Data Validation Package

June 2016
Groundwater Sampling at the Hallam, Nebraska, Decommissioned Reactor Site

August 2016

U.S. DEPARTMENT OF ENERGY | Legacy Management

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Sampling Event Summary

Site: Hallam, Nebraska, Decommissioned Reactor Site

Sampling Period: June 27–28, 2016

The 2008 *Long-Term Surveillance Plan* [LTSP] *for the Decommissioned Hallam Nuclear Power Facility, Hallam, Nebraska* (http://www.lm.doe.gov/Hallam/Documents.aspx) requires groundwater monitoring once every 2 years. Seventeen monitoring wells at the Hallam site were sampled during this event as specified in the plan. Planned monitoring locations are shown in Attachment 1, Sampling and Analysis Work Order.

Water levels were measured at all sampled wells and at two additional wells (6A and 6B) prior to the start of sampling. Additionally, water levels of each sampled well were measured at the beginning of sampling. See Attachment 2, Trip Report, for additional details. Sampling and analysis were conducted as specified in *Sampling and Analysis Plan for U.S. Department of Energy Office of Legacy Management Sites* (LMS/PRO/S04351, continually updated, http://energy.gov/lm/downloads/sampling-and-analysis-plan-us-department-energy-office-legacy-management-sites).

Gross alpha and gross beta are the only parameters that were detected at statistically significant concentrations. Time/concentration graphs of the gross alpha and gross beta data are included in Attachment 3, Data Presentation. The gross alpha and gross beta activity concentrations observed are consistent with values previously observed and are attributed to naturally occurring radionuclides (e.g., uranium and uranium decay chain products) in the groundwater. An assessment of anomalous data is included in Attachment 4.

Michele L. Miller
2016.08.24 16:06:36 -04'00'

Michele Miller, Site Lead
Navarro Research and Engineering, Inc.

Date

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Data Assessment Summary

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Water Sampling Field Activities Verification Checklist

Project	Hallam, Nebraska	**Date(s) of Water Sampling**	June 27–28, 2016
Date(s) of Verification	August 10, 2016	**Name of Verifier**	Stephen Donivan

	Response (Yes, No, NA)	Comments
1. Is the SAP the primary document directing field procedures?	Yes	
List any Program Directives or other documents, SOPs, instructions.		Work Order letter dated May 4, 2016.
2. Were the sampling locations specified in the planning documents sampled?	Yes	
3. Were field equipment calibrations conducted as specified in the above-named documents?	Yes	Calibrations were performed on June 22, 2016.
4. Was an operational check of the field equipment conducted daily?	Yes	
Did the operational checks meet criteria?	Yes	
5. Were the number and types (alkalinity, temperature, specific conductance, pH, turbidity, DO, ORP) of field measurements taken as specified?	Yes	
6. Were wells categorized correctly?	Yes	
7. Were the following conditions met when purging a Category I well:		
Was one pump/tubing volume purged prior to sampling?	Yes	
Did the water level stabilize prior to sampling?	Yes	
Did pH, specific conductance, and turbidity measurements meet criteria prior to sampling?	Yes	
Was the flow rate less than 500 mL/min?	Yes	

Water Sampling Field Activities Verification Checklist (continued)

	Response (Yes, No, NA)	Comments
8. Were the following conditions met when purging a Category II well:		
Was the flow rate less than 500 mL/min?	Yes	
Was one pump/tubing volume removed prior to sampling?	Yes	
9. Were duplicates taken at a frequency of one per 20 samples?	Yes	A duplicate sample was collected at location 1A.
10. Were equipment blanks taken at a frequency of one per 20 samples that were collected with non-dedicated equipment?	NA	An equipment blank was not required.
11. Were trip blanks prepared and included with each shipment of VOC samples?	NA	
12. Were the true identities of the QC samples documented?	Yes	
13. Were samples collected in the containers specified?	Yes	
14. Were samples filtered and preserved as specified?	Yes	
15. Were the number and types of samples collected as specified?	Yes	
16. Were chain of custody records completed and was sample custody maintained?	Yes	
17. Was all pertinent information documented on the field data sheets?	Yes	
18. Was the presence or absence of ice in the cooler documented at every sample location?	NA	Sample cooling was not required.
19. Were water levels measured at the locations specified in the planning documents?	Yes	

Laboratory Performance Assessment

General Information

Report Number (RIN): 16067887
Sample Event: June 27–28, 2016
Site(s): Hallam, Nebraska
Laboratory: ALS Laboratory Group, Fort Collins, Colorado
Work Order No.: 1606558
Analysis: Radiochemistry
Validator: Stephen Donivan
Review Date: August 4, 2016

This validation was performed according to "Standard Practice for Validation of Environmental Data" found in Appendix A of *Sampling and Analysis Plan for U.S. Department of Energy Office of Legacy Management Sites* (LMS/PRO/S04351, continually updated, http://energy.gov/lm/downloads/sampling-and-analysis-plan-us-department-energy-office-legacy-management-sites). The procedure was applied at Level 3, Data Validation.

This validation includes the evaluation of data quality indicators (DQIs) associated with the data. DQIs are the quantitative and qualitative descriptors that are used to interpret the degree of acceptability or utility of data. Indicators of data quality include the analysis of laboratory control samples to assess accuracy; duplicates and replicates to assess precision; and interference check samples to assess bias (see Figures 1 and 2, Data Validation Worksheets). The DQIs comparability, completeness, and sensitivity are also evaluated in the sections to follow.

The samples were prepared and analyzed using accepted procedures based on methods specified by line item code, which are listed in Table 1.

Table 1. Analytes and Methods

Analyte	Line Item Code	Preparation Method	Analytical Method
Gamma Spectrometry	GAM-A-001	SOP713R11	SOP713R11
Gross Alpha/Beta	GPC-A-001	SOP702R19	SOP724R10
Tritium	LSC-A-001	SOP700R10	SOP704R9
Nickel-63	LSC-A-009	SOP774R1	SOP704R9

Data Qualifier Summary

Analytical results were qualified as listed in Table 2. Refer to the sections below for an explanation of the data qualifiers applied.

Table 2. Data Qualifiers

Sample Number	Location	Analyte	Flag	Reason
1606558-1	1A	Thorium-234	U	Nuclide identification criteria
1606558-1	1A	Gross Beta	J	Result less than the determination limit
1606558-2	1B	Actinium-228	U	Nuclide identification criteria
1606558-2	1B	Potassium-40	U	Nuclide identification criteria
1606558-2	1B	Lead-212	U	Nuclide identification criteria
1606558-2	1B	Thorium-234	U	Nuclide identification criteria
1606558-3	1A Duplicate	Actinium-228	U	Nuclide identification criteria
1606558-3	1A Duplicate	Gross Beta	J	Result less than the determination limit
1606558-3	1A Duplicate	Thorium-234	U	Nuclide identification criteria
1606558-7	2C2	Actinium-228	U	Nuclide identification criteria
1606558-8	3A	Gross Alpha	J	Result less than the determination limit
1606558-10	4A	Gross Alpha	J	Result less than the determination limit
1606558-13	5A	Gross Alpha	J	Result less than the determination limit
1606558-14	5B	Actinium-228	U	Nuclide identification criteria
1606558-15	7B	Actinium-228	U	Nuclide identification criteria
1606558-15	7B	Promethium-144	U	Nuclide identification criteria
1606558-16	7C	Actinium-228	U	Nuclide identification criteria

Sample Shipping/Receiving

ALS Laboratory Group in Fort Collins, Colorado received 18 samples on June 30, 2016, accompanied by Chain of Custody (COC) forms. The COC form was checked to confirm that all of the samples were listed on the form with sample collection dates and times, and that signatures and dates were present indicating sample relinquishment and receipt. The sample submittal documents including the COC form and the sample tickets had no errors or omissions.

Holding Times and Preservation

The sample shipments were received intact at ambient temperature. All samples were received in the correct container types and had been preserved correctly for the requested analyses and all samples were analyzed within the applicable holding times.

Detection and Quantitation Limits

Radiochemical results are evaluated using the minimum detectable concentration (MDC), Decision Level Concentration (DLC), and Determination Limit (DL). The MDC is a measure of radiochemical method performance and was calculated and reported as specified in *Quality Systems for Analytical Services*. The DLC is the minimum concentration of an analyte that can be measured and reported with 99 percent confidence that the analyte concentration is greater than zero, and is estimated as 3 times the one-sigma total propagated uncertainty. Results that are greater than the MDC, but less than the DLC are qualified with a “U” flag (not detected). The DL for radiochemical results is the lowest concentration that can be reliably measured, and is

defined as 3 times the MDC. Results not previously "U" qualified that are less than the DL are qualified with a "J" flag as estimated values.

The reported MDCs for radiochemical analytes demonstrate compliance with contractual requirements.

Laboratory Instrument Calibration

Compliance requirements for satisfactory instrument calibration are established to ensure that the instrument is capable of producing acceptable qualitative and quantitative data for all analytes. Initial calibration demonstrates that the instrument is capable of acceptable performance in the beginning of the analytical run and of producing a linear curve. Compliance requirements for continuing calibration checks are established to ensure that the instrument continues to be capable of producing acceptable qualitative and quantitative data. All laboratory instrument calibrations were performed correctly in accordance with the cited methods.

Radiochemical Analysis

Radiochemical results are qualified with a "J" flag (estimated) when the result is greater than the minimum detectable concentration (MDC), but less than Determination Limit (3 times the MDC). Radiochemical results are qualified with a "U" flag (not detected) when the result is greater than the MDC, but less than the Decision Level Concentration estimated as the two sigma total propagated uncertainty.

Gamma Spectrometry

Activity concentrations above the MDC were reported in some instances where minimum nuclide identification criteria were not met. Such tentative identifications result when the software attempts to calculate net activity concentrations for analytes where either one or both of the following criteria are not satisfied: the 'diagnostic' peak for a nuclide must be identified above the critical level, or the minimum library peak abundance must be attained. Sample results for gamma-emitting radionuclides that do not meet the identification criteria are qualified with a "U" flag as not detected.

In some cases where there are no peaks found in the peak search routine, the laboratory software performed a net quantification. This indicates that nuclides are not detected or supported at any level above the reported MDC. Consequently, the results for these nuclides are flagged with an "NQ" qualifier on the final laboratory reports and qualified with a "U" flag as not detected.

Method and Calibration Blanks

Method blanks are analyzed to assess any contamination that may have occurred during sample preparation. Calibration blanks are analyzed to assess instrument contamination prior to and during sample analysis. All blank results were below the minimum detectable concentration.

Matrix Spike Analysis

Matrix spikes are aliquots of environmental samples to which a known concentration of analyte has been added before analysis. Matrix spike and matrix-spike duplicate (MS/MSD) analysis is used to assess the performance of the method by measuring the effects of interferences caused by the sample matrix and reflects the bias of the method for the particular matrix in question. MS/MSD were analyzed for gross alpha, gross beta, and tritium. All spike results were within the acceptance range.

Laboratory Duplicate Analysis

The laboratory replicate sample results demonstrate acceptable laboratory precision with relative error ratios less than 3 for all duplicate sample results.

Laboratory Control Sample

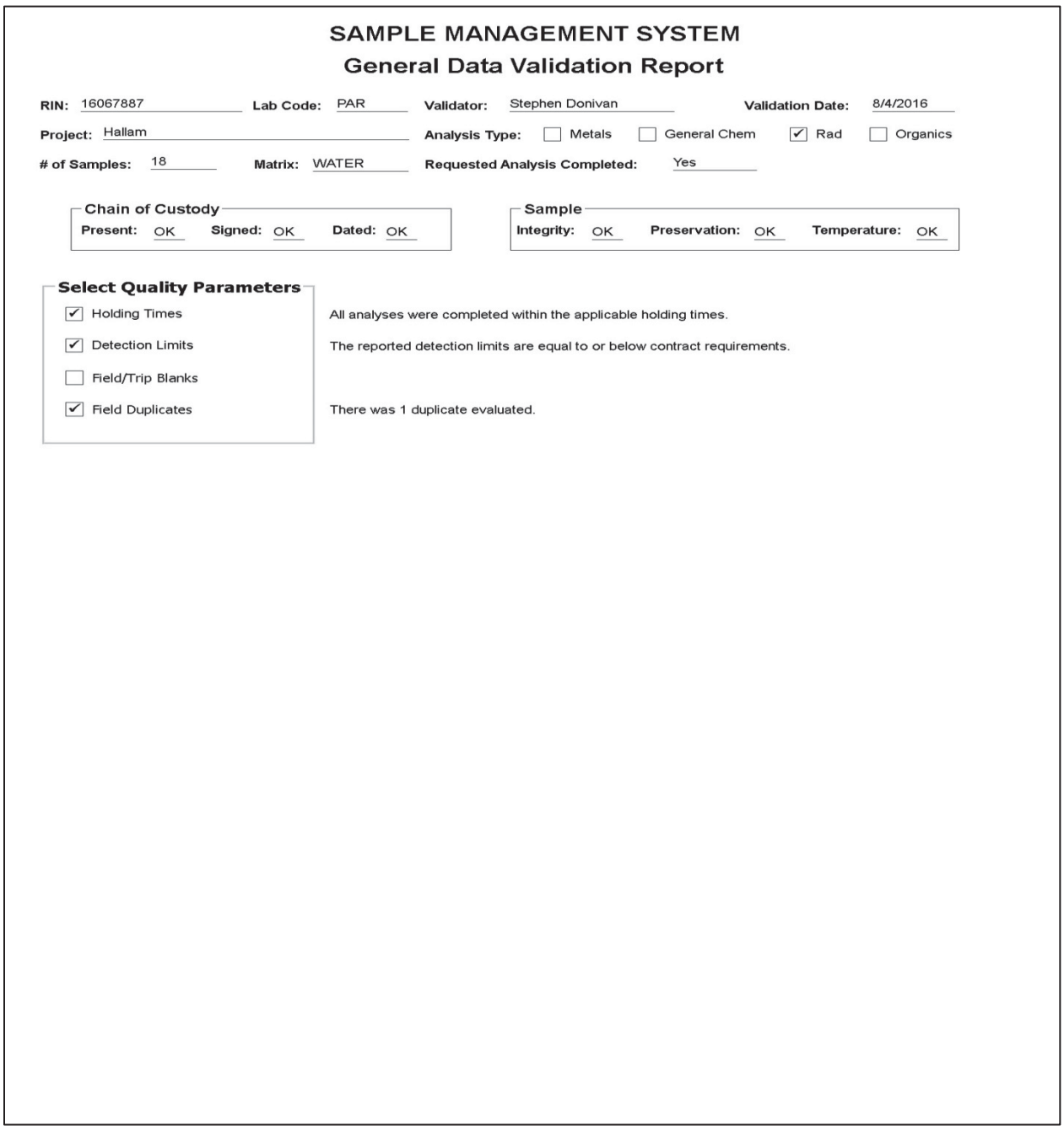
Laboratory control samples (LCS) were analyzed at the correct frequency to provide information on the accuracy of the analytical method and the overall laboratory performance, including sample preparation. The LCS results were acceptable for all analytes.

