix: Water

Constituent	RQ	AQ	B	Result	Unit	ssEQL	Method
Radionuclides							
Tritium				2.13E+05±4.23E+03	pCi/L	1.08E+03	EPA906.0

SURVEY ID: FHB 00803 **Sample ID:** 110562

Survey location: 54022E 72181N (SRS coordinates)
Sample type: Normal Sample matrix: Water

Constituent	RQ	AQ	B	Result	Unit	ssEQL	Method
Radionuclides							
Tritium				1.11E+05±2.26E+03	pCi/L	8.53E+02	EPA906.0

SURVEY ID: FHB 01203 **Sample ID:** 110556

Survey location: 53878E 73424N (SRS coordinates)
Sample type: Normal Sample matrix: Water

Constituent	RQ	AQ	B	Result	Unit	ssEQL	Method
Radionuclides							
Tritium				1.73E+07±2.83E+05	pCi/L	1.09E+04	EPA906.0

SURVEY ID: FHB 01303 **Sample ID:** 110554

Survey location: 53848E 73508N (SRS coordinates)
Sample type: Normal Sample matrix: Water

Constituent	RQ	AQ	B	Result	Unit	ssEQL	Method
Radionuclides							
Tritium				3.05E+06±5.89E+04	pCi/L	6.42E+03	EPA906.0

SURVEY ID: FHB 01403 **Sample ID:** 110555

Survey location: 53728E 73561N (SRS coordinates)
Sample type: Normal Sample matrix: Water

Constituent	RQ	AQ	B	Result	Unit	ssEQL	Method
Radionuclides							
Tritium				1.95E+05±3.89E+03	pCi/L	1.02E+03	EPA906.0

SURVEY ID: FHB 01603 **Sample ID:** 110548

Survey location: 54030E 73716N (SRS coordinates)
Sample type: Normal Sample matrix: Water

Constituent	RQ	AQ	B	Result	Unit	ssEQL	Method
Radionuclides							
Tritium				8.70E+04±6.25E+03	pCi/L	7.08E+03	EPA906.0

SURVEY ID: FHB 01703 **Sample ID:** 110550

Survey location: 54000E 73668N (SRS coordinates)
Sample type: Normal Sample matrix: Water

Constituent	RQ	AQ	B	Result	Unit	ssEQL	Method
Radionuclides							
Tritium				3.47E+06±6.75E+04	pCi/L	7.40E+03	EPA906.0

SURVEY ID: FHB 01803 **Sample ID:** 110551

Survey location: 54026E 73565N (SRS coordinates)
Sample type: Normal Sample matrix: Water

Constituent	RQ	AQ	B	Result	Unit	ssEQL	Method
Radionuclides							
Tritium				1.08E+07±2.02E+05	pCi/L	1.30E+04	EPA906.0

SURVEY ID: FHB 01903 **Sample ID:** 110553

Survey location: 53895E 73485N (SRS coordinates)
Sample type: Normal Sample matrix: Water

Constituent	RQ	AQ	B	Result	Unit	ssEQL	Method
Radionuclides							
Tritium				4.96E+06±9.53E+04	pCi/L	9.88E+03	EPA906.0

SURVEY ID: FHB 02003 **Sample ID:** 110552

Survey location: 54008E 73434N (SRS coordinates)
Sample type: Normal Sample matrix: Water

Constituent	RQ	AQ	B	Result	Unit	ssEQL	Method
Radionuclides							
Tritium				1.63E+04±7.93E+02	pCi/L	6.33E+02	EPA906.0

SURVEY ID: FMC001F03 **Sample ID:** 110563

Survey location: 57050E 70350N (SRS coordinates)
Sample type: Normal Sample matrix: Water

Constituent	RQ	AQ	B	Result	Unit	ssEQL	Method
Radionuclides							
Tritium				3.29E+05±6.52E+03	pCi/L	1.37E+03	EPA906.0

SURVEY ID: FMC001H02 **Sample ID:** 110609

Survey location: 5300E 72600N (SRS coordinates)
Sample type: Normal Sample matrix: Water

Constituent	RQ	AQ	B	Result	Unit	ssEQL	Method
Radionuclides							
Tritium				9.07E+03±6.36E+02	pCi/L	6.04E+02	EPA906.0

SURVEY ID: FMC002H02 **Sample ID:** 110613

Survey location: 53000E 72600N (SRS coordinates)
Sample type: Normal Sample matrix: Water

Constituent	RQ	AQ	B	Result	Unit	ssEQL	Method
Radionuclides							
Tritium				7.80E+04±1.61E+03	pCi/L	6.51E+02	EPA906.0

SURVEY ID: FSP 4703 **Sample ID:** 110521

Survey location:
Sample type: Normal Sample matrix: Water

Constituent	RQ	AQ	B	Result	Unit	ssEQL	Method
Radionuclides							
Tritium				1.52E+04±8.02E+02	pCi/L	6.48E+02	EPA906.0

SURVEY ID: FSP 00203 **Sample ID:** 110510

Survey location: 49133E 72796N (SRS coordinates)
Sample type: Normal Sample matrix: Water

Constituent	RQ	AQ	B	Result	Unit	ssEQL	Method
Radionuclides							
Tritium				4.76E+05±9.32E+03	pCi/L	1.56E+03	EPA906.0

SURVEY ID: FSP 00703 **Sample ID:** 110511

Survey location: 49540E 73008N (SRS coordinates)
Sample type: Normal Sample matrix: Water

Constituent	RQ	AQ	B	Result	Unit	ssEQL	Method
Radionuclides							
Tritium				1.04E+06±2.04E+04	pCi/L	3.65E+03	EPA906.0

SURVEY ID: FSP 01203 **Sample ID:** 110512

Survey location: 49644E 73602N (SRS coordinates)
Sample type: Normal Sample matrix: Water

Constituent	RQ	AQ	B	Result	Unit	ssEQL	Method
Radionuclides							
Tritium				4.44E+04±1.30E+03	pCi/L	6.81E+02	EPA906.0

SURVEY ID: FSP 01403 **Sample ID:** 110513

Survey location: 49802E 73685N (SRS coordinates)
Sample type: Normal Sample matrix: Water

Constituent	RQ	AQ	B	Result	Unit	ssEQL	Method
Radionuclides							
Tritium				1.58E+04±1.34E+03	pCi/L	1.43E+03	EPA906.0
Tritium				1.65E+04±1.54E+03	pCi/L	1.70E+03	EPA906.0

SURVEY ID: FSP 01903 **Sample ID:** 110514

Survey location: 49778E 73177N (SRS coordinates)
Sample type: Normal Sample matrix: Water

Constituent	RQ	AQ	B	Result	Unit	ssEQL	Method
Radionuclides							
Tritium				4.66E+06±8.96E+04	pCi/L	8.06E+03	EPA906.0

SURVEY ID: FSP 02603 **Sample ID:** 110515

Survey location: 49801E 72932N (SRS coordinates)
Sample type: Normal Sample matrix: Water

Constituent	RQ	AQ	B	Result	Unit	ssEQL	Method
Radionuclides							
Tritium				6.77E+06±1.30E+05	pCi/L	1.00E+04	EPA906.0

SURVEY ID: FSP 03203 **Sample ID:** 110516

Survey location: 50258E 73367N (SRS coordinates)
Sample type: Normal Sample matrix: Water

Constituent	RQ	AQ	B	Result	Unit	ssEQL	Method
Radionuclides							
Tritium				7.31E+04±1.52E+03	pCi/L	5.86E+02	EPA906.0

SURVEY ID: FSP 03403 **Sample ID:** 110518

Survey location: 50261E 73156N (SRS coordinates)
Sample type: Normal Sample matrix: Water

Constituent	RQ	AQ	B	Result	Unit	ssEQL	Method
Radionuclides							
Tritium				2.18E+06±4.25E+04	pCi/L	5.41E+03	EPA906.0

SURVEY ID: FSP 03503 **Sample ID:** 110520

Survey location: 50297E 73065N (SRS coordinates)
Sample type: Normal Sample matrix: Water

Constituent	RQ	AQ	B	Result	Unit	ssEQL	Method
Radionuclides							
Tritium				5.09E+06±9.83E+04	pCi/L	8.60E+03	EPA906.0

SURVEY ID: FSP 04003 **Sample ID:** 110519

Survey location: 50630E 73101N (SRS coordinates)
Sample type: Normal Sample matrix: Water

Constituent	RQ	AQ	B	Result	Unit	ssEQL	Method
Radionuclides							
Tritium				5.67E+06±1.13E+05	pCi/L	9.76E+03	EPA906.0

SURVEY ID: FSP 05603 **Sample ID:** 110574

Survey location: 51488E 73824N (SRS coordinates)
Sample type: Normal Sample matrix: Water

