Data Validation Package

September 2016
Groundwater and Surface Water Sampling at the Slick Rock, Colorado, Processing Sites

January 2017

U.S. DEPARTMENT OF ENERGY | Legacy Management

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Sampling Event Summary

Site: Slick Rock, Colorado, Processing Sites

Sampling Period: September 20–21, 2016

The Slick Rock, Colorado, Processing Sites are referred to as the Slick Rock West Processing Site (SRK05) and the Slick Rock East Processing Site (SRK06). This annual event involved sampling both sites for a total of 16 monitoring wells and 6 surface water locations as required by the 2006 *Draft Final Ground Water Compliance Action Plan for the Slick Rock, Colorado, Processing Sites* (GCAP). A domestic well was also sampled at a property adjacent to the Slick Rock East site at the request of the landowner. 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, http://energy.gov/lm/downloads/sampling-and-analysis-plan-us-department-energy-office-legacy-management-sites).

Water levels were measured at all monitoring wells. See Attachment 2, Trip Report for additional details.

The proposed compliance strategy for the Slick Rock sites is natural flushing in conjunction with institutional controls and compliance monitoring. Contaminant concentrations at the Slick Rock sites are compared to their respective maximum concentration limit (MCL) to assess compliance with Title 40, *Code of Federal Regulations*, Part 192 (40 CFR 192), with the exception of manganese and selenium. Manganese concentrations are compared to the maximum historical background concentration of 4.2 milligrams per liter (mg/L) to assess compliance because manganese does not have an MCL. A human-health risk-based alternate concentration limit of 0.18 mg/L has been proposed to assess compliance for selenium because groundwater modeling predicts that selenium concentrations at the Slick Rock West Processing Site will not be reduced to below the MCL within 100 years.

The constituents of potential concern (COPCs) defined in the GCAP for the West Processing Site are manganese, molybdenum, nitrate, selenium, and uranium. Additional COPCs radium-226, radium-228, benzene, toluene, ethylbenzene, and xylenes are isolated to one well (0319). As shown in Table 1, results from this sampling event demonstrate elevated concentrations for most contaminants at West Processing Site locations.

Selenium and uranium are the COPCs at the East Processing Site. Uranium concentrations exceed the MCL at most East Processing Site groundwater locations. The selenium contamination is isolated to the onsite well 0305. Wells with analyte concentrations that exceeded applicable groundwater standards are listed in Table 1.

Table 1. Slick Rock Wells with Samples that Exceeded Standards in September 2016

Analyte	Standard (mg/L)	Site	Location	Concentration (mg/L)
Manganese[a]	4.2	West	0340	5.1
Molybdenum	0.1	West	0317	0.17
			0318A	0.97
			0339	1.0
			0340	1.6
			0508	1.4
			0510	0.87
Nitrate + Nitrite as Nitrogen	10	West	0318A	110
			0339	66
			0340	250
			0508	150
			0510	150
Selenium[b]	0.18	West	0318A	5.3
			0339	4.4
			0340	4.5
			0508	2.6
			0510	1.2
	0.01	East	0305	0.016
Uranium	0.044	West	0508	0.073
	0.044	East	0510	0.095
			0303	1.1
			0305	0.72
			0307	0.44
			0309	0.065
			0311	0.068

Standards are listed in 40 CFR 192.02 Table 1 to Subpart A; concentrations are in milligrams per liter (mg/L).
[a] Manganese standard is the maximum historical background concentration observed in well SRK06 0300.
[b] Selenium standard for the West Processing Site is the proposed Alternate Concentration Limit.

Table 2 lists the drinking water maximum contaminant levels and results for benzene, toluene, ethyl benzene, and xylenes (total) in well 0319. The radium-226 plus radium-228 concentration remains below the maximum contaminant level of 5 picocuries per liter.

Table 2. BTEX[a] Maximum Contaminant Levels and Results for Well 0319 in September 2016

Analyte	Maximum Contaminant Level (mg/L)	Concentration in Well 0319 (mg/L)
Benzene	0.005	3.2
Ethyl benzene	0.7	0.16
Toluene	1	0.77
Xylenes, Total	10	3.75

Maximum Contaminant Levels are listed in the 2009 *National Primary Drinking Water Regulations.* (EPA 816-F-09-0004, May 2009); concentrations are in milligrams per liter (mg/L).
[a] BTEX = Benzene, toluene, ethyl benzene, and xylenes (total).

Surface water results from Dolores River locations downstream of and adjacent to the processing sites were compared to statistical background threshold values (BTVs) derived using historical data (from 1997 to present) at background river locations. The background locations are 0693, which is located upstream of the West Processing Site, but downstream of the East Processing Site, and 0696 which is located upstream of the East Processing Site.

Surface water location 0692 at the East Processing Site is monitored for uranium because it is the predicted location where the centroid of the uranium plume will intersect the river. The uranium concentration at this location remains well below the BTV concentration for background location 0696, as shown in Table 3. Location 0700, which is farther downstream, was not sampled because of access issues.

Table 3. Comparison of Slick Rock East Processing Site September 2016 Surface Water Concentrations to Historical Upgradient BTVs

Analyte	BTV for 0696 (mg/L)	0692 Concentration (mg/L)	0700 Concentration (mg/L)
Uranium	0.00416	0.00076	NA

West Processing Site surface water locations in the Dolores River are monitored to verify that the compliance strategy is protective of the environment. The potential for environmental exposure to site contaminants exists in the Dolores River because it receives groundwater discharge from the contaminated alluvial aquifer. As shown in Table 4, the BTV was exceeded for selenium at location 0347 during this event.

Table 4. Comparison of Slick Rock West Processing Site September 2016 Surface Water Concentrations to Historical Upgradient BTVs

Analyte	BTV for 0693 (mg/L)	0347 Concentration (mg/L)	0349 Concentration (mg/L)	0694 Concentration (mg/L)
Manganese	0.028	0.005	0.006	0.005
Molybdenum	0.008	0.004	0.001	0.007
Nitrate + Nitrite as N	0.47	0.01	0.02	ND[a]
Selenium	0.0047	0.0089	0.001	ND[a]
Uranium	0.0041	0.0007	0.0007	0.0007

[a] ND = Not Detected

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

David Traub — 1-4-17

David Traub
Navarro Research and Engineering, Inc.

Date

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Data Assessment Summary

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Water Sampling Field Activities Verification Checklist

Project	Slick Rock, Colorado	**Date(s) of Water Sampling**	September 20–21, 2016
Date(s) of Verification	December 8, 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 September 2, 2016.
2. Were the sampling locations specified in the planning documents sampled?	No	Monitoring well 0312 was dry. Surface water location 0700 could not be accessed due to a drop off and overgrown willows at the river's edge.
3. Were field equipment calibrations conducted as specified in the above-named documents?	Yes	Calibrations were performed on September 19, 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?	NA	All monitoring wells were Category I wells.
Was one pump/tubing volume removed prior to sampling?		
9. Were duplicates taken at a frequency of one per 20 samples?	Yes	Duplicate samples were collected at locations SRK05-0318A and SRK06-0300.
10. Were equipment blanks taken at a frequency of one per 20 samples that were collected with non-dedicated equipment?	Yes	One equipment blank was collected.
11. Were trip blanks prepared and included with each shipment of VOC samples?	Yes	One trip blank was prepared.
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?	Yes	
19. Were water levels measured at the locations specified in the planning documents?	Yes	

Laboratory Performance Assessment

General Information

Report Number (RIN):	16098018
Sample Event:	September 20–21, 2016
Site(s):	Slick Rock, Colorado; Processing Sites
Laboratory:	ALS Laboratory Group, Fort Collins, Colorado
Work Order No.:	1609411
Analysis:	Metals, Organics, Wet Chemistry, and Radiochemistry
Validator:	Stephen Donivan
Review Date:	December 7, 2016

This validation was performed according to "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, 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 1–5, 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 5.

Table 5. Analytes and Methods

Analyte	Line Item Code	Prep Method	Analytical Method
Manganese	LMM-01	SW-846 3005A	SW-846 6010B
Molybdenum, Selenium, Uranium	LMM-02	SW-846 3005A	SW-846 6020A
Nitrite + Nitrate as N	WCH-A-022	MCAWW 353.2	MCAWW 353.2
Radium-226	ASP-A-016	SOP 783	SOP 783, EPA 903.1m
Radium-228	GPC-A-020	SOP 749	SOP 724
Volatile Organics	VOA-A-009	SW-846 5030C	SW-846 8260

Data Qualifier Summary

Analytical results were qualified as listed in Table 6. Refer to the sections below for an explanation of the data qualifiers applied.

Table 6. Data Qualifier Summary

Sample Number	Location	Analyte	Flag	Reason
1609411-7	0347	Molybdenum	J	Less than 5 times the equipment blank
1609411-7	0347	Selenium	J	Less than 5 times the equipment blank
1609411-8	0349	Molybdenum	J	Less than 5 times the equipment blank
1609411-8	0349	Selenium	J	Less than 5 times the equipment blank
1609411-12	0693	Molybdenum	J	Less than 5 times the equipment blank
1609411-12	0693	Selenium	J	Less than 5 times the equipment blank
1609411-14	0300 Duplicate	Radium-226	J	Less than the determination limit
1609411-14	0300 Duplicate	Radium-228	J	Less than the determination limit
1609411-18	0300	Radium-228	J	Less than the determination limit

Sample Shipping/Receiving

ALS Laboratory Group in Fort Collins, Colorado, received 27 water samples on September 23, 2016, accompanied by a Chain of Custody (COC) form. Copies of the three air bills were included in the receiving documentation. The COC form was checked to confirm that all of the samples were listed with sample collection dates and times, and that signatures and dates were present indicating sample relinquishment and receipt. The COC form was complete with no errors or omissions.

Preservation and Holding Times

The sample shipment was received intact with the temperature inside the iced cooler at 1.6 °C, which complies with requirements. The other two coolers were received at ambient temperature, which complies with requirements. All samples were received in the correct container types and had been preserved correctly. All samples were analyzed within the applicable holding times.

Detection and Quantitation Limits

The method detection limit (MDL) was reported for all metal, organic, and wet chemical analytes as required. The MDL, as defined in 40 CFR 136, is the minimum concentration of an analyte that can be measured and reported with 99% confidence that the analyte concentration is greater than zero. The practical quantitation limit (PQL) for these analytes is the lowest concentration that can be reliably measured, and is defined as 5 times the MDL.

For radiochemical analytes (those measured by radiometric counting) the MDL and PQL are not applicable, and these 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% 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 MDLs for all metal, organic, and wet chemical analytes, and MDCs for radiochemical analytes demonstrate compliance with contractual requirements.

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 EPA 353.2, Nitrate + Nitrite as N
Calibrations were performed using seven calibration standards on October 4, 2016. Calibrations were performed using six calibration standards on July 14, 2016. 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 with the exception of CCV3, CCV5, and CCV9. Samples associated with these CCVs were reanalyzed with acceptable CCVs.

Method SW-846 6010B, Manganese
Calibrations were performed on October 10, 2016, using three 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.

Method SW-846 6020, Molybdenum, Selenium, Uranium
Calibrations were performed on October 11, 2016, 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 SW-846 8260, Volatiles
The initial calibrations for benzene, ethylbenzene, toluene, and xylenes were performed using eight calibration standards on June 3, 2016. Calibration curves are established using linear regression, quadratic regression, or the average response factor approach. Calibrations using average response factors had relative standard deviations of less than 15%. Initial and continuing calibration verification checks were made at the required frequency. The verification checks met all acceptance criteria. Mass spectrometer calibrations and resolutions were checked at the beginning of each analytical run in accordance with the procedure.

Radiochemical Analysis

Radium-226
Emanation cell plateau voltage determinations and cell efficiency calibrations were performed in October 2013. Daily instrument checks performed on October 21, 2016, met the acceptance criteria. All sample chemical recoveries were within the acceptance range of 40% to 110%.

Radium-228
Plateau voltage determinations were performed in November 2014 and detector efficiency calibrations were performed in February 2015. Background determinations were performed on September 24, 2014. The daily instrument checks performed on October 27, 2016, met the acceptance criteria. All sample chemical recoveries were within the acceptance range of 40% to 110%.

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.

Metals and Wet Chemistry
All method blank and continuing calibration blank (CCB) results associated with the samples were below the PQLs for all analytes with the following exceptions. Five nitrate + nitrite as N results were greater than the PQL. The samples associated with these CCBs either had nitrate + nitrite as N concentrations greater than 10 times the blank concentration or were reanalyzed with acceptable CCBs. In cases where a blank concentration exceeds the MDL, the associated sample results are qualified with a "U" flag (not detected) when the sample result is greater than the MDL but less than 5 times the blank concentration. For manganese the method blank was negative and the absolute value was greater than the PQL. All associated manganese results were greater than 5 times the MDL, not requiring qualification.

Volatile Organics
The method blank results were below the MDLs for all target compounds.

Radiochemistry
The radiochemical method blank results were below the DLC.

Inductively Coupled Plasma (ICP) Interference Check Sample (ICS) Analysis

ICP interference check samples ICSA and ICSAB were analyzed at the required frequency to verify the instrumental interelement and background correction factors. All check sample results met the acceptance criteria.

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. 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 non-radiochemical replicate results that are greater than 5 times the PQL should be less than 20% (or less than the laboratory-derived control limits for organics). For results that are less than 5 times the PQL, the range should be no greater than the PQL. The replicate results met these criteria. The relative error ratio for radiochemical replicate results (calculated using the one-sigma total propagated uncertainty) was less than 3, indicating acceptable precision.

Laboratory Control Sample

Laboratory control samples were analyzed at the correct frequency to provide information on the accuracy of the analytical method and the overall laboratory performance, including sample preparation. All control sample results were acceptable.

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 when the concentration of the undiluted sample is greater than 50 times the MDL. All evaluated serial dilution data were acceptable, with the exception of manganese and selenium. The serial dilution percent differences for manganese and selenium were greater than 10% and the associated sample results are qualified with "J" flags as estimated values.

Volatile Organics Internal Standard and Surrogate Recovery

Laboratory performance for individual samples is evaluated by means of surrogate spikes. All samples are spiked with surrogate compounds prior to sample preparation. Surrogate recoveries are used to monitor factors such as interference and high concentrations of analytes. Surrogate recoveries may also be influenced by the success in recoveries of the internal standards. Internal standard recoveries were stable and within acceptance ranges. All surrogate recoveries were within the acceptance ranges.

Chromatography Peak Integration

The integration of analyte peaks was reviewed for all volatile organics data. All peak integrations were satisfactory.

Completeness

Results were reported in the correct units for all analytes requested using contract-required laboratory qualifiers. The analytical report included the MDL (MDC for radiochemistry) and PQL for all analytes and all required supporting documentation.

Electronic Data Deliverable (EDD) File

The EDD file arrived on November 2, 2016. The Sample Management System EDD validation module was used to verify that the EDD file was complete and in compliance with requirements. The module compares the contents of the file 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: 16098018 **Lab Code:** PAR **Validator:** Stephen Donivan **Validation Date:** 12/7/2016

Project: Slick Rock **Analysis Type:** ☑ Metals ☑ General Chem ☑ Rad ☑ Organics

# of Samples: 28 **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	There were 2 trip/equipment blanks evaluated.
☑ Field Duplicates	There were 2 duplicates evaluated.

Figure 1. General Validation Worksheet

SAMPLE MANAGEMENT SYSTEM

Metals Data Validation Worksheet

RIN: 16098018 **Lab Code:** PAR **Date Due:** 10/21/2016

Matrix: Water **Site Code:** SRK01 **Date Completed:** 11/3/2016

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								
Manganese	ICP/ES	10/10/2016	0.0000	1.0000	OK	OK	OK	105.0	99.0	102.0	1.0	100.0	6.0	108.0
Manganese	ICP/ES	10/21/2016	0.0000	1.0000	OK	OK	OK	102.0	102.0	102.0	0.0	97.0		103.0
Molybdenum	ICP/MS	10/12/2016	0.0000	1.0000	OK	OK	OK	95.0	125.0	111.0	1.0	109.0	6.0	86.0
Molybdenum	ICP/MS	10/26/2016	0.0000	1.0000	OK	OK	OK	97.0	97.0	95.0	2.0	101.0		91.0
Selenium	ICP/MS	10/12/2016	0.0000	1.0000	OK	OK	OK	97.0			1.0	101.0	5.0	86.0
Selenium	ICP/MS	10/26/2016	0.0000	1.0000	OK	OK	OK	101.0	101.0	103.0	2.0	99.0		92.0
Uranium	ICP/MS	10/12/2016	0.0000	1.0000	OK	OK	OK	97.0	105.0	102.0	1.0	104.0	7.0	90.0
Uranium	ICP/MS	10/12/2016					OK	99.0				99.0		130.0
Uranium	ICP/MS	10/26/2016	0.0000	1.0000	OK	OK	OK	101.0	104.0	102.0	2.0	100.0	2.0	130.0

Figure 2. Metals Validation Worksheet

SAMPLE MANAGEMENT SYSTEM
Organics Data Validation Summary

RIN: 16098018 **Project:** Slick Rock **Lab Code:** PAR **Validation Date:** 12/7/2016

LCS Recovery: All LCS recoveries were within the laboratory acceptance limits.

