

Data Validation Package

April 2017
Groundwater Sampling at the
Falls City, Texas, Disposal Site

June 2017



U.S. DEPARTMENT OF
ENERGY

Legacy
Management

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Sampling Event Summary

Site: Falls City, Texas, Disposal Site

Sampling Period: April 12, 2017


Ten groundwater samples were collected at the Falls City, Texas, Disposal Site as specified in the March 2008 *Long-Term Surveillance Plan for the U.S. Department of Energy Falls City Uranium Mill Tailings Disposal Site, Falls City, Texas* (DOE-LM/1602-2008). Planned monitoring locations are shown in Attachment 1, Sampling and Analysis Work Order.

Sampling and analyses were conducted as specified in the *Sampling and Analysis Plan for U.S. Department of Energy Office of Legacy Management Sites* (LMS/PRO/S04351, continually updated).

The wells sampled included the cell performance monitoring wells (0709, 0858, 0880, 0906, and 0921) and the groundwater monitoring wells (0862, 0886, 0891, 0924, and 0963). Duplicate samples were collected from locations 0886 and 0891.

Water levels were measured at each sampled well. Historically, cell performance monitoring wells 0908 and 0916 have not produced water and were confirmed as dry during this sampling event. These wells are completed above the saturated interval in the formation. See Attachment 2, Trip Report, for additional details.

Time-concentration graphs for all groundwater locations are included in Attachment 3, Data Presentation. An assessment of anomalous data is included in Attachment 4.



Mike Widdop, Site Lead
Navarro Research and Engineering, Inc.

6/19/2017

Date

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Data Assessment Summary

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Water Sampling Field Activities Verification Checklist

Project	Falls City, Texas, Disposal Site	Date(s) of Water Sampling	April 12, 2017
Date(s) of Verification	May 30, 2017	Name of Verifier	Stephen Donovan

	Response (Yes, No, NA)	Comments
1. Is the SAP the primary document directing field procedures? List any Program Directives or other documents, SOPs, instructions.	Yes	Work Order letter dated February 27, 2017.
2. Were the sampling locations specified in the planning documents sampled?	No	Locations 0908 and 0916 were confirmed dry.
3. Were field equipment calibrations conducted as specified in the above-named documents?	Yes	Calibrations were performed on April 06, 2017.
4. Was an operational check of the field equipment conducted daily? Did the operational checks meet criteria?	Yes	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	Duplicate samples were collected from locations 0886 and 0891.
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

Requisition: 17048386
Sample Event: April 12, 2017
Site(s): Falls City, Texas, Disposal Site
Laboratory: ALS Laboratory Group, Fort Collins, Colorado
Work Order No.: 1704367
Analysis: Uranium
Validator: Stephen Donovan
Review Date: June 1, 2017

This validation was performed according “Standard Practice for Validation of Environmental Data” found in Appendix A of the *Sampling and Analysis Plan for U.S. Department of Energy Office of Legacy Management Sites* (LMS/PRO/S04351, continually updated, <https://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.

All analyses were successfully completed. 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	Prep Method	Analytical Method
Uranium	LMM-02	SW-846 3005A	SW-846 6020A

Data Qualifier Summary

None of the analytical results required qualification.

Sample Shipping/Receiving

ALS Laboratory Group in Fort Collins, Colorado, received 14 water samples on April 18, 2017, accompanied by a Chain of Custody (COC) form. The COC form was checked to confirm that the samples were listed on the form and that signatures and dates were present indicating sample relinquishment and receipt. The sample submittal documents had no errors or omissions. Copies of the air waybill labels were included with the receiving documentation.

Preservation and Holding Times

The sample shipment was received intact at ambient temperature which complies with requirements. The 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

A method detection limit (MDL) is defined in 40 CFR 136 as the minimum concentration of an analyte that can be measured and reported with 99% confidence that the analyte concentration is greater than zero. The MDLs reported by the laboratory were compared to the required MDLs to assess the sensitivity of the analyses and found to be in compliance with contractual requirements.

The practical quantitation limit (PQL) for an analyte, defined as 5 times the MDL, is the lowest concentration that can be quantitatively measured, and is used when evaluating laboratory method performance in the sections below.

Laboratory Instrument Calibration

Method requirements for satisfactory instrument calibration are established to ensure that the instrument is capable of producing acceptable qualitative and quantitative data for the analytes of interest. Initial Calibration Verification (ICV) demonstrates that the instrument is capable of acceptable performance at the beginning of the analytical run. Continuing Calibration Verification (CCV) demonstrates that the initial calibration is still valid by checking the performance of the instrument on a continuing basis. Initial and continuing calibration standards must be prepared from independent sources to ensure the validity of the calibration. All laboratory instrument calibrations and calibration verifications were performed correctly in accordance with the cited methods.

Method SW-846 6020A, Uranium

Calibrations were performed on May 9, 2017, using four calibration standards. The calibration curve correlation coefficient values were greater than 0.995 and the absolute values of the intercepts were less than 3 times the MDL as required by the cited method. The ICV and CCV checks were made at the required frequency. All calibration checks met the acceptance criteria. Reporting limit verification checks were made at the required frequency to verify the linearity of the calibration curve near the PQL and all results were within the acceptance range. Mass calibration and resolution verifications were performed at the beginning of each analytical run in accordance with the analytical procedure. Internal standard recoveries associated with requested analytes were stable and within acceptable ranges.

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 method-blank and calibration-blank results associated with the samples were below the PQL for all analytes. In cases where the blank concentration exceeds the

MDL, associated sample results that are greater than the MDL but less than 5 times the blank concentration are qualified with a “U” flag as not detected.

Inductively Coupled Plasma Interference Check Sample Analysis

Interference check samples are analyzed to verify the instrumental interelement and background correction factors and assess any bias due to interelement interferences. Interference check samples were analyzed at the required frequency with all results meeting the acceptance criteria.

Matrix Spike Analysis

Matrix spikes are aliquots of environmental samples to which a known concentration of an 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. For this task, the MS/MSD data were not evaluated because the concentration of the unspiked sample was greater than 4 times the spike concentration.

Laboratory Replicate Analysis

Laboratory replicate analyses are used to determine laboratory precision for each sample matrix. The relative percent difference for replicate results that are greater than 5 times the PQL should be less than 20%. For results that are less than 5 times the PQL, the range should be no greater than the PQL. All replicate results met these criteria, demonstrating acceptable precision.

Laboratory Control Samples

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 analyses.

Metals Serial Dilution

Serial dilutions were prepared and analyzed for the metals analyses to monitor chemical or physical interferences in the sample matrix. Serial dilution data are evaluated to assess bias when the concentration of the undiluted sample is greater than 50 times the MDL. The uranium serial dilution result was above the acceptance limit. The associated sample uranium result is qualified with a “J” flag as an estimated value.