Constituent	RQ	AQ	B	Result	Unit	ssEQL	Method
Radionuclides							
Tritium				6.29E+03±8.10E+02	pCi/L	1.02E+03	EPA906.0

SURVEY ID: FSP 05603A **Sample ID:** 110575
Sample type: Duplicate Associated sample: 110574

Constituent	RQ	AQ	B	Result	Unit	ssEQL	Method
Radionuclides							
Tritium				5.91E+03±5.83E+02	pCi/L	6.72E+02	EPA906.0

SURVEY ID: FSP 20403 **Sample ID:** 110509

Survey location: 48801E 73281N (SRS coordinates)
Sample type: Normal Sample matrix: Water

Constituent	RQ	AQ	B	Result	Unit	ssEQL	Method
Radionuclides							
Tritium				2.40E+06±4.63E+04	pCi/L	5.55E+03	EPA906.0

SURVEY ID: FSP 21303 **Sample ID:** 110506

Survey location: 48725E 73486N (SRS coordinates)
Sample type: Normal Sample matrix: Water

Constituent	RQ	AQ	B	Result	Unit	ssEQL	Method
Radionuclides							
Tritium				6.84E+05±1.35E+04	pCi/L	2.55E+03	EPA906.0

SURVEY ID: FSP 22003 **Sample ID:** 110531

Survey location: 48644E 72983N (SRS coordinates)
Sample type: Normal Sample matrix: Water

Constituent	**RQ**	**AQ**	**B**	**Result**	**Unit**	**ssEQL**	**Method**
Radionuclides							
Tritium				5.05E+05±1.02E+04	pCi/L	3.53E+03	EPA906.0

SURVEY ID: FSP 22603 **Sample ID:** 110507

Survey location: 48601E 73308N (SRS coordinates)
Sample type: Normal Sample matrix: Water

Constituent	**RQ**	**AQ**	**B**	**Result**	**Unit**	**ssEQL**	**Method**
Radionuclides							
Tritium				7.58E+05±1.48E+04	pCi/L	2.29E+03	EPA906.0

SURVEY ID: FSP 23503 **Sample ID:** 110508

Survey location: 48587E 72979N (SRS coordinates)
Sample type: Normal Sample matrix: Water

Constituent	**RQ**	**AQ**	**B**	**Result**	**Unit**	**ssEQL**	**Method**
Radionuclides							
Tritium				2.42E+05±4.84E+03	pCi/L	1.36E+03	EPA906.0

SURVEY ID: FSP 24103 **Sample ID:** 110503

Survey location: 48190E 72853N (SRS coordinates)
Sample type: Normal Sample matrix: Water

Constituent	**RQ**	**AQ**	**B**	**Result**	**Unit**	**ssEQL**	**Method**
Radionuclides							
Tritium				5.15E+05±1.02E+04	pCi/L	2.04E+03	EPA906.0

SURVEY ID: FSP 24903 **Sample ID:** 110504

Survey location: 47905E 73107N (SRS coordinates)
Sample type: Normal Sample matrix: Water

Constituent	**RQ**	**AQ**	**B**	**Result**	**Unit**	**ssEQL**	**Method**
Radionuclides							
Tritium				1.93E+05±3.86E+03	pCi/L	1.14E+03	EPA906.0

SURVEY ID: FSP 25603 **Sample ID:** 110505

Survey location: 47770E 73435N (SRS coordinates)
Sample type: Normal Sample matrix: Water

Constituent	RQ	AQ	B	Result	Unit	ssEQL	Method
Radionuclides							
Tritium				8.03E+04±4.46E+03	pCi/L	4.51E+03	EPA906.0

SURVEY ID: FSP 27003 **Sample ID:** 110502

Survey location: 47411E 72805N (SRS coordinates)
Sample type: Normal Sample matrix: Water

Constituent	RQ	AQ	B	Result	Unit	ssEQL	Method
Radionuclides							
Tritium				3.22E+04±1.18E+03	pCi/L	7.40E+02	EPA906.0

SURVEY ID: FSP 29003 **Sample ID:** 110500

Survey location: 46865E 73160N (SRS coordinates)
Sample type: Normal Sample matrix: Water

Constituent	RQ	AQ	B	Result	Unit	ssEQL	Method
Radionuclides							
Tritium				2.38E+04±9.85E+02	pCi/L	6.81E+02	EPA906.0

SURVEY ID: FSP 29003A **Sample ID:** 110501
Sample type: Duplicate Associated sample: 110500

Constituent	RQ	AQ	B	Result	Unit	ssEQL	Method
Radionuclides							
Tritium				2.56E+04±1.03E+03	pCi/L	6.92E+02	EPA906.0

SURVEY ID: HSP 00303 **Sample ID:** 110542

Survey location: 56879E 70711N (SRS coordinates)
Sample type: Normal Sample matrix: Water

Constituent	RQ	AQ	B	Result	Unit	ssEQL	Method
Radionuclides							
Tritium				1.48E+06±2.96E+04	pCi/L	9.33E+03	EPA906.0

SURVEY ID: HSP 00403 **Sample ID:** 110543

Survey location: 56819E 70710N (SRS coordinates)
Sample type: Normal Sample matrix: Water

Constituent	**RQ**	**AQ**	**B**	**Result**	**Unit**	**ssEQL**	**Method**
Radionuclides							
Tritium				3.98E+05±7.83E+03	pCi/L	1.56E+03	EPA906.0

SURVEY ID: HSP 00803 **Sample ID:** 110540

Survey location: 56990E 71005N (SRS coordinates)
Sample type: Normal Sample matrix: Water

Constituent	**RQ**	**AQ**	**B**	**Result**	**Unit**	**ssEQL**	**Method**
Radionuclides							
Tritium				1.13E+06±2.22E+04	pCi/L	2.81E+03	EPA906.0

SURVEY ID: HSP 01103 **Sample ID:** 110541

Survey location: 57046E 71099N (SRS coordinates)
Sample type: Normal Sample matrix: Water

Constituent	**RQ**	**AQ**	**B**	**Result**	**Unit**	**ssEQL**	**Method**
Radionuclides							
Tritium				1.35E+05±4.88E+03	pCi/L	3.14E+03	EPA906.0

SURVEY ID: HSP 01303 **Sample ID:** 110538

Survey location: 56878E 71056N (SRS coordinates)
Sample type: Normal Sample matrix: Water

Constituent	**RQ**	**AQ**	**B**	**Result**	**Unit**	**ssEQL**	**Method**
Radionuclides							
Tritium				7.35E+05±1.45E+04	pCi/L	3.12E+03	EPA906.0

SURVEY ID: HSP 01503 **Sample ID:** 110537

Survey location: 56791E 71085N (SRS coordinates)
Sample type: Normal Sample matrix: Water

Constituent	**RQ**	**AQ**	**B**	**Result**	**Unit**	**ssEQL**	**Method**
Radionuclides							
Tritium				5.04E+05±9.99E+03	pCi/L	2.15E+03	EPA906.0

SURVEY ID: HSP 02003 **Sample ID:** 110536

Survey location: 56849E 71142N (SRS coordinates)
Sample type: Normal Sample matrix: Water

Constituent	RQ	AQ	B	Result	Unit	ssEQL	Method
Radionuclides							
Tritium				1.47E+05±7.00E+03	pCi/L	6.53E+03	EPA906.0

SURVEY ID: HSP 02503 **Sample ID:** 110534

Survey location: 56297E 70960N (SRS coordinates)
Sample type: Normal Sample matrix: Water

Constituent	RQ	AQ	B	Result	Unit	ssEQL	Method
Radionuclides							
Tritium				2.58E+05±6.74E+03	pCi/L	3.33E+03	EPA906.0

SURVEY ID: HSP 02903 **Sample ID:** 110535

Survey location: 56257E 71278N (SRS coordinates)
Sample type: Normal Sample matrix: Water

Constituent	RQ	AQ	B	Result	Unit	ssEQL	Method
Radionuclides							
Tritium				5.12E+04±1.30E+03	pCi/L	6.25E+02	EPA906.0

SURVEY ID: HSP 04303 **Sample ID:** 110529

Survey location: 55722E 71644N (SRS coordinates)
Sample type: Normal Sample matrix: Water

Constituent	RQ	AQ	B	Result	Unit	ssEQL	Method
Radionuclides							
Tritium				1.84E+06±3.61E+04	pCi/L	4.97E+03	EPA906.0

SURVEY ID: HSP 04603 **Sample ID:** 110533

Survey location: 56052E 71621N (SRS coordinates)
Sample type: Normal Sample matrix: Water

Constituent	RQ	AQ	B	Result	Unit	ssEQL	Method
Radionuclides							
Tritium				4.94E+05±9.91E+03	pCi/L	3.23E+03	EPA906.0

SURVEY ID: HSP 04903 **Sample ID:** 110532

Survey location: 55987E 71389N (SRS coordinates)
Sample type: Normal Sample matrix: Water