Method Blank(s): All method blanks results were below the method detection limit.

MS/MSD Recovery: All MS/MSD recoveries were within the laboratory acceptance limits.

Surrogate Recovery: All surrogate recoveries were within the laboratory acceptance limits.

Figure 3. Organics Validation Worksheet

SAMPLE MANAGEMENT SYSTEM
Radiochemistry Data Validation Worksheet

RIN: 16098018 **Lab Code:** PAR **Date Due:** 10/21/2016

Matrix: Water **Site Code:** SRK01 **Date Completed:** 11/3/2016

Sample	Analyte	Date Analyzed	Result	Flag	Tracer %R	LCS %R	MS %R	Duplicate RER
0300	Radium-226	10/21/2016			93.7			
0319	Radium-226	10/21/2016			91.0			
2498	Radium-226	10/21/2016			93.6			
0300	Radium-226	10/21/2016			92.7			0.51
Blank_Spike	Radium-226	10/21/2016			92.0	99.00		
Blank	Radium-226	10/21/2016	0.0547	U	92.2			
0300	Radium-228	10/27/2016			97.1			
0319	Radium-228	10/27/2016			92.4			
2498	Radium-228	10/27/2016			95.3			
0300	Radium-228	10/27/2016			95.3			0
Blank_Spike	Radium-228	10/27/2016			95.7	98.70		
Blank	Radium-228	10/27/2016	-0.2060	U	100.0			

Figure 4. Radiochemistry Validation Worksheet

SAMPLE MANAGEMENT SYSTEM

Wet Chemistry Data Validation Worksheet

RIN: 16098018 **Lab Code:** PAR **Date Due:** 10/21/2016

Matrix: Water **Site Code:** SRK01 **Date Completed:** 11/3/2016

Analyte	Date Analyzed	CALIBRATION				Method Blank	LCS %R	MS %R	MSD %R	DUP RPD	Serial Dil. %R
		Int.	R^2	CCV	CCB						
Nitrate+Nitrite as N	10/04/2016	0.000	0.9999	OK	OK	OK	103.00	108.0	107.0	1.00	

Figure 5. Wet Chemistry Validation Worksheet

Sampling Quality Control Assessment

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

Sampling Protocol

Surface water locations were sampled using a peristaltic pump and tubing reel or container immersion. Monitoring wells were sampled using a peristaltic pump and dedicated tubing. All monitoring wells met the Category I low-flow sampling criteria. Sample results for these wells were qualified with an "F" flag in the database, indicating the wells were purged and sampled using the low-flow sampling method.

Equipment Blank

Equipment blanks are prepared and analyzed to document contamination attributable to the sample collection process. An equipment blank (field ID 2676) was taken from the tubing reel used to collect the surface water samples. Molybdenum, selenium, and uranium were detected in the equipment blank. The associated sample results that are greater than the MDL but less than 5 times the equipment blank concentration are qualified with a "J" flag as estimated values (See Figure 6).

Trip Blank Assessment

A trip blank (field ID 2500) was prepared and analyzed for volatile organics to document contamination attributable to shipping and field handling procedures. There were no target analytes detected in the trip blank.

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. Duplicate samples were collected from locations 0300 and 0318A (field duplicate IDs 2498 and 2533). For non-radiochemical measurements, the relative percent difference for duplicate results that are greater than 5 times the PQL should be less than 20%. For results less than 5 times the PQL, the range should be no greater than the PQL. For radiochemical measurements, the relative error ratio (the ratio of the absolute difference between the sample and duplicate results and the sum of the 1-sigma uncertainties) is used to evaluate duplicate results and should be less than three. All duplicate results met these criteria, demonstrating acceptable precision (See Figure 7).

SAMPLE MANAGEMENT SYSTEM

Validation Report: Equipment/Trip Blanks

RIN: 16098018 **Lab Code:** PAR **Project:** Slick Rock **Validation Date:** 12/7/2016

Blank Data

Blank Type	Lab Sample ID	Lab Method	Analyte Name	Result	Qualifier	MDL	Units
Equipment Blank	1609411-17	SW6020	Molybdenum	0.0033		0.00032	MG/L

Sample ID	Sample Ticket	Location	Result	Dilution Factor	Lab Qualifier	Validation Qualifier
1609411-12	OKU 637	0693	0.0014	10	J	J
1609411-7	OKU 623	0347	0.0044	10		J
1609411-8	OKU 624	0349	0.0013	10	J	J

Blank Data

Blank Type	Lab Sample ID	Lab Method	Analyte Name	Result	Qualifier	MDL	Units
Equipment Blank	1609411-17	SW6020	Selenium	0.016		0.00066	MG/L

Sample ID	Sample Ticket	Location	Result	Dilution Factor	Lab Qualifier	Validation Qualifier
1609411-12	OKU 637	0693	0.001	10		J
1609411-7	OKU 623	0347	0.0089	10		J
1609411-8	OKU 624	0349	0.001	10	J	J

Blank Data

Blank Type	Lab Sample ID	Lab Method	Analyte Name	Result	Qualifier	MDL	Units
Equipment Blank	1609411-17	SW6020	Uranium	0.00009	J	0.000012	MG/L

Sample ID	Sample Ticket	Location	Result	Dilution Factor	Lab Qualifier	Validation Qualifier
1609411-12	OKU 637	0693	0.0007	10		
1609411-26	OKU 626	0692	0.00076	10		
1609411-7	OKU 623	0347	0.00073	10		
1609411-8	OKU 624	0349	0.00069	10		

Figure 6. Equipment Blank Validation Worksheet

SAMPLE MANAGEMENT SYSTEM

Validation Report: Field Duplicates

RIN: 16098018 **Lab Code:** PAR **Project:** Slick Rock **Validation Date:** 12/7/2016

Duplicate: 2498 **Sample:** 0300

Analyte	Sample Result	Sample Flag	Sample Error	Sample Dilution	Duplicate Result	Duplicate Flag	Duplicate Error	Duplicate Dilution	RPD	RER	Units
Manganese	1.9			1	2			1	5.13		MG/L
Molybdenum	0.0064			10	0.0055			10	15.13		MG/L
Nitrate+Nitrite as N	0.015			1	0.01	U		1			MG/L
Radium-226	0.344		0.155	1	0.184		0.113	1		1.6	pCi/L
Radium-228	0.593		0.385	1	0.796		0.369	1		0.7	pCi/L
Selenium	0.0014			10	0.0012			10			MG/L
Uranium	0.017			10	0.016			10	6.06		MG/L

Duplicate: 2533 **Sample:** 0318A

Analyte	Sample Result	Sample Flag	Sample Error	Sample Dilution	Duplicate Result	Duplicate Flag	Duplicate Error	Duplicate Dilution	RPD	RER	Units
Manganese	0.81			1	0.85			1	4.82		MG/L
Molybdenum	0.97			10	0.98			10	1.03		MG/L
Nitrate+Nitrite as N	110			500	110			100	0		MG/L
Selenium	5.3			10	5.3			10	0		MG/L
Uranium	0.028			10	0.028			10	0		MG/L

Figure 7. Field Duplicates 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.

Laboratory Coordinator: Stephen Donivan — Stephen Donivan — 12-30-2016 — Date

Data Validation Lead: Stephen Donivan — Stephen Donivan — 12-30-2016 — Date

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Attachment 1

Sampling and Analysis Work Order

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September 2, 2016

Task Assignment 103
Control Number 16-0840

U.S. Department of Energy
Office of Legacy Management
ATTN: Jason Nguyen
Site Manger
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
September 2016 Environmental Sampling at the Slick Rock, Colorado, Processing Sites

REFERENCE: Task Assignment 103, 1-103-1-02-120, Slick Rock, Colorado, Processing Sites

Dear Mr. Nguyen:

The purpose of this letter is to inform you of the upcoming sampling event at Slick Rock, Colorado. Enclosed are the map and tables specifying sample locations and analytes for monitoring at the Slick Rock processing sites. Water quality data will be collected at these sites as part of the routine environmental sampling currently scheduled to begin the week of September 19, 2016.

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

MONITORING WELLS

West Site

317 Je	319 Al	320 Al	339 Al	340 Al	508 Al	510 Al	684 Al
318A Al							

East Site

300 Al	305 Al	307 Al	309 Al	310 Al	311 Al	312 Al	672 Unk
303 Al							

*NOTE: Al = Alluvium; Je = Jurassic Entrada Sandstone; Unk = unknown

SURFACE LOCATIONS

West Site

347	349	693	694

East Site

692	696	700

2597 Legacy Way - Grand Junction, CO 81503-1789 -Telephone (970) 248-6000 - Fax (970) 248-6040

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) 248-6557 if you have any questions.

Sincerely,

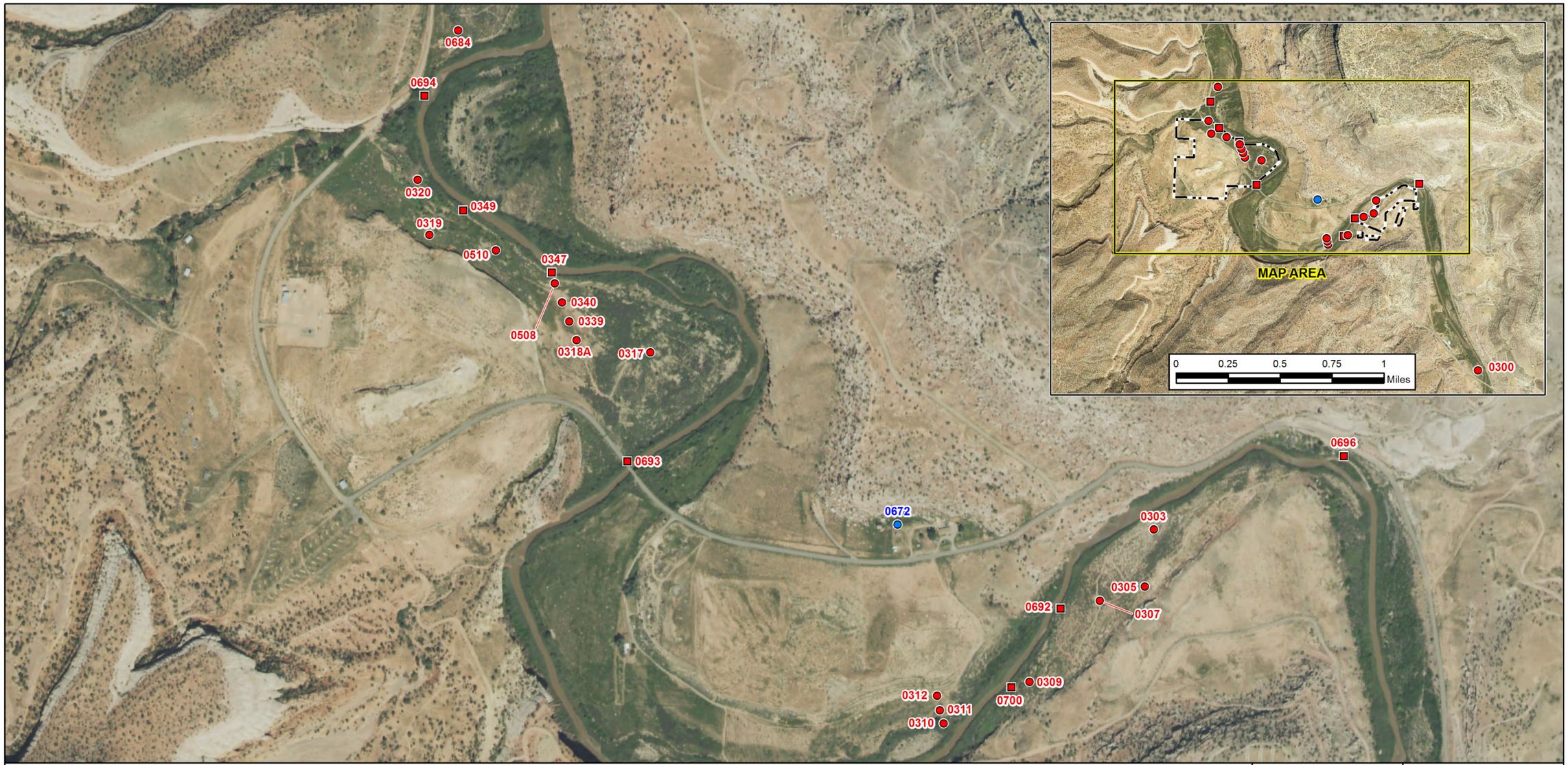
David Traub

David Traub
LMS Site Lead

DT/lcg/csa

Enclosures

cc: (electronic)
Christina Pennal, DOE
Jeff Carman, Navarro
Beverly Cook, Navarro
Steve Donivan, Navarro
Lauren Goodknight, Navarro
Sam Marutzky, Navarro
Diana Osborne, Navarro
David Traub, Navarro
EDD Delivery
rc-grand.junction
File: SRE 0400.02
SRW 0400.02



Slick Rock, Colorado, Planned Sample Locations

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Sampling Frequencies for Locations at Slick Rock, Colorado

Location ID	Quarterly	Semiannually	Annually	Biennially	Not Sampled	Notes
Monitoring Wells						
WEST						
317			X			
318A			X			
319			X			
320			X			
339			X			
340			X			
508			X			
510			X			
684			X			
EAST						
300			X			
303			X			
305			X			
307			X			
309			X			
310			X			
311			X			
312			X			
672			X			Domestic well
Surface Locations						
WEST						
347			X			
349			X			
693			X			
694			X			
EAST						
692			X			
696			X			
700			X			

Sampling conducted in September

Constituent Sampling Breakdown

Site	Slick Rock				
Analyte	Groundwater	Surface Water	Required Detection Limit (mg/L)	Analytical Method	Line Item Code
Approx. No. Samples/yr	14	7			
Field Measurements					
Alkalinity	X	X			
Dissolved Oxygen					
Redox Potential	X	X			
pH	X	X			
Specific Conductance	X	X			
Turbidity	X	X			
Temperature	X	X			
Laboratory Measurements					
Ammonia as N (NH3-N)					
Calcium					
Magnesium					
Manganese	0300, 0318A, 0320, 0339, 0340, 0508, 0510, 0684, 0672	0347, 0349, 0693, 0694	0.005	SW-846 6010	LMM-01
Molybdenum	0300, 0317, 0318A, 0320, 0339, 0340, 0508, 0510, 0684, 0672	0347, 0349, 0693, 0694	0.003	SW-846 6020	LMM-02
Nickel					
Nickel-63					
Nitrate + Nitrite as N (NO3+NO2)-N	0300, 0318A, 0320, 0339, 0340, 0508, 0510, 0684	0347, 0349, 0693, 0694	0.05	EPA 353.1	WCH-A-022
Potassium					
Radium-226	0300, 0319		1 pCi/L	Gas Proportional Counter	GPC-A-018
Radium-228	0300, 0319		1 pCi/L	Gas Proportional Counter	GPC-A-020
Selenium	0300, 0305, 0307, 0317, 0318A, 0319, 0320, 0339, 0340, 0508, 0510, 0684, 0672	0347, 0349, 0693, 0694	0.0001	SW-846 6020	LMM-02
Sodium					
Total Dissolved Solids					
Uranium	0300, 0303, 0305, 0307, 0309, 0310, 0311, 0312, 0318A, 0320, 0339, 0340, 0508, 0510, 0684, 0672	X	0.0001	SW-846 6020	LMM-02
Vanadium					
VOCs (BETX)	0319 only		0.005	SW-846 8260	VOA-A-009
Zinc					
Total No. of Analytes	8	5			

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: David Traub, Navarro

From: Jennifer Graham and Samantha Tigar, Navarro

Date: September 29, 2016

CC: Jason Nguyen, DOE
Steve Donivan, Navarro
EDD Delivery

Re: Sampling Trip Report

Site: Slick Rock, Colorado, Processing Site

Dates of Event: September 20 and 21, 2016

Team Members: Jennifer Graham and Samantha Tigar, Navarro

Number of Locations Sampled: Samples were collected from 23 of the 25 locations identified on the sampling notification letter as follows:

	Locations That Were Sampled	Planned Locations
Slick Rock West Monitoring wells	9	9
Slick Rock West Surface water locations	4	4
Slick Rock East Monitoring wells	8	9
Slick Rock East Surface water locations	2	3

Locations Not Sampled/Reason: Monitoring well 0312 was dry. Surface water location 0700 could not be accessed due to a drop off and overgrown willows at the river's edge.

Location Specific Information:

Location IDs	Comments
SRK05-0319	Well water had a heavy petroleum odor. Both purge and sample water had presence of black particulates.
SRK05-0320, SRK06-0303 and 0307	Purge water had presence of iron bacteria.
SRK06-0309	Well had presence of iron bacteria in purge water. Well initially made turbidity then became turbid with iron bacteria as sample was filled. Turbidity was checked after sample collection and was 6.52 NTU. Sample water may contain some particulates.
SRK06-0672	Property owner was not available to collect water from their kitchen sink. Water was alternatively sampled from the north-west spigot behind the home.
SRK06-0696	The side channel collection point for this sample location was dry. Water was collected at the confluence of the side channel and the main channel, (approximately 20 ft to the west) – per Site Lead.