Completeness

Results were reported in the correct units for all analytes requested using contract-required laboratory qualifiers.

Electronic Data Deliverable (EDD) File

The EDD file arrived on July 30, 2016. The EDD was examined to verify that the file was complete and in compliance with requirements. The contents of the file were compared to the requested analyses to ensure all and only the requested data are delivered. The contents of the EDD were manually examined to verify that the sample results accurately reflect the data contained in the sample data package.



SAMPLE MANAGEMENT SYSTEM

General Data Validation Report

RIN: 16067887 Lab Code: PAR Validator: Stephen Donivan Validation Date: 8/4/2016

Project: Hallam Analysis Type: ☐ Metals ☐ General Chem ☑ Rad ☐ Organics

# of Samples: 18 Matrix: WATER Requested Analysis Completed: Yes

Chain of Custody

Present: OK Signed: OK Dated: OK

Sample

Integrity: OK Preservation: OK Temperature: OK

Select Quality Parameters

☑ Holding Times	All analyses were completed within the applicable holding times.
☑ Detection Limits	The reported detection limits are equal to or below contract requirements.
☐ Field/Trip Blanks	
☑ Field Duplicates	There was 1 duplicate evaluated.

Figure 1. General Validation Worksheet

SAMPLE MANAGEMENT SYSTEM
Radiochemistry Data Validation Worksheet

RIN: 16067887 **Lab Code:** PAR **Date Due:** 7/28/2016

Matrix: Water **Site Code:** HAL01 **Date Completed:** 8/1/2016

Sample	Analyte	Date Analyzed	Result	Flag	Tracer %R	LCS %R	MS %R	Duplicate RER
2A	Actinium-228	07/24/2016						0.65
2A	Americium-241	07/24/2016						1.47
Blank_Spike	Americium-241	07/25/2016				99.60		
2A	Antimony-125	07/24/2016						1.01
2A	Cerium-144	07/24/2016						0.73
2A	Cesium-134	07/24/2016						1.38
2A	Cesium-137	07/24/2016						0.76
Blank_Spike	Cesium-137	07/25/2016				97.00		
2A	Cobalt-60	07/24/2016						0.26
Blank_Spike	Cobalt-60	07/25/2016				101.00		
2A	Europium-152	07/24/2016						0.55
2A	Europium-154	07/24/2016						0.98
2A	Europium-155	07/24/2016						0.13
Blank	GROSS ALPHA	07/19/2016	0.2860	U				
1A	GROSS ALPHA	07/19/2016					72.5	
Blank_Spike	GROSS ALPHA	07/19/2016				95.00		
2B	GROSS ALPHA	07/25/2016						1.11
Blank	GROSS BETA	07/19/2016	0.1650	U				
1A	GROSS BETA	07/19/2016					86.1	
Blank_Spike	GROSS BETA	07/19/2016				101.00		
2B	GROSS BETA	07/25/2016						0.32
2A	H-3	07/27/2016						0.08
Blank	H-3	07/29/2016	-151.0000	U				
8C	H-3	07/29/2016					101.0	
Blank_Spike	H-3	07/29/2016				105.00		
2A	Lead-212	07/24/2016						0.34
1A	Nickel-63	07/25/2016			75.7			
1B	Nickel-63	07/25/2016			75.3			
1Z	Nickel-63	07/25/2016			77.3			
2A	Nickel-63	07/25/2016			78.5			
2B	Nickel-63	07/25/2016			87.1			
2B2	Nickel-63	07/25/2016			80.0			

Figure 2. Radiochemistry Validation Worksheet

SAMPLE MANAGEMENT SYSTEM
Radiochemistry Data Validation Worksheet

RIN: 16067887 **Lab Code:** PAR **Date Due:** 7/28/2016

Matrix: Water **Site Code:** HAL01 **Date Completed:** 8/1/2016

Sample	Analyte	Date Analyzed	Result	Flag	Tracer %R	LCS %R	MS %R	Duplicate RER
2C2	Nickel-63	07/25/2016			71.4			
3A	Nickel-63	07/25/2016			72.5			
3B	Nickel-63	07/25/2016			69.4			
4A	Nickel-63	07/25/2016			67.6			
4B	Nickel-63	07/25/2016			75.4			
4C	Nickel-63	07/25/2016			67.8			
5A	Nickel-63	07/25/2016			79.1			
5B	Nickel-63	07/25/2016			86.0			
7B	Nickel-63	07/25/2016			76.4			
7C	Nickel-63	07/25/2016			76.9			
4A	Nickel-63	07/25/2016			69.7			0.75
8B	Nickel-63	07/26/2016			75.4			
8C	Nickel-63	07/26/2016			80.9			
Blank_Spike	Nickel-63	07/26/2016			79.0	86.20		
Blank	Nickel-63	07/26/2016	-3.2300	U	78.5			
2A	Potassium-40	07/24/2016						0.35
2A	Promethium-144	07/24/2016						0.10
2A	Promethium-146	07/24/2016						0.39
2A	Ruthenium-106	07/24/2016						1.38
2A	Thorium-234	07/24/2016						0.07
2A	Uranium-235	07/24/2016						0.26
2A	Yttrium-88	07/24/2016						0.06

Figure 2. Radiochemistry Validation Worksheet (cont.)

Sampling Quality Control Assessment

The following information summarizes and assesses quality control for this sampling event.

Sampling Protocol

All monitoring wells were purged and sampled using Category I or II low-flow sampling methods. The sample results from all Category I and II wells are qualified with a “F” flag indicating that the wells were sampled using the low-flow technique. With the exception of well 1A, the data were further qualified with a “Q” flag as estimated values because these are Category II wells.

Equipment Blank Assessment

An equipment blank was not collected because dedicated tubing was used to sample all wells.

Field Duplicate Assessment

Field duplicate samples are collected and analyzed as an indication of overall precision of the measurement process. The precision observed includes both field and laboratory precision and has more variability than laboratory duplicates, which measure only laboratory performance. A duplicate sample was collected from location 1A. For radiochemical measurements, the relative error ratio calculated from the 1-sigma uncertainties should be less than three. All duplicate results met these criteria demonstrating acceptable precision (Figure 3).

SAMPLE MANAGEMENT SYSTEM

Validation Report: Field Duplicates

RIN: 16067887 **Lab Code:** PAR **Project:** Hallam **Validation Date:** 8/4/2016

Duplicate: 1Z **Sample:** 1A

Analyte	Sample Result	Flag	Error	Dilution	Duplicate Result	Flag	Error	Dilution	RPD	RER	Units
Actinium-228	5.17	U	11.2	1	20		11.2	1		1.8	pCi/L
Americium-241	-3.34	U	54.6	1	-5.63	U	19.9	1		0.1	pCi/L
Antimony-125	0.219	U	6.54	1	3.9	U	6.46	1		0.8	pCi/L
Cerium-144	-7.11	U	12.9	1	4.56	U	13.1	1		1.2	pCi/L
Cesium-134	-1.24	U	2.77	1	2.18	U	4.08	1		1.4	pCi/L
Cesium-137	0.544	U	2.85	1	-0.806	U	2.87	1		0.7	pCi/L
Cobalt-60	-0.405	U	2.78	1	-1.69	U	3.18	1		0.6	pCi/L
Europium-152	3.56	U	13.4	1	-5.35	U	16.6	1		0.8	pCi/L
Europium-154	-6.78	U	15.9	1	-2.67	U	15.3	1		0.4	pCi/L
Europium-155	-4.66	U	7.62	1	-0.573	U	7.59	1		0.7	pCi/L
GROSS ALPHA	1.58	U	1.91	1	1.05	U	1.87	1		0.4	pCi/L
GROSS BETA	5.03		2.14	1	5.24		2.35	1		0.1	pCi/L
H-3	-131	U	196	1	-135	U	189	1		0	pCi/L
Lead-212	6.67	U	4.28	1	-0.891	U	8.41	1		1.6	pCi/L
Nickel-63	-2.88	U	4.46	1	-7.39	U	4.43	1		1.4	pCi/L
Potassium-40	-38.3	U	93	1	-21.1	U	82.6	1		0.3	pCi/L
Promethium-144	2.81	U	3.23	1	2.49	U	3.09	1		0.1	pCi/L
Promethium-146	0.762	U	3.03	1	-1.26	U	3.34	1		0.9	pCi/L
Ruthenium-106	2.61	U	26.3	1	-6.97	U	27.3	1		0.5	pCi/L
Thorium-234	81.3	U	40.8	1	187	U	46.6	1		2.3	pCi/L
Uranium-235	6.98	U	12.3	1	16.2	U	12.7	1		1.0	pCi/L
Yttrium-88	3.55	U	3.27	1	2.52	U	3.63	1		0.4	pCi/L

Figure 3. Field Duplicate Validation Worksheet

Certification

All laboratory analytical quality control criteria were met except as qualified in this report. The data qualifiers listed on the environmental database reports are defined on the last page of each report. All data in this package are considered validated and available for use.

STEPHEN DONIVAN (Affiliate)
2016.08.23 10:59:01 -06'00'

Laboratory Coordinator: _____ _____
Stephen Donivan Date

STEPHEN DONIVAN
(Affiliate)
2016.08.23 10:59:28 -06'00'

Data Validation Lead: _____ _____
Stephen Donivan Date

Attachment 1

Sampling and Analysis Work Order

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May 4, 2016

Task Assignment 101
Control Number 16-0574

U.S. Department of Energy
Office of Legacy Management
ATTN: Scott Surovchak
Site Manager
2597 Legacy Way
Grand Junction, CO 81503

SUBJECT: Contract No. DE-LM0000421, Navarro Research & Engineering, Inc. (Navarro)
Task Assignment 101 LTS&M-CERCLA/RCRA, D&D and Other Sites

REFERENCE: Task Assignment 101, 1-101-1-07-303, Hallam, Nebraska, Site

Dear Mr. Surovchak:

The purpose of this letter is to inform you of the upcoming sampling event at the Hallam, Nebraska Decommissioned Reactor Site. Enclosed are the map and tables specifying sample locations and analytes for monitoring at the Hallam site. Water quality data will be collected at this site as part of the routine environmental sampling currently scheduled to begin the week of June 13, 2016.

The following list shows the wells (with zone of completion) scheduled to be sampled during this event.

Monitoring Wells (filtered)*

1A Gt	2B Gt	3A Gt	4B Gt	5A Gt	7B Gt	8B Gt
1B Gt	2B2 Gt	3B Gt	4C Gt	5B Gt	7C Gt	8C Gt
2A Gt	2C2 Gt	4A Gt				

*NOTE: Gt = Glacial till

All samples will be collected as directed in the *Sampling and Analysis Plan for U.S. Department of Energy Office of Legacy Management Sites*. Access agreements are being reviewed and are expected to be complete by the beginning of fieldwork.

Please contact me at (412) 818-7015 if you have any questions.

Sincerely,

Michele L. Miller
2016.05.04 13:16:57
-04'00'

Michele Miller
LMS Site Lead

MM/lcg/jp

Enclosures (3)

cc: (electronic)
Christina Pennal, DOE
Jeff Carman, Navarro
Beverly Cook, Navarro
Yvonne Deyo, Navarro
Steve Donivan, Navarro
Lauren Goodknight, Navarro
Sam Marutzky, Navarro
Michelle Miller, Navarro
Diana Osborne, Navarro
Debbie Pleva, Navarro
rc-grand.junction
File: HAL 0400.02

Hallam, Nebraska, Decommissioned Reactor Site Planned Sampling Map

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Sampling Frequencies for Locations at Hallam, Nebraska

Location ID	Quarterly	Semiannually	Annually	Biennially	Not Sampled	Notes
Monitoring Wells						
1A				X		Next in 6/2014
1B				X		Next in 6/2014
2A				X		Next in 6/2014
2B				X		Next in 6/2014
2B2				X		Next in 6/2014
2C2				X		Next in 6/2014
3A				X		Next in 6/2014
3B				X		Next in 6/2014
4A				X		Next in 6/2014
4B				X		Next in 6/2014
4C				X		Next in 6/2014
5A				X		Next in 6/2014
5B				X		Next in 6/2014
6A					X	Water level; micropurge if possible
6B					X	Water level; micropurge if possible
7B				X		Next in 6/2014
7C				X		Next in 6/2014
8B				X		Next in 6/2014
8C				X		Next in 6/2014

Sampling conducted in June
Based on LTSP dated June 2008

Constituent Sampling Breakdown

Site	Hallam				
Analyte	Groundwater	Surface Water	Required Detection Limit (mg/L)	Analytical Method	Line Item Code
Approx. No. Samples/yr	17	0			
Field Measurements					
Alkalinity	X				
Dissolved Oxygen					
Redox Potential	X				
pH	X				
Specific Conductance	X				
Turbidity	X				
Temperature	X				
Laboratory Measurements					
Aluminum					
Ammonia as N (NH3-N)					
Calcium					
Chloride					
Chromium					
Gamma Spec	X		10 pCi/L	Gamma Spectrometry	GAM-A-001
Gross Alpha	X		2 pCi/L	EPA 900.0	GPC-A-001
Gross Beta	X		4 pCi/L	EPA 900.0	GPC-A-001
Iron					
Lead					
Magnesium					
Manganese					
Molybdenum					
Nickel					
Nickel-63	X		700 pCi/L	Liquid Scintillation	LSC-A-009
Nitrate + Nitrite as N (NO3+NO2)-N					
Potassium					
Radium-226					
Radium-228					
Selenium					
Silica					
Sodium					
Strontium					
Sulfate					
Sulfide					
Total Dissolved Solids					
Total Organic Carbon					
Tritium	X		400 pCi/L	Liquid Scintillation	GPC-A-001
Uranium					
Vanadium					
Zinc					
Total No. of Analytes	5	0			

Note: All private well samples are to be unfiltered. The total number of analytes does not include field parameters.

Attachment 2

Trip Report

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memo

NAVARRO

To: Michelle Miller, Navarro
From: Jennifer Graham, Navarro
Date: July 8, 2016
CC: Scott Surovchak, DOE
Ken Broberg, Navarro
Steve Donivan, Navarro
EDD Delivery
Re: Sampling Trip Report

Site: Hallam, Nebraska, Decommissioned Reactor Site

Dates of Event: June 27 –29, 2016

Team Members: Jennifer Graham and Tim Zirbes, Navarro

Number of Locations Sampled: Samples were collected from all 17 of the locations identified on the sampling notification letter.

Locations Not Sampled/Reason: All scheduled locations were sampled.