Constituent	RQ	AQ	B	Result	Unit	ssEQL	Method
Radionuclides							
Tritium				1.25E+06±2.45E+04	pCi/L	4.13E+03	EPA906.0

SURVEY ID: HSP 05203 **Sample ID:** 110530

Survey location: 55743E 71413N (SRS coordinates)
Sample type: Normal Sample matrix: Water

Constituent	RQ	AQ	B	Result	Unit	ssEQL	Method
Radionuclides							
Tritium				7.32E+06±1.43E+05	pCi/L	1.08E+04	EPA906.0

SURVEY ID: HSP 05703 **Sample ID:** 110526

Survey location: 55516E 71567N (SRS coordinates)
Sample type: Normal Sample matrix: Water

Constituent	RQ	AQ	B	Result	Unit	ssEQL	Method
Radionuclides							
Tritium				3.54E+05±7.04E+03	pCi/L	1.91E+03	EPA906.0

SURVEY ID: HSP 06003 **Sample ID:** 110525

Survey location: 55190E 71629N (SRS coordinates)
Sample type: Normal Sample matrix: Water

Constituent	RQ	AQ	B	Result	Unit	ssEQL	Method
Radionuclides							
Tritium				1.47E+06±2.87E+04	pCi/L	4.38E+03	EPA906.0

SURVEY ID: HSP 06403 **Sample ID:** 110576

Survey location: 54768E 71846N (SRS coordinates)
Sample type: Normal Sample matrix: Water

Constituent	RQ	AQ	B	Result	Unit	ssEQL	Method
Radionuclides							
Tritium				1.36E+04±7.53E+02	pCi/L	6.51E+02	EPA906.0

SURVEY ID: HSP 06403A **Sample ID:** 110577
Sample type: Duplicate Associated sample: 110576

Constituent	RQ	AQ	B	Result	Unit	ssEQL	Method
Radionuclides							
Tritium				1.45E+04±7.64E+02	pCi/L	6.41E+02	EPA906.0

SURVEY ID: HSP 07103 **Sample ID:** 110524

Survey location: 54937E 71588N (SRS coordinates)
Sample type: Normal Sample matrix: Water

Constituent	RQ	AQ	B	Result	Unit	ssEQL	Method
Radionuclides							
Tritium				1.07E+06±2.12E+04	pCi/L	2.54E+03	EPA906.0

SURVEY ID: HSP 07603 **Sample ID:** 110522

Survey location: 54571E 71494N (SRS coordinates)
Sample type: Normal Sample matrix: Water

Constituent	RQ	AQ	B	Result	Unit	ssEQL	Method
Radionuclides							
Tritium				2.02E+05±4.01E+03	pCi/L	1.05E+03	EPA906.0

SURVEY ID: HSP 07603D **Sample ID:** 110523
Sample type: Split Associated sample: 110522

Constituent	RQ	AQ	B	Result	Unit	ssEQL	Method
Radionuclides							
Tritium		I		1.63E+05±1.19E+04	pCi/L	1.50E+06	3Q161410

SURVEY ID: HSP 09703 **Sample ID:** 110545

Survey location: 54029E 72371N (SRS coordinates)
Sample type: Normal Sample matrix: Water

Constituent	RQ	AQ	B	Result	Unit	ssEQL	Method
Radionuclides							
Tritium				1.37E+06±2.69E+04	pCi/L	4.19E+03	EPA906.0

SURVEY ID: HSP 10303 **Sample ID:** 110544

Survey location: 53665E 72448N (SRS coordinates)
Sample type: Normal Sample matrix: Water

Constituent	RQ	AQ	B	Result	Unit	ssEQL	Method
Radionuclides							
Tritium				9.27E+05±1.82E+04	pCi/L	2.32E+03	EPA906.0
Tritium				8.95E+05±1.76E+04	pCi/L	2.18E+03	EPA906.0

Table D.11 Results Sorted by Sample for FHST4

SURVEY ID: FHB 01204 Sample ID: 111731

Survey location: 53878E 73424N (SRS coordinates)
Sample type: Normal Sample matrix: Water

Constituent	RQ	AQ	B	Result	Unit	ssEQL	Method
Radionuclides							
Tritium				2.13E+07±3.58E+05	pCi/L	1.30E+04	EPA906.0

SURVEY ID: FHB 01304 Sample ID: 111730

Survey location: 53848E 73508N (SRS coordinates)
Sample type: Normal Sample matrix: Water

Constituent	RQ	AQ	B	Result	Unit	ssEQL	Method
Radionuclides							
Tritium				6.66E+06±1.34E+05	pCi/L	4.36E+04	EPA906.0

SURVEY ID: FHB 01404 Sample ID: 111762

Survey location: 53728E 73561N (SRS coordinates)
Sample type: Normal Sample matrix: Water

Constituent	RQ	AQ	B	Result	Unit	ssEQL	Method
Radionuclides							
Tritium				1.50E+06±2.96E+04	pCi/L	6.34E+03	EPA906.0

SURVEY ID: FHB 01704 Sample ID: 111727

Survey location: 54000E 73668N (SRS coordinates)
Sample type: Normal Sample matrix: Water

Constituent	RQ	AQ	B	Result	Unit	ssEQL	Method
Radionuclides							
Tritium				2.11E+07±4.14E+05	pCi/L	5.89E+04	EPA906.0

SURVEY ID: FHB 01804 Sample ID: 111726

Survey location: 54026E 73565N (SRS coordinates)
Sample type: Normal Sample matrix: Water

Constituent	RQ	AQ	B	Result	Unit	ssEQL	Method
Radionuclides							
Tritium				3.06E+06±5.90E+04	pCi/L	5.68E+03	EPA906.0
Tritium				3.14E+06±6.12E+04	pCi/L	5.86E+03	EPA906.0

SURVEY ID: FHB 02004 Sample ID: 111724

Survey location: 54008E 73434N (SRS coordinates)
Sample type: Normal Sample matrix: Water

Constituent	RQ	AQ	B	Result	Unit	ssEQL	Method
Radionuclides							
Tritium				2.94E+03±5.66E+02	pCi/L	7.81E+02	EPA906.0

SURVEY ID: FMC001F04 Sample ID: 111760

Survey location: 57050E 70350N (SRS coordinates)
Sample type: Normal Sample matrix: Water

Constituent	RQ	AQ	B	Result	Unit	ssEQL	Method
Radionuclides							
Tritium				6.15E+05±1.21E+04	pCi/L	1.85E+03	EPA906.0

SURVEY ID: FMC001F04A Sample ID: 111764

Sample type: Duplicate Associated sample: 111760

Constituent	RQ	AQ	B	Result	Unit	ssEQL	Method
Radionuclides							
Tritium				5.77E+05±1.13E+04	pCi/L	1.71E+03	EPA906.0

SURVEY ID: FMC001H04 Sample ID: 111746

Survey location: 5300E 72600N (SRS coordinates)
Sample type: Normal Sample matrix: Water

Constituent	RQ	AQ	B	Result	Unit	ssEQL	Method
Radionuclides							
Tritium				1.63E+04±8.11E+02	pCi/L	6.39E+02	EPA906.0

SURVEY ID: FMC002H04 Sample ID: 111759

Survey location: 53000E 72600N (SRS coordinates)
Sample type: Normal Sample matrix: Water

Constituent	RQ	AQ	B	Result	Unit	ssEQL	Method
Radionuclides							
Tritium				6.05E+04±1.44E+03	pCi/L	6.34E+02	EPA906.0

SURVEY ID: FSP 00204 Sample ID: 111711

Survey location: 49133E 72796N (SRS coordinates)
Sample type: Normal Sample matrix: Water

Constituent	RQ	AQ	B	Result	Unit	ssEQL	Method
Radionuclides							
Tritium				7.17E+05±1.40E+04	pCi/L	1.89E+03	EPA906.0

SURVEY ID: FSP 00704 Sample ID: 111712

Survey location: 49540E 73008N (SRS coordinates)
Sample type: Normal Sample matrix: Water

Constituent	RQ	AQ	B	Result	Unit	ssEQL	Method
Radionuclides							
Tritium				1.00E+06±1.95E+04	pCi/L	2.49E+03	EPA906.0

SURVEY ID: FSP 01204 Sample ID: 111713

Survey location: 49644E 73602N (SRS coordinates)
Sample type: Normal Sample matrix: Water

Constituent	RQ	AQ	B	Result	Unit	ssEQL	Method
Radionuclides							
Tritium				5.43E+04±1.36E+03	pCi/L	6.02E+02	EPA906.0

SURVEY ID: FSP 01904 Sample ID: 111715

Survey location: 49778E 73177N (SRS coordinates)
Sample type: Normal Sample matrix: Water

Constituent	RQ	AQ	B	Result	Unit	ssEQL	Method
Radionuclides							
Tritium				3.00E+06±5.82E+04	pCi/L	4.51E+03	EPA906.0