All groundwater locations sampled for this event were sampled with a peristaltic pump and dedicated downhole tubing. The tubing was marked for sampling depth and the intake depth was

measured and recorded (see table below). The intake depths were entered into the Excel worksheet, 'LM Sites Pump and Sampling Intake Data.xlsx' found in <\\lm\projects\SamplingProg\Sampling Data>

Well ID	Intake Depth (from TOC)	Depth to Top of Screen	Depth to Bottom of Screen	Screen Length	Comment
SRK05-0317	38.55	21.79	41.82	20	Tubing marked on arrival.
SRK05-0318A	12.47	7.44	17.47	10	Tubing was marked for mid-screen sample intake.
SRK05-0319	15.27	7.09	17.12	10	Tubing was marked for mid-screen sample intake.
SRK05-0320	10.55	7.51	12.55	5	Tubing was marked for mid-screen sample intake.
SRK05-0339	12.4	11	14	3	Did not mark tubing, could not field verify unusual screen length.
SRK05-0340	11.3	6.51	11.51	5	Did not mark tubing since the water level was very near bottom of screen.
SRK05-0508	7.9	2.19	12.9	10	Tubing was marked for mid-screen sample intake.
SRK05-0510	10.49	6.47	15.47	9	Tubing was marked for mid-screen sample intake.
SRK05-0684	20.34	13.34	23.34	10	Tubing was marked for mid-screen sample intake.
SRK06-0300	15.42	11.92	21.92	10	Tubing was marked for mid-screen sample intake.
SRK06-0303	12.36	6.86	16.86	10	Tubing was marked for mid-screen sample intake.
SRK06-0305	17.71	11.21	21.21	10	Tubing was marked for mid-screen sample intake.
SRK06-0307	12.42	6.92	16.92	10	Tubing was marked for mid-screen sample intake.
SRK06-0309	18.15	12.65	22.65	10	Tubing was marked for mid-screen sample intake.
SRK06-0310	20.36	17.36	22.36	5	Tubing was marked for mid-screen sample intake.
SRK06-0311	19.73	16.73	21.73	5	Tubing was marked for mid-screen sample intake.

All units are in feet
TOC=Top of casing

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	Associated Samples
2498	OKU 628	SRK06-0300	Duplicate	Groundwater	N/A
2500	OKU 631	0999	Trip Blank	Groundwater	VOC samples (SRK05-0319)
2533	OKU 636	SRK05-0318A	Duplicate	Groundwater	N/A
2676	OKU 632	0999	Equipment Blank	Surface Water	SRK05-0347, 0349, 0693, and SRK06-0692; collected after 0693

Requisition Index Number (RIN) Assigned: Samples were assigned to RIN 16098018. Field data sheets can be found in \\crow\SMS\16098018\FieldData.

Sample Shipment: Samples were shipped overnight via FedEx from Grand Junction, CO, to ALS Laboratory in Fort Collins, CO, on September 22, 2016.

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).

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

Equipment: All equipment functioned properly. The turbidimeter was dropped during the sampling event and was periodically checked to verify the calibration remained acceptable.

Stakeholder/Regulatory/DOE: Nothing to note.

Site Conditions:

Fences, Gates, and Locks: All gates were left as found.
Signs: No issues were observed.
Trespassing/Site Disturbances: None observed.
Disposal Cell/Drainage Structure Integrity: N/A

Safety Issues: None

Access Issues: Due to a barbed wire fence and overgrown willows near the river bank, surface locations SRK05-0347 and SRK05-0349 were difficult to safely access. Ladders over the fence and clear paths cut to the river bank are needed. Surface location SRK06-0700 could not be sampled due to a drop off and overgrown willows at the river bank. A path to the river bank needs to be cleared for safe access.

General Information: Nothing to note.

Immediate Actions Taken: A lock is daisy-chained onto the gate leading to the Slick Rock West wells.

Future Actions Required or Suggested: Paths to surface water locations should be cleared for safe access. The road leading to locations SRK06-0309 and 0700 is blocked by a large rock that needs to be removed. Paths to all Slick Rock East and West wells should be cut to ensure access continues.

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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 SRK05, Slick Rock West Processing Site
REPORT DATE: 12/9/2016
Location: 0317 WELL

Parameter	Units	Sample Date	Sample ID	Depth Range (Ft BLS)	Result	Qualifiers Lab	Qualifiers Data	Qualifiers QA	Detection Limit	Uncertainty
Alkalinity, Total (as $CaCO_3$)	mg/L	09/21/2016	N001	19.46 - 39.52	278		F	#		
Molybdenum	mg/L	09/21/2016	N001	19.46 - 39.52	0.17		F	#	0.00032	
Oxidation Reduction Potential	mV	09/21/2016	N001	19.46 - 39.52	97.1		F	#		
pH	s.u.	09/21/2016	N001	19.46 - 39.52	7.28		F	#		
Selenium	mg/L	09/21/2016	N001	19.46 - 39.52	0.0025		F	#	0.00066	
Specific Conductance	umhos /cm	09/21/2016	N001	19.46 - 39.52	2736		F	#		
Temperature	C	09/21/2016	N001	19.46 - 39.52	13.77		F	#		
Turbidity	NTU	09/21/2016	N001	19.46 - 39.52	1.91		F	#		

Groundwater Quality Data by Location (USEE100) FOR SITE SRK05, Slick Rock West Processing Site
REPORT DATE: 12/9/2016
Location: 0318A WELL Replacement well for 0318

Parameter	Units	Sample Date	Sample ID	Depth Range (Ft BLS)			Result	Qualifiers Lab	Qualifiers Data	Qualifiers QA	Detection Limit	Uncertainty
Alkalinity, Total (as $CaCO_3$)	mg/L	09/21/2016	N001	9.2	-	14.2	264		F	#		
Manganese	mg/L	09/21/2016	N001	9.2	-	14.2	0.81		F	#	0.00011	
Manganese	mg/L	09/21/2016	N002	9.2	-	14.2	0.85		F	#	0.00011	
Molybdenum	mg/L	09/21/2016	N001	9.2	-	14.2	0.97		F	#	0.00032	
Molybdenum	mg/L	09/21/2016	N002	9.2	-	14.2	0.98		F	#	0.00032	
Nitrate + Nitrite as Nitrogen	mg/L	09/21/2016	N001	9.2	-	14.2	110		F	#	5	
Nitrate + Nitrite as Nitrogen	mg/L	09/21/2016	N002	9.2	-	14.2	110		F	#	1	
Oxidation Reduction Potential	mV	09/21/2016	N001	9.2	-	14.2	84.6		F	#		
pH	s.u.	09/21/2016	N001	9.2	-	14.2	6.97		F	#		
Selenium	mg/L	09/21/2016	N001	9.2	-	14.2	5.3		F	#	0.00066	
Selenium	mg/L	09/21/2016	N002	9.2	-	14.2	5.3		F	#	0.00066	
Specific Conductance	umhos /cm	09/21/2016	N001	9.2	-	14.2	2585		F	#		
Temperature	C	09/21/2016	N001	9.2	-	14.2	17.28		F	#		
Turbidity	NTU	09/21/2016	N001	9.2	-	14.2	8.63		F	#		
Uranium	mg/L	09/21/2016	N001	9.2	-	14.2	0.028		F	#	0.000012	
Uranium	mg/L	09/21/2016	N002	9.2	-	14.2	0.028		F	#	0.000012	

Groundwater Quality Data by Location (USEE100) FOR SITE SRK05, Slick Rock West Processing Site
REPORT DATE: 12/9/2016
Location: 0319 WELL

Parameter	Units	Sample Date	Sample ID	Depth Range (Ft BLS)			Result	Qualifiers Lab	Qualifiers Data	Qualifiers QA	Detection Limit	Uncertainty
Alkalinity, Total (as $CaCO_3$)	mg/L	09/21/2016	N001	4.55	-	14.58	926		F	#		
Benzene	ug/L	09/21/2016	N001	4.55	-	14.58	3200		F	#	60	
Ethylbenzene	ug/L	09/21/2016	N001	4.55	-	14.58	140	J	F	#	60	
m,p-Xylene	ug/L	09/21/2016	N001	4.55	-	14.58	3000		F	#	60	
o-Xylene	ug/L	09/21/2016	N001	4.55	-	14.58	670		F	#	60	
Oxidation Reduction Potential	mV	09/21/2016	N001	4.55	-	14.58	-119.2		F	#		
pH	s.u.	09/21/2016	N001	4.55	-	14.58	6.98		F	#		
Radium-226	pCi/L	09/21/2016	N001	4.55	-	14.58	1.96		F	#	0.16	0.56
Radium-228	pCi/L	09/21/2016	N001	4.55	-	14.58	2.23		F	#	0.54	0.676
Selenium	mg/L	09/21/2016	N001	4.55	-	14.58	0.003		F	#	0.00066	
Specific Conductance	umhos /cm	09/21/2016	N001	4.55	-	14.58	3214		F	#		
Temperature	C	09/21/2016	N001	4.55	-	14.58	18.59		F	#		
Toluene	ug/L	09/21/2016	N001	4.55	-	14.58	710		F	#	60	
Turbidity	NTU	09/21/2016	N001	4.55	-	14.58	5.72		F	#		

Groundwater Quality Data by Location (USEE100) FOR SITE SRK05, Slick Rock West Processing Site
REPORT DATE: 12/9/2016
Location: 0320 WELL

Parameter	Units	Sample Date	Sample ID	Depth Range (Ft BLS)	Result	Qualifiers Lab	Qualifiers Data	Qualifiers QA	Detection Limit	Uncertainty
Alkalinity, Total (as $CaCO_3$)	mg/L	09/21/2016	N001	4.92 - 9.96	365		F	#		
Manganese	mg/L	09/21/2016	N001	4.92 - 9.96	0.53		F	#	0.00011	
Molybdenum	mg/L	09/21/2016	N001	4.92 - 9.96	0.012		F	#	0.00032	
Nitrate + Nitrite as Nitrogen	mg/L	09/21/2016	N001	4.92 - 9.96	0.78		F	#	0.01	
Oxidation Reduction Potential	mV	09/21/2016	N001	4.92 - 9.96	-73.8		F	#		
pH	s.u.	09/21/2016	N001	4.92 - 9.96	7.08		F	#		
Selenium	mg/L	09/21/2016	N001	4.92 - 9.96	0.0013		F	#	0.00066	
Specific Conductance	umhos /cm	09/21/2016	N001	4.92 - 9.96	890		F	#		
Temperature	C	09/21/2016	N001	4.92 - 9.96	15.91		F	#		
Turbidity	NTU	09/21/2016	N001	4.92 - 9.96	1.99		F	#		
Uranium	mg/L	09/21/2016	N001	4.92 - 9.96	0.0093		F	#	0.000012	

Groundwater Quality Data by Location (USEE100) FOR SITE SRK05, Slick Rock West Processing Site
REPORT DATE: 12/9/2016
Location: 0339 WELL

Parameter	Units	Sample Date	Sample ID	Depth Range (Ft BLS)			Result	Qualifiers Lab	Qualifiers Data	Qualifiers QA	Detection Limit	Uncertainty
Alkalinity, Total (as $CaCO_3$)	mg/L	09/21/2016	N001	11	-	14	262		F	#		
Manganese	mg/L	09/21/2016	N001	11	-	14	2.1		F	#	0.00011	
Molybdenum	mg/L	09/21/2016	N001	11	-	14	1		F	#	0.00032	
Nitrate + Nitrite as Nitrogen	mg/L	09/21/2016	N001	11	-	14	66		F	#	0.5	
Oxidation Reduction Potential	mV	09/21/2016	N001	11	-	14	120.1		F	#		
pH	s.u.	09/21/2016	N001	11	-	14	6.94		F	#		
Selenium	mg/L	09/21/2016	N001	11	-	14	4.4		F	#	0.00066	
Specific Conductance	umhos /cm	09/21/2016	N001	11	-	14	2197		F	#		
Temperature	C	09/21/2016	N001	11	-	14	16.51		F	#		
Turbidity	NTU	09/21/2016	N001	11	-	14	6.39		F	#		
Uranium	mg/L	09/21/2016	N001	11	-	14	0.032		F	#	0.000012	

Groundwater Quality Data by Location (USEE100) FOR SITE SRK05, Slick Rock West Processing Site
REPORT DATE: 12/9/2016
Location: 0340 WELL

Parameter	Units	Sample Date	Sample ID	Depth Range (Ft BLS)	Result	Qualifiers Lab	Qualifiers Data	Qualifiers QA	Detection Limit	Uncertainty
Alkalinity, Total (as $CaCO_3$)	mg/L	09/21/2016	N001	6.51 - 11.51	249		F	#		
Manganese	mg/L	09/21/2016	N001	6.51 - 11.51	5.1		F	#	0.00011	
Molybdenum	mg/L	09/21/2016	N001	6.51 - 11.51	1.6		F	#	0.00032	
Nitrate + Nitrite as Nitrogen	mg/L	09/21/2016	N001	6.51 - 11.51	250		F	#	10	
Oxidation Reduction Potential	mV	09/21/2016	N001	6.51 - 11.51	150.8		F	#		
pH	s.u.	09/21/2016	N001	6.51 - 11.51	6.75		F	#		
Selenium	mg/L	09/21/2016	N001	6.51 - 11.51	4.5		F	#	0.00066	
Specific Conductance	umhos /cm	09/21/2016	N001	6.51 - 11.51	3960		F	#		
Temperature	C	09/21/2016	N001	6.51 - 11.51	18.19		F	#		
Turbidity	NTU	09/21/2016	N001	6.51 - 11.51	8.69		F	#		
Uranium	mg/L	09/21/2016	N001	6.51 - 11.51	0.042		F	#	0.000012	

Groundwater Quality Data by Location (USEE100) FOR SITE SRK05, Slick Rock West Processing Site
REPORT DATE: 12/9/2016
Location: 0508 WELL

Parameter	Units	Sample Date	Sample ID	Depth Range (Ft BLS)	Result	Qualifiers Lab	Qualifiers Data	Qualifiers QA	Detection Limit	Uncertainty
Alkalinity, Total (as $CaCO_3$)	mg/L	09/21/2016	N001	1.01 - 11.01	285		F	#		
Manganese	mg/L	09/21/2016	N001	1.01 - 11.01	3.2		F	#	0.00011	
Molybdenum	mg/L	09/21/2016	N001	1.01 - 11.01	1.4		F	#	0.00032	
Nitrate + Nitrite as Nitrogen	mg/L	09/21/2016	N001	1.01 - 11.01	150		F	#	10	
Oxidation Reduction Potential	mV	09/21/2016	N001	1.01 - 11.01	145.3		F	#		
pH	s.u.	09/21/2016	N001	1.01 - 11.01	6.86		F	#		
Selenium	mg/L	09/21/2016	N001	1.01 - 11.01	2.6		F	#	0.00066	
Specific Conductance	umhos /cm	09/21/2016	N001	1.01 - 11.01	3270		F	#		
Temperature	C	09/21/2016	N001	1.01 - 11.01	18.5		F	#		
Turbidity	NTU	09/21/2016	N001	1.01 - 11.01	2.25		F	#		
Uranium	mg/L	09/21/2016	N001	1.01 - 11.01	0.073		F	#	0.000012	

Groundwater Quality Data by Location (USEE100) FOR SITE SRK05, Slick Rock West Processing Site
REPORT DATE: 12/9/2016
Location: 0510 WELL

Parameter	Units	Sample Date	Sample ID	Depth Range (Ft BLS)	Result	Qualifiers Lab	Qualifiers Data	Qualifiers QA	Detection Limit	Uncertainty
Alkalinity, Total (as $CaCO_3$)	mg/L	09/21/2016	N001	4.92 - 13.92	314		F	#		
Manganese	mg/L	09/21/2016	N001	4.92 - 13.92	3.8		F	#	0.00011	
Molybdenum	mg/L	09/21/2016	N001	4.92 - 13.92	0.87		F	#	0.00032	
Nitrate + Nitrite as Nitrogen	mg/L	09/21/2016	N001	4.92 - 13.92	150		F	#	1	
Oxidation Reduction Potential	mV	09/21/2016	N001	4.92 - 13.92	144.4		F	#		
pH	s.u.	09/21/2016	N001	4.92 - 13.92	6.71		F	#		
Selenium	mg/L	09/21/2016	N001	4.92 - 13.92	1.2		F	#	0.00066	
Specific Conductance	umhos /cm	09/21/2016	N001	4.92 - 13.92	3476		F	#		
Temperature	C	09/21/2016	N001	4.92 - 13.92	17.21		F	#		
Turbidity	NTU	09/21/2016	N001	4.92 - 13.92	3.18		F	#		
Uranium	mg/L	09/21/2016	N001	4.92 - 13.92	0.095		F	#	0.000012	

Groundwater Quality Data by Location (USEE100) FOR SITE SRK05, Slick Rock West Processing Site
REPORT DATE: 12/9/2016
Location: 0684 WELL