Location Specific Information:

Location IDs	Comments
2B2 and 2C2	Water was very limited in well. Only a partial sample bottle was collected for Gross Alpha/ Beta (GAB) at each location. Between 500 and 700 mL of water was collected for each sample.
2A	Filtration was required. All samples except H-3 were Filtered
7B and 7C	GAB samples were filtered. All other sample bottles collected were unfiltered.

Quality Control Sample Cross Reference: The following are the false identifications assigned to the quality control samples.

False ID	Ticket Number	True ID	Sample Type	Associated Matrix
1Z	OHX 456	1A	Duplicate	Groundwater

Requisition Index Number (RIN) Assigned: Samples were assigned to RIN16067887. Field data sheets can be found in \\crow\sms\16067887\FieldData.

Sample Shipment: Samples were shipped overnight from the FedEx Office at 4747 Old Cheney Rd, Lincoln, Nebraska, to ALS Laboratory Group, Ft. Collins, Colorado, on June 29, 2016.

Water Level Measurements: Water levels were measured in all sampled wells and in 2 additional wells. A water level data report for these 2 wells can be found in \\crow\sms\FDCS\WATER LEVELS.

Well Inspection Summary:

- Labels on the following wells were repainted: 1A, 1B, 3A, 3B, 4A, 4B, 4C, 5A, 5B, 6A, 6B, and 7C.
- All protective casings were sprayed with primer and paint as necessary where the paint was compromised.
- The lock was not functional and was replaced at well 7C.
- Old bolts securing flush mount lids were not usable and were replaced at both 6A and 6B.

Sampling Method: Samples were collected according to the *Sampling and Analysis Plan* (SAP) *for the U. S. Department of Energy Office of Legacy Management Sites* (LMS/PRO/S04351, continually updated).

Field Variance: None. Samples were collected according to the SAP.

Equipment: All equipment functioned properly.

Stakeholder/Regulatory/DOE: Mr. Howard Shuman from the Department of Health and Human Services Nebraska met the field team on site on June 28th to observe sampling.

Institutional Controls:

Fences, Gates, and Locks: N/A
Signs: No issues were observed.
Trespassing/Site Disturbances: None observed.

Safety Issues: None. The field team used all appropriate and required PPE while working on the Sheldon Power Station site.

Access Issues: None.

General Information: Nothing to note.

Immediate Actions Taken: The combined well pad and bollards at wells 8B and 8C was repaired. The field team used paver base to support the concrete pad. Paver base was packed under and around the existing concrete pad. Additional cement was installed around loose bollards. Photos for all maintenance can be found on the network at: \\lm\gis\Sites_Prod\Sites\NE\HallamDecommissionedReactor\Images\2016\20160629_Graham_SiteMaintenance.

Future Actions Required or Suggested: The field team recommends redeveloping all sampled wells prior to the next sampling event.

Attachment 3

Data Presentation

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Groundwater Quality Data

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Groundwater Quality Data by Location (USEE100) FOR SITE HAL01, Hallam Decommissioned Reactor Site
REPORT DATE: 8/11/2016
Location: 1A WELL

Parameter	Units	Sample Date	Sample ID	Depth Range (Ft BLS)			Result	Qualifiers Lab	Qualifiers Data	Qualifiers QA	Detection Limit	Uncertainty
Actinium-228	pCi/L	06/28/2016	N001	16	-	23.5	19	U	F	#	19	11.2
Actinium-228	pCi/L	06/28/2016	N002	16	-	23.5	20		UF	#	17	11.2
Alkalinity, Total (as $CaCO_3$)	mg/L	06/28/2016	N001	16	-	23.5	220		F	#		
Americium-241	pCi/L	06/28/2016	N001	16	-	23.5	91	U	F	#	91	54.6
Americium-241	pCi/L	06/28/2016	N002	16	-	23.5	34	U	F	#	34	19.9
Antimony-125	pCi/L	06/28/2016	N001	16	-	23.5	12	U	F	#	12	6.54
Antimony-125	pCi/L	06/28/2016	N002	16	-	23.5	11	U	F	#	11	6.46
Cerium-144	pCi/L	06/28/2016	N001	16	-	23.5	22	U	F	#	22	12.9
Cerium-144	pCi/L	06/28/2016	N002	16	-	23.5	22	U	F	#	22	13.1
Cesium-134	pCi/L	06/28/2016	N001	16	-	23.5	5	U	F	#	5	2.77
Cesium-134	pCi/L	06/28/2016	N002	16	-	23.5	7	U	F	#	7	4.08
Cesium-137	pCi/L	06/28/2016	N001	16	-	23.5	4.8	U	F	#	4.8	2.85
Cesium-137	pCi/L	06/28/2016	N002	16	-	23.5	4.9	U	F	#	4.9	2.87
Cobalt-60	pCi/L	06/28/2016	N001	16	-	23.5	4.9	U	F	#	4.9	2.78
Cobalt-60	pCi/L	06/28/2016	N002	16	-	23.5	5.6	U	F	#	5.6	3.18
Europium-152	pCi/L	06/28/2016	N001	16	-	23.5	23	U	F	#	23	13.4
Europium-152	pCi/L	06/28/2016	N002	16	-	23.5	29	U	F	#	29	16.6
Europium-154	pCi/L	06/28/2016	N001	16	-	23.5	28	U	F	#	28	15.9

Groundwater Quality Data by Location (USEE100) FOR SITE HAL01, Hallam Decommissioned Reactor Site
REPORT DATE: 8/11/2016
Location: 1A WELL

Parameter	Units	Sample Date	Sample ID	Depth Range (Ft BLS)			Result	Qualifiers Lab	Qualifiers Data	Qualifiers QA	Detection Limit	Uncertainty
Europium-154	pCi/L	06/28/2016	N002	16	-	23.5	26	U	F	#	26	15.3
Europium-155	pCi/L	06/28/2016	N001	16	-	23.5	13	U	F	#	13	7.62
Europium-155	pCi/L	06/28/2016	N002	16	-	23.5	13	U	F	#	13	7.59
Gross Alpha	pCi/L	06/28/2016	N001	16	-	23.5	3.1	U	F	#	3.1	1.91
Gross Alpha	pCi/L	06/28/2016	N002	16	-	23.5	3.1	U	F	#	3.1	1.87
Gross Beta	pCi/L	06/28/2016	N001	16	-	23.5	5.03		FJ	#	3.2	2.14
Gross Beta	pCi/L	06/28/2016	N002	16	-	23.5	5.24		FJ	#	3.5	2.35
Lead-212	pCi/L	06/28/2016	N001	16	-	23.5	6.8	U	F	#	6.8	4.28
Lead-212	pCi/L	06/28/2016	N002	16	-	23.5	14	U	F	#	14	8.41
Nickel-63	pCi/L	06/28/2016	N001	16	-	23.5	15	U	F	#	15	4.46
Nickel-63	pCi/L	06/28/2016	N002	16	-	23.5	15	U	F	#	15	4.43
Oxidation Reduction Potential	mV	06/28/2016	N001	16	-	23.5	117.3		F	#		
pH	s.u.	06/28/2016	N001	16	-	23.5	7.03		F	#		
Potassium-40	pCi/L	06/28/2016	N001	16	-	23.5	160	U	F	#	160	93
Potassium-40	pCi/L	06/28/2016	N002	16	-	23.5	140	U	F	#	140	82.6
Promethium-144	pCi/L	06/28/2016	N001	16	-	23.5	5.3	U	F	#	5.3	3.23
Promethium-144	pCi/L	06/28/2016	N002	16	-	23.5	5.1	U	F	#	5.1	3.09
Promethium-146	pCi/L	06/28/2016	N001	16	-	23.5	5.1	U	F	#	5.1	3.03

Groundwater Quality Data by Location (USEE100) FOR SITE HAL01, Hallam Decommissioned Reactor Site
REPORT DATE: 8/11/2016
Location: 1A WELL

Parameter	Units	Sample Date	Sample ID	Depth Range (Ft BLS)			Result	Qualifiers Lab	Qualifiers Data	Qualifiers QA	Detection Limit	Uncertainty
Promethium-146	pCi/L	06/28/2016	N002	16	-	23.5	5.7	U	F	#	5.7	3.34
Ruthenium-106	pCi/L	06/28/2016	N001	16	-	23.5	44	U	F	#	44	26.3
Ruthenium-106	pCi/L	06/28/2016	N002	16	-	23.5	47	U	F	#	47	27.3
Specific Conductance	umhos /cm	06/28/2016	N001	16	-	23.5	1901		F	#		
Temperature	C	06/28/2016	N001	16	-	23.5	23.78		F	#		
Thorium-234	pCi/L	06/28/2016	N001	16	-	23.5	81.3		UF	#	63	40.8
Thorium-234	pCi/L	06/28/2016	N002	16	-	23.5	187		UF	#	62	46.6
Tritium	pCi/L	06/28/2016	N001	16	-	23.5	330	U	F	#	330	196
Tritium	pCi/L	06/28/2016	N002	16	-	23.5	320	U	F	#	320	189
Turbidity	NTU	06/28/2016	N001	16	-	23.5	1.44		F	#		
Uranium-235	pCi/L	06/28/2016	N001	16	-	23.5	20	U	F	#	20	12.3
Uranium-235	pCi/L	06/28/2016	N002	16	-	23.5	20	U	F	#	20	12.7
Yttrium-88	pCi/L	06/28/2016	N001	16	-	23.5	5.3	U	F	#	5.3	3.27
Yttrium-88	pCi/L	06/28/2016	N002	16	-	23.5	6	U	F	#	6	3.63

Groundwater Quality Data by Location (USEE100) FOR SITE HAL01, Hallam Decommissioned Reactor Site
REPORT DATE: 8/11/2016
Location: 1B WELL

Parameter	Units	Sample Date	Sample ID	Depth Range (Ft BLS)			Result	Qualifiers Lab	Qualifiers Data	Qualifiers QA	Detection Limit	Uncertainty
Actinium-228	pCi/L	06/28/2016	N001	39	-	49	20.7		UFQ	#	14	9.63
Alkalinity, Total (as $CaCO_3$)	mg/L	06/28/2016	N001	39	-	49	266		FQ	#		
Americium-241	pCi/L	06/28/2016	N001	39	-	49	110	U	FQ	#	110	65.1
Antimony-125	pCi/L	06/28/2016	N001	39	-	49	11	U	FQ	#	11	6.18
Cerium-144	pCi/L	06/28/2016	N001	39	-	49	26	U	FQ	#	26	15.4
Cesium-134	pCi/L	06/28/2016	N001	39	-	49	4.9	U	FQ	#	4.9	2.86
Cesium-137	pCi/L	06/28/2016	N001	39	-	49	4.5	U	FQ	#	4.5	2.65
Cobalt-60	pCi/L	06/28/2016	N001	39	-	49	5	U	FQ	#	5	2.87
Europium-152	pCi/L	06/28/2016	N001	39	-	49	22	U	FQ	#	22	13
Europium-154	pCi/L	06/28/2016	N001	39	-	49	23	U	FQ	#	23	13.7
Europium-155	pCi/L	06/28/2016	N001	39	-	49	17	U	FQ	#	17	10.1
Gross Alpha	pCi/L	06/28/2016	N001	39	-	49	7.55		FQ	#	1.5	1.77
Gross Beta	pCi/L	06/28/2016	N001	39	-	49	7.71		FQ	#	1.8	1.71
Lead-212	pCi/L	06/28/2016	N001	39	-	49	12.2		UFQ	#	7.4	4.87
Nickel-63	pCi/L	06/28/2016	N001	39	-	49	15	U	FQ	#	15	4.49
Oxidation Reduction Potential	mV	06/28/2016	N001	39	-	49	118.7		FQ	#		
pH	s.u.	06/28/2016	N001	39	-	49	7.26		FQ	#		
Potassium-40	pCi/L	06/28/2016	N001	39	-	49	189		UFQ	#	44	40.8

Groundwater Quality Data by Location (USEE100) FOR SITE HAL01, Hallam Decommissioned Reactor Site
REPORT DATE: 8/11/2016
Location: 1B WELL

Parameter	Units	Sample Date	Sample ID	Depth Range (Ft BLS)			Result	Qualifiers Lab	Qualifiers Data	Qualifiers QA	Detection Limit	Uncertainty
Promethium-144	pCi/L	06/28/2016	N001	39	-	49	4.4	U	FQ	#	4.4	2.68
Promethium-146	pCi/L	06/28/2016	N001	39	-	49	5.1	U	FQ	#	5.1	3.02
Ruthenium-106	pCi/L	06/28/2016	N001	39	-	49	41	U	FQ	#	41	24.6
Specific Conductance	umhos /cm	06/28/2016	N001	39	-	49	1127		FQ	#		
Temperature	C	06/28/2016	N001	39	-	49	20.4		FQ	#		
Thorium-234	pCi/L	06/28/2016	N001	39	-	49	144		UFQ	#	79	53.1
Tritium	pCi/L	06/28/2016	N001	39	-	49	330	U	FQ	#	330	195
Turbidity	NTU	06/28/2016	N001	39	-	49	3.5		FQ	#		
Uranium-235	pCi/L	06/28/2016	N001	39	-	49	24	U	FQ	#	24	14.7
Yttrium-88	pCi/L	06/28/2016	N001	39	-	49	4.9	U	FQ	#	4.9	2.99

Groundwater Quality Data by Location (USEE100) FOR SITE HAL01, Hallam Decommissioned Reactor Site
REPORT DATE: 8/11/2016
Location: 2A WELL

Parameter	Units	Sample Date	Sample ID	Depth Range (Ft BLS)			Result	Qualifiers Lab	Qualifiers Data	Qualifiers QA	Detection Limit	Uncertainty
Actinium-228	pCi/L	06/28/2016	0001	20	-	25	14	U	FQ	#	14	8.96
Alkalinity, Total (as $CaCO_3$)	mg/L	06/28/2016	0001	20	-	25	235		FQ	#		
Americium-241	pCi/L	06/28/2016	0001	20	-	25	160	U	FQ	#	160	93.5
Antimony-125	pCi/L	06/28/2016	0001	20	-	25	22	U	FQ	#	22	11.9
Cerium-144	pCi/L	06/28/2016	0001	20	-	25	24	U	FQ	#	24	14.4
Cesium-134	pCi/L	06/28/2016	0001	20	-	25	4.1	U	FQ	#	4.1	2.47
Cesium-137	pCi/L	06/28/2016	0001	20	-	25	4.4	U	FQ	#	4.4	2.58
Cobalt-60	pCi/L	06/28/2016	0001	20	-	25	4.6	U	FQ	#	4.6	2.63
Europium-152	pCi/L	06/28/2016	0001	20	-	25	21	U	FQ	#	21	12.6
Europium-154	pCi/L	06/28/2016	0001	20	-	25	24	U	FQ	#	24	13.5
Europium-155	pCi/L	06/28/2016	0001	20	-	25	24	U	FQ	#	24	14.2
Gross Alpha	pCi/L	06/28/2016	0001	20	-	25	6.07		FQ	#	2	1.8
Gross Beta	pCi/L	06/28/2016	0001	20	-	25	6.91		FQ	#	2.2	1.82
Lead-212	pCi/L	06/28/2016	0001	20	-	25	12	U	FQ	#	12	7.3
Nickel-63	pCi/L	06/28/2016	0001	20	-	25	15	U	FQ	#	15	4.28
Oxidation Reduction Potential	mV	06/28/2016	N001	20	-	25	71.9		FQ	#		
pH	s.u.	06/28/2016	N001	20	-	25	7.5		FQ	#		
Potassium-40	pCi/L	06/28/2016	0001	20	-	25	130	U	FQ	#	130	78.1