SURVEY ID: FSP 02604 Sample ID: 111716

Survey location: 49801E 72932N (SRS coordinates)
Sample type: Normal Sample matrix: Water

Constituent	RQ	AQ	B	Result	Unit	ssEQL	Method
Radionuclides							
Tritium				2.75E+06±5.42E+04	pCi/L	1.24E+04	EPA906.0

SURVEY ID: FSP 03504 Sample ID: 111719

Survey location: 50297E 73065N (SRS coordinates)
Sample type: Normal Sample matrix: Water

Constituent	RQ	AQ	B	Result	Unit	ssEQL	Method
Radionuclides							
Tritium				8.38E+06±1.67E+05	pCi/L	4.63E+04	EPA906.0

SURVEY ID: FSP 04004 Sample ID: 111720

Survey location: 50630E 73101N (SRS coordinates)
Sample type: Normal Sample matrix: Water

Constituent	RQ	AQ	B	Result	Unit	ssEQL	Method
Radionuclides							
Tritium				3.97E+06±7.90E+04	pCi/L	2.30E+04	EPA906.0

SURVEY ID: FSP 04704 Sample ID: 111721

Survey location: 50607E 73609N (SRS coordinates)
Sample type: Normal Sample matrix: Water

Constituent	RQ	AQ	B	Result	Unit	ssEQL	Method
Radionuclides							
Tritium				1.14E+05±2.26E+03	pCi/L	7.09E+02	EPA906.0

SURVEY ID: FSP 04704D Sample ID: 111722

Sample type: Split Associated sample: 111721

Constituent	RQ	AQ	B	Result	Unit	ssEQL	Method
WSRC3Q16							
Tritium				1.19E+05±2.50E+03	pCi/L	1.50E+03	WSRC3Q161410
Tritium				1.18E+05±2.48E+03	pCi/L	1.50E+03	WSRC3Q161410

SURVEY ID: FSP 05604 Sample ID: 111723

Survey location: 51488E 73824N (SRS coordinates)
Sample type: Normal Sample matrix: Water

Constituent	RQ	AQ	B	Result	Unit	ssEQL	Method
Radionuclides							
Tritium	J	C		9.02E+03±3.58E+03	pCi/L	5.57E+03	EPA906.0

SURVEY ID: FSP 20404 Sample ID: 111710

Survey location: 48801E 73281N (SRS coordinates)
Sample type: Normal Sample matrix: Water

Constituent	RQ	AQ	B	Result	Unit	ssEQL	Method
Radionuclides							
Tritium				2.07E+06±4.11E+04	pCi/L	1.06E+04	EPA906.0

SURVEY ID: FSP 21304 Sample ID: 111709

Survey location: 48725E 73486N (SRS coordinates)
Sample type: Normal Sample matrix: Water

Constituent	RQ	AQ	B	Result	Unit	ssEQL	Method
Radionuclides							
Tritium				2.53E+06±4.86E+04	pCi/L	4.09E+03	EPA906.0

SURVEY ID: FSP 22004 Sample ID: 111707

Survey location: 48644E 72983N (SRS coordinates)
Sample type: Normal Sample matrix: Water

Constituent	RQ	AQ	B	Result	Unit	ssEQL	Method
Radionuclides							
Tritium				8.47E+05±2.56E+04	pCi/L	1.34E+04	EPA906.0

SURVEY ID: FSP 22604 Sample ID: 111708

Survey location: 48601E 73308N (SRS coordinates)
Sample type: Normal Sample matrix: Water

Constituent	RQ	AQ	B	Result	Unit	ssEQL	Method
Radionuclides							
Tritium				4.76E+05±1.27E+04	pCi/L	5.97E+03	EPA906.0

SURVEY ID: FSP 24104 Sample ID: 111705

Survey location: 48190E 72853N (SRS coordinates)
Sample type: Normal Sample matrix: Water

Constituent	RQ	AQ	B	Result	Unit	ssEQL	Method
Radionuclides							
Tritium				1.05E+06±2.09E+04	pCi/L	6.91E+03	EPA906.0

SURVEY ID: FSP 24904 Sample ID: 111704

Survey location: 47905E 73107N (SRS coordinates)
Sample type: Normal Sample matrix: Water

Constituent	RQ	AQ	B	Result	Unit	ssEQL	Method
Radionuclides							
Tritium				7.02E+05±1.46E+04	pCi/L	5.50E+03	EPA906.0

SURVEY ID: FSP 25604 Sample ID: 111703

Survey location: 47770E 73435N (SRS coordinates)
Sample type: Normal Sample matrix: Water

Constituent	RQ	AQ	B	Result	Unit	ssEQL	Method
Radionuclides							
Tritium				6.08E+05±1.19E+04	pCi/L	1.78E+03	EPA906.0

SURVEY ID: FSP 27004 Sample ID: 111702

Survey location: 47411E 72805N (SRS coordinates)
Sample type: Normal Sample matrix: Water

Constituent	RQ	AQ	B	Result	Unit	ssEQL	Method
Radionuclides							
Tritium				4.69E+04±1.45E+03	pCi/L	7.72E+02	EPA906.0

SURVEY ID: FSP 29004 Sample ID: 111700

Survey location: 46865E 73160N (SRS coordinates)
Sample type: Normal Sample matrix: Water

Constituent	RQ	AQ	B	Result	Unit	ssEQL	Method
Radionuclides							
Tritium				4.10E+04±1.22E+03	pCi/L	6.28E+02	EPA906.0

SURVEY ID: FSP 29004D Sample ID: 111701

Sample type: Split Associated sample: 111700

Constituent	RQ	AQ	B	Result	Unit	ssEQL	Method
WSRC3Q16							
Tritium				4.09E+04±1.57E+03	pCi/L	1.50E+03	WSRC3Q161410

SURVEY ID: HSP 00804 Sample ID: 111747

Survey location: 56990E 71005N (SRS coordinates)
Sample type: Normal Sample matrix: Water

Constituent	RQ	AQ	B	Result	Unit	ssEQL	Method
Radionuclides							
Tritium				8.84E+05±1.75E+04	pCi/L	4.41E+03	EPA906.0

SURVEY ID: HSP 01304 Sample ID: 111750

Survey location: 56878E 71056N (SRS coordinates)
Sample type: Normal Sample matrix: Water

Constituent	RQ	AQ	B	Result	Unit	ssEQL	Method
Radionuclides							
Tritium				1.65E+05±7.23E+03	pCi/L	5.06E+03	EPA906.0
Tritium				1.68E+05±7.45E+03	pCi/L	5.24E+03	EPA906.0

SURVEY ID: HSP 01504 Sample ID: 111749

Survey location: 56791E 71085N (SRS coordinates)
Sample type: Normal Sample matrix: Water

Constituent	RQ	AQ	B	Result	Unit	ssEQL	Method
Radionuclides							
Tritium				5.93E+05±1.35E+04	pCi/L	5.51E+03	EPA906.0

SURVEY ID: HSP 02504 Sample ID: 111756

Survey location: 56297E 70960N (SRS coordinates)
Sample type: Normal Sample matrix: Water

Constituent	RQ	AQ	B	Result	Unit	ssEQL	Method
Radionuclides							
Tritium				4.41E+05±8.70E+03	pCi/L	1.78E+03	EPA906.0

SURVEY ID: HSP 02904 Sample ID: 111757

Survey location: 56257E 71278N (SRS coordinates)
Sample type: Normal Sample matrix: Water

Constituent	RQ	AQ	B	Result	Unit	ssEQL	Method
Radionuclides							
Tritium				3.76E+04±1.14E+03	pCi/L	6.21E+02	EPA906.0

SURVEY ID: HSP 04904 Sample ID: 111744

Survey location: 55987E 71389N (SRS coordinates)
Sample type: Normal Sample matrix: Water

Constituent	RQ	AQ	B	Result	Unit	ssEQL	Method
Radionuclides							
Tritium				1.24E+06±4.70E+04	pCi/L	2.91E+04	EPA906.0

SURVEY ID: HSP 05204 Sample ID: 111743

Survey location: 55743E 71413N (SRS coordinates)
Sample type: Normal Sample matrix: Water

Constituent	RQ	AQ	B	Result	Unit	ssEQL	Method
Radionuclides							
Tritium				8.12E+06±1.53E+05	pCi/L	1.01E+04	EPA906.0

SURVEY ID: HSP 07104 Sample ID: 111741

Survey location: 54937E 71588N (SRS coordinates)
Sample type: Normal Sample matrix: Water

Constituent	RQ	AQ	B	Result	Unit	ssEQL	Method
Radionuclides							
Tritium				1.83E+06±3.50E+04	pCi/L	3.17E+03	EPA906.0

SURVEY ID: HSP 07604 Sample ID: 111740

Survey location: 54571E 71494N (SRS coordinates)
Sample type: Normal Sample matrix: Water