Parameter	Units	Sample Date	Sample ID	Depth Range (Ft BLS)	Result	Qualifiers Lab	Qualifiers Data	Qualifiers QA	Detection Limit	Uncertainty
Alkalinity, Total (as $CaCO_3$)	mg/L	09/21/2016	N001	11 - 21	226		F	#		
Manganese	mg/L	09/21/2016	N001	11 - 21	0.19		F	#	0.00011	
Molybdenum	mg/L	09/21/2016	N001	11 - 21	0.0074		F	#	0.00032	
Nitrate + Nitrite as Nitrogen	mg/L	09/21/2016	N001	11 - 21	0.01	U	F	#	0.01	
Oxidation Reduction Potential	mV	09/21/2016	N001	11 - 21	82.8		F	#		
pH	s.u.	09/21/2016	N001	11 - 21	6.93		F	#		
Selenium	mg/L	09/21/2016	N001	11 - 21	0.0027		F	#	0.00066	
Specific Conductance	umhos /cm	09/21/2016	N001	11 - 21	956		F	#		
Temperature	C	09/21/2016	N001	11 - 21	14.24		F	#		
Turbidity	NTU	09/21/2016	N001	11 - 21	1.29		F	#		
Uranium	mg/L	09/21/2016	N001	11 - 21	0.012		F	#	0.000012	

Groundwater Quality Data by Location (USEE100) FOR SITE SRK06, Slick Rock East Processing Site
REPORT DATE: 12/9/2016
Location: 0300 WELL

Parameter	Units	Sample Date	Sample ID	Depth Range (Ft BLS)			Result	Qualifiers Lab	Qualifiers Data	Qualifiers QA	Detection Limit	Uncertainty
Alkalinity, Total (as $CaCO_3$)	mg/L	09/20/2016	N001	9.5	-	19.5	611		F	#		
Manganese	mg/L	09/20/2016	N001	9.5	-	19.5	1.9		F	#	0.00011	
Manganese	mg/L	09/20/2016	N002	9.5	-	19.5	2		F	#	0.00011	
Molybdenum	mg/L	09/20/2016	N001	9.5	-	19.5	0.0064		F	#	0.00032	
Molybdenum	mg/L	09/20/2016	N002	9.5	-	19.5	0.0055		F	#	0.00032	
Nitrate + Nitrite as Nitrogen	mg/L	09/20/2016	N001	9.5	-	19.5	0.015		F	#	0.01	
Nitrate + Nitrite as Nitrogen	mg/L	09/20/2016	N002	9.5	-	19.5	0.01	U	F	#	0.01	
Oxidation Reduction Potential	mV	09/20/2016	N001	9.5	-	19.5	-75.9		F	#		
pH	s.u.	09/20/2016	N001	9.5	-	19.5	6.89		F	#		
Radium-226	pCi/L	09/20/2016	N001	9.5	-	19.5	0.344		F	#	0.11	0.155
Radium-226	pCi/L	09/20/2016	N002	9.5	-	19.5	0.184		FJ	#	0.12	0.113
Radium-228	pCi/L	09/20/2016	N001	9.5	-	19.5	0.593		FJ	#	0.56	0.385
Radium-228	pCi/L	09/20/2016	N002	9.5	-	19.5	0.796		FJ	#	0.46	0.369
Selenium	mg/L	09/20/2016	N001	9.5	-	19.5	0.0014		F	#	0.00066	
Selenium	mg/L	09/20/2016	N002	9.5	-	19.5	0.0012		F	#	0.00066	
Specific Conductance	umhos /cm	09/20/2016	N001	9.5	-	19.5	7954		F	#		
Temperature	C	09/20/2016	N001	9.5	-	19.5	16.26		F	#		

Groundwater Quality Data by Location (USEE100) FOR SITE SRK06, Slick Rock East Processing Site
REPORT DATE: 12/9/2016
Location: 0300 WELL

Parameter	Units	Sample Date	Sample ID	Depth Range (Ft BLS)			Result	Qualifiers Lab	Qualifiers Data	Qualifiers QA	Detection Limit	Uncertainty
Turbidity	NTU	09/20/2016	N001	9.5	-	19.5	1.92		F	#		
Uranium	mg/L	09/20/2016	N001	9.5	-	19.5	0.017		F	#	0.000012	
Uranium	mg/L	09/20/2016	N002	9.5	-	19.5	0.016		F	#	0.000012	

Groundwater Quality Data by Location (USEE100) FOR SITE SRK06, Slick Rock East Processing Site
REPORT DATE: 12/9/2016
Location: 0303 WELL

Parameter	Units	Sample Date	Sample ID	Depth Range (Ft BLS)			Result	Qualifiers Lab	Qualifiers Data	Qualifiers QA	Detection Limit	Uncertainty
Alkalinity, Total (as $CaCO_3$)	mg/L	09/20/2016	N001	4.3	-	14.3	481		F	#		
Oxidation Reduction Potential	mV	09/20/2016	N001	4.3	-	14.3	-85.5		F	#		
pH	s.u.	09/20/2016	N001	4.3	-	14.3	7.17		F	#		
Specific Conductance	umhos /cm	09/20/2016	N001	4.3	-	14.3	3235		F	#		
Temperature	C	09/20/2016	N001	4.3	-	14.3	19.12		F	#		
Turbidity	NTU	09/20/2016	N001	4.3	-	14.3	4.84		F	#		
Uranium	mg/L	09/20/2016	N001	4.3	-	14.3	1.1		F	#	0.00012	

Groundwater Quality Data by Location (USEE100) FOR SITE SRK06, Slick Rock East Processing Site
REPORT DATE: 12/9/2016
Location: 0305 WELL

Parameter	Units	Sample Date	Sample ID	Depth Range (Ft BLS)			Result	Qualifiers Lab	Qualifiers Data	Qualifiers QA	Detection Limit	Uncertainty
Alkalinity, Total (as $CaCO_3$)	mg/L	09/20/2016	N001	8.7	-	18.7	440		F	#		
Oxidation Reduction Potential	mV	09/20/2016	N001	8.7	-	18.7	46.9		F	#		
pH	s.u.	09/20/2016	N001	8.7	-	18.7	7.11		F	#		
Selenium	mg/L	09/20/2016	N001	8.7	-	18.7	0.016		F	#	0.00066	
Specific Conductance	umhos /cm	09/20/2016	N001	8.7	-	18.7	3028		F	#		
Temperature	C	09/20/2016	N001	8.7	-	18.7	18.15		F	#		
Turbidity	NTU	09/20/2016	N001	8.7	-	18.7	6.55		F	#		
Uranium	mg/L	09/20/2016	N001	8.7	-	18.7	0.72		F	#	0.000012	

Groundwater Quality Data by Location (USEE100) FOR SITE SRK06, Slick Rock East Processing Site
REPORT DATE: 12/9/2016
Location: 0307 WELL

Parameter	Units	Sample Date	Sample ID	Depth Range (Ft BLS)	Result	Qualifiers Lab	Qualifiers Data	Qualifiers QA	Detection Limit	Uncertainty
Alkalinity, Total (as $CaCO_3$)	mg/L	09/20/2016	N001	4.4 - 14.4	729		F	#		
Oxidation Reduction Potential	mV	09/20/2016	N001	4.4 - 14.4	-77.2		F	#		
pH	s.u.	09/20/2016	N001	4.4 - 14.4	7.18		F	#		
Selenium	mg/L	09/20/2016	N001	4.4 - 14.4	0.00066	U	F	#	0.00066	
Specific Conductance	umhos /cm	09/20/2016	N001	4.4 - 14.4	5222		F	#		
Temperature	C	09/20/2016	N001	4.4 - 14.4	15.64		F	#		
Turbidity	NTU	09/20/2016	N001	4.4 - 14.4	8.62		F	#		
Uranium	mg/L	09/20/2016	N001	4.4 - 14.4	0.44		F	#	0.000012	

Groundwater Quality Data by Location (USEE100) FOR SITE SRK06, Slick Rock East Processing Site
REPORT DATE: 12/9/2016
Location: 0309 WELL

Parameter	Units	Sample Date	Sample ID	Depth Range (Ft BLS)			Result	Qualifiers Lab	Qualifiers Data	Qualifiers QA	Detection Limit	Uncertainty
Alkalinity, Total (as $CaCO_3$)	mg/L	09/20/2016	N001	10.2	-	20.2	787		F	#		
Oxidation Reduction Potential	mV	09/20/2016	N001	10.2	-	20.2	-112.8		F	#		
pH	s.u.	09/20/2016	N001	10.2	-	20.2	7.4		F	#		
Specific Conductance	umhos /cm	09/20/2016	N001	10.2	-	20.2	2802		F	#		
Temperature	C	09/20/2016	N001	10.2	-	20.2	15.49		F	#		
Turbidity	NTU	09/20/2016	N001	10.2	-	20.2	4.69		F	#		
Uranium	mg/L	09/20/2016	N001	10.2	-	20.2	0.065		F	#	0.000012	

Groundwater Quality Data by Location (USEE100) FOR SITE SRK06, Slick Rock East Processing Site
REPORT DATE: 12/9/2016
Location: 0310 WELL

Parameter	Units	Sample Date	Sample ID	Depth Range (Ft BLS)			Result	Qualifiers Lab	Qualifiers Data	Qualifiers QA	Detection Limit	Uncertainty
Alkalinity, Total (as $CaCO_3$)	mg/L	09/20/2016	N001	14.7	-	19.7	197		F	#		
Oxidation Reduction Potential	mV	09/20/2016	N001	14.7	-	19.7	-76		F	#		
pH	s.u.	09/20/2016	N001	14.7	-	19.7	7.14		F	#		
Specific Conductance	umhos /cm	09/20/2016	N001	14.7	-	19.7	916		F	#		
Temperature	C	09/20/2016	N001	14.7	-	19.7	14.08		F	#		
Turbidity	NTU	09/20/2016	N001	14.7	-	19.7	1.33		F	#		
Uranium	mg/L	09/20/2016	N001	14.7	-	19.7	0.023		F	#	0.000012	

Groundwater Quality Data by Location (USEE100) FOR SITE SRK06, Slick Rock East Processing Site
REPORT DATE: 12/9/2016
Location: 0311 WELL

Parameter	Units	Sample Date	Sample ID	Depth Range (Ft BLS)			Result	Qualifiers Lab	Qualifiers Data	Qualifiers QA	Detection Limit	Uncertainty
Alkalinity, Total (as $CaCO_3$)	mg/L	09/20/2016	N001	14.1	-	19.1	276		F	#		
Oxidation Reduction Potential	mV	09/20/2016	N001	14.1	-	19.1	55.1		F	#		
pH	s.u.	09/20/2016	N001	14.1	-	19.1	6.92		F	#		
Specific Conductance	umhos /cm	09/20/2016	N001	14.1	-	19.1	1596		F	#		
Temperature	C	09/20/2016	N001	14.1	-	19.1	16.05		F	#		
Turbidity	NTU	09/20/2016	N001	14.1	-	19.1	3.74		F	#		
Uranium	mg/L	09/20/2016	N001	14.1	-	19.1	0.068		F	#	0.000012	

Groundwater Quality Data by Location (USEE100) FOR SITE SRK06, Slick Rock East Processing Site
REPORT DATE: 12/9/2016
Location: 0672 WELL

Parameter	Units	Sample Date	Sample ID	Depth Range (Ft BLS)	Result	Qualifiers Lab	Qualifiers Data	Qualifiers QA	Detection Limit	Uncertainty
Alkalinity, Total (as $CaCO_3$)	mg/L	09/21/2016	N001	-	254			#		
Manganese	mg/L	09/21/2016	N001	-	0.0004	J		#	0.00011	
Molybdenum	mg/L	09/21/2016	N001	-	0.00098	J		#	0.00032	
Oxidation Reduction Potential	mV	09/21/2016	N001	-	48.4			#		
pH	s.u.	09/21/2016	N001	-	8.04			#		
Selenium	mg/L	09/21/2016	N001	-	0.0012			#	0.00066	
Specific Conductance	umhos /cm	09/21/2016	N001	-	523			#		
Temperature	C	09/21/2016	N001	-	18.62			#		
Turbidity	NTU	09/21/2016	N001	-	1.15			#		
Uranium	mg/L	09/21/2016	N001	-	0.0028			#	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.
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.

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Surface Water Quality Data

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Surface Water Quality Data by Location (USEE102) FOR SITE SRK05, Slick Rock West Processing Site
REPORT DATE: 12/9/2016
Location: 0347 SURFACE LOCATION

Parameter	Units	Sample Date	Sample ID	Result	Qualifiers Lab	Qualifiers Data	Qualifiers QA	Detection Limit	Uncertainty
Alkalinity, Total (as $CaCO_3$)	mg/L	09/21/2016	N001	115			#		
Manganese	mg/L	09/21/2016	0001	0.0045	J		#	0.00011	
Molybdenum	mg/L	09/21/2016	0001	0.0044		J	#	0.00032	
Nitrate + Nitrite as Nitrogen	mg/L	09/21/2016	0001	0.011			#	0.01	
Oxidation Reduction Potential	mV	09/21/2016	N001	77.1			#		
pH	s.u.	09/21/2016	N001	8.17			#		
Selenium	mg/L	09/21/2016	0001	0.0089		J	#	0.00066	
Specific Conductance	umhos/cm	09/21/2016	N001	377			#		
Temperature	C	09/21/2016	N001	17.71			#		
Turbidity	NTU	09/21/2016	N001	18.7			#		
Uranium	mg/L	09/21/2016	0001	0.00073			#	0.000012	

Surface Water Quality Data by Location (USEE102) FOR SITE SRK05, Slick Rock West Processing Site
REPORT DATE: 12/9/2016
Location: 0349 SURFACE LOCATION

Parameter	Units	Sample Date	Sample ID	Result	Qualifiers Lab	Qualifiers Data	Qualifiers QA	Detection Limit	Uncertainty
Alkalinity, Total (as $CaCO_3$)	mg/L	09/21/2016	N001	112			#		
Manganese	mg/L	09/21/2016	0001	0.0059			#	0.00011	
Molybdenum	mg/L	09/21/2016	0001	0.0013	J	J	#	0.00032	
Nitrate + Nitrite as Nitrogen	mg/L	09/21/2016	0001	0.024			#	0.01	
Oxidation Reduction Potential	mV	09/21/2016	N001	5			#		
pH	s.u.	09/21/2016	N001	8.15			#		
Selenium	mg/L	09/21/2016	0001	0.001	J	J	#	0.00066	
Specific Conductance	umhos/cm	09/21/2016	N001	369			#		
Temperature	C	09/21/2016	N001	19.88			#		
Turbidity	NTU	09/21/2016	N001	242			#		
Uranium	mg/L	09/21/2016	0001	0.00069			#	0.000012	

Surface Water Quality Data by Location (USEE102) FOR SITE SRK05, Slick Rock West Processing Site
REPORT DATE: 12/9/2016
Location: 0693 SURFACE LOCATION

Parameter	Units	Sample Date	Sample ID	Result	Qualifiers Lab	Qualifiers Data	Qualifiers QA	Detection Limit	Uncertainty
Alkalinity, Total (as $CaCO_3$)	mg/L	09/21/2016	N001	108			#		
Manganese	mg/L	09/21/2016	0001	0.0029	J		#	0.00011	
Molybdenum	mg/L	09/21/2016	0001	0.0014	J	J	#	0.00032	
Nitrate + Nitrite as Nitrogen	mg/L	09/21/2016	0001	0.01	U		#	0.01	
Oxidation Reduction Potential	mV	09/21/2016	N001	-38			#		
pH	s.u.	09/21/2016	N001	8.33			#		
Selenium	mg/L	09/21/2016	0001	0.001		J	#	0.00066	
Specific Conductance	umhos/cm	09/21/2016	N001	365			#		
Temperature	C	09/21/2016	N001	22.82			#		
Turbidity	NTU	09/21/2016	N001	67.4			#		
Uranium	mg/L	09/21/2016	0001	0.0007			#	0.000012	

Surface Water Quality Data by Location (USEE102) FOR SITE SRK05, Slick Rock West Processing Site
REPORT DATE: 12/9/2016
Location: 0694 SURFACE LOCATION

Parameter	Units	Sample Date	Sample ID	Result	Qualifiers Lab	Qualifiers Data	Qualifiers QA	Detection Limit	Uncertainty
Alkalinity, Total (as $CaCO_3$)	mg/L	09/21/2016	N001	102			#		
Manganese	mg/L	09/21/2016	0001	0.0045	J		#	0.00011	
Molybdenum	mg/L	09/21/2016	0001	0.0011	J		#	0.00032	
Nitrate + Nitrite as Nitrogen	mg/L	09/21/2016	0001	0.01	U		#	0.01	
Oxidation Reduction Potential	mV	09/21/2016	N001	26			#		
pH	s.u.	09/21/2016	N001	8.38			#		
Selenium	mg/L	09/21/2016	0001	0.00066	U		#	0.00066	
Specific Conductance	umhos/cm	09/21/2016	N001	364			#		
Temperature	C	09/21/2016	N001	19.26			#		
Turbidity	NTU	09/21/2016	N001	50.5			#		
Uranium	mg/L	09/21/2016	0001	0.00066			#	0.000012	

Surface Water Quality Data by Location (USEE102) FOR SITE SRK06, Slick Rock East Processing Site
REPORT DATE: 12/9/2016
Location: 0692 SURFACE LOCATION

Parameter	Units	Sample Date	Sample ID	Result	Qualifiers Lab	Qualifiers Data	Qualifiers QA	Detection Limit	Uncertainty
Alkalinity, Total (as $CaCO_3$)	mg/L	09/20/2016	N001	97			#		
Oxidation Reduction Potential	mV	09/20/2016	N001	-29			#		
pH	s.u.	09/20/2016	N001	8.53			#		
Specific Conductance	umhos/cm	09/20/2016	N001	374			#		
Temperature	C	09/20/2016	N001	18.32			#		
Turbidity	NTU	09/20/2016	N001	19.6			#		
Uranium	mg/L	09/20/2016	0001	0.00076			#	0.000012	

Surface Water Quality Data by Location (USEE102) FOR SITE SRK06, Slick Rock East Processing Site
REPORT DATE: 12/9/2016
Location: 0696 SURFACE LOCATION WQD, KNOWNS

Parameter	Units	Sample Date	Sample ID	Result	Qualifiers Lab	Qualifiers Data	Qualifiers QA	Detection Limit	Uncertainty
Alkalinity, Total (as $CaCO_3$)	mg/L	09/21/2016	N001	103			#		
Oxidation Reduction Potential	mV	09/21/2016	N001	43.8			#		
pH	s.u.	09/21/2016	N001	8.28			#		
Specific Conductance	umhos/cm	09/21/2016	N001	364			#		
Temperature	C	09/21/2016	N001	19.98			#		
Turbidity	NTU	09/21/2016	N001	19.1			#		
Uranium	mg/L	09/21/2016	0001	0.00063			#	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.
- 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.