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 May 12, 2017. 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 were 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: 17048386 Lab Code: PAR Validator: _____ Validation Date: 5/30/2017
Project: Falls City Analysis Type: Metals General Chem Rad Organics
of Samples: 14 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
- Detection Limits
- Field/Trip Blanks
- Field Duplicates

All analyses were completed within the applicable holding times.

The reported detection limits are equal to or below contract requirements.

There were 4 duplicates evaluated.

Figure 1. General Validation Report

SAMPLE MANAGEMENT SYSTEM Metals Data Validation Worksheet

RIN: 17048386 **Lab Code:** PAR **Date Due:** 5/16/2017
Matrix: Water **Site Code:** FCT01 **Date Completed:** 5/16/2017

Analyte	Method Type	Date Analyzed	CALIBRATION				Method Blank	LCS %R	MS %R	MSD %R	Dup. RPD	ICSAB %R	Serial Dil. %R	CRI %R
			Int.	R^2	CCV	CCB								
Uranium	ICP/MS	05/10/2017	0.0000	1.0000	OK	OK	OK	99.0			2.0	98.0	4.0	90.0

Figure 2. Metals Validation Worksheet

Sampling Quality Control Assessment

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

Sampling Protocol

Sample results for all monitoring wells met the Category I or II low-flow sampling criteria and were qualified with an “F” flag in the database, indicating the wells were purged and sampled using the low-flow sampling method.

The groundwater sample results for wells 0858, 0862, 0880, 0886, and 0906 were qualified with a “Q” flag in the database indicating the data are considered qualitative because the wells were sampled using Category II criteria.

Equipment Blank Assessment

An equipment blank was not required because dedicated sampling equipment was used at all locations.

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. The relative percent difference for duplicate results that are greater than 5 times the PQL should be less than 20%. For results that are less than the PQL, the range should be no greater than the PQL. One duplicate sample was collected from location 0891. Three duplicate samples were collected from location 0886 at intervals approximately 5 minutes apart. The duplicate results met these criteria (Figure 3), demonstrating acceptable overall precision.

SAMPLE MANAGEMENT SYSTEM
Validation Report: Field Duplicates

RIN: 17048386 Lab Code: PAR Project: Falls City Validation Date: 5/30/2017

Duplicate: 2580 **Sample: 0891**

Analyte	Sample				Duplicate				RPD	RER	Units
	Result	Flag	Error	Dilution	Result	Flag	Error	Dilution			
Uranium	2.5			100	2.3			100	8.33		MG/L

Duplicate: 2890 **Sample: 0886**

Analyte	Sample				Duplicate				RPD	RER	Units
	Result	Flag	Error	Dilution	Result	Flag	Error	Dilution			
Uranium	0.09			10	0.08			10	11.76		MG/L

Duplicate: 2891 **Sample: 0886**

Analyte	Sample				Duplicate				RPD	RER	Units
	Result	Flag	Error	Dilution	Result	Flag	Error	Dilution			
Uranium	0.09			10	0.08			10	11.76		MG/L

Duplicate: 2892 **Sample: 0886**

Analyte	Sample				Duplicate				RPD	RER	Units
	Result	Flag	Error	Dilution	Result	Flag	Error	Dilution			
Uranium	0.09			10	0.078			10	14.29		MG/L

Figure 3. Field Duplicates 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.

Laboratory Coordinator: Stephen Donovan 6-19-2017
Stephen Donovan Date

Data Validation Lead: Stephen Donovan 6-19-2017
Stephen Donovan Date

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Attachment 1

Sampling and Analysis Work Order

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February 27, 2017

Task Assignment 103
Control Number 17-0377

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

SUBJECT: Contract No. DE-LM0000421, Navarro Research & Engineering, Inc. (Navarro)
Task Assignment 103 LTS&M-UMTRCA Title I and II Sites, D&D Sites, Other
Sites, and Other
April 2017 Environmental Sampling at the Falls City, Texas, Disposal Site

REFERENCE: Task Assignment 103, 1-103-1-02-105, Falls City, Texas, Disposal Site

Dear Ms. Jasso:

The purpose of this letter is to inform you of the upcoming sampling event at the Falls City, Texas, disposal site. Enclosed are the map and tables specifying sample locations and analytes for monitoring at the site. Water quality data will be collected at this site as part of the routine environmental sampling currently scheduled to begin the week of April 4, 2016.

The following list shows the monitoring wells (along with associated zone of completion) scheduled for sampling during this event.

Monitoring Wells*

709 Cq/Ct	862 DI	886 De	906 Cq	916 Cq	921 Cq	924 Cq	963 Cq
858 Cq	880 De	891 DI	908 Cq				

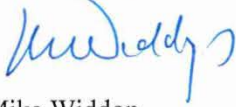
*NOTE: Cq = Conquista Clay – Whitsett Formation; Ct = Claystone; De = DeWeesville Sand – Whitsett Formation; DI = Dilworth Sand – Whitsett Formation

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 (970) 248-6793 if you have any questions.

Tashina Jasso
Control Number 17-0377
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Sincerely,



Mike Widdop
LMS Site Lead

MW/lcg/csa

Enclosures (3)

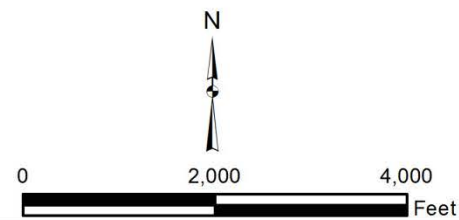
cc: (electronic)
Christine Hopper, DOE
Christina Pennal, DOE
Jeff Carman, Navarro
Bev Cook, Navarro
Steve Donovan, Navarro
Lauren Goodknight, Navarro
Sam Marutzky, Navarro
Diana Osborne, Navarro
Mike Widdop, Navarro
Document Determination
EDD Delivery
Records
File: FCT 400.02



Aerial Imagery: ESRI World Imagery (Texas Orthoimagery Program)

LEGEND

- WELL TO BE SAMPLED
- - - SITE BOUNDARY



U.S. DEPARTMENT OF ENERGY OFFICE OF LEGACY MANAGEMENT	Work Performed by Navarro Research & Engineering, Inc. Under DOE Contract Number DE-LM0000421
Groundwater Sample Locations Falls City, TX, Disposal Site April 2017	
DATE PREPARED: February 22, 2017	FILE NAME: S1574500-11x17

\\LM\ess\Env\Projects\EBM\LT\S111\000116\004\S1574500-11x17.mxd smithw 02/22/2017 9:37:52 AM

Falls City, Texas, Disposal Site Groundwater Sample Locations

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**Sampling Frequencies for Locations at
Falls City, Texas**

Location ID	Quarterly	Semiannually	Annually	Biennially	Not Sampled	Notes
Monitoring Wells						
709			X			
858			X			
862			X			
880			X			
886			X			
891			X			Collect duplicate from this well
906			X			
908			X			
916			X			
921			X			
924			X			
963			X			