Constituent	RQ	AQ	B	Result	Unit	ssEQL	Method
Radionuclides							
Tritium				9.56E+04±1.92E+03	pCi/L	6.61E+02	EPA906.0

SURVEY ID: HSP 09704 Sample ID: 111751

Survey location: 54029E 72371N (SRS coordinates)
Sample type: Normal Sample matrix: Water

Constituent	RQ	AQ	B	Result	Unit	ssEQL	Method
Radionuclides							
Tritium				1.58E+06±3.07E+04	pCi/L	3.10E+03	EPA906.0

SURVEY ID: HSP 09704A Sample ID: 111752

Sample type: Duplicate Associated sample: 111751

Constituent	**RQ**	**AQ**	**B**	**Result**	**Unit**	**ssEQL**	**Method**
Radionuclides							
Tritium				1.60E+06±3.11E+04	pCi/L	2.85E+03	EPA906.0

SURVEY ID: HSP 10304 Sample ID: 111735

Survey location: 53665E 72448N (SRS coordinates)
Sample type: Normal Sample matrix: Water

Constituent	**RQ**	**AQ**	**B**	**Result**	**Unit**	**ssEQL**	**Method**
Radionuclides							
Tritium				1.94E+06±3.77E+04	pCi/L	3.30E+03	EPA906.0

SURVEY ID: HSP 10304D Sample ID: 111763

Sample type: Split Associated sample: 111735

Constituent	**RQ**	**AQ**	**B**	**Result**	**Unit**	**ssEQL**	**Method**
Radionuclides							
Tritium				1.96E+06±9.84E+03	pCi/L	1.50E+03	WSRC3Q161410

D.4 Results Sorted by Analyte

Table D.12 Sample Results Sorted by Analyte for FHST3

ANALYTE: Tritium
Analytical Group: *Radionuclides*

Survey ID	Sample ID	RQ	B	Result	Unit	ssEQL	Method	AQ
FHB 00103	110547			4.19E+04±4.37E+03	pCi/L	5.62E+03	EPA906.0	
FHB 00203	110546			1.23E+04±9.29E+02	pCi/L	9.48E+02	EPA906.0	
FHB 00303	110558			1.01E+05±2.58E+03	pCi/L	1.26E+03	EPA906.0	
FHB 00303D	110559			1.16E+05±3.68E+03	pCi/L	1.50E+06	3Q161410	I
FHB 00303D	110559			1.14E+05±3.64E+03	pCi/L	1.50E+06	3Q161410	I
FHB 00403	110557			1.58E+05±3.63E+03	pCi/L	1.62E+03	EPA906.0	
FHB 00503	110561			4.35E+05±8.58E+03	pCi/L	1.97E+03	EPA906.0	
FHB 00603	110560			2.13E+05±4.23E+03	pCi/L	1.08E+03	EPA906.0	
FHB 00803	110562			1.11E+05±2.26E+03	pCi/L	8.53E+02	EPA906.0	
FHB 01203	110556			1.73E+07±2.83E+05	pCi/L	1.09E+04	EPA906.0	
FHB 01303	110554			3.05E+06±5.89E+04	pCi/L	6.42E+03	EPA906.0	
FHB 01403	110555			1.95E+05±3.89E+03	pCi/L	1.02E+03	EPA906.0	
FHB 01603	110548			8.70E+04±6.25E+03	pCi/L	7.08E+03	EPA906.0	
FHB 01703	110550			3.47E+06±6.75E+04	pCi/L	7.40E+03	EPA906.0	
FHB 01803	110551			1.08E+07±2.02E+05	pCi/L	1.30E+04	EPA906.0	
FHB 01903	110553			4.96E+06±9.53E+04	pCi/L	9.88E+03	EPA906.0	
FHB 02003	110552			1.63E+04±7.93E+02	pCi/L	6.33E+02	EPA906.0	
FMC001F03	110563			3.29E+05±6.52E+03	pCi/L	1.37E+03	EPA906.0	
FMC001H02	110609			9.07E+03±6.36E+02	pCi/L	6.04E+02	EPA906.0	
FMC002H02	110613			7.80E+04±1.61E+03	pCi/L	6.51E+02	EPA906.0	
FSP 4703	110521			1.52E+04±8.02E+02	pCi/L	6.48E+02	EPA906.0	
FSP 00203	110510			4.76E+05±9.32E+03	pCi/L	1.56E+03	EPA906.0	
FSP 00703	110511			1.04E+06±2.04E+04	pCi/L	3.65E+03	EPA906.0	
FSP 01203	110512			4.44E+04±1.30E+03	pCi/L	6.81E+02	EPA906.0	
FSP 01403	110513			1.58E+04±1.34E+03	pCi/L	1.43E+03	EPA906.0	
FSP 01403	110513			1.65E+04±1.54E+03	pCi/L	1.70E+03	EPA906.0	
FSP 01903	110514			4.66E+06±8.96E+04	pCi/L	8.06E+03	EPA906.0	
FSP 02603	110515			6.77E+06±1.30E+05	pCi/L	1.00E+04	EPA906.0	
FSP 03203	110516			7.31E+04±1.52E+03	pCi/L	5.86E+02	EPA906.0	
FSP 03403	110518			2.18E+06±4.25E+04	pCi/L	5.41E+03	EPA906.0	
FSP 03503	110520			5.09E+06±9.83E+04	pCi/L	8.60E+03	EPA906.0	
FSP 04003	110519			5.67E+06±1.13E+05	pCi/L	9.76E+03	EPA906.0	
FSP 05603	110574			6.29E+03±8.10E+02	pCi/L	1.02E+03	EPA906.0	
FSP 05603A	110575			5.91E+03±5.83E+02	pCi/L	6.72E+02	EPA906.0	
FSP 20403	110509			2.40E+06±4.63E+04	pCi/L	5.55E+03	EPA906.0	
FSP 21303	110506			6.84E+05±1.35E+04	pCi/L	2.55E+03	EPA906.0	
FSP 22003	110531			5.05E+05±1.02E+04	pCi/L	3.53E+03	EPA906.0	
FSP 22603	110507			7.58E+05±1.48E+04	pCi/L	2.29E+03	EPA906.0	
FSP 23503	110508			2.42E+05±4.84E+03	pCi/L	1.36E+03	EPA906.0	
FSP 24103	110503			5.15E+05±1.02E+04	pCi/L	2.04E+03	EPA906.0	
FSP 24903	110504			1.93E+05±3.86E+03	pCi/L	1.14E+03	EPA906.0	
FSP 25603	110505			8.03E+04±4.46E+03	pCi/L	4.51E+03	EPA906.0	
FSP 27003	110502			3.22E+04±1.18E+03	pCi/L	7.40E+02	EPA906.0	
FSP 29003	110500			2.38E+04±9.85E+02	pCi/L	6.81E+02	EPA906.0	
FSP 29003A	110501			2.56E+04±1.03E+03	pCi/L	6.92E+02	EPA906.0	
HSP 00303	110542			1.48E+06±2.96E+04	pCi/L	9.33E+03	EPA906.0	
HSP 00403	110543			3.98E+05±7.83E+03	pCi/L	1.56E+03	EPA906.0	
HSP 00803	110540			1.13E+06±2.22E+04	pCi/L	2.81E+03	EPA906.0	
HSP 01103	110541			1.35E+05±4.88E+03	pCi/L	3.14E+03	EPA906.0	
HSP 01303	110538			7.35E+05±1.45E+04	pCi/L	3.12E+03	EPA906.0	
HSP 01503	110537			5.04E+05±9.99E+03	pCi/L	2.15E+03	EPA906.0	

ANALYTE: Tritium (cont.)