Equipment Blank and Trip Blank Data

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BLANKS REPORT

LAB: PARAGON/ALS LABORATORY GROUP (Fort Collins, CO)
RIN: 16098018
Report Date: 12/9/2016

Parameter	Site Code	Location ID	Sample Date	Sample ID	Units	Result	Qualifiers Lab	Qualifiers Data	Detection Limit	Uncertainty	Sample Type
Benzene	SRK05	0999	09/21/2016	N001	ug/L	0.3	U		0.3		TB
Ethylbenzene	SRK05	0999	09/21/2016	N001	ug/L	0.3	U		0.3		TB
m,p-Xylene	SRK05	0999	09/21/2016	N001	ug/L	0.3	U		0.3		TB
Manganese	SRK05	0999	09/21/2016	N002	mg/L	0.00011	U		0.00011		E
Molybdenum	SRK05	0999	09/21/2016	N002	mg/L	0.0033			0.00032		E
Nitrate + Nitrite as Nitrogen	SRK05	0999	09/21/2016	N002	mg/L	0.01	U		0.01		E
o-Xylene	SRK05	0999	09/21/2016	N001	ug/L	0.3	U		0.3		TB
Selenium	SRK05	0999	09/21/2016	N002	mg/L	0.016			0.00066		E
Toluene	SRK05	0999	09/21/2016	N001	ug/L	0.3	U		0.3		TB
Uranium	SRK05	0999	09/21/2016	N002	mg/L	0.00009	J		0.000012		E

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.		

SAMPLE TYPES:

E	Equipment Blank.
TB	Trip Blank

Static Water Level Data

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STATIC WATER LEVELS (USEE700) FOR SITE SRK05, Slick Rock West Processing Site
REPORT DATE: 12/9/2016

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
0317		5435.18	09/21/2016	11:05:01	11.65	5423.53	
0318A		5435.77	09/21/2016	11:30:38	12.45	5423.32	
0319	O	5430.66	09/21/2016	13:55:49	8.8	5421.86	
0320	O	5427.4	09/21/2016	14:30:09	5.53	5421.87	
0339		5434.47	09/21/2016	12:00:21	11.3	5423.17	
0340		5433.09	09/21/2016	12:30:03	10	5423.09	
0508	O	5430.2	09/21/2016	12:50:16	7.17	5423.03	
0510	O	5427.87	09/21/2016	13:25:41	5.79	5422.08	
0684	D	5432.68	09/21/2016	10:25:03	16.22	5416.46	

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

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

STATIC WATER LEVELS (USEE700) FOR SITE SRK06, Slick Rock East Processing Site
REPORT DATE: 12/9/2016

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
0300	U	5467.35	09/20/2016	12:05:47	13.43	5453.92	
0303	O	5446.91	09/20/2016	13:35:23	10	5436.91	
0305	O	5448.75	09/20/2016	14:05:22	12.4	5436.35	
0307	O	5447.1	09/20/2016	14:30:09	11.28	5435.82	
0309	O	5450.18	09/20/2016	15:50:21	15.31	5434.87	
0310	D	5450.56	09/20/2016	17:30:32	17.9	5432.66	
0311	D	5450.7	09/20/2016	17:10:51	18.35	5432.35	
0312	D	5451.06	09/20/2016	16:49:00			D

FLOW CODES: B BACKGROUND C CROSS GRADIENT D DOWN GRADIENT F OFF SITE
N UNKNOWN O ONSITE U UPGRADIENT

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

Hydrographs

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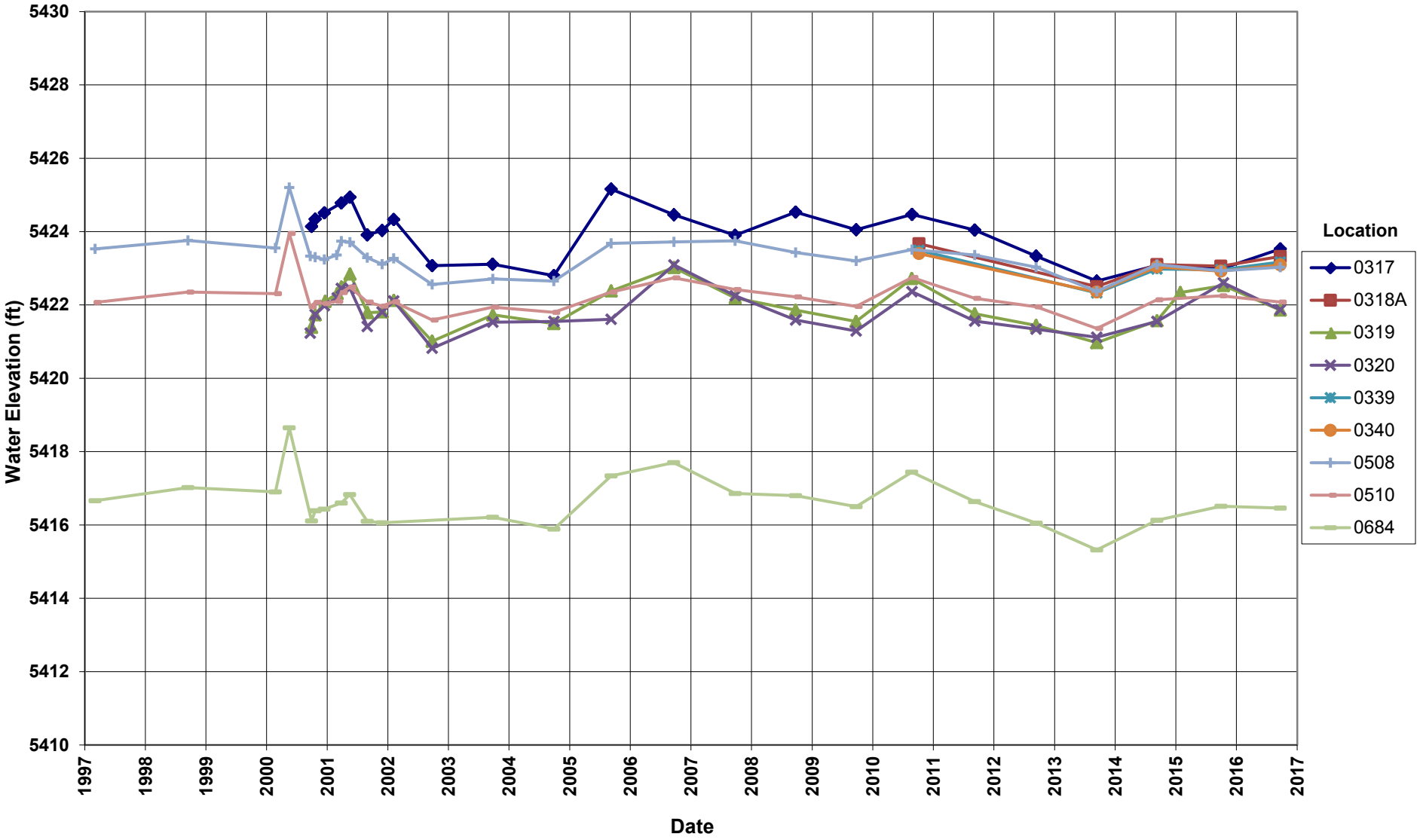
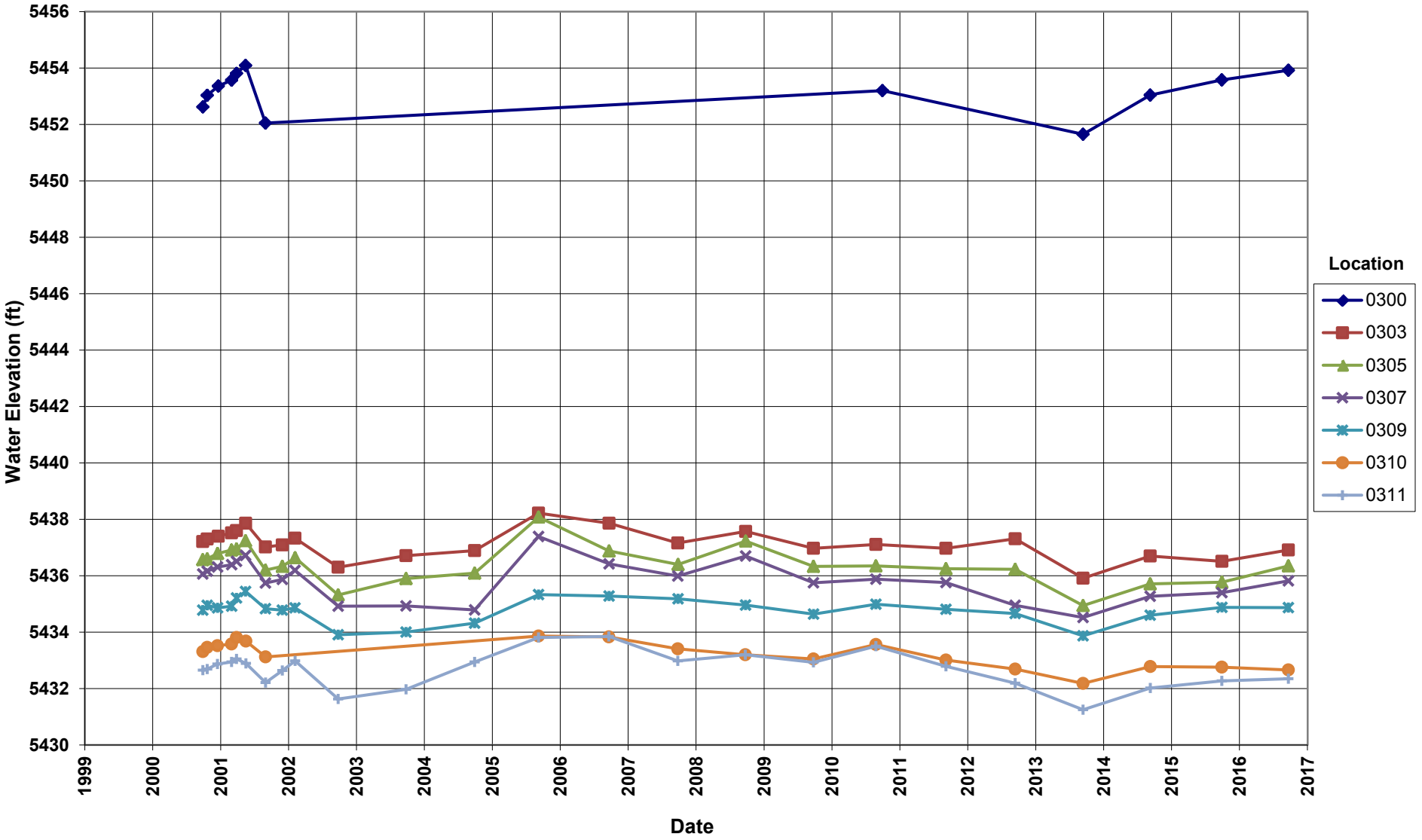
Slick Rock West Processing Site
Hydrograph