Groundwater Quality Data by Location (USEE100) FOR SITE HAL01, Hallam Decommissioned Reactor Site
REPORT DATE: 8/11/2016
Location: 2A WELL

Parameter	Units	Sample Date	Sample ID	Depth Range (Ft BLS)			Result	Qualifiers Lab	Qualifiers Data	Qualifiers QA	Detection Limit	Uncertainty
Promethium-144	pCi/L	06/28/2016	0001	20	-	25	4.5	U	FQ	#	4.5	2.7
Promethium-146	pCi/L	06/28/2016	0001	20	-	25	4.5	U	FQ	#	4.5	2.67
Ruthenium-106	pCi/L	06/28/2016	0001	20	-	25	38	U	FQ	#	38	21.7
Specific Conductance	umhos /cm	06/28/2016	N001	20	-	25	1334		FQ	#		
Temperature	C	06/28/2016	N001	20	-	25	17.75		FQ	#		
Thorium-234	pCi/L	06/28/2016	0001	20	-	25	220	U	FQ	#	220	130
Tritium	pCi/L	06/28/2016	N001	20	-	25	330	U	FQ	#	330	192
Turbidity	NTU	06/28/2016	N001	20	-	25	36.8		FQ	#		
Uranium-235	pCi/L	06/28/2016	0001	20	-	25	22	U	FQ	#	22	13.5
Yttrium-88	pCi/L	06/28/2016	0001	20	-	25	4.7	U	FQ	#	4.7	3.02

Groundwater Quality Data by Location (USEE100) FOR SITE HAL01, Hallam Decommissioned Reactor Site
REPORT DATE: 8/11/2016
Location: 2B WELL

Parameter	Units	Sample Date	Sample ID	Depth Range (Ft BLS)			Result	Qualifiers Lab	Qualifiers Data	Qualifiers QA	Detection Limit	Uncertainty
Actinium-228	pCi/L	06/28/2016	N001	43	-	53	32	U	FQ	#	32	19.7
Alkalinity, Total (as $CaCO_3$)	mg/L	06/28/2016	N001	43	-	53	244		FQ	#		
Americium-241	pCi/L	06/28/2016	N001	43	-	53	26	U	FQ	#	26	15.4
Antimony-125	pCi/L	06/28/2016	N001	43	-	53	11	U	FQ	#	11	6.07
Cerium-144	pCi/L	06/28/2016	N001	43	-	53	21	U	FQ	#	21	12.8
Cesium-134	pCi/L	06/28/2016	N001	43	-	53	6.5	U	FQ	#	6.5	3.89
Cesium-137	pCi/L	06/28/2016	N001	43	-	53	4.9	U	FQ	#	4.9	2.88
Cobalt-60	pCi/L	06/28/2016	N001	43	-	53	5.7	U	FQ	#	5.7	3.24
Europium-152	pCi/L	06/28/2016	N001	43	-	53	25	U	FQ	#	25	14.8
Europium-154	pCi/L	06/28/2016	N001	43	-	53	25	U	FQ	#	25	15.6
Europium-155	pCi/L	06/28/2016	N001	43	-	53	12	U	FQ	#	12	6.92
Gross Alpha	pCi/L	06/28/2016	N001	43	-	53	16.1		FQ	#	2	3.19
Gross Beta	pCi/L	06/28/2016	N001	43	-	53	14.4		FQ	#	2	2.7
Lead-212	pCi/L	06/28/2016	N001	43	-	53	14	U	FQ	#	14	8.31
Nickel-63	pCi/L	06/28/2016	N001	43	-	53	13	U	FQ	#	13	3.89
Oxidation Reduction Potential	mV	06/28/2016	N001	43	-	53	-72		FQ	#		
pH	s.u.	06/28/2016	N001	43	-	53	7.64		FQ	#		
Potassium-40	pCi/L	06/28/2016	N001	43	-	53	140	U	FQ	#	140	80.8

Groundwater Quality Data by Location (USEE100) FOR SITE HAL01, Hallam Decommissioned Reactor Site
REPORT DATE: 8/11/2016
Location: 2B WELL

Parameter	Units	Sample Date	Sample ID	Depth Range (Ft BLS)			Result	Qualifiers Lab	Qualifiers Data	Qualifiers QA	Detection Limit	Uncertainty
Promethium-144	pCi/L	06/28/2016	N001	43	-	53	13	U	FQ	#	13	7.85
Promethium-146	pCi/L	06/28/2016	N001	43	-	53	5.1	U	FQ	#	5.1	2.99
Ruthenium-106	pCi/L	06/28/2016	N001	43	-	53	45	U	FQ	#	45	26.8
Specific Conductance	umhos /cm	06/28/2016	N001	43	-	53	1393		FQ	#		
Temperature	C	06/28/2016	N001	43	-	53	16.87		FQ	#		
Thorium-234	pCi/L	06/28/2016	N001	43	-	53	130	U	FQ	#	130	79.5
Tritium	pCi/L	06/28/2016	N001	43	-	53	330	U	FQ	#	330	191
Turbidity	NTU	06/28/2016	N001	43	-	53	0.93		FQ	#		
Uranium-235	pCi/L	06/28/2016	N001	43	-	53	20	U	FQ	#	20	12.4
Yttrium-88	pCi/L	06/28/2016	N001	43	-	53	11	U	FQ	#	11	6.69

Groundwater Quality Data by Location (USEE100) FOR SITE HAL01, Hallam Decommissioned Reactor Site
REPORT DATE: 8/11/2016
Location: 2B2 WELL

Parameter	Units	Sample Date	Sample ID	Depth Range (Ft BLS)	Result	Qualifiers Lab	Qualifiers Data	Qualifiers QA	Detection Limit	Uncertainty
Actinium-228	pCi/L	06/28/2016	N001	-	17	U	FQ	#	17	10.8
Alkalinity, Total (as $CaCO_3$)	mg/L	06/28/2016	N001	-	131		FQ	#		
Americium-241	pCi/L	06/28/2016	N001	-	25	U	FQ	#	25	15.3
Antimony-125	pCi/L	06/28/2016	N001	-	9.9	U	FQ	#	9.9	5.9
Cerium-144	pCi/L	06/28/2016	N001	-	18	U	FQ	#	18	10.7
Cesium-134	pCi/L	06/28/2016	N001	-	4.5	U	FQ	#	4.5	2.56
Cesium-137	pCi/L	06/28/2016	N001	-	4.6	U	FQ	#	4.6	2.6
Cobalt-60	pCi/L	06/28/2016	N001	-	5.6	U	FQ	#	5.6	3.17
Europium-152	pCi/L	06/28/2016	N001	-	25	U	FQ	#	25	14.9
Europium-154	pCi/L	06/28/2016	N001	-	25	U	FQ	#	25	14.9
Europium-155	pCi/L	06/28/2016	N001	-	10	U	FQ	#	10	6.18
Gross Alpha	pCi/L	06/28/2016	N001	-	5.02		FQ	#	1.3	1.28
Gross Beta	pCi/L	06/28/2016	N001	-	8.92		FQ	#	1.5	1.78
Lead-212	pCi/L	06/28/2016	N001	-	12	U	FQ	#	12	7.14
Nickel-63	pCi/L	06/28/2016	N001	-	15	U	FQ	#	15	4.29
Oxidation Reduction Potential	mV	06/28/2016	N001	-	-1.9		FQ	#		
pH	s.u.	06/28/2016	N001	-	7.45		FQ	#		
Potassium-40	pCi/L	06/28/2016	N001	-	120	U	FQ	#	120	69.9

Groundwater Quality Data by Location (USEE100) FOR SITE HAL01, Hallam Decommissioned Reactor Site
REPORT DATE: 8/11/2016
Location: 2B2 WELL

Parameter	Units	Sample Date	Sample ID	Depth Range (Ft BLS)	Result	Qualifiers Lab	Qualifiers Data	Qualifiers QA	Detection Limit	Uncertainty
Promethium-144	pCi/L	06/28/2016	N001	-	4.7	U	FQ	#	4.7	2.78
Promethium-146	pCi/L	06/28/2016	N001	-	4.8	U	FQ	#	4.8	2.84
Ruthenium-106	pCi/L	06/28/2016	N001	-	42	U	FQ	#	42	24.8
Specific Conductance	umhos /cm	06/28/2016	N001	-	1245		FQ	#		
Temperature	C	06/28/2016	N001	-	20.25		FQ	#		
Thorium-234	pCi/L	06/28/2016	N001	-	130	U	FQ	#	130	74
Tritium	pCi/L	06/28/2016	N001	-	330	U	FQ	#	330	192
Turbidity	NTU	06/28/2016	N001	-	9.81		FQ	#		
Uranium-235	pCi/L	06/28/2016	N001	-	17	U	FQ	#	17	10.5
Yttrium-88	pCi/L	06/28/2016	N001	-	5.4	U	FQ	#	5.4	3.31

Groundwater Quality Data by Location (USEE100) FOR SITE HAL01, Hallam Decommissioned Reactor Site
REPORT DATE: 8/11/2016
Location: 2C2 WELL

Parameter	Units	Sample Date	Sample ID	Depth Range (Ft BLS)	Result	Qualifiers Lab	Qualifiers Data	Qualifiers QA	Detection Limit	Uncertainty
Actinium-228	pCi/L	06/28/2016	N001	-	16		UFQ	#	14	9.23
Alkalinity, Total (as $CaCO_3$)	mg/L	06/28/2016	N001	-	198		FQ	#		
Americium-241	pCi/L	06/28/2016	N001	-	4	U	FQ	#	4	2.38
Antimony-125	pCi/L	06/28/2016	N001	-	8.8	U	FQ	#	8.8	4.76
Cerium-144	pCi/L	06/28/2016	N001	-	14	U	FQ	#	14	8.31
Cesium-134	pCi/L	06/28/2016	N001	-	3.7	U	FQ	#	3.7	2.19
Cesium-137	pCi/L	06/28/2016	N001	-	3.5	U	FQ	#	3.5	2.04
Cobalt-60	pCi/L	06/28/2016	N001	-	4	U	FQ	#	4	2.42
Europium-152	pCi/L	06/28/2016	N001	-	20	U	FQ	#	20	12.3
Europium-154	pCi/L	06/28/2016	N001	-	21	U	FQ	#	21	12.5
Europium-155	pCi/L	06/28/2016	N001	-	4.7	U	FQ	#	4.7	2.87
Gross Alpha	pCi/L	06/28/2016	N001	-	5.92		FQ	#	1.6	1.58
Gross Beta	pCi/L	06/28/2016	N001	-	6.22		FQ	#	1.8	1.52
Lead-212	pCi/L	06/28/2016	N001	-	9.9	U	FQ	#	9.9	5.93
Nickel-63	pCi/L	06/28/2016	N001	-	16	U	FQ	#	16	4.71
Oxidation Reduction Potential	mV	06/28/2016	N001	-	114.5		FQ	#		
pH	s.u.	06/28/2016	N001	-	7.61		FQ	#		
Potassium-40	pCi/L	06/28/2016	N001	-	100	U	FQ	#	100	61.5

Groundwater Quality Data by Location (USEE100) FOR SITE HAL01, Hallam Decommissioned Reactor Site
REPORT DATE: 8/11/2016
Location: 2C2 WELL

Parameter	Units	Sample Date	Sample ID	Depth Range (Ft BLS)	Result	Qualifiers Lab	Qualifiers Data	Qualifiers QA	Detection Limit	Uncertainty
Promethium-144	pCi/L	06/28/2016	N001	-	7.2	U	FQ	#	7.2	4.25
Promethium-146	pCi/L	06/28/2016	N001	-	4	U	FQ	#	4	2.38
Ruthenium-106	pCi/L	06/28/2016	N001	-	34	U	FQ	#	34	20
Specific Conductance	umhos /cm	06/28/2016	N001	-	1125		FQ	#		
Temperature	C	06/28/2016	N001	-	18.82		FQ	#		
Thorium-234	pCi/L	06/28/2016	N001	-	70	U	FQ	#	70	42.3
Tritium	pCi/L	06/28/2016	N001	-	330	U	FQ	#	330	193
Turbidity	NTU	06/28/2016	N001	-	3.69		FQ	#		
Uranium-235	pCi/L	06/28/2016	N001	-	13	U	FQ	#	13	8.27
Yttrium-88	pCi/L	06/28/2016	N001	-	4.2	U	FQ	#	4.2	2.57

Groundwater Quality Data by Location (USEE100) FOR SITE HAL01, Hallam Decommissioned Reactor Site
REPORT DATE: 8/11/2016
Location: 3A WELL

Parameter	Units	Sample Date	Sample ID	Depth Range (Ft BLS)			Result	Qualifiers Lab	Qualifiers Data	Qualifiers QA	Detection Limit	Uncertainty
Actinium-228	pCi/L	06/27/2016	N001	19	-	24	35	U	FQ	#	35	21.2
Alkalinity, Total (as $CaCO_3$)	mg/L	06/27/2016	N001	19	-	24	182		FQ	#		
Americium-241	pCi/L	06/27/2016	N001	19	-	24	4.9	U	FQ	#	4.9	3
Antimony-125	pCi/L	06/27/2016	N001	19	-	24	9.3	U	FQ	#	9.3	5.54
Cerium-144	pCi/L	06/27/2016	N001	19	-	24	15	U	FQ	#	15	9.01
Cesium-134	pCi/L	06/27/2016	N001	19	-	24	4.4	U	FQ	#	4.4	2.54
Cesium-137	pCi/L	06/27/2016	N001	19	-	24	4.3	U	FQ	#	4.3	2.47
Cobalt-60	pCi/L	06/27/2016	N001	19	-	24	4.7	U	FQ	#	4.7	2.78
Europium-152	pCi/L	06/27/2016	N001	19	-	24	24	U	FQ	#	24	14.5
Europium-154	pCi/L	06/27/2016	N001	19	-	24	26	U	FQ	#	26	14.7
Europium-155	pCi/L	06/27/2016	N001	19	-	24	16	U	FQ	#	16	9.41
Gross Alpha	pCi/L	06/27/2016	N001	19	-	24	17.5		FQJ	#	15	10.1
Gross Beta	pCi/L	06/27/2016	N001	19	-	24	21	U	FQ	#	21	13.1
Lead-212	pCi/L	06/27/2016	N001	19	-	24	11	U	FQ	#	11	6.74
Nickel-63	pCi/L	06/27/2016	N001	19	-	24	16	U	FQ	#	16	4.63
Oxidation Reduction Potential	mV	06/27/2016	N001	19	-	24	120.4		FQ	#		
pH	s.u.	06/27/2016	N001	19	-	24	7.32		FQ	#		
Potassium-40	pCi/L	06/27/2016	N001	19	-	24	140	U	FQ	#	140	83.2