Survey ID	Sample ID	RQ	B	Result	Unit	ssEQL	Method	AQ
HSP 02003	110536			1.47E+05±7.00E+03	pCi/L	6.53E+03	EPA906.0	
HSP 02503	110534			2.58E+05±6.74E+03	pCi/L	3.33E+03	EPA906.0	
HSP 02903	110535			5.12E+04±1.30E+03	pCi/L	6.25E+02	EPA906.0	
HSP 04303	110529			1.84E+06±3.61E+04	pCi/L	4.97E+03	EPA906.0	
HSP 04603	110533			4.94E+05±9.91E+03	pCi/L	3.23E+03	EPA906.0	
HSP 04903	110532			1.25E+06±2.45E+04	pCi/L	4.13E+03	EPA906.0	
HSP 05203	110530			7.32E+06±1.43E+05	pCi/L	1.08E+04	EPA906.0	
HSP 05703	110526			3.54E+05±7.04E+03	pCi/L	1.91E+03	EPA906.0	
HSP 06003	110525			1.47E+06±2.87E+04	pCi/L	4.38E+03	EPA906.0	
HSP 06403	110576			1.36E+04±7.53E+02	pCi/L	6.51E+02	EPA906.0	
HSP 06403A	110577			1.45E+04±7.64E+02	pCi/L	6.41E+02	EPA906.0	
HSP 07103	110524			1.07E+06±2.12E+04	pCi/L	2.54E+03	EPA906.0	
HSP 07603	110522			2.02E+05±4.01E+03	pCi/L	1.05E+03	EPA906.0	
HSP 07603D	110523			1.63E+05±1.19E+04	pCi/L	1.50E+06	3Q161410	I
HSP 09703	110545			1.37E+06±2.69E+04	pCi/L	4.19E+03	EPA906.0	
HSP 10303	110544			9.27E+05±1.82E+04	pCi/L	2.32E+03	EPA906.0	
HSP 10303	110544			8.95E+05±1.76E+04	pCi/L	2.18E+03	EPA906.0	

Table D.13 Sample Results Sorted by Analyte for FHST4

ANALYTE: Tritium
Analytical Group: *Radionuclides*

Survey ID	Sample ID	RQ	B	Result	Unit	EQL	Method	AQ
FHB 01204	111731			2.13E+07±3.58E+05	pCi/L	1.30E+04	EPA906.0	
FHB 01304	111730			6.66E+06±1.34E+05	pCi/L	4.36E+04	EPA906.0	
FHB 01404	111762			1.50E+06±2.96E+04	pCi/L	6.34E+03	EPA906.0	
FHB 01704	111727			2.11E+07±4.14E+05	pCi/L	5.89E+04	EPA906.0	
FHB 01804	111726			3.06E+06±5.90E+04	pCi/L	5.68E+03	EPA906.0	
FHB 01804	111726			3.14E+06±6.12E+04	pCi/L	5.86E+03	EPA906.0	
FHB 02004	111724			2.94E+03±5.66E+02	pCi/L	7.81E+02	EPA906.0	
FMC001F04	111760			6.15E+05±1.21E+04	pCi/L	1.85E+03	EPA906.0	
FMC001F04A	111764			5.77E+05±1.13E+04	pCi/L	1.71E+03	EPA906.0	
FMC001H04	111746			1.63E+04±8.11E+02	pCi/L	6.39E+02	EPA906.0	
FMC002H04	111759			6.05E+04±1.44E+03	pCi/L	6.34E+02	EPA906.0	
FSP 00204	111711			7.17E+05±1.40E+04	pCi/L	1.89E+03	EPA906.0	
FSP 00704	111712			1.00E+06±1.95E+04	pCi/L	2.49E+03	EPA906.0	
FSP 01204	111713			5.43E+04±1.36E+03	pCi/L	6.02E+02	EPA906.0	
FSP 01904	111715			3.00E+06±5.82E+04	pCi/L	4.51E+03	EPA906.0	
FSP 02604	111716			2.75E+06±5.42E+04	pCi/L	1.24E+04	EPA906.0	
FSP 03504	111719			8.38E+06±1.67E+05	pCi/L	4.63E+04	EPA906.0	
FSP 04004	111720			3.97E+06±7.90E+04	pCi/L	2.30E+04	EPA906.0	
FSP 04704	111721			1.14E+05±2.26E+03	pCi/L	7.09E+02	EPA906.0	
FSP 04704D	111722			1.19E+05±2.50E+03	pCi/L	1.50E+03	WSRC3Q161410	
FSP 04704D	111722			1.18E+05±2.48E+03	pCi/L	1.50E+03	WSRC3Q161410	
FSP 05604	111723	J		9.02E+03±3.58E+03	pCi/L	5.57E+03	EPA906.0	C
FSP 20404	111710			2.07E+06±4.11E+04	pCi/L	1.06E+04	EPA906.0	
FSP 21304	111709			2.53E+06±4.86E+04	pCi/L	4.09E+03	EPA906.0	
FSP 22004	111707			8.47E+05±2.56E+04	pCi/L	1.34E+04	EPA906.0	
FSP 22604	111708			4.76E+05±1.27E+04	pCi/L	5.97E+03	EPA906.0	
FSP 24104	111705			1.05E+06±2.09E+04	pCi/L	6.91E+03	EPA906.0	
FSP 24904	111704			7.02E+05±1.46E+04	pCi/L	5.50E+03	EPA906.0	
FSP 25604	111703			6.08E+05±1.19E+04	pCi/L	1.78E+03	EPA906.0	
FSP 27004	111702			4.69E+04±1.45E+03	pCi/L	7.72E+02	EPA906.0	
FSP 29004	111700			4.10E+04±1.22E+03	pCi/L	6.28E+02	EPA906.0	
FSP 29004D	111701			4.09E+04±1.57E+03	pCi/L	1.50E+03	WSRC3Q161410	
HSP 00804	111747			8.84E+05±1.75E+04	pCi/L	4.41E+03	EPA906.0	
HSP 01304	111750			1.65E+05±7.23E+03	pCi/L	5.06E+03	EPA906.0	
HSP 01304	111750			1.68E+05±7.45E+03	pCi/L	5.24E+03	EPA906.0	
HSP 01504	111749			5.93E+05±1.35E+04	pCi/L	5.51E+03	EPA906.0	
HSP 02504	111756			4.41E+05±8.70E+03	pCi/L	1.78E+03	EPA906.0	
HSP 02904	111757			3.76E+04±1.14E+03	pCi/L	6.21E+02	EPA906.0	
HSP 04904	111744			1.24E+06±4.70E+04	pCi/L	2.91E+04	EPA906.0	
HSP 05204	111743			8.12E+06±1.53E+05	pCi/L	1.01E+04	EPA906.0	
HSP 07104	111741			1.83E+06±3.50E+04	pCi/L	3.17E+03	EPA906.0	
HSP 07604	111740			9.56E+04±1.92E+03	pCi/L	6.61E+02	EPA906.0	
HSP 09704	111751			1.58E+06±3.07E+04	pCi/L	3.10E+03	EPA906.0	
HSP 09704A	111752			1.60E+06±3.11E+04	pCi/L	2.85E+03	EPA906.0	
HSP 10304	111735			1.94E+06±3.77E+04	pCi/L	3.30E+03	EPA906.0	
HSP 10304D	111763			1.96E+06±9.84E+03	pCi/L	1.50E+03	WSRC3Q161410	

Appendix E: Data Management/Administrative Files

This section discusses the generation, processing, and storage of paper and computer records produced during the completion of this project. The processing of the materials follows methodology prescribed by EGG EPD/EMS.

EGG establishes administrative files for each project that are maintained as permanent SRS records. The following materials are placed in the administrative files:

- Bound sample-collection logbooks
- Original copies of the chain-of-custody forms
- Case narratives from the laboratories
- Data-validation logbooks
- Data-entry cover sheets for data files created by EGG
- Copies of all correspondence between data validation personnel and the laboratories

EGG generates computer data files from paper records using double-entry methods to ensure a low transcription error rate. Computer data files for analytical data also are received from the laboratories. Changes to the data are recorded in the data-validation logbook, approved by the project technical manager, and confirmed through a computer program by comparing the modified and original data files. EGG stores the final computer data files, original source files, and computer listings of all changes made to the original files in the administrative files.

Access to the administrative files remains with the manager of EGG. Paper materials eventually will be transferred to permanent box storage; however, EGG plans to make the final data files available to SRS computer users indefinitely. Please contact the manager of EGG to obtain access to this data.

Appendix F: Glossary

Acceptance limits: The range of acceptable analytical results established by a laboratory for spike recovery, duplicate precision, and contamination levels.

Accuracy: The closeness of agreement between an observed value and an accepted reference value.

Activity: The rate of decay of a radioactive source at a given time.

Advisory range: The limits of acceptable analytical results established by the provider of certified quality control standards.

Aliquot: A measured portion of a sample taken for analysis.

Analysis: The separation and determination of the component parts or a specific property or element contained within a sample. The determination of the concentration or activity of an analyte contained within a sample.

Analysis date/time: The date and military time (24-hour clock) of the start of analysis on a prepared sample.

Analysis qualifier (AQ): See **Qualifier**.

Analyte: The specific compound, element, isotope, or radionuclide of interest that an analyst seeks to determine.

Analytical batch: A group of samples of the same matrix analyzed together using the same method and containing the required number of method blanks, matrix spike samples, laboratory control samples, and duplicate samples.

Analytical narrative: A portion of the data package that includes laboratory, contract, and sample identification. The analytical narrative also contains descriptive documentation of any problems encountered in processing the samples, along with corrective action taken and problems resolved.

Analytical sample: Any solution or medium introduced into an instrument on which an analysis is performed, excluding instrument calibration standards, calibration verification standards, and calibration blanks.

Appendix IX analytes: The list of analytes specified in Appendix IX of the *Code of Federal Regulations, Title 40, Part 264* that is required by the Resource Conservation and Recovery Act.