Slick Rock East Processing Site
Hydrograph



Groundwater
Time-Concentration Graphs

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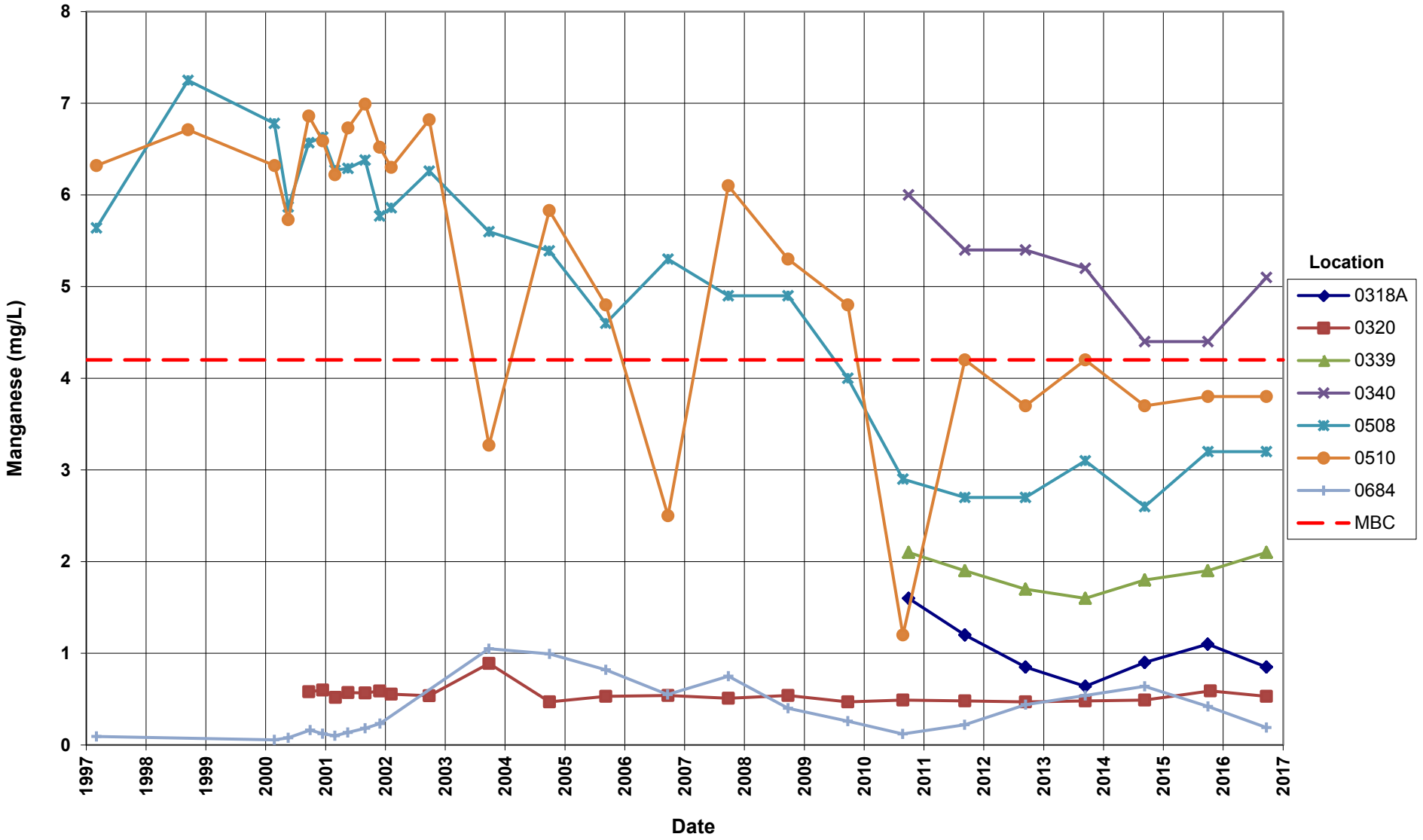
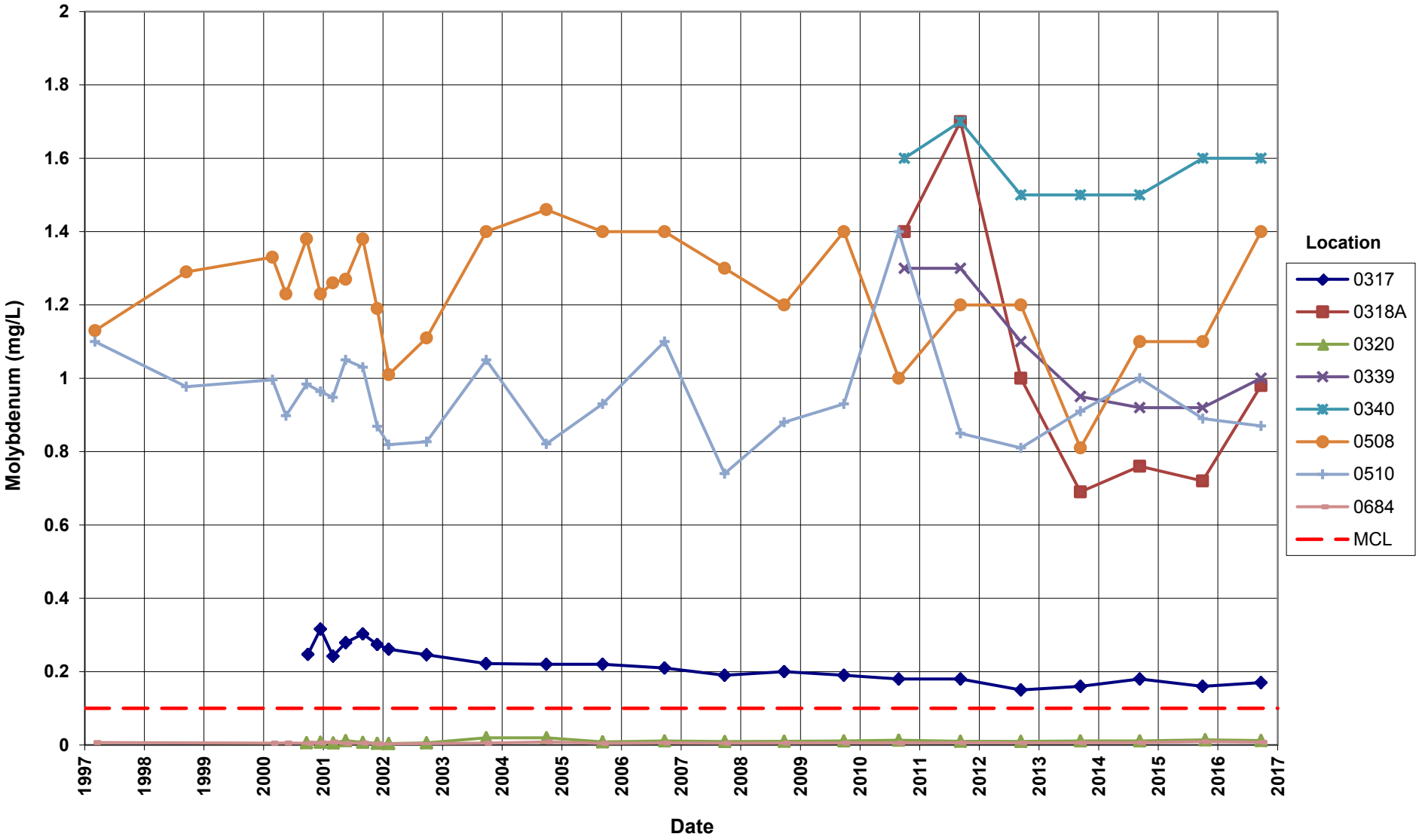
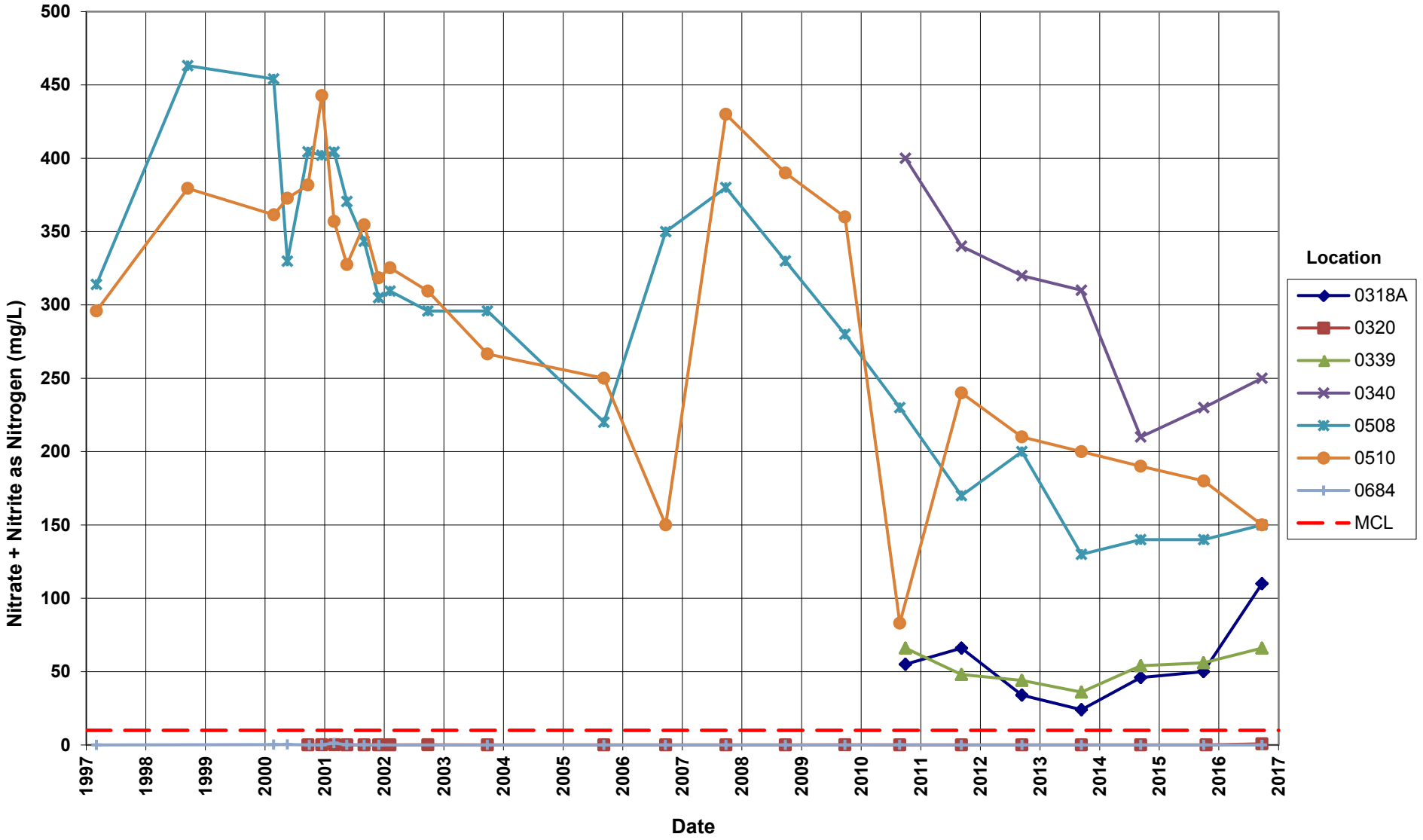
Slick Rock West Processing Site
Manganese Concentration
Maximum Background Concentration (MBC) = 4.2 mg/L



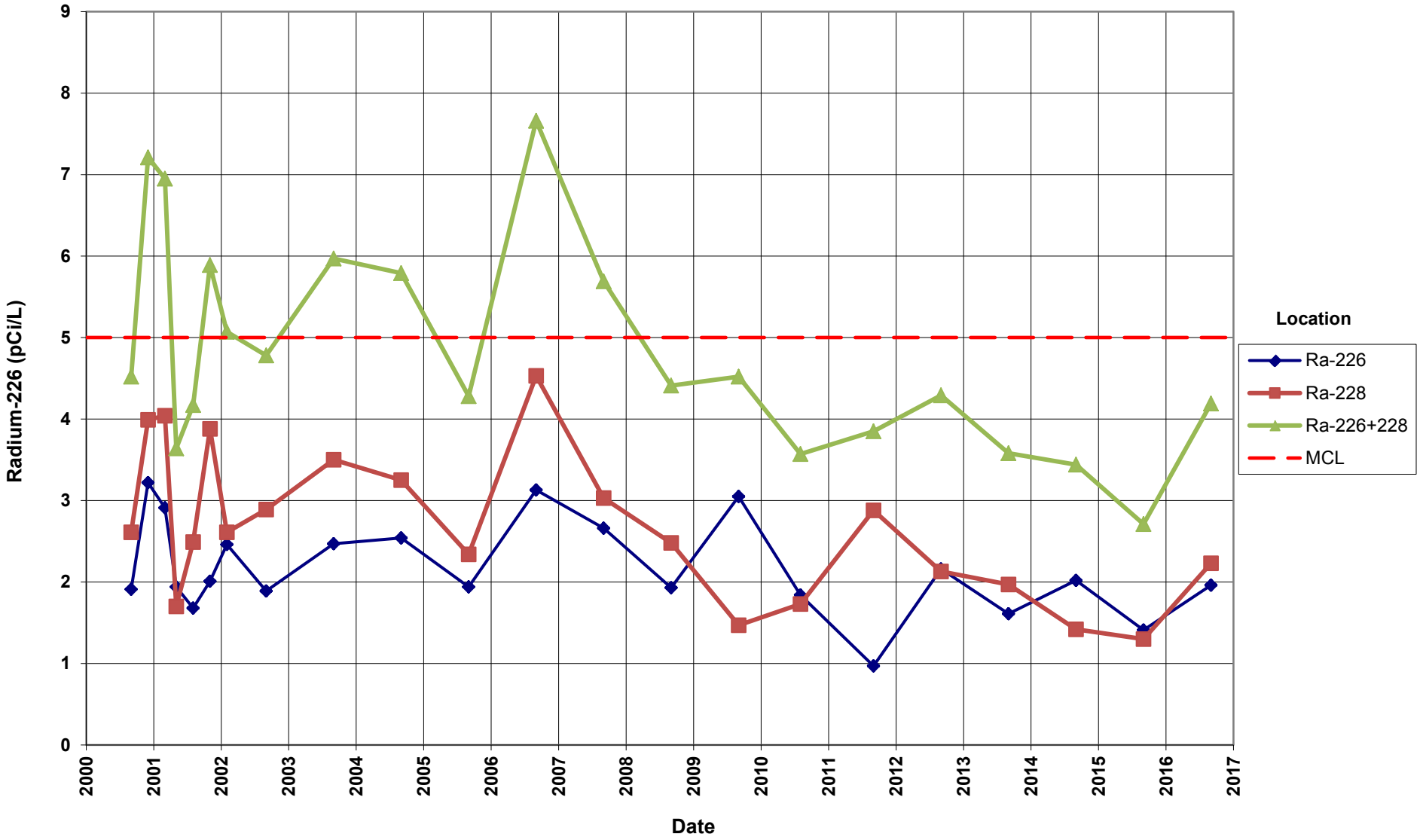
Slick Rock West Processing Site
Molybdenum Concentration
Maximum Concentration Limit (MCL) = 0.10 mg/L



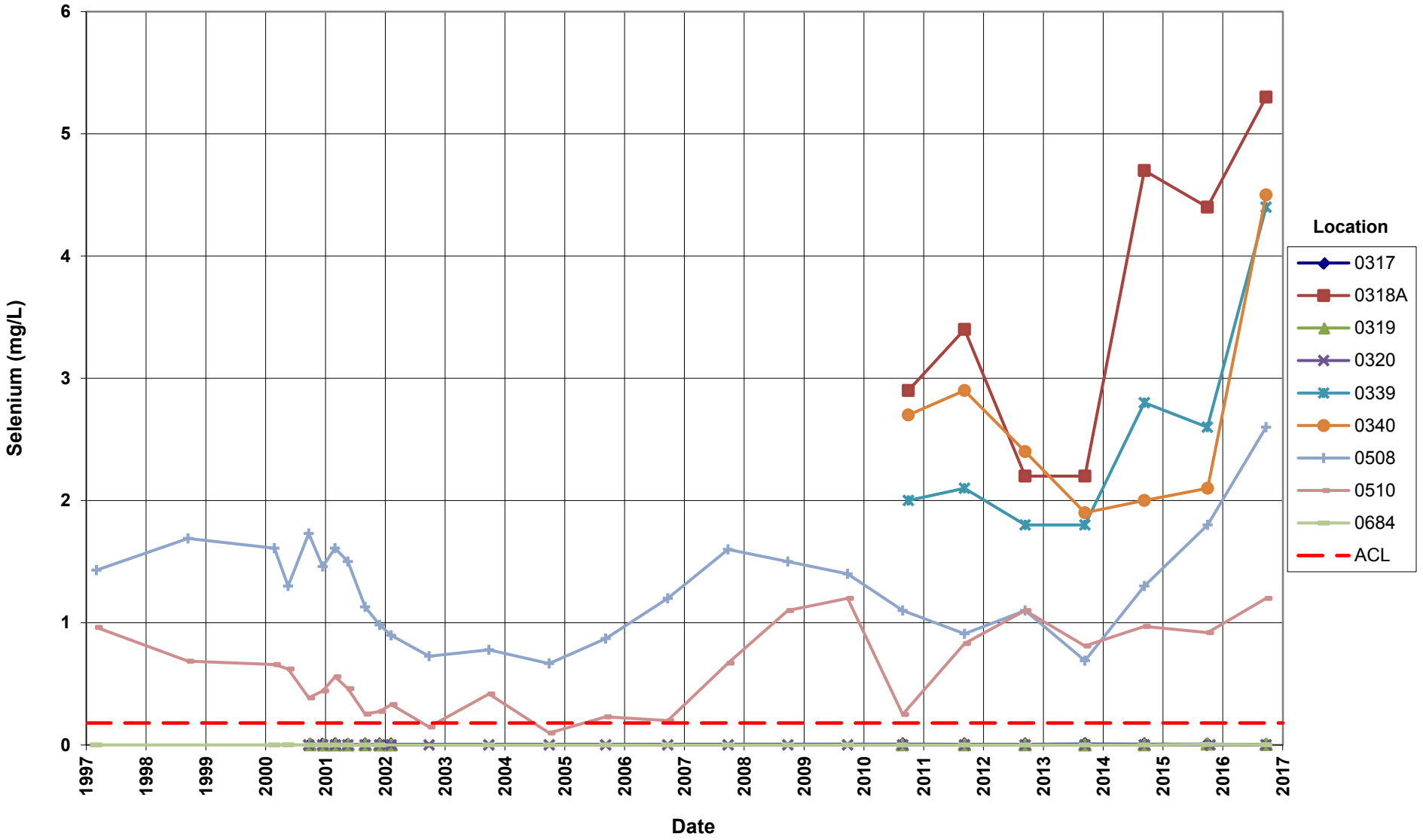
Slick Rock West Processing Site
Nitrate + Nitrite as Nitrogen Concentration
Maximum Concentration Limit (MCL) = 10 mg/L



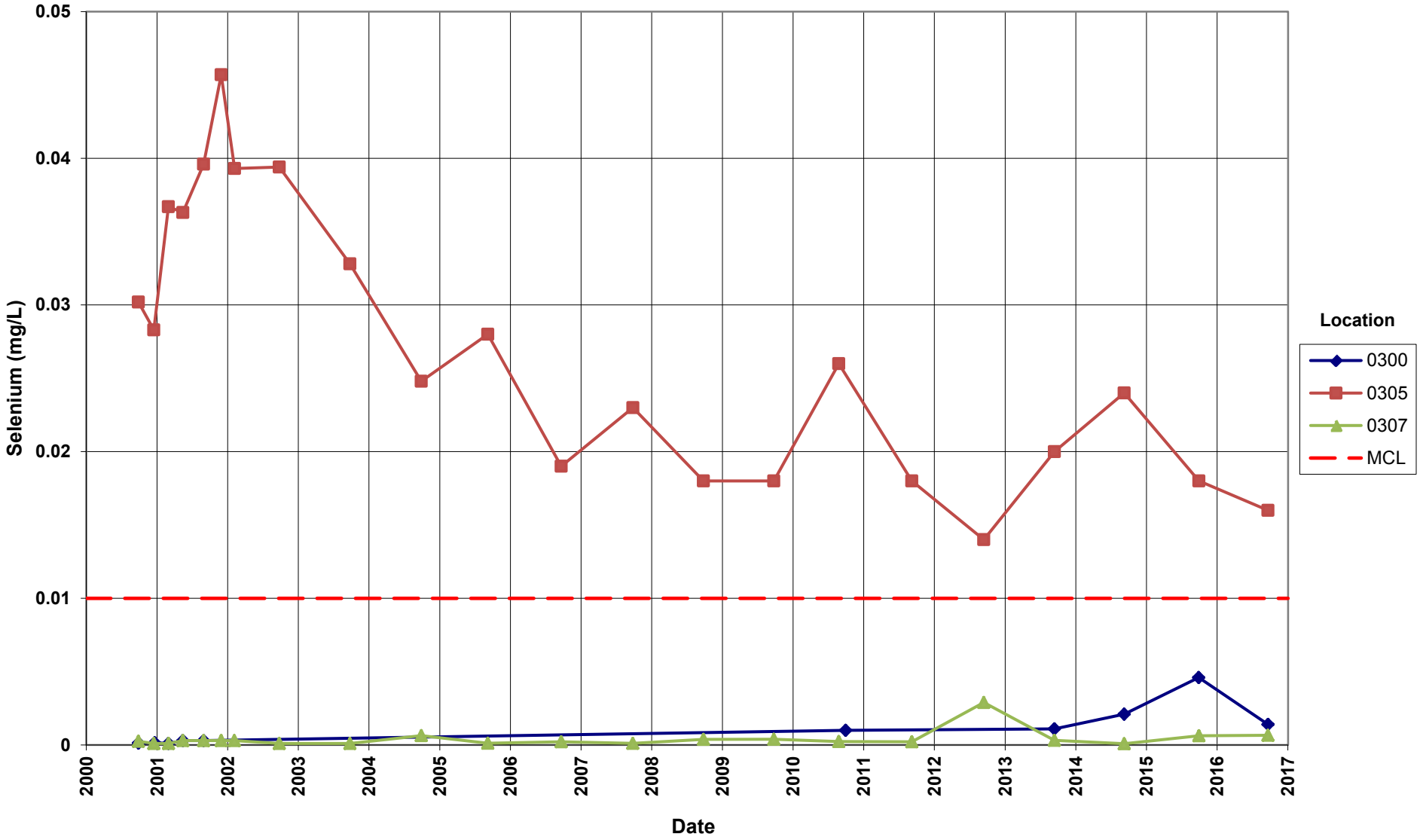
Slick Rock West Processing Site
Radium-226 and Radium-228 Concentrations in Well 0319
Maximum Concentration Limit (MCL) = 5 pCi/L for Ra-226+228