Annual sampling conducted in April
Based on LTSP dated March 2008

Constituent Sampling Breakdown

Site	Falls City		Required Detection Limit (mg/L)	Analytical Method	Line Item Code
	Groundwater	Surface Water			
Analyte					
Approx. No. Samples/yr	12	0			
Field Measurements					
Total Alkalinity					
Dissolved Oxygen	X				
Redox Potential	X				
pH	X				
Specific Conductance	X				
Turbidity	X				
Temperature	X				
Laboratory Measurements					
Aluminum					
Ammonia as N (NH ₃ -N)					
Calcium					
Chloride					
Chromium					
Iron					
Lead					
Magnesium					
Manganese					
Molybdenum					
Nickel					
Nitrate + Nitrite as N (NO ₃ +NO ₂)-N					
Potassium					
Selenium					
Sodium					
Strontium					
Sulfate					
Sulfide					
Total Dissolved Solids					
Uranium	X		0.0001	SW-846 6020	LMM-02
Vanadium					
Zinc					
Total No. of Analytes	1	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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To: Mike Widdop, Navarro
From: Gretchen Baer, Navarro
Date: April 19, 2017
CC: Tashina Jasso, DOE
Steve Donovan, Navarro
Mike Widdop, Navarro
EDD Delivery
Re: Sampling Trip Report

Site: Falls City, Texas

Date of Event: April 12, 2017

Team Members: Gretchen Baer and Jeff Price, Navarro

Number of Locations Sampled: Samples were collected from 10 of the 12 locations identified on the sampling notification letter.

Locations Not Sampled/Reason: Monitoring wells 0908 and 0916 were not sampled because they were dry.

Location Specific Information:

- All times recorded in the field sheets are in the CDT time zone.
- Wells 0858, 0862, 0880, 0886, and 0906 were identified as Category II for this event.
- A field duplicate sample was collected from well 0891, as instructed by the “Sampling Frequencies for Locations at Falls City, Texas” table in the SAP.
- Split samples were collected at well 0886 with Pee Wee King (Conoco representative). Immediately after purging the minimum volume, approximately 250 mL was collected for King’s pH bottle. Then approximately 4.5 L was collected in large containers, mixed well, and distributed into King’s 2 2-L bottles and Navarro’s 0.5-L bottle. The bottles were acidified separately (King used his own acid and the Navarro bottle was acidified with Navarro acid). The sample time of 14:30 was the approximate midpoint of filling the large containers. Three field duplicates were then collected for Navarro. Specific conductivity (SC) measurements were collected as follows:
 - SC measured in the flow cell at the end of the purge and before sample collection: 2142 $\mu\text{S}/\text{cm}$.
 - SC measured in the split samples: 518 $\mu\text{S}/\text{cm}$.
 - SC of the 1st field duplicate (time=14:44): 437 $\mu\text{S}/\text{cm}$.
 - SC of the 2nd field duplicate (time=14:49): 430 $\mu\text{S}/\text{cm}$.
 - SC of the 3rd field duplicate (time=14:54): 460 $\mu\text{S}/\text{cm}$.
 - SC measured from the purge bucket: 4145 $\mu\text{S}/\text{cm}$.

Quality Control Sample Cross Reference: A summary of the quality control samples collected is shown in Table 1.

Table 1. Quality Control Sample Summary

False ID	Ticket Number	True ID	Sample Type	Associated Matrix	Comment
2580	PFR 768	0891	Duplicate	Groundwater	-----
2890	PFT 037	0886	Duplicate	Groundwater	Time: 14:44
2891	PFT 038	0886	Duplicate	Groundwater	Time: 14:49
2892	PFT 039	0886	Duplicate	Groundwater	Time: 14:54

Requisition Index Number (RIN) Assigned: Samples were assigned to RIN 17048386. Field data sheets can be found in [\\crow\SMS\17048386\FieldData](#).

Sample Shipment: Samples were shipped overnight via FedEx from Grand Junction, CO, to ALS Laboratory Group, Ft. Collins, CO, on April 17, 2017.

Water Level Measurements: Water levels were measured in all sampled wells.

Well Inspection Summary: No issues were identified.

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).
- Additional field duplicates and specific conductivity measurements were collected at location 0886 according to site lead instruction.

Field Variance: None.

Equipment: No issues.

Stakeholder/Regulatory/DOE: None.

Institutional Controls:

Fences, Gates, and Locks: No issues were observed. All landowner gates accessed during the event were closed and locked.

Signs: No issues were observed.

Trespassing/Site Disturbances: None observed.

Disposal Cell/Drainage Structure Integrity: No issues were observed.

Safety Issues: None observed.

Access Issues:

- A side-by-side off road vehicle was used to access most locations.
- Overgrowth of brush is causing access problems to wells 0891, 0921, and 0963.

General Information: Nothing to note.

Immediate Actions Taken:

- Chains and locks were replaced on both gates to the disposal cell.
- The loose fence strands south of the entrance gate were tightened.
- Signs and hardware were delivered to Roger Lyssy.

Future Actions Required or Suggested: Paths to the wells should be cleared before the next sampling event.

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Attachment 3

Data Presentation

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Groundwater Quality Data

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Groundwater Quality Data by Location (USEE100) FOR SITE FCT03, Falls City Disposal Site

REPORT DATE: 6/7/2017

Location: 0709 WELL

Parameter	Units	Sample		Depth Range (Ft BLS)	Result	Qualifiers			Detection Limit	Uncertainty
		Date	ID			Lab	Data	QA		
Dissolved Oxygen	mg/L	04/12/2017	N001	12.65 - 32.65	6.92		F	#		
Oxidation Reduction Potential	mV	04/12/2017	N001	12.65 - 32.65	94.8		F	#		
pH	s.u.	04/12/2017	N001	12.65 - 32.65	6.29		F	#		
Specific Conductance	umhos/cm	04/12/2017	N001	12.65 - 32.65	8814		F	#		
Temperature	C	04/12/2017	N001	12.65 - 32.65	23.37		F	#		
Turbidity	NTU	04/12/2017	N001	12.65 - 32.65	2.58		F	#		
Uranium	mg/L	04/12/2017	N001	12.65 - 32.65	0.41		F	#	0.000012	

Groundwater Quality Data by Location (USEE100) FOR SITE FCT03, Falls City Disposal Site

REPORT DATE: 6/7/2017

Location: 0858 WELL

Parameter	Units	Sample		Depth Range			Result	Qualifiers			Detection Limit	Uncertainty
		Date	ID	(Ft BLS)				Lab	Data	QA		
Dissolved Oxygen	mg/L	04/12/2017	N001	39.42	-	49.42	3.81		FQ	#		
Oxidation Reduction Potential	mV	04/12/2017	N001	39.42	-	49.42	-222		FQ	#		
pH	s.u.	04/12/2017	N001	39.42	-	49.42	6.58		FQ	#		
Specific Conductance	umhos /cm	04/12/2017	N001	39.42	-	49.42	10385		FQ	#		
Temperature	C	04/12/2017	N001	39.42	-	49.42	23		FQ	#		
Turbidity	NTU	04/12/2017	N001	39.42	-	49.42	2.25		FQ	#		
Uranium	mg/L	04/12/2017	N001	39.42	-	49.42	0.04		FQ	#	0.000012	