Aquifer: A geologic formation, group of formations, or part of a formation capable of yielding groundwater to wells or springs.

Associated sample: Any sample that is related to another sample or quality control sample. Some examples are the parent sample of a matrix spike, a sample in a preparation batch, a split sample, a duplicate sample, and a sample related to a blank.

Batch: A group of samples prepared at the same time, in the same location, using the same method.

Bias qualifier (BQ): See **Qualifier**.

Blank: An artificial sample designed to monitor the introduction of artifacts into the measurement process. For aqueous samples, deionized water is used as the blank matrix. A universal matrix does not exist for solid samples; therefore, no matrix blank is routinely used. There are several types of blanks that monitor a variety of processes. They are

- A *Field Blank for Soils* consists of DI water or dry quartz sand placed in a stainless steel bowl and exposed to the atmosphere while the associated sample is being taken. The field blank is shipped to the laboratory with the samples. The field blank measures contamination introduced during sample collection.
- A *Field Blank for Groundwater* is a sample container filled with DI water and capped in the WSRC well building. It is taken to the field during sampling, but is not opened. It is shipped to the laboratory with the samples to be analyzed.
- A *Rinsate* or *Equipment Blank* is deionized water poured over or through sample collection devices that tests for cleanliness of sampling equipment.
- A *Trip Blank* is shipped to the laboratory in the same cooler with the sample containers for volatile organic analytes. It provides a test for contamination from sample preservation and transport as well as sample storage, preparation, and analysis.
- A *Method Blank* is prepared in the laboratory and analyzed exactly as the samples it accompanies. It is a test for contamination in laboratory sample preparation and analyses.

These blanks are handled by the laboratory as actual samples; however, they are not to be used for matrix spike or duplicate samples.

Blank spike (BS): See **Laboratory Control Sample**.

Calibration: The establishment of an instrument response curve or mathematical correlation based on the measured response of known concentrations of an analyte or group of analytes.

Calibration blank: A volume of deionized water in the same matrix as the calibration standards, an empty planchet, or the instrument geometry that is analyzed to establish the instrument accuracy at the low end of the calibration curve.

Calibration verification: The periodic analysis of one or more standards independent of the calibration standards to verify the accuracy and stability of the initial instrument calibration.

Cation exchange capacity: The sum of exchangeable cations a soil can absorb expressed in milli-equivalents per 100 grams of soil. The cation exchange capacity is determined by sampling to the depth of solid waste placement and analyzing by the summation method for distinctly acid soils or the sodium acetate method for neutral, calcareous, or saline soils.

Certified value: The known concentration of an analyte in a reference sample as affirmed by the preparer.

Chain-of-custody (COC) form: A document designed to trace the custody of a sample(s) from the point of origin to final disposition, with the intent of legally proving that custody remained intact and that tampering or substitutions were precluded.

Coefficient of variation (CV): The standard deviation as a percent of the arithmetic mean.

Comparability: The degree of confidence with which one set of data can be compared to a related set of data.

Completeness: A measure of the amount of valid data obtained from a measurement system relative to the amount that was expected to be obtained under current, normal conditions.

Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA): A federal law passed in 1980 and periodically modified by the Superfund Amendments and Reauthorization Acts passed by the U.S. Congress. The acts created a special tax that goes into a trust fund, commonly known as Superfund, to investigate and clean up abandoned or uncontrolled hazardous waste sites. Under the program, the EPA has the following options:

- pay for the site cleanup when parties responsible for the contamination cannot be located or are unwilling or unable to perform the work
- take legal action to force parties responsible for site contamination to clean up the site or repay the federal government for the cost of the cleanup

Concentration: The relative fraction of one substance in another, normally expressed in weight percent, in volume percent, as a weight per volume ratio, or as a weight per weight ratio.

Confidence limits: The limits within which, at some specified level of probability, the true value of a result lies.

Confined aquifer: An aquifer bounded above and below by impermeable beds or by beds of distinctly lower permeability than the aquifer itself. Also, an aquifer containing confined groundwater.

Congener: Any one particular member of a class of chemical substances. A specific congener is denoted by a unique chemical structure e.g., 2,3,7,8-tetrachlorodibenzofuran.

Contaminant: A chemical or biological substance that is harmful if it is incorporated into, onto, or ingested by organisms, consumers of organisms, or users of the environment.

Continuing calibration blank (CCB): A blank analyzed periodically during an analytical run to detect carryover contamination.

Continuing calibration verification (CCV): The periodic analysis of one or more standards during an analytical run to verify that the initial calibration continues to be valid.

Contract-required quantitation limit (CRQL): The lowest required concentration of an analyte the laboratory may report for a specific contract. The contract-required quantitation limit is usually greater than the method detection limit.

Control limits: A range within which specified measurement results must fall to be compliant. Control limits may be mandatory, requiring corrective action if exceeded, or advisory, requiring that noncompliant data be flagged.

Correlation coefficient (r): A numeric value (r) that indicates the degree of dependence between two variables (concentration vs. response). The more dependent they are, the closer the value is to one. The correlation coefficient is determined on the basis of the least squares function.

Custody: Immediate charge, control, or possession exercised by a competent authority on a sample.

Data quality objectives: The objectives for precision, accuracy, representativeness, completeness, comparability, and detection levels that are required to support the intended use of the data.

Definitive data: Data for which the accuracy of the concentration level and the identity of the analyte of interest are assessed. Definitive data are determined for samples considered essential in the decision-making process.

Deionized (DI) water: Water from which all charged species or ionizable organic and inorganic salts are removed by means of ion exchange.

Detection: The act of measuring the quantity of a property, compound, or element contained in a sample.

Dilution factor: The mathematical factor by which a sample is diluted to bring the concentration of an analyte in the sample within the analytical range of the instrument (e.g., 1 mL of sample + 9 mL of solvent = 1:10 dilution, or a dilution factor of 10).

Dry weight: The weight of a sample based on percent solids or the weight after drying in an oven for a specified time period at a specified temperature.

Electronic data deliverable (EDD): The summary of analytical results on machine-readable media received from a laboratory.

Estimated quantitation limit (EQL): The minimum concentration of a substance that can be reliably measured and reported within specified limits of precision and accuracy during routine laboratory operating conditions.

Field blank: See **Blank**.

Field duplicate: A second sample taken at the same time as the primary sample and sent to the laboratory for analysis as an unknown. The field duplicate is used to determine the precision of the entire sampling and analytical process.

Field sample: The material received at the laboratory to be analyzed that is contained in single or multiple containers and identified by a unique WSRC sample identification number.

Frequency: The specified intervals between samples in which quality control samples or standards must be analyzed during an analytical run.

Groundwater: Water in a saturated zone or stratum beneath the surface of land.

Half-life: The time required for one-half of the initial number of radioactive nuclei of a specific isotopic species to undergo radioactive decay.

Holding time: The maximum amount of time allowed for samples to be held from sample collection to laboratory analysis.

Independent standard: A laboratory-prepared standard solution that is composed of analytes from a different source than those used in the standards for the initial calibration.

Initial calibration: The analysis of standards containing varying concentration levels of the analytes of interest in order to establish the ratio of concentration vs. response across the working range of the analytical technique. The initial calibration is used to define the linearity and dynamic range of response of the detector to the target analytes.

Initial calibration blank (ICB): A blank analyzed immediately after the initial calibration verification but before the analytical run to detect carryover contamination.

Initial calibration verification (ICV): The analysis of one or more standards immediately after the initial calibration but before the analytical run to verify that the initial calibration was valid.

Instrument detection limit (IDL): The minimum concentration of an analyte that can be measured and reported with 99% confidence that the analyte concentration is greater than zero. It is determined from analysis of a deionized water blank containing the analyte.

Interference check sample (ICS): Two solutions, one consisting of interferents only (ICSA) and one consisting of interferents mixed with the analytes (ICSAB), that are analyzed consecutively to verify the interelement and background correction factors for inductively coupled plasma metal analyses.

Interferents: Substances that affect the analysis for the element of interest.

Interlaboratory comparison: The comparison of results from split samples analyzed by two laboratories.

Internal standard: A chemically inert compound not expected to occur in an environmental sample that is added to a sample prior to analysis; it is used as an instrument response check.

Intralaboratory comparison: The comparison of duplicate results from a single sample analyzed by a laboratory.

Isomer: One of two or more chemical substances having the same elementary percentage composition and molecular weight but differing in structure and properties.

Isotope: One of a number of specific atoms with identical atomic numbers but with discrete atomic weights, or similarly specific atoms whose nuclei have the same number of protons but different numbers of neutrons.

Laboratory control sample (LCS): A control sample of known composition. Aqueous and solid laboratory control samples are analyzed using the same sample preparation, reagents, and analytical methods employed for the samples received.