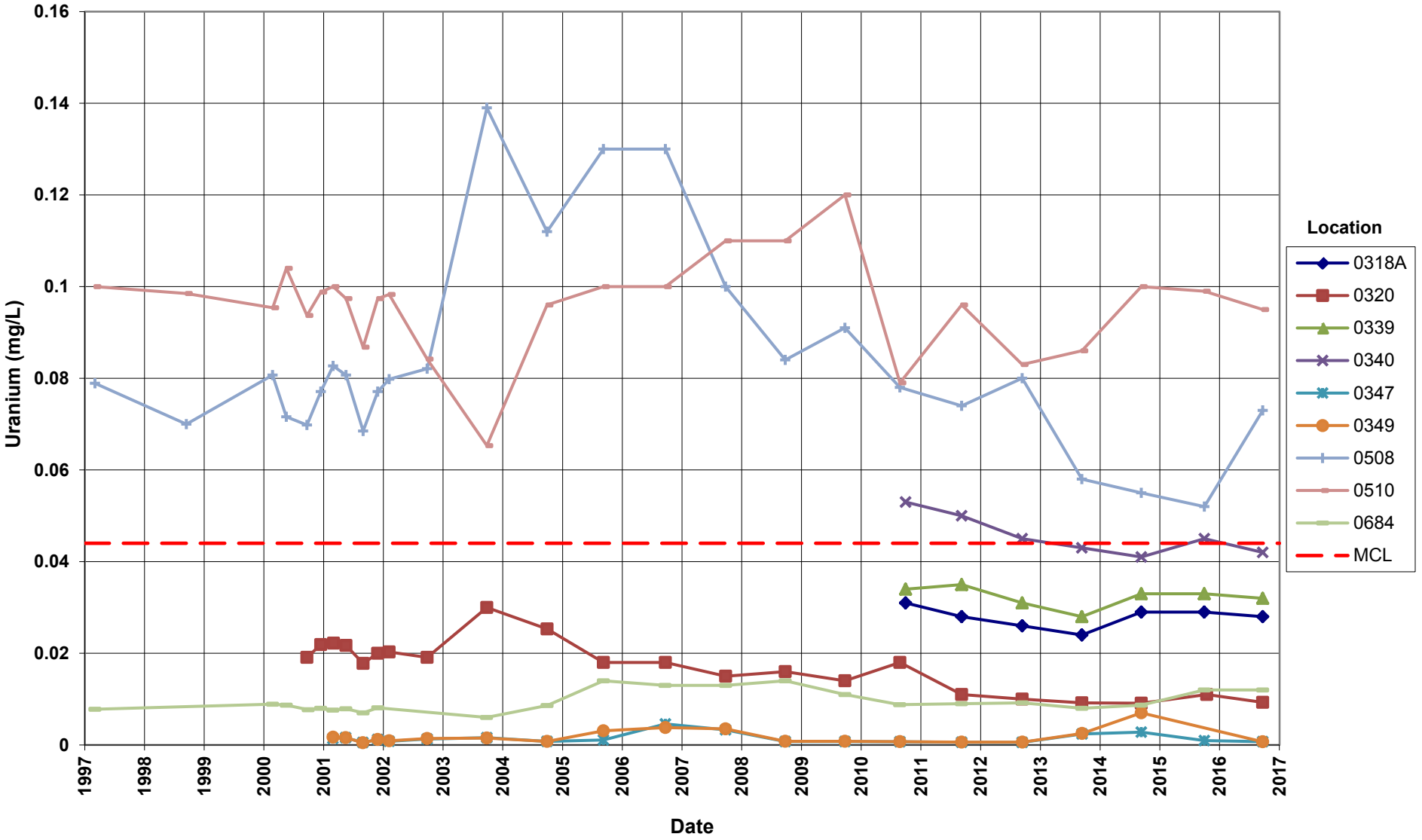
Slick Rock West Processing Site
Selenium Concentration
Alternate Concentration Limit (ACL) = 0.18 mg/L



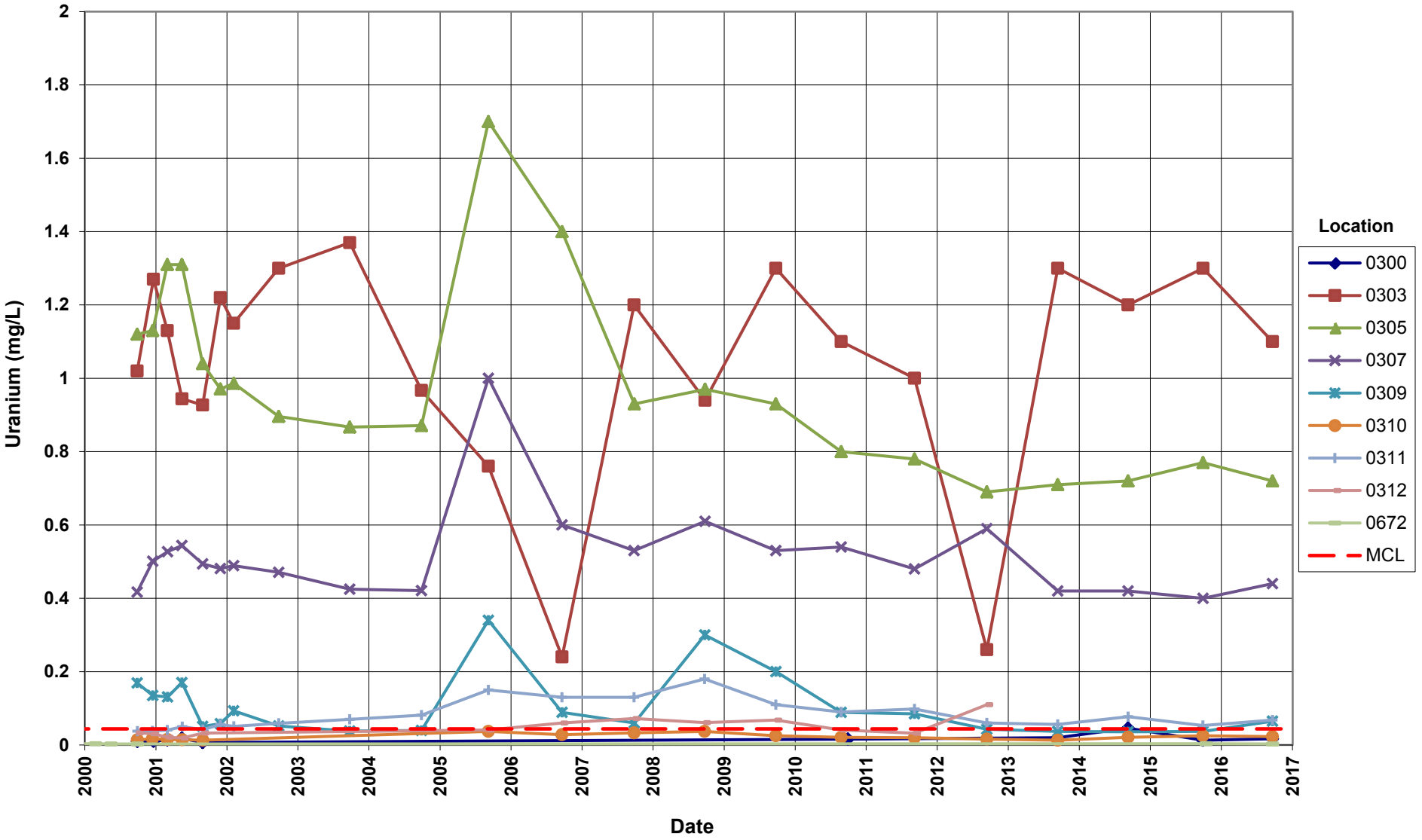
Slick Rock East Processing Site
Selenium Concentration
Maximum Concentration Limit (MCL) = 0.01 mg/L



Slick Rock West Processing Site
Uranium Concentration
Maximimun Concentration Limit (MCL) = 0.044 mg/L



Slick Rock East Processing Site
Uranium Concentration
Maximum Concentration Limit (MCL) = 0.044 mg/L



Surface Water
Time-Concentration Graphs

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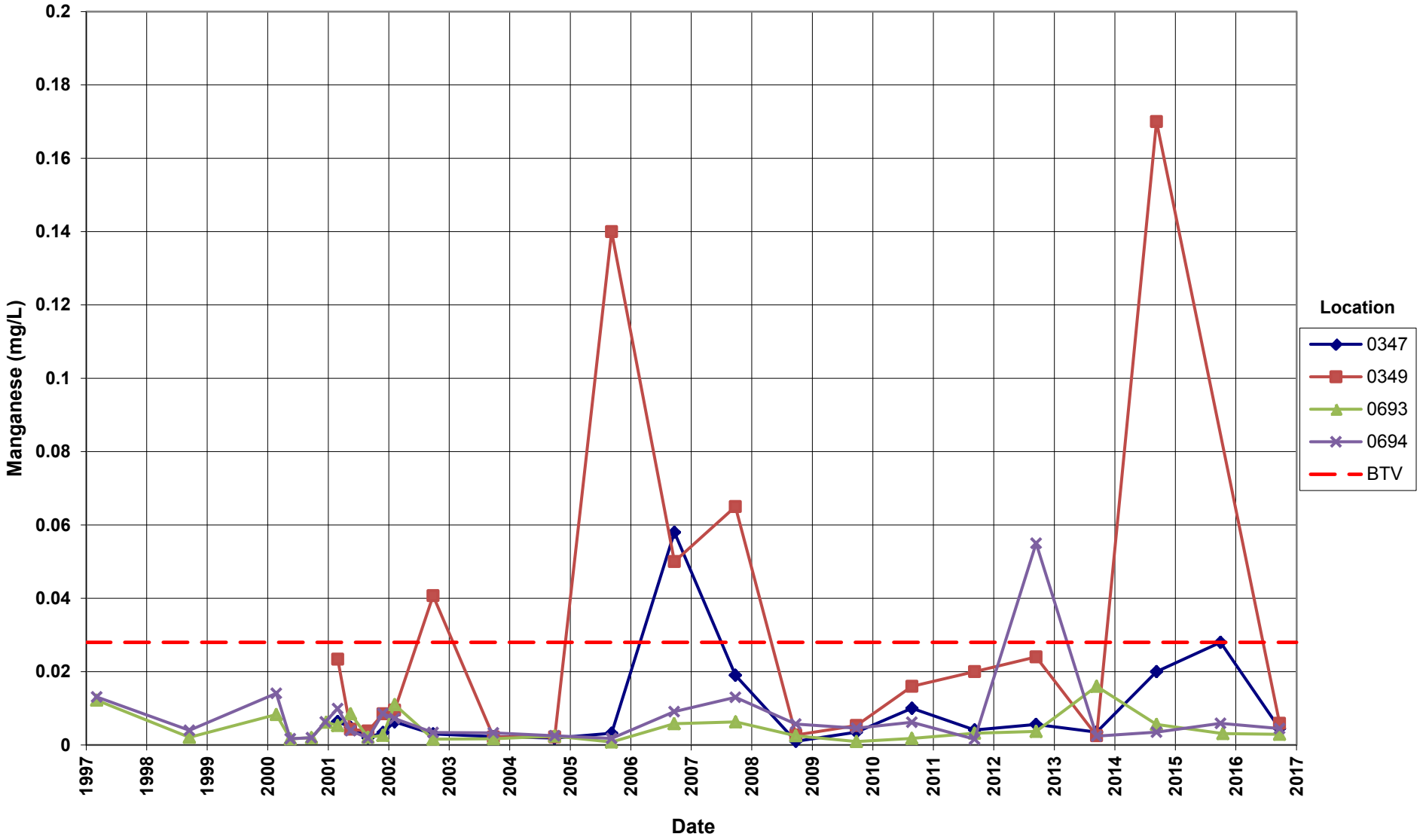
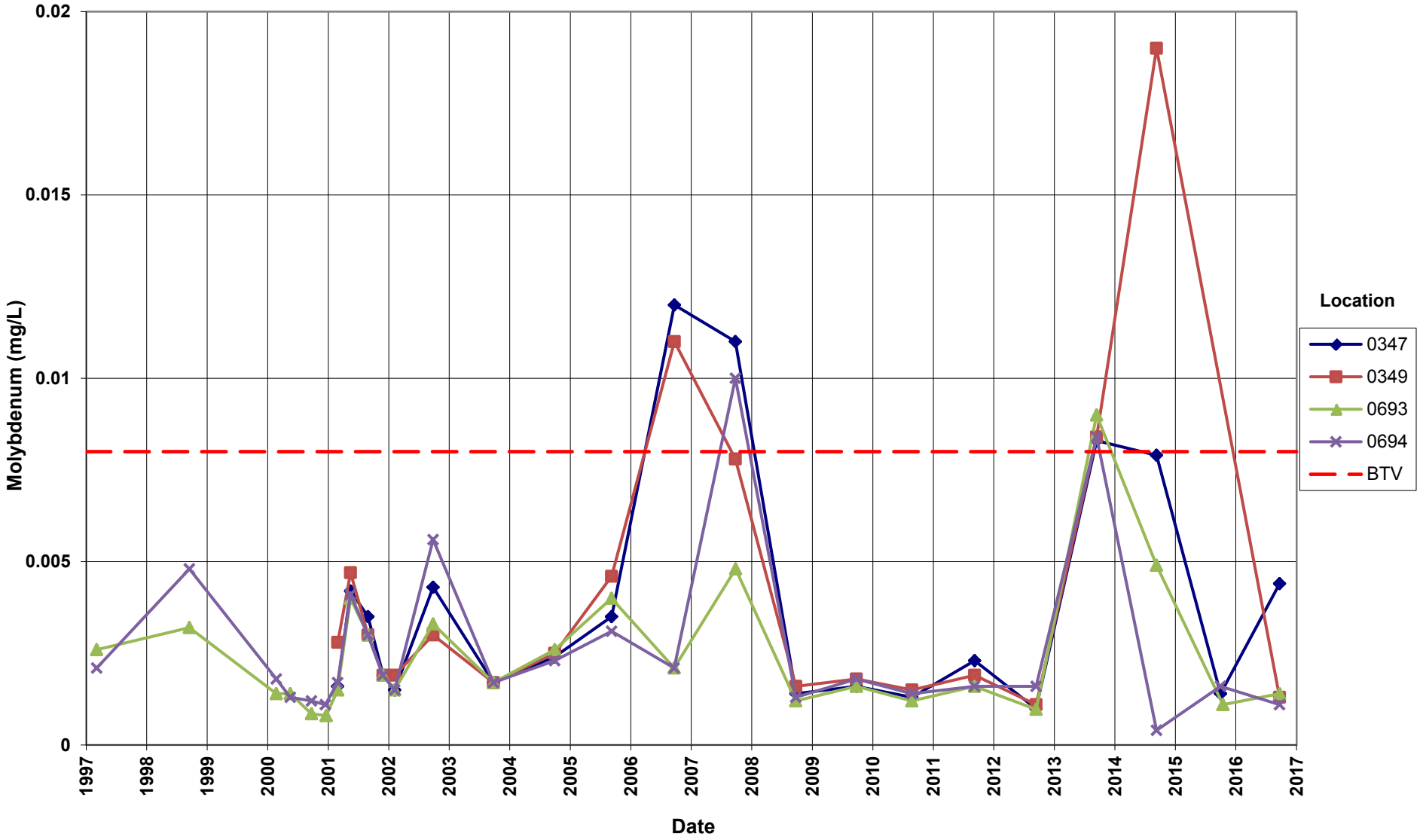
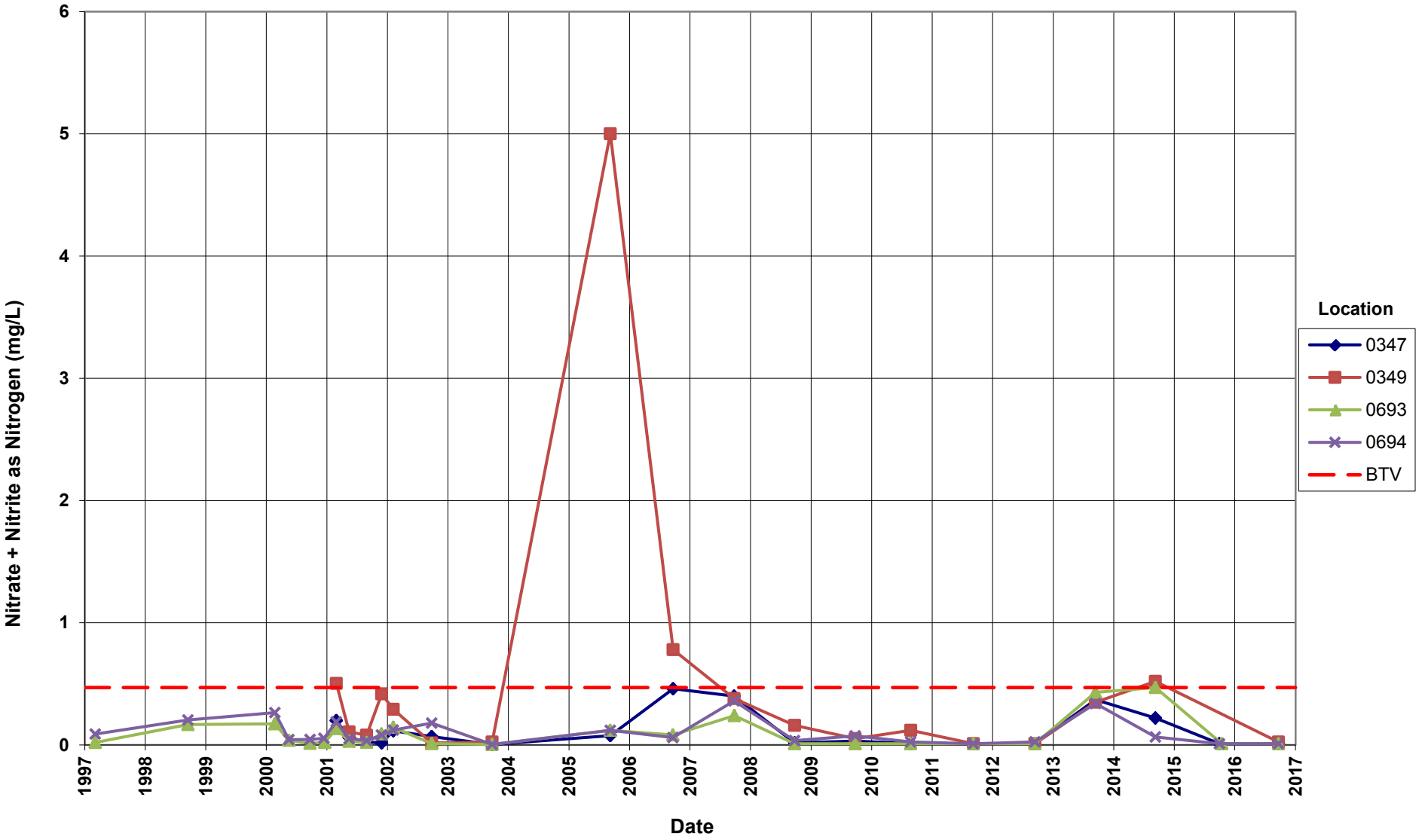
Slick Rock West Processing Site
Manganese Concentration
Background Threshold Value (BTV) = 0.028 mg/L