Groundwater Quality Data by Location (USEE100) FOR SITE HAL01, Hallam Decommissioned Reactor Site
REPORT DATE: 8/11/2016
Location: 3A WELL

Parameter	Units	Sample Date	Sample ID	Depth Range (Ft BLS)			Result	Qualifiers Lab	Qualifiers Data	Qualifiers QA	Detection Limit	Uncertainty
Promethium-144	pCi/L	06/27/2016	N001	19	-	24	4.9	U	FQ	#	4.9	2.88
Promethium-146	pCi/L	06/27/2016	N001	19	-	24	4.4	U	FQ	#	4.4	2.58
Ruthenium-106	pCi/L	06/27/2016	N001	19	-	24	38	U	FQ	#	38	22.7
Specific Conductance	umhos /cm	06/27/2016	N001	19	-	24	3871		FQ	#		
Temperature	C	06/27/2016	N001	19	-	24	19.09		FQ	#		
Thorium-234	pCi/L	06/27/2016	N001	19	-	24	74	U	FQ	#	74	36.3
Tritium	pCi/L	06/27/2016	N001	19	-	24	330	U	FQ	#	330	194
Turbidity	NTU	06/27/2016	N001	19	-	24	4.04		FQ	#		
Uranium-235	pCi/L	06/27/2016	N001	19	-	24	17	U	FQ	#	17	9.27
Yttrium-88	pCi/L	06/27/2016	N001	19	-	24	5.1	U	FQ	#	5.1	3.1

Groundwater Quality Data by Location (USEE100) FOR SITE HAL01, Hallam Decommissioned Reactor Site
REPORT DATE: 8/11/2016
Location: 3B WELL

Parameter	Units	Sample Date	Sample ID	Depth Range (Ft BLS)			Result	Qualifiers Lab	Qualifiers Data	Qualifiers QA	Detection Limit	Uncertainty
Actinium-228	pCi/L	06/27/2016	N001	43	-	53	27	U	FQ	#	27	16.2
Alkalinity, Total (as $CaCO_3$)	mg/L	06/27/2016	N001	43	-	53	227		FQ	#		
Americium-241	pCi/L	06/27/2016	N001	43	-	53	32	U	FQ	#	32	20
Antimony-125	pCi/L	06/27/2016	N001	43	-	53	13	U	FQ	#	13	7.73
Cerium-144	pCi/L	06/27/2016	N001	43	-	53	26	U	FQ	#	26	15.4
Cesium-134	pCi/L	06/27/2016	N001	43	-	53	9.3	U	FQ	#	9.3	5.72
Cesium-137	pCi/L	06/27/2016	N001	43	-	53	6.4	U	FQ	#	6.4	3.75
Cobalt-60	pCi/L	06/27/2016	N001	43	-	53	9	U	FQ	#	9	5.12
Europium-152	pCi/L	06/27/2016	N001	43	-	53	40	U	FQ	#	40	23.3
Europium-154	pCi/L	06/27/2016	N001	43	-	53	37	U	FQ	#	37	22.7
Europium-155	pCi/L	06/27/2016	N001	43	-	53	12	U	FQ	#	12	7.45
Gross Alpha	pCi/L	06/27/2016	N001	43	-	53	13	U	FQ	#	13	7.6
Gross Beta	pCi/L	06/27/2016	N001	43	-	53	21	U	FQ	#	21	12.7
Lead-212	pCi/L	06/27/2016	N001	43	-	53	15	U	FQ	#	15	8.88
Nickel-63	pCi/L	06/27/2016	N001	43	-	53	17	U	FQ	#	17	4.86
Oxidation Reduction Potential	mV	06/27/2016	N001	43	-	53	86.1		FQ	#		
pH	s.u.	06/27/2016	N001	43	-	53	7.43		FQ	#		
Potassium-40	pCi/L	06/27/2016	N001	43	-	53	180	U	FQ	#	180	111

Groundwater Quality Data by Location (USEE100) FOR SITE HAL01, Hallam Decommissioned Reactor Site
REPORT DATE: 8/11/2016
Location: 3B WELL

Parameter	Units	Sample Date	Sample ID	Depth Range (Ft BLS)			Result	Qualifiers Lab	Qualifiers Data	Qualifiers QA	Detection Limit	Uncertainty
Promethium-144	pCi/L	06/27/2016	N001	43	-	53	24	U	FQ	#	24	14.6
Promethium-146	pCi/L	06/27/2016	N001	43	-	53	6.9	U	FQ	#	6.9	4.04
Ruthenium-106	pCi/L	06/27/2016	N001	43	-	53	61	U	FQ	#	61	35.4
Specific Conductance	umhos /cm	06/27/2016	N001	43	-	53	2825		FQ	#		
Temperature	C	06/27/2016	N001	43	-	53	17.66		FQ	#		
Thorium-234	pCi/L	06/27/2016	N001	43	-	53	150	U	FQ	#	150	90.6
Tritium	pCi/L	06/27/2016	N001	43	-	53	330	U	FQ	#	330	194
Turbidity	NTU	06/27/2016	N001	43	-	53	1.8		FQ	#		
Uranium-235	pCi/L	06/27/2016	N001	43	-	53	25	U	FQ	#	25	15.2
Yttrium-88	pCi/L	06/27/2016	N001	43	-	53	8.2	U	FQ	#	8.2	5.02

Groundwater Quality Data by Location (USEE100) FOR SITE HAL01, Hallam Decommissioned Reactor Site
REPORT DATE: 8/11/2016
Location: 4A WELL

Parameter	Units	Sample Date	Sample ID	Depth Range (Ft BLS)			Result	Qualifiers Lab	Qualifiers Data	Qualifiers QA	Detection Limit	Uncertainty
Actinium-228	pCi/L	06/27/2016	N001	19	-	24	38	U	FQ	#	38	22.9
Alkalinity, Total (as $CaCO_3$)	mg/L	06/27/2016	N001	19	-	24	225		FQ	#		
Americium-241	pCi/L	06/27/2016	N001	19	-	24	110	U	FQ	#	110	65.7
Antimony-125	pCi/L	06/27/2016	N001	19	-	24	11	U	FQ	#	11	5.89
Cerium-144	pCi/L	06/27/2016	N001	19	-	24	26	U	FQ	#	26	15.6
Cesium-134	pCi/L	06/27/2016	N001	19	-	24	4.9	U	FQ	#	4.9	2.84
Cesium-137	pCi/L	06/27/2016	N001	19	-	24	4.2	U	FQ	#	4.2	2.58
Cobalt-60	pCi/L	06/27/2016	N001	19	-	24	4.6	U	FQ	#	4.6	2.72
Europium-152	pCi/L	06/27/2016	N001	19	-	24	23	U	FQ	#	23	12.9
Europium-154	pCi/L	06/27/2016	N001	19	-	24	24	U	FQ	#	24	14.1
Europium-155	pCi/L	06/27/2016	N001	19	-	24	17	U	FQ	#	17	10.3
Gross Alpha	pCi/L	06/27/2016	N001	19	-	24	4.09		FQJ	#	2.4	1.78
Gross Beta	pCi/L	06/27/2016	N001	19	-	24	14.5		FQ	#	3.1	3.09
Lead-212	pCi/L	06/27/2016	N001	19	-	24	16	U	FQ	#	16	9.63
Nickel-63	pCi/L	06/27/2016	N001	19	-	24	17	U	FQ	#	17	5.03
Oxidation Reduction Potential	mV	06/27/2016	N001	19	-	24	114.8		FQ	#		
pH	s.u.	06/27/2016	N001	19	-	24	7.36		FQ	#		
Potassium-40	pCi/L	06/27/2016	N001	19	-	24	120	U	FQ	#	120	73.4

Groundwater Quality Data by Location (USEE100) FOR SITE HAL01, Hallam Decommissioned Reactor Site
REPORT DATE: 8/11/2016
Location: 4A WELL

Parameter	Units	Sample Date	Sample ID	Depth Range (Ft BLS)			Result	Qualifiers Lab	Qualifiers Data	Qualifiers QA	Detection Limit	Uncertainty
Promethium-144	pCi/L	06/27/2016	N001	19	-	24	9	U	FQ	#	9	5.36
Promethium-146	pCi/L	06/27/2016	N001	19	-	24	5.1	U	FQ	#	5.1	2.95
Ruthenium-106	pCi/L	06/27/2016	N001	19	-	24	42	U	FQ	#	42	24.6
Specific Conductance	umhos /cm	06/27/2016	N001	19	-	24	2159		FQ	#		
Temperature	C	06/27/2016	N001	19	-	24	19.77		FQ	#		
Thorium-234	pCi/L	06/27/2016	N001	19	-	24	210	U	FQ	#	210	128
Tritium	pCi/L	06/27/2016	N001	19	-	24	330	U	FQ	#	330	195
Turbidity	NTU	06/27/2016	N001	19	-	24	1.96		FQ	#		
Uranium-235	pCi/L	06/27/2016	N001	19	-	24	24	U	FQ	#	24	14.9
Yttrium-88	pCi/L	06/27/2016	N001	19	-	24	5	U	FQ	#	5	3.1

Groundwater Quality Data by Location (USEE100) FOR SITE HAL01, Hallam Decommissioned Reactor Site
REPORT DATE: 8/11/2016
Location: 4B WELL

Parameter	Units	Sample Date	Sample ID	Depth Range (Ft BLS)			Result	Qualifiers Lab	Qualifiers Data	Qualifiers QA	Detection Limit	Uncertainty
Actinium-228	pCi/L	06/27/2016	N001	44	-	54	18	U	FQ	#	18	11.7
Alkalinity, Total (as $CaCO_3$)	mg/L	06/27/2016	N001	44	-	54	226		FQ	#		
Americium-241	pCi/L	06/27/2016	N001	44	-	54	33	U	FQ	#	33	19.2
Antimony-125	pCi/L	06/27/2016	N001	44	-	54	11	U	FQ	#	11	6.14
Cerium-144	pCi/L	06/27/2016	N001	44	-	54	22	U	FQ	#	22	12.8
Cesium-134	pCi/L	06/27/2016	N001	44	-	54	7	U	FQ	#	7	4.2
Cesium-137	pCi/L	06/27/2016	N001	44	-	54	4.9	U	FQ	#	4.9	2.87
Cobalt-60	pCi/L	06/27/2016	N001	44	-	54	5.1	U	FQ	#	5.1	2.98
Europium-152	pCi/L	06/27/2016	N001	44	-	54	29	U	FQ	#	29	16
Europium-154	pCi/L	06/27/2016	N001	44	-	54	27	U	FQ	#	27	15.7
Europium-155	pCi/L	06/27/2016	N001	44	-	54	13	U	FQ	#	13	7.65
Gross Alpha	pCi/L	06/27/2016	N001	44	-	54	8.76		FQ	#	2.3	2.28
Gross Beta	pCi/L	06/27/2016	N001	44	-	54	10.8		FQ	#	2.1	2.25
Lead-212	pCi/L	06/27/2016	N001	44	-	54	14	U	FQ	#	14	8.21
Nickel-63	pCi/L	06/27/2016	N001	44	-	54	15	U	FQ	#	15	4.47
Oxidation Reduction Potential	mV	06/27/2016	N001	44	-	54	7.6		FQ	#		
pH	s.u.	06/27/2016	N001	44	-	54	7.2		FQ	#		
Potassium-40	pCi/L	06/27/2016	N001	44	-	54	140	U	FQ	#	140	81.7

Groundwater Quality Data by Location (USEE100) FOR SITE HAL01, Hallam Decommissioned Reactor Site
REPORT DATE: 8/11/2016
Location: 4B WELL

Parameter	Units	Sample Date	Sample ID	Depth Range (Ft BLS)			Result	Qualifiers Lab	Qualifiers Data	Qualifiers QA	Detection Limit	Uncertainty
Promethium-144	pCi/L	06/27/2016	N001	44	-	54	5	U	FQ	#	5	3.07
Promethium-146	pCi/L	06/27/2016	N001	44	-	54	5.6	U	FQ	#	5.6	3.28
Ruthenium-106	pCi/L	06/27/2016	N001	44	-	54	46	U	FQ	#	46	27.1
Specific Conductance	umhos /cm	06/27/2016	N001	44	-	54	1611		FQ	#		
Temperature	C	06/27/2016	N001	44	-	54	20.27		FQ	#		
Thorium-234	pCi/L	06/27/2016	N001	44	-	54	150	U	FQ	#	150	89.2
Tritium	pCi/L	06/27/2016	N001	44	-	54	330	U	FQ	#	330	195
Turbidity	NTU	06/27/2016	N001	44	-	54	1.01		FQ	#		
Uranium-235	pCi/L	06/27/2016	N001	44	-	54	20	U	FQ	#	20	12.5
Yttrium-88	pCi/L	06/27/2016	N001	44	-	54	5.7	U	FQ	#	5.7	3.46

Groundwater Quality Data by Location (USEE100) FOR SITE HAL01, Hallam Decommissioned Reactor Site
REPORT DATE: 8/11/2016
Location: 4C WELL