Laboratory data records review (LDRR): The investigation of technical data validation issues that are not adequately addressed by the computer checking of EDDs, the review of the analytical narratives, and the review of the COC forms. The review is conducted at the laboratory using the laboratory's instrument logs, raw analytical data, and other pertinent documentation.

Laboratory duplicate: A second aliquot of a homogenized sample that is analyzed as an individual sample, using the same procedure. This duplicate is used to determine the precision of the method.

Laboratory ID: The identifier assigned by the laboratory for its internal use during the analytical process.

Linear range, linear dynamic range: The concentration range over which the calibration curve remains linear.

Lowest practical quantitation limit (LPQL): The lowest concentration of an analyte that can be reliably achieved within specified limits of precision and accuracy during routine laboratory operating conditions.

Matrix: The predominant material of which the sample to be analyzed is composed. For the purpose of this document, a sample matrix is either water or soil/sediment.

Matrix interference: The influence of the sample matrix or sample components upon the ability to quantitatively measure compounds in environmental samples.

Matrix spike/matrix spike duplicate: A first and second aliquot of a matrix fortified (spiked) with a known quantity of analyte(s) and subjected to the entire analytical procedure in order to determine the appropriateness of the method for the matrix by measuring accuracy (recovery) and precision (relative percent difference).

Maximum contaminant level (MCL): The maximum permissible level of a contaminant in a specified medium.

Mean relative difference (MRD): The average of the absolute difference of the results from two laboratories for the i^{th} sample that is expressed as a percentage of the mean of both laboratories.

Method blank: See **Blank.**

Method detection limit (MDL): The minimum concentration of an analyte that can be measured and reported with 99% confidence that the analyte concentration is greater than zero. It is determined from analysis of a sample in a given matrix containing the analyte.

Minimum detectable activity (MDA): The smallest quantity of a radionuclide that can be detected in a sample with a 95% confidence level.

Nuclide: General term applied to all isotopes of all elements including stable and radioactive forms. Nuclides are not considered isotopes; rather, a given nuclide is characterized by the number of neutrons and protons contained in the atomic nuclei of that species.

Null hypothesis: A statement that can be tested statistically to determine if there is a significant difference between duplicate/split results.

Parts per billion (ppb)/Parts per million (ppm): Units commonly used to express low concentrations of contaminants. For example, 5 micrograms of benzene in 1 kilogram of soil is 5 ppb; 3 milligrams of nitrate in 1 liter of water is 3 ppm.

Percent moisture: An approximation of the amount of water in a soil/sediment sample determined by drying an aliquot of sample at a specified temperature until constant weight is achieved.

Percent recovery: A measure of recovery that is calculated as the measured value relative to the true value, expressed as a percent.

Percent solids: The proportion of solid in a soil/sediment sample determined by the percent moisture procedure.

Performance evaluation sample: A sample of known composition that may be provided by the EPA or WSRC for laboratory analysis that is used to evaluate laboratory performance.

PicoCurie (pCi): The unit of radiation equivalent to 3.7×10^{-2} disintegrations per second.

Precision: The agreement or repeatability of a set of replicate results among themselves, usually expressed in terms of the deviation of a set of results from the arithmetic mean. Precision may be qualified in terms of possible sources of variability, replicability, repeatability, and reproducibility.

Preparation log: An official record of the sample preparation.

Preservative: A chemical compound added to a sample or a physical process (such as cooling) to prevent or slow decomposition or degradation of a target analyte. Physical and chemical preservation may be used in tandem to prevent sample deterioration.

Primary laboratory: The laboratory having a contract with WSRC to perform a specific set of analyses for field-generated samples, duplicates, and blanks. A primary laboratory may subcontract this work to other laboratories.

Qualifier: A code used to convey additional information about an analytical result. See the following examples.

- A *Result Qualifier* is used to indicate the usability of the result for regulatory purposes.

- An *Analysis Qualifier* is used to describes analytical conditions which apply to the datum. Analysis qualifiers are included for information only.
- A *Bias Qualifier* is a code used to indicate whether a result may overestimate or underestimate the true value. It also may be used to indicate poor precision.

See *Appendix D* for additional information and the specific qualifiers used.

Qualitative analysis: An analysis to determine the presence or absence of a target analyte.

Quality assurance plan: The documented data quality objectives and the actions to be performed to meet those objectives.

Quality control (QC): The performance of actions that provide a way to control and measure the characteristics of measurement equipment and processes to meet the established data quality objectives.

Quantitative analysis: An analysis to measure or determine the amount of a target compound or analyte within the limits of defined precision and accuracy requirements.

Radionuclide: Any radioactive isotope of an element.

Range: The difference between the maximum and minimum values within a set of values.

RCRA Facility Investigation/Remedial Investigation (RFI/RI) program: The EPA-regulated investigation of a solid-waste management site, including CERCLA and hazardous-substance regulations, with regard to its potential impact on the environment.

Recovery: A determination of accuracy of the analytical procedure made by comparing measured values for a reference or fortified (spiked) sample against the known true reference or spike values.

Reference detection limit (RDL): The detection limit chosen to allow comparison of multiple analyses with different detection limits. For this report, the individual detection limits of at least 90% of the analyses are less than the reference detection limit.

Relative percent difference (RPD): A measure of precision that is calculated as the absolute value of the difference between two results, relative to their arithmetic mean, expressed as a percent.

Reporting limit: The value reported in the result field when an analyte is not detected.

Reproducibility: The precision of measurements of the same sample at different laboratories using the same protocols.

Resolution: The degree to which two signal peaks are separated. Resolution is calculated by dividing the height of the valley between the peaks by the height of the peak being resolved, multiplied by 100.

Resource Conservation and Recovery Act (RCRA): A 1976 federal law that established a regulatory system to define and track hazardous wastes from the time of generation to disposal. The law requires safe and secure procedures to be used in treating, transporting, storing, and disposing of hazardous substances.

Rinsate blank: See **Blank**.

Run: A continuous analytical sequence consisting of prepared samples and all associated quality control measurements.

Sample: A portion of material to be analyzed that is contained in single or multiple containers and identified by a unique sample number.

Sample ID: A unique identification number designated by WSRC for each sample. The WSRC sample ID appears on the sample chain of custody that documents information on that sample.

Sample matrix: All of the chemical components and physical characteristics of a sample other than the parameter of interest.

Sample-specific estimated quantitation limit (ssEQL): The estimated quantitation limit multiplied by factors of concentration, dilution, aliquot size, and percent solids.

Sediment: The unconsolidated inorganic and organic material that is suspended in and being transported by surface water or that has settled out and has deposited into beds.

Self-absorption: The internal absorption of radiation by material in which radioactive atoms are located.

Sensitivity: The ability of a measurement system to detect and accurately quantitate a parameter at a critical level within a specific sample matrix. The critical level may be a regulatory maximum contaminant level (MCL), MDA, or risk-based exposure level.

Significance of probability: The probability of observing a statistical value as significant as, or even more significant than, the value actually observed.

Soil: All unconsolidated materials normally found on or near the surface of the earth including, but not limited to, silts, clays, sands, gravel, and small rocks.

Solvent: Liquid that is capable of dissolving another substance.

Split sample: A second aliquot of a sample, generated in the field, that is sent to a secondary laboratory for analysis; a split sample serves as a quality control check.

Standard deviation: The measurement of dispersion about a mean value of a series of observations expressed in the same units as the mean value.

Surface water: All water that is open to the atmosphere and subject to surface runoff.

Surrogate: A chemically inert organic compound similar in composition and test performance to an analyte of interest added to samples prior to analysis as a quality control check.

Surrogate recovery: A quality control measurement to monitor unusual matrix effects, gross sample processing errors, etc. It is evaluated for acceptance by determining whether the measured concentration falls within the statistical acceptance limits established by the laboratory.

Target analyte list (TAL): The list of inorganic analytes required by CERCLA.

Target compound list (TCL): The list of organic analytes required by CERCLA.

Technical holding time: The storage time allowed between sample collection and sample analysis when designated preservation and storage techniques are employed. This is determined by the elapsed time in days from the date and time of collection to the date and time of sample preparation and analysis.

- Technical holding time = (sample analysis date and time – sample collection date and time).

Tentatively identified compound (TIC): Chromatographic peak in volatile and semivolatile fraction analysis that is not a target analyte, surrogate, or internal standard.

Time: When required to record time on any deliverable item, time is expressed as military time, i.e., on a 24-hour clock.

Toxicity characteristic leaching procedure (TCLP): An analytical extraction procedure used to determine the mobility of both inorganic and organic analytes present in solid, liquid, and multiphasic wastes.

Tracer: A quantity of a unique radioisotope of the same element added to a sample, chemically prepared, or separated and counted. The quantity of tracer measured is compared to the quantity of target radioactive element measured, and the target quantity is calculated on the basis of unity with the tracer concentration.

Trip blank: See **Blank**.

Wet weight: The weight of a sample aliquot including moisture (undried).