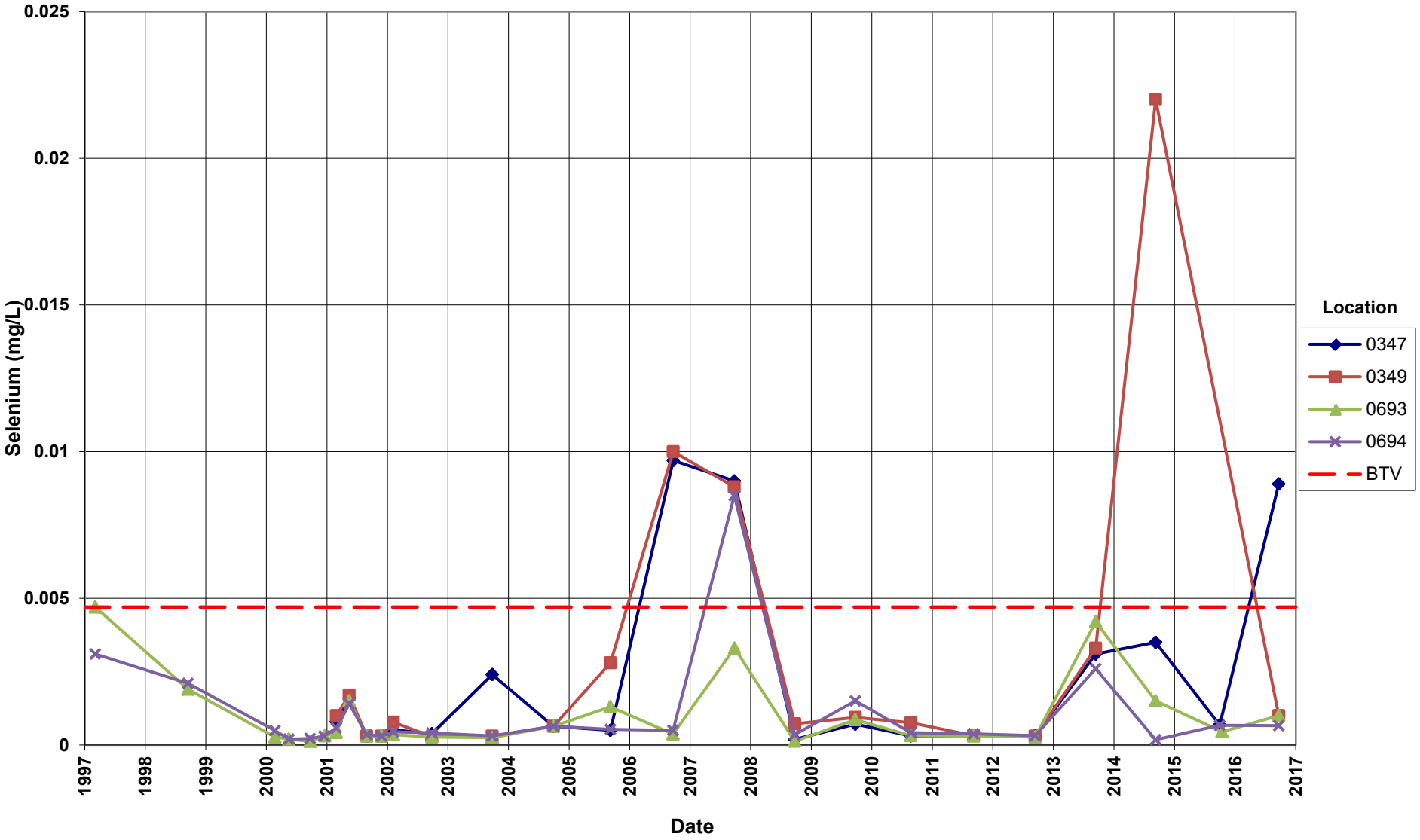
Slick Rock West Processing Site
Molybdenum Concentration
Background Treshold Value (BTV) = 0.008 mg/L



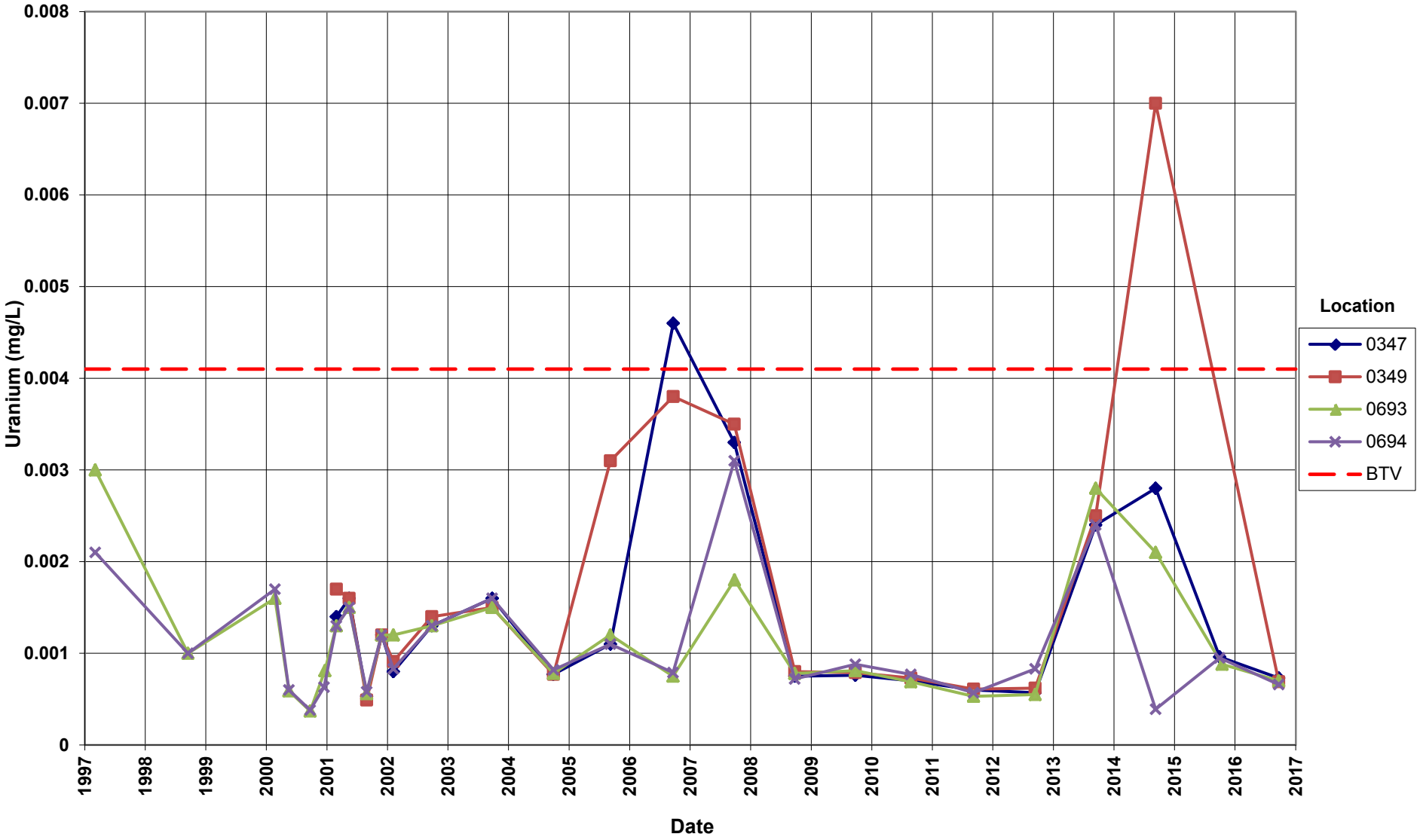
Slick Rock West Processing Site
Nitrate + Nitrite as Nitrogen Concentration
Background Threshold Value (BTV) = 0.47 mg/L



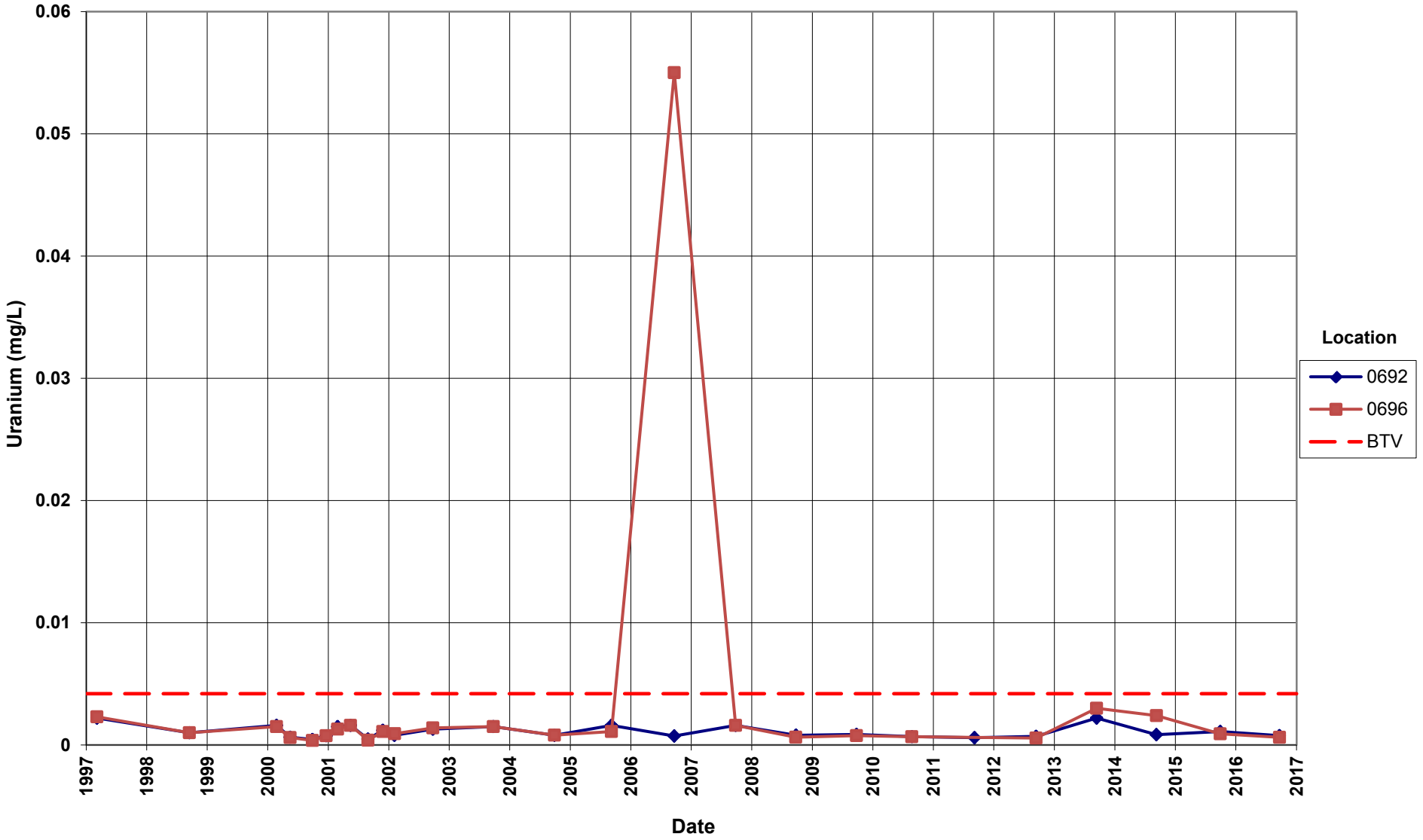
Slick Rock West Processing Site
Selenium Concentration
Background Threshold Value (BTV) = 0.0047 mg/L



Slick Rock West Processing Site
Uranium Concentration
Background Threshold Value (BTV) = 0.0041 mg/L



Slick Rock East Processing Site
Uranium Concentration
Background Threshold Value (BTV) = 0.0042 mg/L



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.

The nitrate + nitrite as N result for location 0318A was identified as a statistical outlier. The sample from location 0318A was selected for the MS/MSD analysis, it was also the field duplicate location. All sample, duplicate, and MS/MSD nitrate + nitrite as N results are consistent, confirming the reported result.

The selenium results for locations 0339, 0340, and 0508 were identified as statistical outliers. The selenium concentrations at these locations are trending upward. Review of these data did not identify any errors and the data from this event are acceptable as qualified.

Data Validation Outliers Report - No Field Parameters
Comparison: All historical Data Beginning 1/1/2006
Laboratory: ALS Laboratory Group
RIN: 16098018
Report Date: 12/9/2016

					Current			Historical Maximum			Historical Minimum			Number of Data Points		Statistical Outlier
						Qualifiers			Qualifiers			Qualifiers				
Site Code	Location Code	Sample ID	Sample Date	Analyte	Result	Lab	Data	Result	Lab	Data	Result	Lab	Data	N	N Below Detect	
SRK05	0317	N001	09/21/2016	Selenium	0.00250		F	0.00730		F	0.00520		F	6	0	Yes
SRK05	0318A	N001	09/21/2016	Nitrate + Nitrite as Nitrogen	110		F	66.0		F	24.0		F	7	0	Yes
SRK05	0318A	N001	09/21/2016	Selenium	5.30		F	4.70		F	2.20		F	7	0	No
SRK05	0320	N001	09/21/2016	Nitrate + Nitrite as Nitrogen	0.780		F	0.0860		F	0.01000	U	F	11	6	NA
SRK05	0320	N001	09/21/2016	Selenium	0.00130		F	0.0006	J	FJ	0.000042	B	F	11	2	No
SRK05	0339	N001	09/21/2016	Selenium	4.40		F	2.80		F	1.80		F	8	0	Yes
SRK05	0340	N001	09/21/2016	Selenium	4.50		F	2.90		F	1.80		F	7	0	Yes
SRK05	0508	N001	09/21/2016	Selenium	2.60		F	1.80		F	0.690		F	12	0	Yes

STATISTICAL TESTS:
The distribution of the data is tested for normality or lognormality using the Shapiro-Wilk Test
Outliers are identified using Dixon's Test when there are 25 or fewer data points.
Outliers are identified using Rosner's Test when there are 26 or more data points.
See Data Quality Assessment: Statistical Methods for Practitioners, EPA QC/G-9S, February 2006.

NA: Data are not normally or lognormally distributed.