Parameter	Units	Sample Date	Sample ID	Depth Range (Ft BLS)			Result	Qualifiers Lab	Qualifiers Data	Qualifiers QA	Detection Limit	Uncertainty
Actinium-228	pCi/L	06/27/2016	N001	64	-	74	23	U	FQ	#	23	14.1
Alkalinity, Total (as $CaCO_3$)	mg/L	06/27/2016	N001	64	-	74	216		FQ	#		
Americium-241	pCi/L	06/27/2016	N001	64	-	74	34	U	FQ	#	34	20
Antimony-125	pCi/L	06/27/2016	N001	64	-	74	13	U	FQ	#	13	7.01
Cerium-144	pCi/L	06/27/2016	N001	64	-	74	26	U	FQ	#	26	15.6
Cesium-134	pCi/L	06/27/2016	N001	64	-	74	9.4	U	FQ	#	9.4	5.63
Cesium-137	pCi/L	06/27/2016	N001	64	-	74	6.6	U	FQ	#	6.6	3.72
Cobalt-60	pCi/L	06/27/2016	N001	64	-	74	8	U	FQ	#	8	4.74
Europium-152	pCi/L	06/27/2016	N001	64	-	74	46	U	FQ	#	46	25.8
Europium-154	pCi/L	06/27/2016	N001	64	-	74	44	U	FQ	#	44	25
Europium-155	pCi/L	06/27/2016	N001	64	-	74	12	U	FQ	#	12	7.5
Gross Alpha	pCi/L	06/27/2016	N001	64	-	74	11.6		FQ	#	2.2	2.66
Gross Beta	pCi/L	06/27/2016	N001	64	-	74	14.8		FQ	#	2.3	2.86
Lead-212	pCi/L	06/27/2016	N001	64	-	74	14	U	FQ	#	14	8.32
Nickel-63	pCi/L	06/27/2016	N001	64	-	74	17	U	FQ	#	17	5.1
Oxidation Reduction Potential	mV	06/27/2016	N001	64	-	74	-82.5		FQ	#		
pH	s.u.	06/27/2016	N001	64	-	74	7.35		FQ	#		
Potassium-40	pCi/L	06/27/2016	N001	64	-	74	180	U	FQ	#	180	107

Groundwater Quality Data by Location (USEE100) FOR SITE HAL01, Hallam Decommissioned Reactor Site
REPORT DATE: 8/11/2016
Location: 4C WELL

Parameter	Units	Sample Date	Sample ID	Depth Range (Ft BLS)			Result	Qualifiers Lab	Qualifiers Data	Qualifiers QA	Detection Limit	Uncertainty
Promethium-144	pCi/L	06/27/2016	N001	64	-	74	24	U	FQ	#	24	14.7
Promethium-146	pCi/L	06/27/2016	N001	64	-	74	6.7	U	FQ	#	6.7	3.91
Ruthenium-106	pCi/L	06/27/2016	N001	64	-	74	60	U	FQ	#	60	35
Specific Conductance	umhos /cm	06/27/2016	N001	64	-	74	1418		FQ	#		
Temperature	C	06/27/2016	N001	64	-	74	18.09		FQ	#		
Thorium-234	pCi/L	06/27/2016	N001	64	-	74	150	U	FQ	#	150	88.9
Tritium	pCi/L	06/27/2016	N001	64	-	74	320	U	FQ	#	320	192
Turbidity	NTU	06/27/2016	N001	64	-	74	0.58		FQ	#		
Uranium-235	pCi/L	06/27/2016	N001	64	-	74	24	U	FQ	#	24	15.2
Yttrium-88	pCi/L	06/27/2016	N001	64	-	74	8.5	U	FQ	#	8.5	5.09

Groundwater Quality Data by Location (USEE100) FOR SITE HAL01, Hallam Decommissioned Reactor Site
REPORT DATE: 8/11/2016
Location: 5A WELL

Parameter	Units	Sample Date	Sample ID	Depth Range (Ft BLS)			Result	Qualifiers Lab	Qualifiers Data	Qualifiers QA	Detection Limit	Uncertainty
Actinium-228	pCi/L	06/28/2016	N001	19	-	24	26	U	FQ	#	26	15.7
Alkalinity, Total (as $CaCO_3$)	mg/L	06/28/2016	N001	19	-	24	225		FQ	#		
Americium-241	pCi/L	06/28/2016	N001	19	-	24	160	U	FQ	#	160	94.7
Antimony-125	pCi/L	06/28/2016	N001	19	-	24	22	U	FQ	#	22	11.8
Cerium-144	pCi/L	06/28/2016	N001	19	-	24	24	U	FQ	#	24	14.2
Cesium-134	pCi/L	06/28/2016	N001	19	-	24	4.3	U	FQ	#	4.3	2.48
Cesium-137	pCi/L	06/28/2016	N001	19	-	24	4.3	U	FQ	#	4.3	2.56
Cobalt-60	pCi/L	06/28/2016	N001	19	-	24	4.5	U	FQ	#	4.5	2.64
Europium-152	pCi/L	06/28/2016	N001	19	-	24	22	U	FQ	#	22	13
Europium-154	pCi/L	06/28/2016	N001	19	-	24	36	U	FQ	#	36	20
Europium-155	pCi/L	06/28/2016	N001	19	-	24	23	U	FQ	#	23	14.1
Gross Alpha	pCi/L	06/28/2016	N001	19	-	24	5.58		FQJ	#	2	1.74
Gross Beta	pCi/L	06/28/2016	N001	19	-	24	6.7		FQ	#	2.2	1.81
Lead-212	pCi/L	06/28/2016	N001	19	-	24	13	U	FQ	#	13	7.94
Nickel-63	pCi/L	06/28/2016	N001	19	-	24	14	U	FQ	#	14	4.35
Oxidation Reduction Potential	mV	06/28/2016	N001	19	-	24	136.6		FQ	#		
pH	s.u.	06/28/2016	N001	19	-	24	7.31		FQ	#		
Potassium-40	pCi/L	06/28/2016	N001	19	-	24	130	U	FQ	#	130	76.9

Groundwater Quality Data by Location (USEE100) FOR SITE HAL01, Hallam Decommissioned Reactor Site
REPORT DATE: 8/11/2016
Location: 5A WELL

Parameter	Units	Sample Date	Sample ID	Depth Range (Ft BLS)			Result	Qualifiers Lab	Qualifiers Data	Qualifiers QA	Detection Limit	Uncertainty
Promethium-144	pCi/L	06/28/2016	N001	19	-	24	4.3	U	FQ	#	4.3	2.71
Promethium-146	pCi/L	06/28/2016	N001	19	-	24	4.5	U	FQ	#	4.5	2.6
Ruthenium-106	pCi/L	06/28/2016	N001	19	-	24	38	U	FQ	#	38	22.6
Specific Conductance	umhos /cm	06/28/2016	N001	19	-	24	1356		FQ	#		
Temperature	C	06/28/2016	N001	19	-	24	18.37		FQ	#		
Thorium-234	pCi/L	06/28/2016	N001	19	-	24	240	U	FQ	#	240	142
Tritium	pCi/L	06/28/2016	N001	19	-	24	330	U	FQ	#	330	196
Turbidity	NTU	06/28/2016	N001	19	-	24	1.86		FQ	#		
Uranium-235	pCi/L	06/28/2016	N001	19	-	24	22	U	FQ	#	22	13.3
Yttrium-88	pCi/L	06/28/2016	N001	19	-	24	4.9	U	FQ	#	4.9	3.01

Groundwater Quality Data by Location (USEE100) FOR SITE HAL01, Hallam Decommissioned Reactor Site
REPORT DATE: 8/11/2016
Location: 5B WELL

Parameter	Units	Sample Date	Sample ID	Depth Range (Ft BLS)			Result	Qualifiers Lab	Qualifiers Data	Qualifiers QA	Detection Limit	Uncertainty
Actinium-228	pCi/L	06/28/2016	N001	39	-	49	19.2		UFQ	#	18	10.5
Alkalinity, Total (as $CaCO_3$)	mg/L	06/28/2016	N001	39	-	49	277		FQ	#		
Americium-241	pCi/L	06/28/2016	N001	39	-	49	26	U	FQ	#	26	15.4
Antimony-125	pCi/L	06/28/2016	N001	39	-	49	11	U	FQ	#	11	6.37
Cerium-144	pCi/L	06/28/2016	N001	39	-	49	22	U	FQ	#	22	13.2
Cesium-134	pCi/L	06/28/2016	N001	39	-	49	6.7	U	FQ	#	6.7	3.95
Cesium-137	pCi/L	06/28/2016	N001	39	-	49	4.8	U	FQ	#	4.8	2.81
Cobalt-60	pCi/L	06/28/2016	N001	39	-	49	6.1	U	FQ	#	6.1	3.4
Europium-152	pCi/L	06/28/2016	N001	39	-	49	27	U	FQ	#	27	15.6
Europium-154	pCi/L	06/28/2016	N001	39	-	49	26	U	FQ	#	26	14.9
Europium-155	pCi/L	06/28/2016	N001	39	-	49	12	U	FQ	#	12	7.16
Gross Alpha	pCi/L	06/28/2016	N001	39	-	49	12.5		FQ	#	1.1	2.34
Gross Beta	pCi/L	06/28/2016	N001	39	-	49	10.8		FQ	#	1	1.9
Lead-212	pCi/L	06/28/2016	N001	39	-	49	13	U	FQ	#	13	7.79
Nickel-63	pCi/L	06/28/2016	N001	39	-	49	14	U	FQ	#	14	3.97
Oxidation Reduction Potential	mV	06/28/2016	N001	39	-	49	132.9		FQ	#		
pH	s.u.	06/28/2016	N001	39	-	49	7.4		FQ	#		
Potassium-40	pCi/L	06/28/2016	N001	39	-	49	140	U	FQ	#	140	82.5

Groundwater Quality Data by Location (USEE100) FOR SITE HAL01, Hallam Decommissioned Reactor Site
REPORT DATE: 8/11/2016
Location: 5B WELL

Parameter	Units	Sample Date	Sample ID	Depth Range (Ft BLS)			Result	Qualifiers Lab	Qualifiers Data	Qualifiers QA	Detection Limit	Uncertainty
Promethium-144	pCi/L	06/28/2016	N001	39	-	49	4.9	U	FQ	#	4.9	3.06
Promethium-146	pCi/L	06/28/2016	N001	39	-	49	4.9	U	FQ	#	4.9	2.92
Ruthenium-106	pCi/L	06/28/2016	N001	39	-	49	46	U	FQ	#	46	26.9
Specific Conductance	umhos /cm	06/28/2016	N001	39	-	49	748		FQ	#		
Temperature	C	06/28/2016	N001	39	-	49	19.55		FQ	#		
Thorium-234	pCi/L	06/28/2016	N001	39	-	49	130	U	FQ	#	130	77.2
Tritium	pCi/L	06/28/2016	N001	39	-	49	330	U	FQ	#	330	193
Turbidity	NTU	06/28/2016	N001	39	-	49	2.37		FQ	#		
Uranium-235	pCi/L	06/28/2016	N001	39	-	49	20	U	FQ	#	20	12.1
Yttrium-88	pCi/L	06/28/2016	N001	39	-	49	11	U	FQ	#	11	6.76

Groundwater Quality Data by Location (USEE100) FOR SITE HAL01, Hallam Decommissioned Reactor Site
REPORT DATE: 8/11/2016
Location: 7B WELL

Parameter	Units	Sample Date	Sample ID	Depth Range (Ft BLS)	Result	Qualifiers Lab	Qualifiers Data	Qualifiers QA	Detection Limit	Uncertainty
Actinium-228	pCi/L	06/27/2016	N001	-	17		UFQ	#	16	10.5
Alkalinity, Total (as $CaCO_3$)	mg/L	06/27/2016	N001	-	274		FQ	#		
Americium-241	pCi/L	06/27/2016	N001	-	27	U	FQ	#	27	15.8
Antimony-125	pCi/L	06/27/2016	N001	-	10	U	FQ	#	10	6.1
Cerium-144	pCi/L	06/27/2016	N001	-	18	U	FQ	#	18	10.6
Cesium-134	pCi/L	06/27/2016	N001	-	6.2	U	FQ	#	6.2	3.45
Cesium-137	pCi/L	06/27/2016	N001	-	4.4	U	FQ	#	4.4	2.6
Cobalt-60	pCi/L	06/27/2016	N001	-	5.3	U	FQ	#	5.3	3.02
Europium-152	pCi/L	06/27/2016	N001	-	25	U	FQ	#	25	14.5
Europium-154	pCi/L	06/27/2016	N001	-	36	U	FQ	#	36	21.2
Europium-155	pCi/L	06/27/2016	N001	-	10	U	FQ	#	10	6.05
Gross Alpha	pCi/L	06/27/2016	0001	-	5.58		FQ	#	1.2	1.32
Gross Beta	pCi/L	06/27/2016	0001	-	8.06		FQ	#	0.98	1.47
Lead-212	pCi/L	06/27/2016	N001	-	12	U	FQ	#	12	7.13
Nickel-63	pCi/L	06/27/2016	N001	-	15	U	FQ	#	15	4.32
Oxidation Reduction Potential	mV	06/27/2016	N001	-	105.3		FQ	#		
pH	s.u.	06/27/2016	N001	-	7.45		FQ	#		
Potassium-40	pCi/L	06/27/2016	N001	-	110	U	FQ	#	110	70

Groundwater Quality Data by Location (USEE100) FOR SITE HAL01, Hallam Decommissioned Reactor Site
REPORT DATE: 8/11/2016
Location: 7B WELL

Parameter	Units	Sample Date	Sample ID	Depth Range (Ft BLS)	Result	Qualifiers Lab	Qualifiers Data	Qualifiers QA	Detection Limit	Uncertainty
Promethium-144	pCi/L	06/27/2016	N001	-	4.51		UFQ	#	4.5	2.86
Promethium-146	pCi/L	06/27/2016	N001	-	4.8	U	FQ	#	4.8	2.87
Ruthenium-106	pCi/L	06/27/2016	N001	-	42	U	FQ	#	42	24.5
Specific Conductance	umhos /cm	06/27/2016	N001	-	732		FQ	#		
Temperature	C	06/27/2016	N001	-	23.82		FQ	#		
Thorium-234	pCi/L	06/27/2016	N001	-	130	U	FQ	#	130	77
Tritium	pCi/L	06/27/2016	N001	-	330	U	FQ	#	330	195
Turbidity	NTU	06/27/2016	N001	-	0.58		FQ	#		
Uranium-235	pCi/L	06/27/2016	N001	-	12	U	FQ	#	12	7.54
Yttrium-88	pCi/L	06/27/2016	N001	-	5.4	U	FQ	#	5.4	3.36

Groundwater Quality Data by Location (USEE100) FOR SITE HAL01, Hallam Decommissioned Reactor Site
REPORT DATE: 8/11/2016
Location: 7C WELL

