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2016 Verification Monitoring Report for the Slick Rock, Colorado, Processing Sites

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2016 Verification Monitoring Report for the Slick Rock, Colorado, Processing Sites

The U.S. Department of Energy (DOE) has prepared a Verification Monitoring Report, documenting the evaluation of groundwater and surface water monitoring data generated from the 2016 annual sampling event at the Slick Rock, Colorado, Processing Sites. **At your request, you are receiving a hard copy of the report.**

The report is also available for your review on the DOE Office of Legacy Management (LM) website at <https://energy.gov/lm>. From the LM website home page, select the LM SITES. Then select Slick Rock, CO, Disposal/Processing Site from the LM SITE NAME list, and select Slick Rock Processing Sites on the Slick Rock Sites page. The report will be available on the Slick Rock Processing Site page under Site Documents and Links.



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Abbreviations

ACL	alternate concentration limit
BTEX	benzene, toluene, ethylbenzene, and xylenes
CCR	<i>Colorado Code of Regulations</i>
CDPHE	Colorado Department of Public Health and Environment
CFR	<i>Code of Federal Regulations</i>
COPC	constituent of potential concern
DOE	U.S. Department of Energy
ft	feet
GCAP	Groundwater Compliance Action Plan
K_d	soil-water distribution coefficient
LOESS	a nonparametric, locally weighted statistical regression method
MCL	maximum contaminant level (SDWA); maximum concentration limit (UMTRCA)
mg/L	milligrams per liter
NO_3	nitrate
NRC	U.S. Nuclear Regulatory Commission
pCi/L	picocuries per liter
^{226}Ra	radium-226
^{228}Ra	radium-228
SDWA	Safe Drinking Water Act
SOWP	Site Observational Work Plan
SRE	Slick Rock East
SRW	Slick Rock West
UMTRCA	Uranium Mill Tailings Radiation Control Act
VMR	Verification Monitoring Report

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Executive Summary

The Slick Rock, Colorado, Processing Sites consist of two former uranium-ore processing facilities, the Slick Rock East (SRE) site and the Slick Rock West (SRW) site. The sites, managed by the U.S. Department of Energy, are located along the Dolores River in San Miguel County. Surface remediation of the two sites was completed in 1996. This Verification Monitoring Report presents groundwater and surface water monitoring data collected during calendar year 2016 and evaluates the status of the proposed compliance strategy for groundwater cleanup at the two sites. The proposed compliance strategy for the Slick Rock sites is natural flushing combined with institutional controls and compliance monitoring, as documented in the *Draft Final Groundwater Compliance Action Plan for the Slick Rock, Colorado, UMTRA Project Sites* (GCAP) for the sites. The U.S. Nuclear Regulatory Commission (NRC) has not yet concurred on the GCAP because institutional controls have yet to be implemented by the State of Colorado.

Constituents of potential concern (COPCs) at the Slick Rock sites are, in order of general importance: uranium, selenium, molybdenum, nitrate, and manganese. Several other COPCs—benzene, toluene, ethylbenzene, and xylenes (collectively referred to as BTEX); radium-226 (^{226}Ra); and radium-228 (^{228}Ra)—are limited to a single SRW alluvial well (0319). Selenium and uranium are the only COPCs common to both the SRE and SRW sites. To assess the status of compliance, COPC concentrations are compared to either (1) maximum concentration limits (MCLs) established under the Uranium Mill Tailings Radiation Control Act (UMTRCA) or (2) alternative benchmark values (for constituents without UMTRCA MCLs), such as Safe Drinking Water Act (SDWA) maximum contaminant levels, maximum background concentrations, or alternate concentration limits proposed in the GCAP.

The monitoring network at the SRE site consists of eight monitoring wells and three surface water locations. Uranium and selenium are the only groundwater COPCs at this site. Uranium is monitored at all SRE wells, but selenium is monitored at only three wells: 0305 (the only location where it has been elevated), nearby well 0307, and background well 0300. Uranium concentrations are highest in the central portion of the site, just downgradient of the historical tailings boundary. No attenuation is apparent in these wells, as uranium levels have remained generally stable since 2000 at about 1 milligram per liter (mg/L) in wells 0303 and 0305, and at 0.5 mg/L in well 0307. Selenium concentrations in well 0305 have been stable at about 0.02 mg/L since 2006, below the 0.05 mg/L SDWA standard but slightly exceeding the 0.01 mg/L UMTRCA MCL. As was the case in 2013–2015 (previous three sampling events), well 0312 (north of the Dolores River) was dry in 2016 and could not be sampled.