Groundwater Quality Data by Location (USEE100) FOR SITE FCT03, Falls City Disposal Site

REPORT DATE: 6/7/2017

Location: 0862 WELL

Parameter	Units	Sample		Depth Range (Ft BLS)	Result	Qualifiers			Detection Limit	Uncertainty
		Date	ID			Lab	Data	QA		
Dissolved Oxygen	mg/L	04/12/2017	N001	117.77 - 127.77	5.17		FQ	#		
Oxidation Reduction Potential	mV	04/12/2017	N001	117.77 - 127.77	-104.5		FQ	#		
pH	s.u.	04/12/2017	N001	117.77 - 127.77	6.81		FQ	#		
Specific Conductance	umhos/cm	04/12/2017	N001	117.77 - 127.77	4359		FQ	#		
Temperature	C	04/12/2017	N001	117.77 - 127.77	23.25		FQ	#		
Turbidity	NTU	04/12/2017	N001	117.77 - 127.77	2.93		FQ	#		
Uranium	mg/L	04/12/2017	N001	117.77 - 127.77	0.0016		FQ	#	0.000012	

Groundwater Quality Data by Location (USEE100) FOR SITE FCT03, Falls City Disposal Site

REPORT DATE: 6/7/2017

Location: 0880 WELL

Parameter	Units	Sample		Depth Range			Result	Qualifiers			Detection Limit	Uncertainty
		Date	ID	(Ft BLS)				Lab	Data	QA		
Dissolved Oxygen	mg/L	04/12/2017	N001	32.3	-	42.3	3.15		FQ	#		
Oxidation Reduction Potential	mV	04/12/2017	N001	32.3	-	42.3	228.3		FQ	#		
pH	s.u.	04/12/2017	N001	32.3	-	42.3	4.21		FQ	#		
Specific Conductance	umhos/cm	04/12/2017	N001	32.3	-	42.3	19590		FQ	#		
Temperature	C	04/12/2017	N001	32.3	-	42.3	23.85		FQ	#		
Turbidity	NTU	04/12/2017	N001	32.3	-	42.3	41.3		FQ	#		
Uranium	mg/L	04/12/2017	0001	32.3	-	42.3	3.1		FQ	#	0.00012	

Groundwater Quality Data by Location (USEE100) FOR SITE FCT03, Falls City Disposal Site

REPORT DATE: 6/7/2017

Location: 0886 WELL

Parameter	Units	Sample		Depth Range (Ft BLS)	Result	Qualifiers			Detection Limit	Uncertainty
		Date	ID			Lab	Data	QA		
Dissolved Oxygen	mg/L	04/12/2017	N001	19.17 - 49.17	2.19		FQ	#		
Oxidation Reduction Potential	mV	04/12/2017	N001	19.17 - 49.17	97.8		FQ	#		
pH	s.u.	04/12/2017	N001	19.17 - 49.17	6.1		FQ	#		
Specific Conductance	umhos/cm	04/12/2017	N001	19.17 - 49.17	2142		FQ	#		
Temperature	C	04/12/2017	N001	19.17 - 49.17	24.3		FQ	#		
Turbidity	NTU	04/12/2017	N001	19.17 - 49.17	111		FQ	#		
Uranium	mg/L	04/12/2017	0001	19.17 - 49.17	0.09		FQ	#	0.000012	
Uranium	mg/L	04/12/2017	0002	19.17 - 49.17	0.08		FQ	#	0.000012	
Uranium	mg/L	04/12/2017	0003	19.17 - 49.17	0.08		FQ	#	0.000012	
Uranium	mg/L	04/12/2017	0004	19.17 - 49.17	0.078		FQ	#	0.000012	

Groundwater Quality Data by Location (USEE100) FOR SITE FCT03, Falls City Disposal Site

REPORT DATE: 6/7/2017

Location: 0891 WELL

Parameter	Units	Sample		Depth Range (Ft BLS)	Result	Qualifiers			Detection Limit	Uncertainty
		Date	ID			Lab	Data	QA		
Dissolved Oxygen	mg/L	04/12/2017	N001	10.74 - 20.74	2.94		F	#		
Oxidation Reduction Potential	mV	04/12/2017	N001	10.74 - 20.74	40		F	#		
pH	s.u.	04/12/2017	N001	10.74 - 20.74	6.71		F	#		
Specific Conductance	umhos/cm	04/12/2017	N001	10.74 - 20.74	18790		F	#		
Temperature	C	04/12/2017	N001	10.74 - 20.74	23.81		F	#		
Turbidity	NTU	04/12/2017	N001	10.74 - 20.74	9.37		F	#		
Uranium	mg/L	04/12/2017	N001	10.74 - 20.74	2.5		F	#	0.00012	
Uranium	mg/L	04/12/2017	N002	10.74 - 20.74	2.3		F	#	0.00012	

Groundwater Quality Data by Location (USEE100) FOR SITE FCT03, Falls City Disposal Site

REPORT DATE: 6/7/2017

Location: 0906 WELL

Parameter	Units	Sample		Depth Range (Ft BLS)	Result	Qualifiers			Detection Limit	Uncertainty
		Date	ID			Lab	Data	QA		
Dissolved Oxygen	mg/L	04/12/2017	N001	12.49 - 27.49	2.88		FQ	#		
Oxidation Reduction Potential	mV	04/12/2017	N001	12.49 - 27.49	5.1		FQ	#		
pH	s.u.	04/12/2017	N001	12.49 - 27.49	5.7		FQ	#		
Specific Conductance	umhos/cm	04/12/2017	N001	12.49 - 27.49	11417		FQ	#		
Temperature	C	04/12/2017	N001	12.49 - 27.49	23.51		FQ	#		
Turbidity	NTU	04/12/2017	N001	12.49 - 27.49	5.44		FQ	#		
Uranium	mg/L	04/12/2017	N001	12.49 - 27.49	0.078		FQ	#	0.000012	

Groundwater Quality Data by Location (USEE100) FOR SITE FCT03, Falls City Disposal Site

REPORT DATE: 6/7/2017

Location: 0921 WELL

Parameter	Units	Sample		Depth Range (Ft BLS)	Result	Qualifiers			Detection Limit	Uncertainty
		Date	ID			Lab	Data	QA		
Dissolved Oxygen	mg/L	04/12/2017	N001	44.55 - 54.55	2.64		F	#		
Oxidation Reduction Potential	mV	04/12/2017	N001	44.55 - 54.55	25		F	#		
pH	s.u.	04/12/2017	N001	44.55 - 54.55	6.06		F	#		
Specific Conductance	umhos/cm	04/12/2017	N001	44.55 - 54.55	10259		F	#		
Temperature	C	04/12/2017	N001	44.55 - 54.55	24.09		F	#		
Turbidity	NTU	04/12/2017	N001	44.55 - 54.55	3.2		F	#		
Uranium	mg/L	04/12/2017	N001	44.55 - 54.55	2.2		F	#	0.00012	