Parameter	Units	Sample Date	Sample ID	Depth Range (Ft BLS)	Result	Qualifiers Lab	Qualifiers Data	Qualifiers QA	Detection Limit	Uncertainty
Actinium-228	pCi/L	06/27/2016	N001	-	20.6		UFQ	#	15	9.71
Americium-241	pCi/L	06/27/2016	N001	-	4	U	FQ	#	4	2.44
Antimony-125	pCi/L	06/27/2016	N001	-	8.5	U	FQ	#	8.5	4.72
Cerium-144	pCi/L	06/27/2016	N001	-	14	U	FQ	#	14	8.42
Cesium-134	pCi/L	06/27/2016	N001	-	3.7	U	FQ	#	3.7	2.17
Cesium-137	pCi/L	06/27/2016	N001	-	3.8	U	FQ	#	3.8	2.17
Cobalt-60	pCi/L	06/27/2016	N001	-	4.2	U	FQ	#	4.2	2.43
Europium-152	pCi/L	06/27/2016	N001	-	21	U	FQ	#	21	11.6
Europium-154	pCi/L	06/27/2016	N001	-	21	U	FQ	#	21	12.3
Europium-155	pCi/L	06/27/2016	N001	-	6.5	U	FQ	#	6.5	3.84
Gross Alpha	pCi/L	06/27/2016	0001	-	7.99		FQ	#	1.1	1.68
Gross Beta	pCi/L	06/27/2016	0001	-	6.38		FQ	#	1.5	1.43
Lead-212	pCi/L	06/27/2016	N001	-	9.9	U	FQ	#	9.9	5.9
Nickel-63	pCi/L	06/27/2016	N001	-	15	U	FQ	#	15	4.35
Potassium-40	pCi/L	06/27/2016	N001	-	100	U	FQ	#	100	61
Promethium-144	pCi/L	06/27/2016	N001	-	7.1	U	FQ	#	7.1	4.22
Promethium-146	pCi/L	06/27/2016	N001	-	4.3	U	FQ	#	4.3	2.52
Ruthenium-106	pCi/L	06/27/2016	N001	-	34	U	FQ	#	34	20.1

Groundwater Quality Data by Location (USEE100) FOR SITE HAL01, Hallam Decommissioned Reactor Site
REPORT DATE: 8/11/2016
Location: 7C WELL

Parameter	Units	Sample Date	Sample ID	Depth Range (Ft BLS)	Result	Qualifiers Lab	Qualifiers Data	Qualifiers QA	Detection Limit	Uncertainty
Thorium-234	pCi/L	06/27/2016	N001	-	69	U	FQ	#	69	34.5
Tritium	pCi/L	06/27/2016	N001	-	330	U	FQ	#	330	191
Uranium-235	pCi/L	06/27/2016	N001	-	25	U	FQ	#	25	12.9
Yttrium-88	pCi/L	06/27/2016	N001	-	4.5	U	FQ	#	4.5	2.73

Groundwater Quality Data by Location (USEE100) FOR SITE HAL01, Hallam Decommissioned Reactor Site
REPORT DATE: 8/11/2016
Location: 8B WELL

Parameter	Units	Sample Date	Sample ID	Depth Range (Ft BLS)	Result	Qualifiers Lab	Qualifiers Data	Qualifiers QA	Detection Limit	Uncertainty
Actinium-228	pCi/L	06/27/2016	N001	-	17	U	FQ	#	17	8.72
Alkalinity, Total (as $CaCO_3$)	mg/L	06/27/2016	N001	-	305		FQ	#		
Americium-241	pCi/L	06/27/2016	N001	-	4.9	U	FQ	#	4.9	3.02
Antimony-125	pCi/L	06/27/2016	N001	-	9.1	U	FQ	#	9.1	5.5
Cerium-144	pCi/L	06/27/2016	N001	-	15	U	FQ	#	15	9.1
Cesium-134	pCi/L	06/27/2016	N001	-	4.3	U	FQ	#	4.3	2.49
Cesium-137	pCi/L	06/27/2016	N001	-	4.2	U	FQ	#	4.2	2.49
Cobalt-60	pCi/L	06/27/2016	N001	-	4.7	U	FQ	#	4.7	2.8
Europium-152	pCi/L	06/27/2016	N001	-	24	U	FQ	#	24	13.8
Europium-154	pCi/L	06/27/2016	N001	-	25	U	FQ	#	25	14.6
Europium-155	pCi/L	06/27/2016	N001	-	16	U	FQ	#	16	9.4
Gross Alpha	pCi/L	06/27/2016	N001	-	7.15		FQ	#	1.4	1.64
Gross Beta	pCi/L	06/27/2016	N001	-	8.65		FQ	#	1.4	1.68
Lead-212	pCi/L	06/27/2016	N001	-	12	U	FQ	#	12	7.05
Nickel-63	pCi/L	06/27/2016	N001	-	16	U	FQ	#	16	4.61
Oxidation Reduction Potential	mV	06/27/2016	N001	-	129.1		FQ	#		
pH	s.u.	06/27/2016	N001	-	7.36		FQ	#		
Potassium-40	pCi/L	06/27/2016	N001	-	140	U	FQ	#	140	83

Groundwater Quality Data by Location (USEE100) FOR SITE HAL01, Hallam Decommissioned Reactor Site
REPORT DATE: 8/11/2016
Location: 8B WELL

Parameter	Units	Sample Date	Sample ID	Depth Range (Ft BLS)	Result	Qualifiers Lab	Qualifiers Data	Qualifiers QA	Detection Limit	Uncertainty
Promethium-144	pCi/L	06/27/2016	N001	-	4.8	U	FQ	#	4.8	3.07
Promethium-146	pCi/L	06/27/2016	N001	-	4.4	U	FQ	#	4.4	2.58
Ruthenium-106	pCi/L	06/27/2016	N001	-	39	U	FQ	#	39	22.9
Specific Conductance	umhos /cm	06/27/2016	N001	-	1069		FQ	#		
Temperature	C	06/27/2016	N001	-	17.24		FQ	#		
Thorium-234	pCi/L	06/27/2016	N001	-	74	U	FQ	#	74	36.2
Tritium	pCi/L	06/27/2016	N001	-	320	U	FQ	#	320	186
Turbidity	NTU	06/27/2016	N001	-	9.64		FQ	#		
Uranium-235	pCi/L	06/27/2016	N001	-	34	U	FQ	#	34	17.9
Yttrium-88	pCi/L	06/27/2016	N001	-	5.3	U	FQ	#	5.3	3.13

Groundwater Quality Data by Location (USEE100) FOR SITE HAL01, Hallam Decommissioned Reactor Site
REPORT DATE: 8/11/2016
Location: 8C WELL

Parameter	Units	Sample Date	Sample ID	Depth Range (Ft BLS)	Result	Qualifiers Lab	Qualifiers Data	Qualifiers QA	Detection Limit	Uncertainty
Actinium-228	pCi/L	06/27/2016	N001	-	27	U	FQ	#	27	15.8
Alkalinity, Total (as $CaCO_3$)	mg/L	06/27/2016	N001	-	274		FQ	#		
Americium-241	pCi/L	06/27/2016	N001	-	34	U	FQ	#	34	20.1
Antimony-125	pCi/L	06/27/2016	N001	-	14	U	FQ	#	14	7.99
Cerium-144	pCi/L	06/27/2016	N001	-	26	U	FQ	#	26	15.4
Cesium-134	pCi/L	06/27/2016	N001	-	9.3	U	FQ	#	9.3	5.77
Cesium-137	pCi/L	06/27/2016	N001	-	6.2	U	FQ	#	6.2	3.72
Cobalt-60	pCi/L	06/27/2016	N001	-	8.1	U	FQ	#	8.1	4.82
Europium-152	pCi/L	06/27/2016	N001	-	40	U	FQ	#	40	23.2
Europium-154	pCi/L	06/27/2016	N001	-	40	U	FQ	#	40	23.8
Europium-155	pCi/L	06/27/2016	N001	-	13	U	FQ	#	13	7.63
Gross Alpha	pCi/L	06/27/2016	N001	-	6.78		FQ	#	1.7	2.1
Gross Beta	pCi/L	06/27/2016	N001	-	6.06		FQ	#	1.9	1.7
Lead-212	pCi/L	06/27/2016	N001	-	14	U	FQ	#	14	8.49
Nickel-63	pCi/L	06/27/2016	N001	-	14	U	FQ	#	14	4.21
Oxidation Reduction Potential	mV	06/27/2016	N001	-	-116.6		FQ	#		
pH	s.u.	06/27/2016	N001	-	7.27		FQ	#		
Potassium-40	pCi/L	06/27/2016	N001	-	190	U	FQ	#	190	114

Groundwater Quality Data by Location (USEE100) FOR SITE HAL01, Hallam Decommissioned Reactor Site
REPORT DATE: 8/11/2016
Location: 8C WELL

Parameter	Units	Sample Date	Sample ID	Depth Range (Ft BLS)	Result	Qualifiers Lab	Qualifiers Data	Qualifiers QA	Detection Limit	Uncertainty
Promethium-144	pCi/L	06/27/2016	N001	-	24	U	FQ	#	24	14.7
Promethium-146	pCi/L	06/27/2016	N001	-	6.8	U	FQ	#	6.8	4.01
Ruthenium-106	pCi/L	06/27/2016	N001	-	59	U	FQ	#	59	35
Specific Conductance	umhos /cm	06/27/2016	N001	-	805		FQ	#		
Temperature	C	06/27/2016	N001	-	17.18		FQ	#		
Thorium-234	pCi/L	06/27/2016	N001	-	150	U	FQ	#	150	90.8
Tritium	pCi/L	06/27/2016	N001	-	330	U	FQ	#	330	194
Turbidity	NTU	06/27/2016	N001	-	2.37		FQ	#		
Uranium-235	pCi/L	06/27/2016	N001	-	24	U	FQ	#	24	13.9
Yttrium-88	pCi/L	06/27/2016	N001	-	8.3	U	FQ	#	8.3	4.95

SAMPLE ID CODES: 000X = Filtered sample (0.45 µm). N00X = Unfiltered sample. X = replicate number.

LAB QUALIFIERS:

*	Replicate analysis not within control limits.
>	Result above upper detection limit.
A	TIC is a suspected aldol-condensation product.
B	Inorganic: Result is between the IDL and CRDL. Organic: Analyte also found in method blank.
C	Pesticide result confirmed by GC-MS.
D	Analyte determined in diluted sample.
E	Inorganic: Estimate value because of interference, see case narrative. Organic: Analyte exceeded calibration range of the GC-MS.
H	Holding time expired, value suspect.
I	Increased detection limit due to required dilution.
J	Estimated
N	Inorganic or radiochemical: Spike sample recovery not within control limits. Organic: Tentatively identified compound (TIC).
P	> 25% difference in detected pesticide or Aroclor concentrations between 2 columns.
U	Analytical result below detection limit.
W	Post-digestion spike outside control limits while sample absorbance < 50% of analytical spike absorbance.
X,Y,Z	Laboratory defined qualifier, see case narrative.

DATA QUALIFIERS:

F	Low flow sampling method used.	G	Possible grout contamination, pH > 9.	J	Estimated value.
L	Less than 3 bore volumes purged prior to sampling.	Q	Qualitative result due to sampling technique.	R	Unusable result.
U	Parameter analyzed for but was not detected.	X	Location is undefined.		

QA QUALIFIER:

#	Validated according to quality assurance guidelines.

Static Water Level Data

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STATIC WATER LEVELS (USEE700) FOR SITE HAL01, Hallam Decommissioned Reactor Site
REPORT DATE: 8/11/2016

Location Code	Flow Code	Top of Casing Elevation (Ft)	Measurement Date	Measurement Time	Depth From Top of Casing (Ft)	Water Elevation (Ft)
1A	N	1440.35	06/28/2016	13:40:49	4.7	1435.65
1B	N	1440.5	06/28/2016	14:25:58	4.72	1435.78
2A	N	1441.02	06/28/2016	09:40:18	6.94	1434.08
2B	N	1441.29	06/28/2016	09:00:20	7.02	1434.27
2B2	N	1442.62	06/28/2016	11:35:31	8.31	1434.31
2C2	N	1442.61	06/28/2016	10:05:40	11.74	1430.87
3A	N	1439.03	06/27/2016	17:00:19	8.3	1430.73
3B	N	1439.39	06/27/2016	16:45:16	6.94	1432.45
4A	N	1438.5	06/27/2016	11:10:27	5.74	1432.76
4B	N	1438.61	06/27/2016	10:10:39	5.41	1433.2
4C	N	1439.77	06/27/2016	10:40:19	20.23	1419.54
5A	N	1437.63	06/28/2016	15:05:13	8.36	1429.27
5B	N	1437.95	06/28/2016	15:25:40	9.56	1428.39
6A	N	1438.13	06/28/2016	16:10:00	4.03	1434.1
6B	N	1438.15	06/28/2016	16:15:00	5.87	1432.28
7B	N	1443.11	06/27/2016	14:00:09	7.84	1435.27
8B	N	1440.97	06/27/2016	11:46:11	7.9	1433.07
8C	N	1441.03	06/27/2016	12:20:42	10.07	1430.96