Groundwater Quality Data by Location (USEE100) FOR SITE FCT03, Falls City Disposal Site

REPORT DATE: 6/7/2017

Location: 0924 WELL

Parameter	Units	Sample		Depth Range			Result	Qualifiers			Detection Limit	Uncertainty
		Date	ID	(Ft BLS)				Lab	Data	QA		
Dissolved Oxygen	mg/L	04/12/2017	N001	19.7	-	29.7	2.55		F	#		
Oxidation Reduction Potential	mV	04/12/2017	N001	19.7	-	29.7	80.5		F	#		
pH	s.u.	04/12/2017	N001	19.7	-	29.7	6.3		F	#		
Specific Conductance	umhos/cm	04/12/2017	N001	19.7	-	29.7	11903		F	#		
Temperature	C	04/12/2017	N001	19.7	-	29.7	25.56		F	#		
Turbidity	NTU	04/12/2017	N001	19.7	-	29.7	0.4		F	#		
Uranium	mg/L	04/12/2017	N001	19.7	-	29.7	0.5		F	#	0.000012	

Groundwater Quality Data by Location (USEE100) FOR SITE FCT03, Falls City Disposal Site

REPORT DATE: 6/7/2017

Location: 0963 WELL

Parameter	Units	Sample		Depth Range			Result	Qualifiers			Detection Limit	Uncertainty
		Date	ID	(Ft BLS)				Lab	Data	QA		
Dissolved Oxygen	mg/L	04/12/2017	N001	4.38	-	14.38	3.02		F	#		
Oxidation Reduction Potential	mV	04/12/2017	N001	4.38	-	14.38	342		F	#		
pH	s.u.	04/12/2017	N001	4.38	-	14.38	3.48		F	#		
Specific Conductance	umhos /cm	04/12/2017	N001	4.38	-	14.38	7661		F	#		
Temperature	C	04/12/2017	N001	4.38	-	14.38	23		F	#		
Turbidity	NTU	04/12/2017	N001	4.38	-	14.38	9.9		F	#		
Uranium	mg/L	04/12/2017	N001	4.38	-	14.38	0.067		F	#	0.000012	

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.

DATA QUALIFIERS:

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

QA QUALIFIER:

- # Validated according to quality assurance guidelines.

Static Water Level Data

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STATIC WATER LEVELS (USEE700) FOR SITE FCT03, Falls City Disposal Site
REPORT DATE: 6/7/2017

Location Code	Flow Code	Top of Casing Elevation (Ft)	Measurement Date	Measurement Time	Depth From Top of Casing (Ft)	Water Elevation (Ft)	Water Level Flag
0709	D	451.58	04/12/2017	11:05:06	33.2	418.38	
0858	O	441.03	04/12/2017	08:25:39	30.5	410.53	
0862	O	428.67	04/12/2017	08:45:13	66.95	361.72	
0880	O	446.84	04/12/2017	10:35:50	28.32	418.52	
0886	D	403.52	04/12/2017	14:30:38	34.8	368.72	
0891	D	349.63	04/12/2017	12:55:48	12.75	336.88	
0906	D	420.17	04/12/2017	09:05:01	14.5	405.67	
0908	N	495.67	04/12/2017	09:10:00			D
0916	D	420.39	04/12/2017	10:09:00			D
0921	D	435.75	04/12/2017	10:00:10	34.09	401.66	
0924	D	396.44	04/12/2017	15:50:22	17.65	378.79	
0963	D	373.23	04/12/2017	14:00:50	7.7	365.53	

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

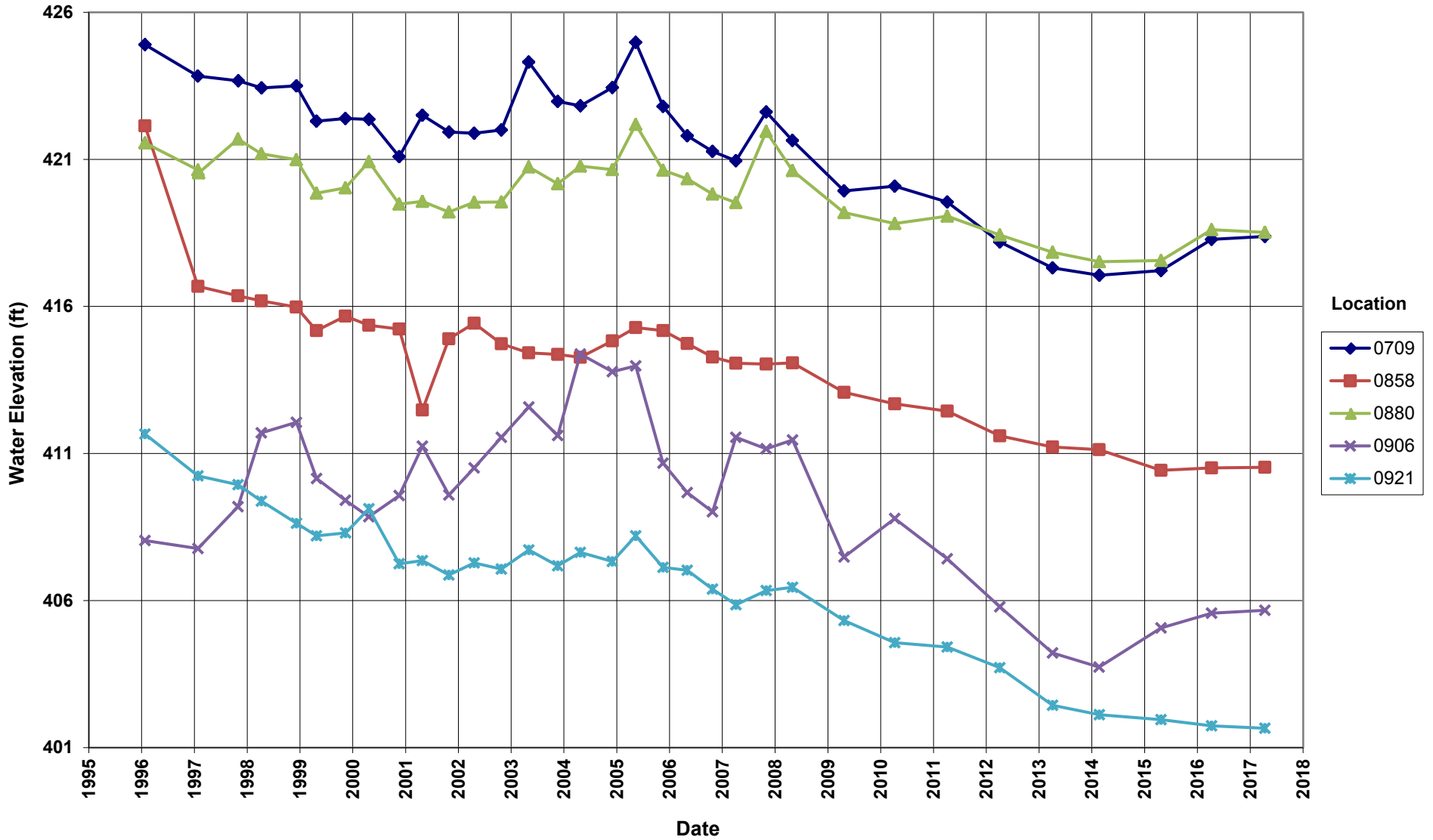
WATER LEVEL FLAGS: D Dry F Flowing B Below top of pump

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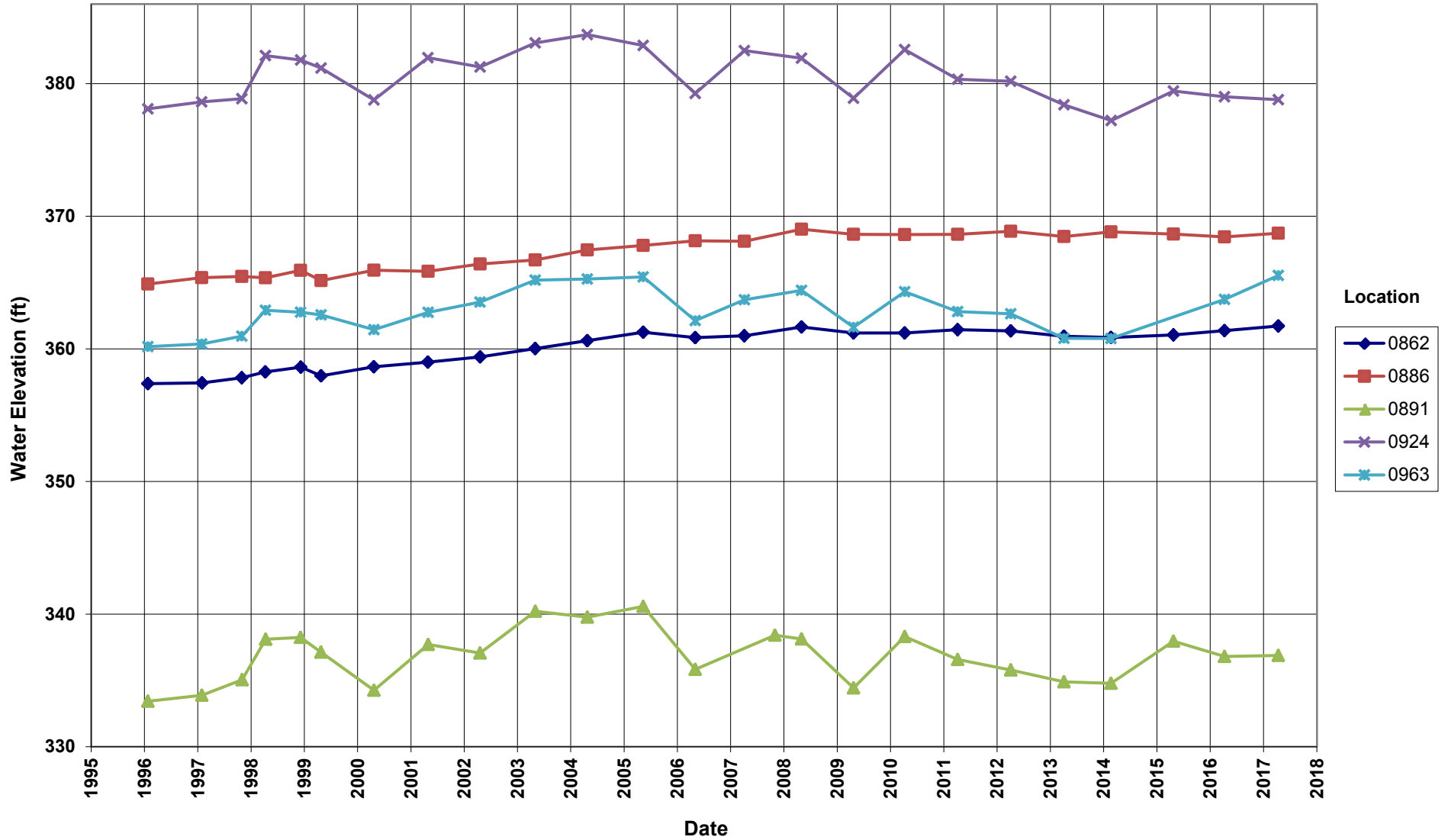
Hydrographs

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Falls City Disposal Site Cell Performance Monitoring Wells Hydrograph



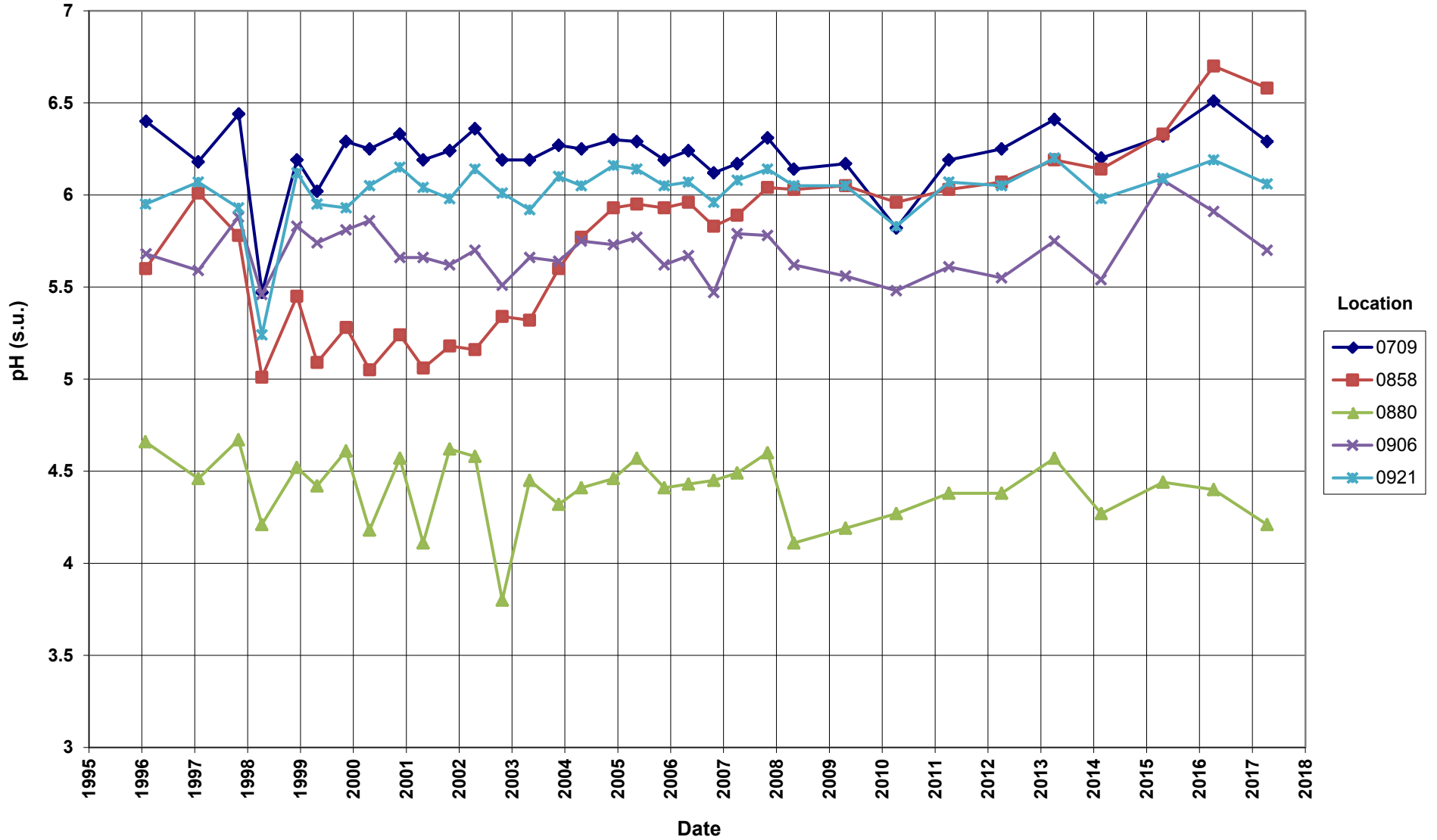
Falls City Disposal Site Groundwater Compliance Monitoring Wells Hydrograph