FLOW CODES: B BACKGROUND C CROSS GRADIENT D DOWNGRADIENT F OFFSITE
N UNKNOWN O ONSITE U UPGRADIENT

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Time-Concentration Graphs

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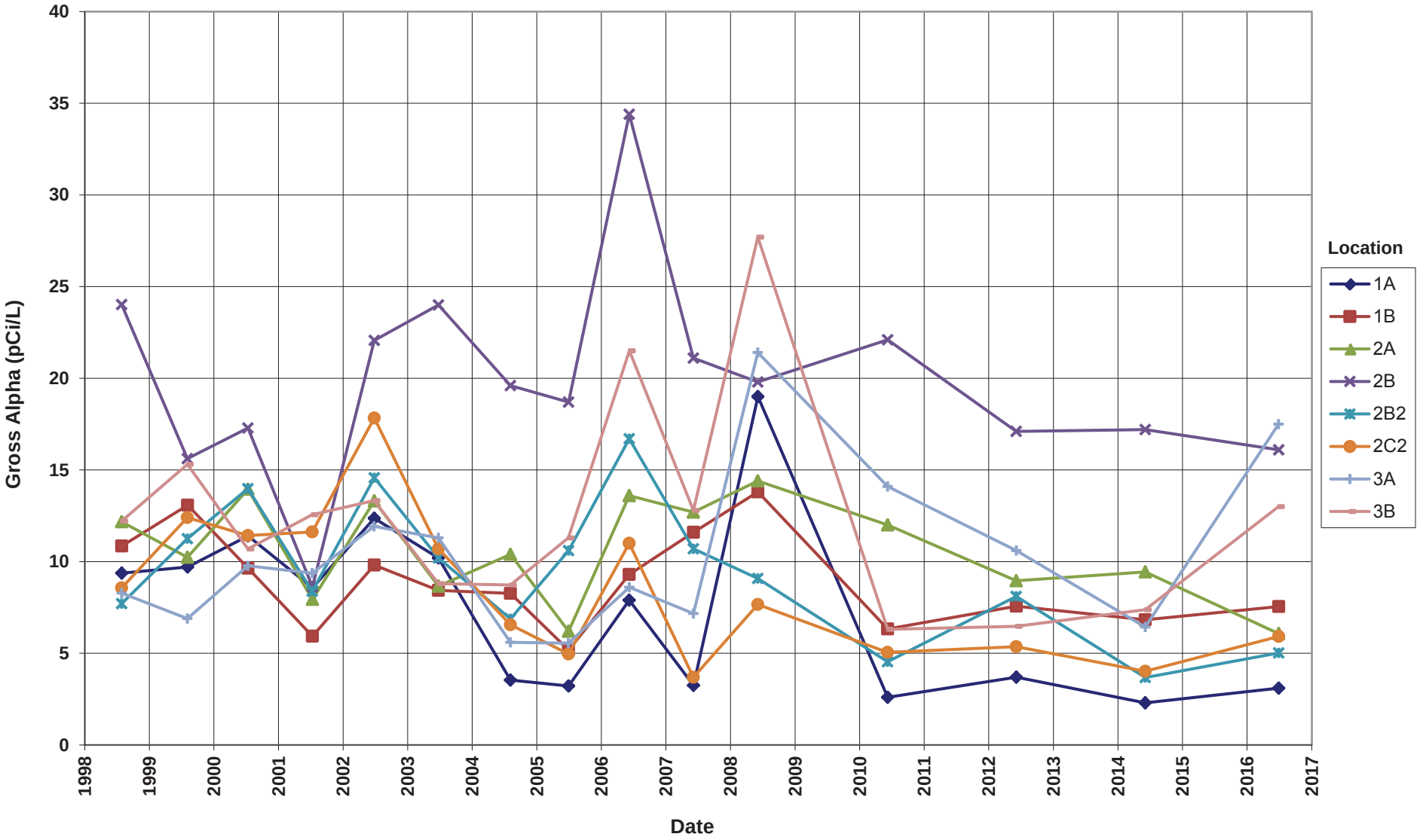
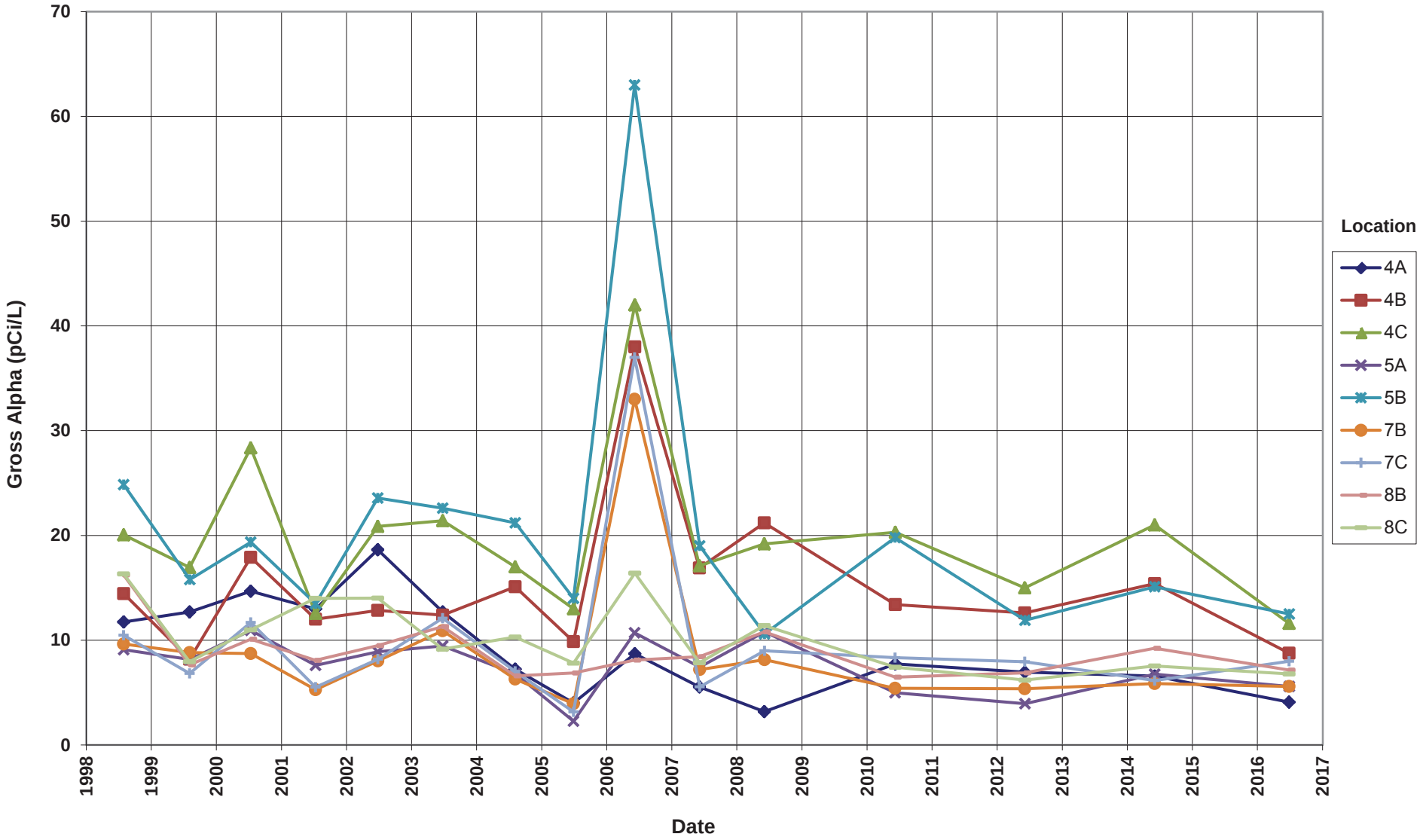
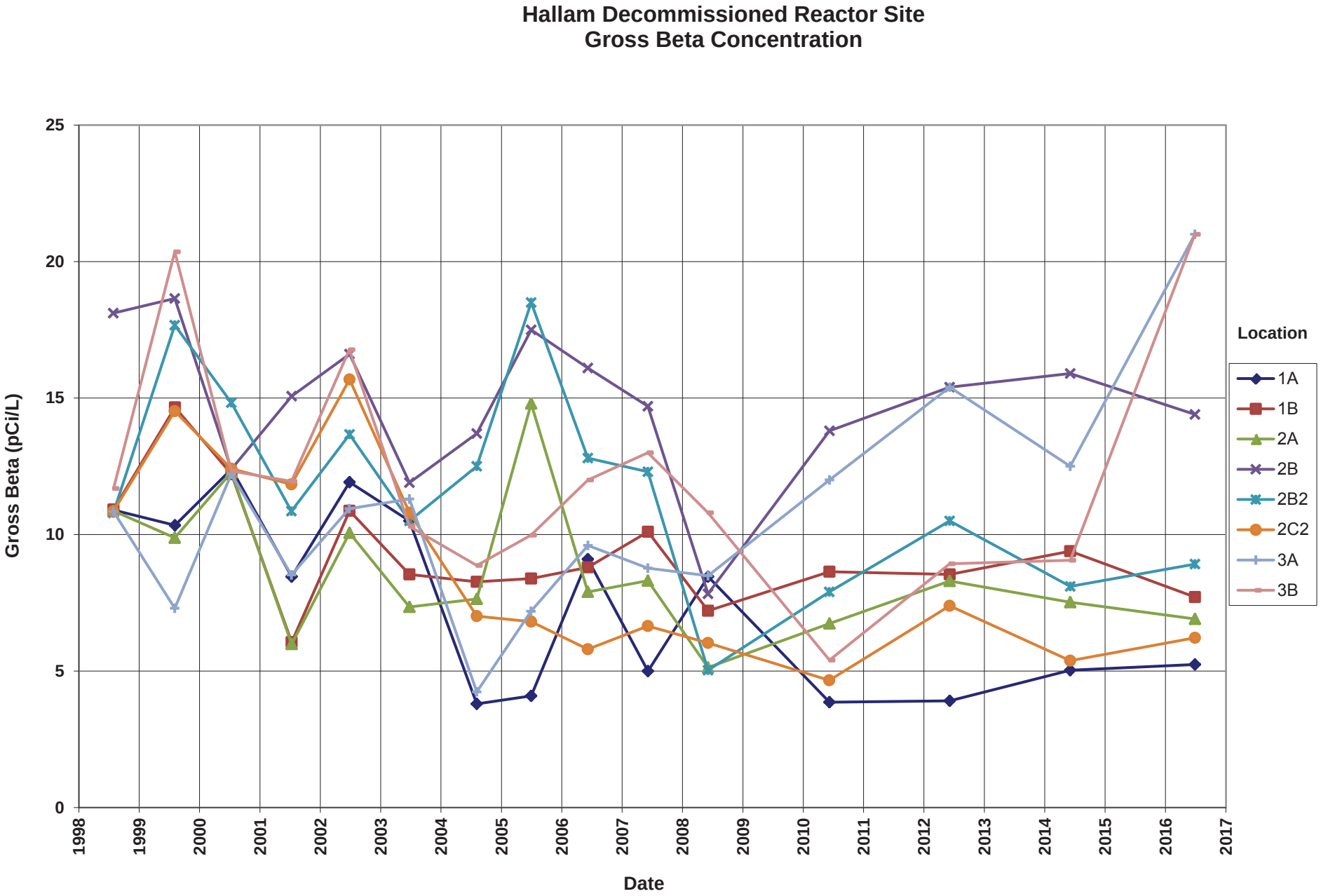
Hallam Decommissioned Reactor Site
Gross Alpha Concentration

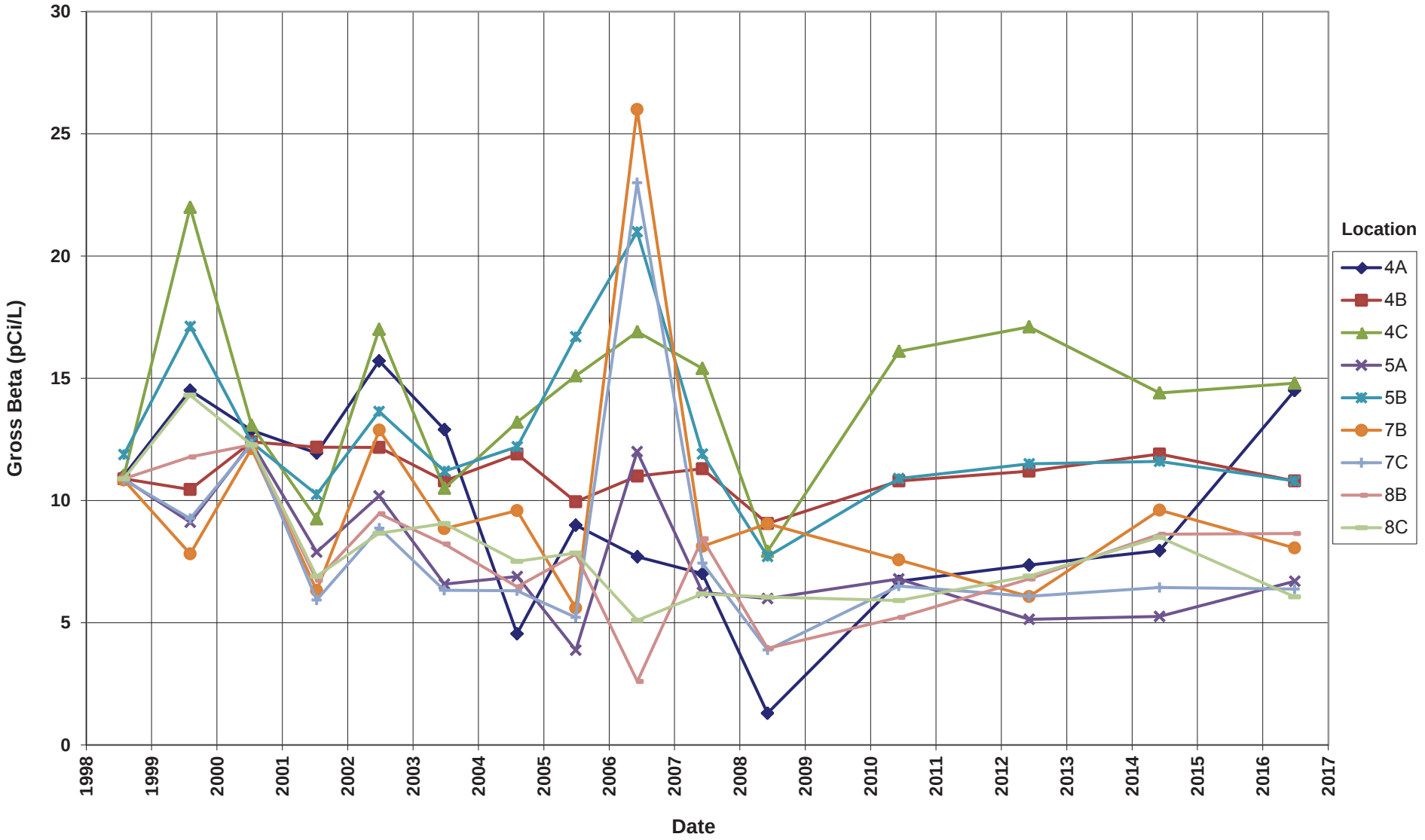


Hallam Decommissioned Reactor Site
Gross Alpha Concentration




Hallam Decommissioned Reactor Site
Gross Beta Concentration
Gross Beta (pCi/L)
25
20
15
10
5
0
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
Date
Location
1A
1B
2A
2B
2B2
2C2
3A
3B

Hallam Decommissioned Reactor Site
Gross Beta Concentration



Attachment 4

Assessment of Anomalous Data

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Potential Outliers Report

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Potential Outliers Report

Potential outliers are measurements that are extremely large or small relative to the rest of the data and, therefore, are suspected of misrepresenting the population from which they were collected. Potential outliers can result from transcription errors, data-coding errors, or measurement system problems. However, outliers can also represent true extreme values of a distribution and can indicate more variability in the population than was expected.

Statistical outlier tests give probabilistic evidence that an extreme value does not “fit” with the distribution of the remainder of the data and is therefore a statistical outlier. These tests should only be used to identify data points that require further investigation. The tests alone cannot determine whether a statistical outlier should be discarded or corrected within a data set.

There are three steps involved in identifying extreme values or outliers:

1. **Identify extreme values that may be potential outliers.** Do this by generating the Outliers Report using the Sample Management System from data in the environmental database. The application compares the new data set (in standard environmental database units) with historical data and lists the new data that fall outside the historical data range. A determination is also made as to whether the data are normally distributed using the Shapiro-Wilk Test.
2. **Apply the appropriate statistical test.** Dixon's Test for extreme values is used to test for statistical outliers when the sample size is less than or equal to 25. This test considers both extreme values that are much smaller than the rest of the data (case 1) and extreme values that are much larger than the rest of the data (case 2). This test is valid only if the data without the suspected outlier are normally distributed. Rosner's Test is a parametric test that is used to detect outliers for sample sizes of 25 or more. This test also assumes that the data without the suspected outliers are normally distributed.
3. **Scientifically review statistical outliers and decide on their disposition.** The review should include an evaluation of any notable trends in the data that may indicate the outliers represent true extreme values.

There were no potential outliers identified, and the data for this event are acceptable as qualified.

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