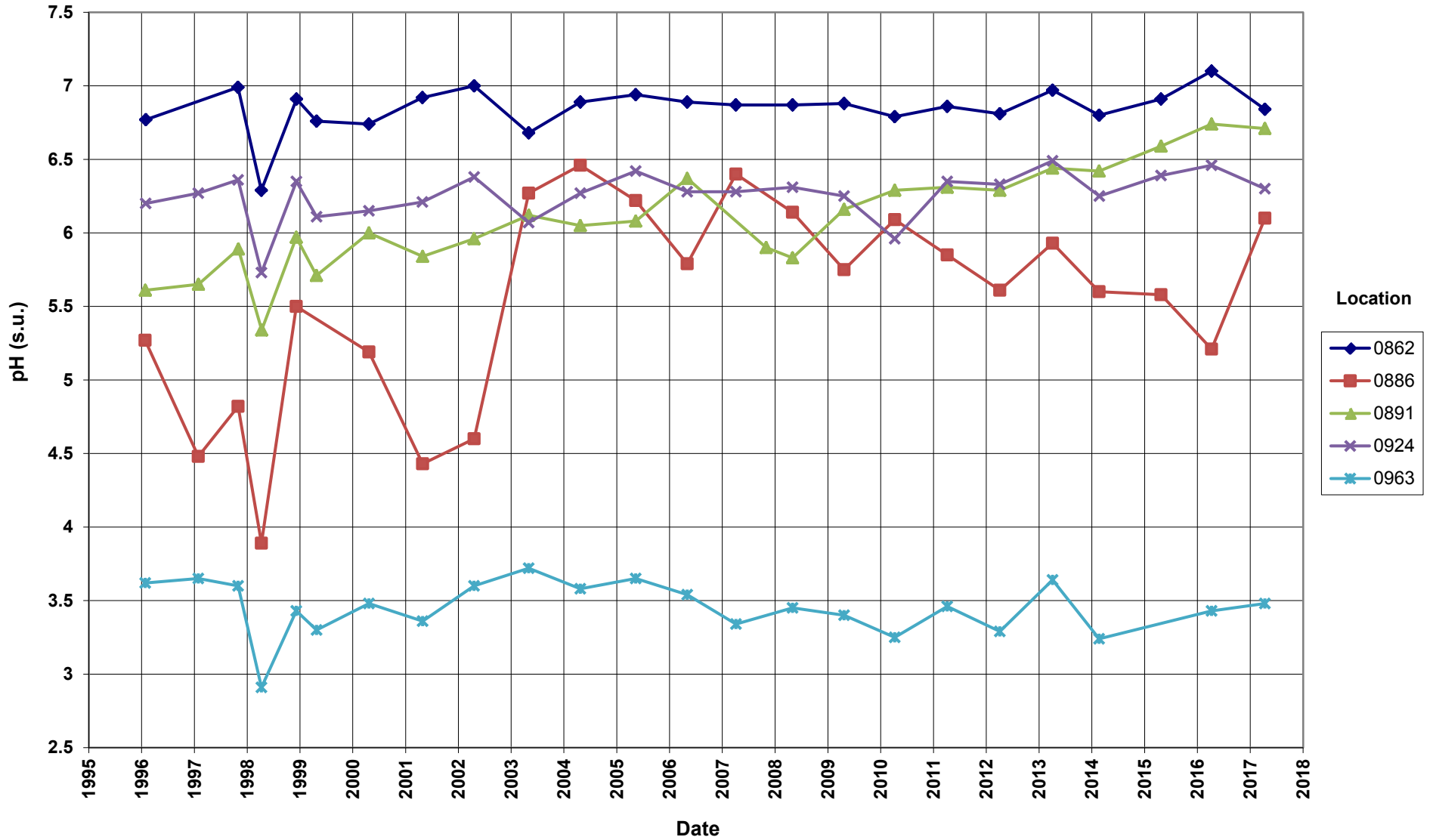
Time-Concentration Graphs

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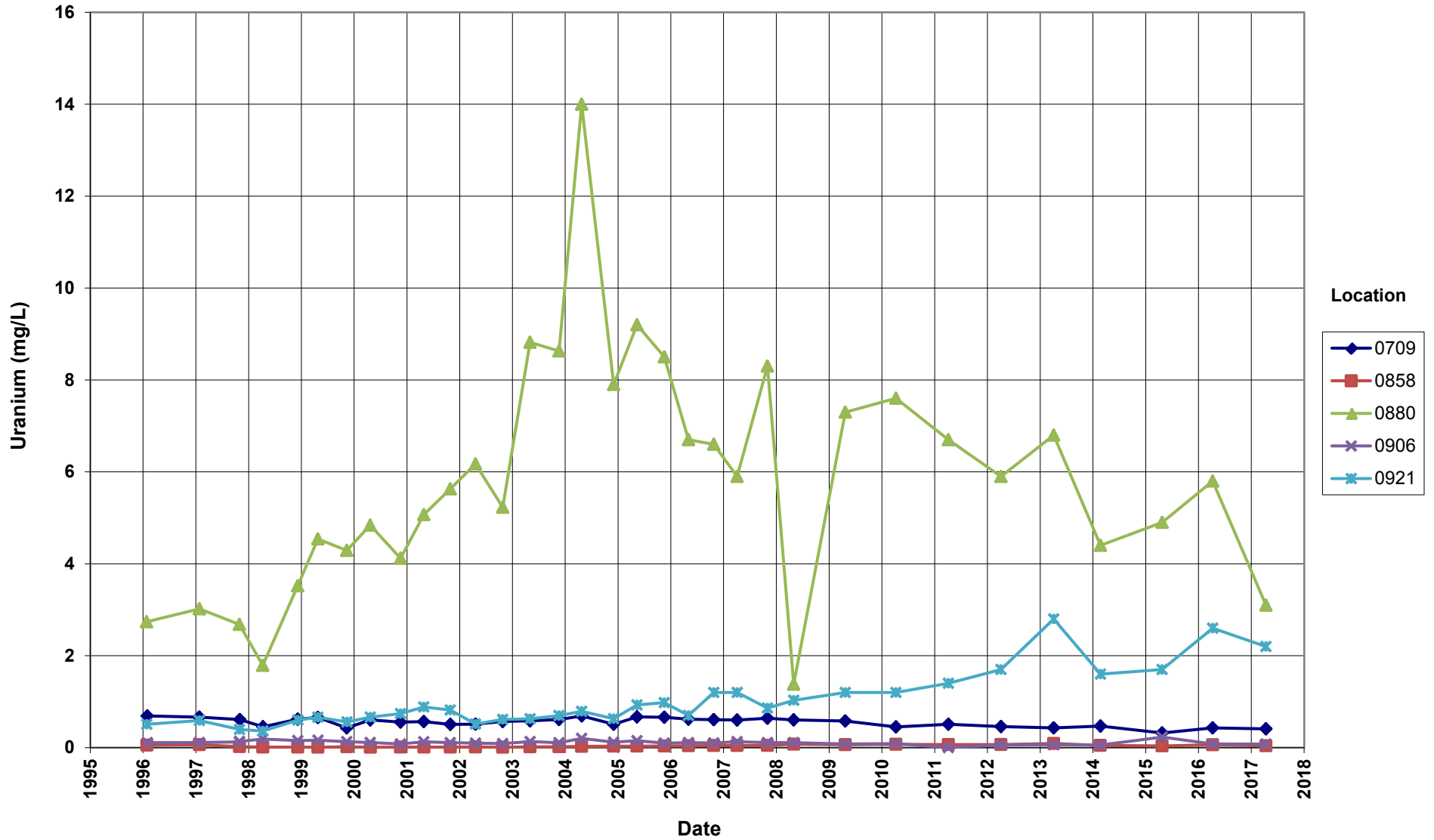
Falls City Disposal Site Cell Performance Monitoring Wells pH Concentration



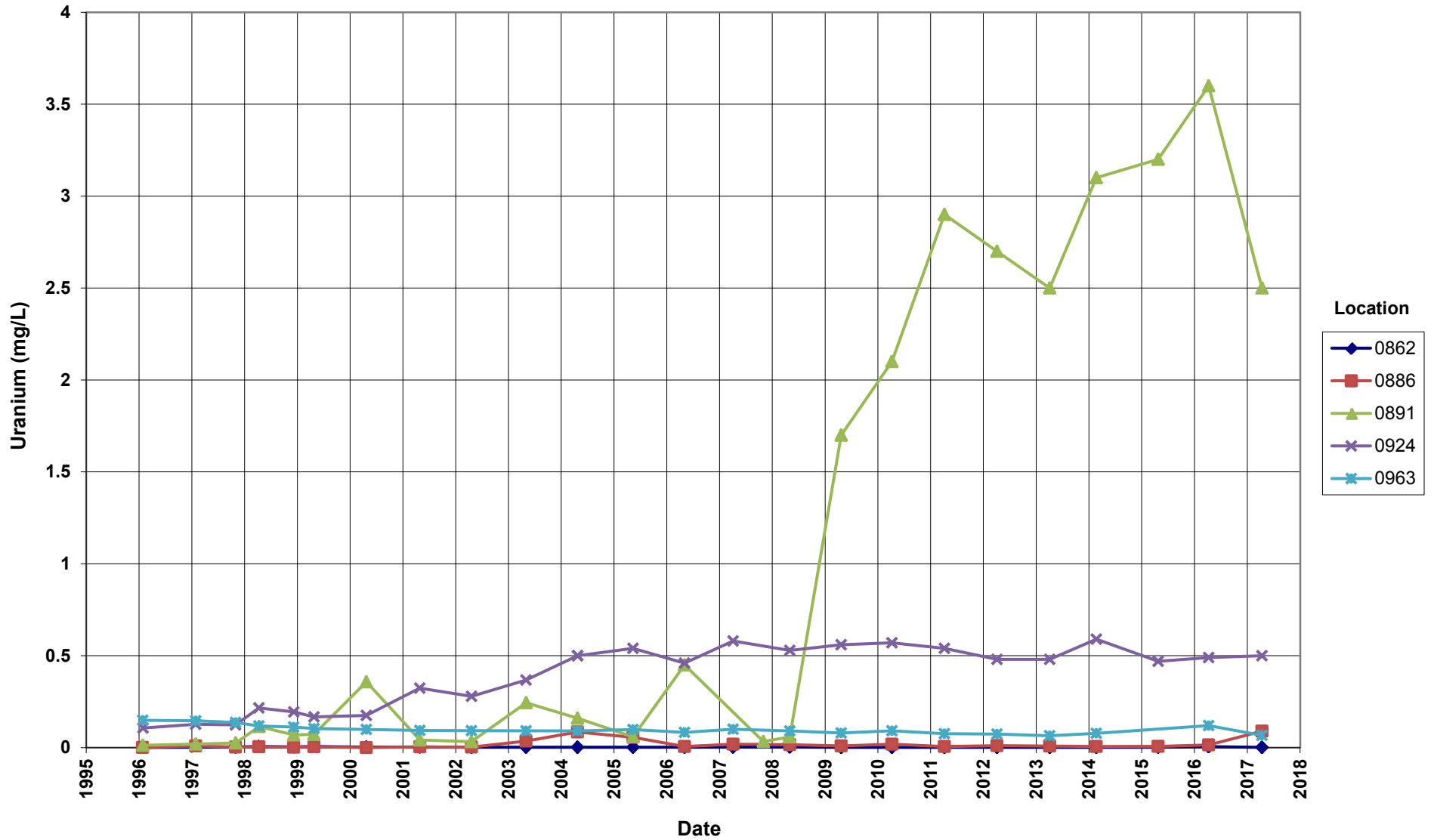
Falls City Disposal Site Groundwater Compliance Monitoring Wells pH Concentration



Falls City Disposal Site Cell Performance Monitoring Wells Uranium Concentration



Falls City Disposal Site Groundwater Compliance Monitoring Wells Uranium 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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