Nine wells and four surface water locations are currently monitored at the SRW site. Relative to the SRE site, the contaminant suite at the SRW site is larger. In addition to uranium and selenium, COPCs at this site are molybdenum, nitrate, manganese, and (in the vicinity of well 0319 only) BTEX and radium ($^{226}\text{Ra} + ^{228}\text{Ra}$ combined). Groundwater concentrations of uranium, selenium, molybdenum, and nitrate remain elevated within the SRW site's historical tailings boundary. Uranium and nitrate levels have decreased in some wells, but molybdenum and selenium have remained fairly stable in alluvial wells since 2000—little to no attenuation is apparent. For example, in all SRW alluvial wells that have been monitored since 2000, selenium concentrations are greater than levels measured 16 years ago. In all wells, manganese levels are now comparable to or less than background.

In well 0319, only benzene remains elevated relative to the corresponding benchmark. In the last several years, benzene concentrations have averaged about 3 mg/L, exceeding the corresponding 0.005 mg/L SDWA standard. Remaining BTEX constituents are below corresponding SDWA standards. This is also true for $^{226}\text{Ra} + ^{228}\text{Ra}$ levels, which have been below the corresponding 5 picocuries per liter benchmark since 2008.

Since monitoring began in 2000, surface water sampling results have indicated minimal impact to the Dolores River from historical milling activities at the SRE and SRW sites. At most Dolores River monitoring locations, no State of Colorado water quality benchmarks were exceeded in 2016, consistent with historical results. An exception is the selenium concentration measured at SRW river location 0349 (0.0089 mg/L), which exceeds the corresponding chronic Colorado Department of Public Health and Environment benchmark for aquatic life (0.0046 mg/L). However, this result is below corresponding acute and agricultural standards (0.02 mg/L).

Although the 100-year time frame established in Title 40 *Code of Federal Regulations* Part 192 does not commence until NRC approves the GCAP, data collected to date indicate that most site constituents—in particular molybdenum and selenium—are not attenuating as initially predicted based on groundwater modeling conducted in 2000–2001.

1.0 Introduction

The Slick Rock, Colorado, Processing Sites consist of two former uranium-ore processing facilities, referred to as the Slick Rock East (SRE) site (formerly the North Continent site) and, approximately 1 mile downstream from SRE, the Slick Rock West (SRW) site (formerly the Union Carbide site). The processing sites, owned by Umetco Minerals Corporation but managed by the U.S. Department of Energy (DOE), are located along the Dolores River in San Miguel County (Figure 1 and Figure 2). Surface remediation of the two sites was completed in 1996.

1.1 Purpose

The purpose of this Verification Monitoring Report (VMR) is to evaluate groundwater and surface water monitoring data collected at the Slick Rock processing sites since 2000 and to assess the status of the natural flushing compliance strategy for groundwater cleanup. VMRs have been issued annually for the Slick Rock processing sites since 2005.

1.2 Compliance Strategy

The proposed compliance strategy for the Slick Rock sites is natural flushing combined with institutional controls and compliance monitoring, as stated in the *Draft Final Groundwater Compliance Action Plan for the Slick Rock, Colorado, UMTRA Project Sites* (GCAP) (DOE 2006). The GCAP states that public health will be protected during the natural flushing process through institutional controls, which will restrict access to contaminated groundwater in the Dolores River alluvium. The institutional controls to be used for the Slick Rock sites are environmental covenants between the State of Colorado, represented by the Colorado Department of Public Health and Environment (CDPHE), and the landowner, Umetco Minerals Corporation. The environmental covenants are still pending for the Slick Rock sites while Umetco and CDPHE resolve mineral ownership issues. The U.S. Nuclear Regulatory Commission (NRC) will not concur with the GCAP until institutional controls are established.

Constituents of potential concern (COPCs) at the Slick Rock sites are manganese, molybdenum, nitrate, selenium, and uranium (Table 1). Several other COPCs—benzene, toluene, ethylbenzene, and xylenes (collectively referred to as BTEX); radium-226 (^{226}Ra); and radium-228 (^{228}Ra)—are limited to a single SRW alluvial well (0319). Selenium and uranium are the only COPCs common to both the SRE and SRW sites.

To assess the status of compliance, COPC concentrations are compared to the benchmark values listed in Table 1. Groundwater benchmarks for molybdenum, nitrate, ^{226}Ra , ^{228}Ra , selenium (at SRE only), and uranium are the maximum concentration limits (MCLs) established under the Uranium Mill Tailings Radiation Control Act (UMTRCA) and codified in Title 40 *Code of Federal Regulations* Part 192 (40 CFR 192). At SRW, benchmarks for BTEX are maximum contaminant levels (also abbreviated as MCLs) established under the U.S. Environmental Protection Agency Safe Drinking Water Act (SDWA). The benchmark for manganese is the maximum background (upgradient) concentration measured at the site. Groundwater modeling conducted for the Site Observational Work Plan (SOWP) (DOE 2002) predicted that, based on a natural flushing remedy, concentrations of all COPCs would decrease to values below UMTRCA MCLs (except for selenium in SRW wells) within the 100-year regulatory time frame established in 40 CFR 192.

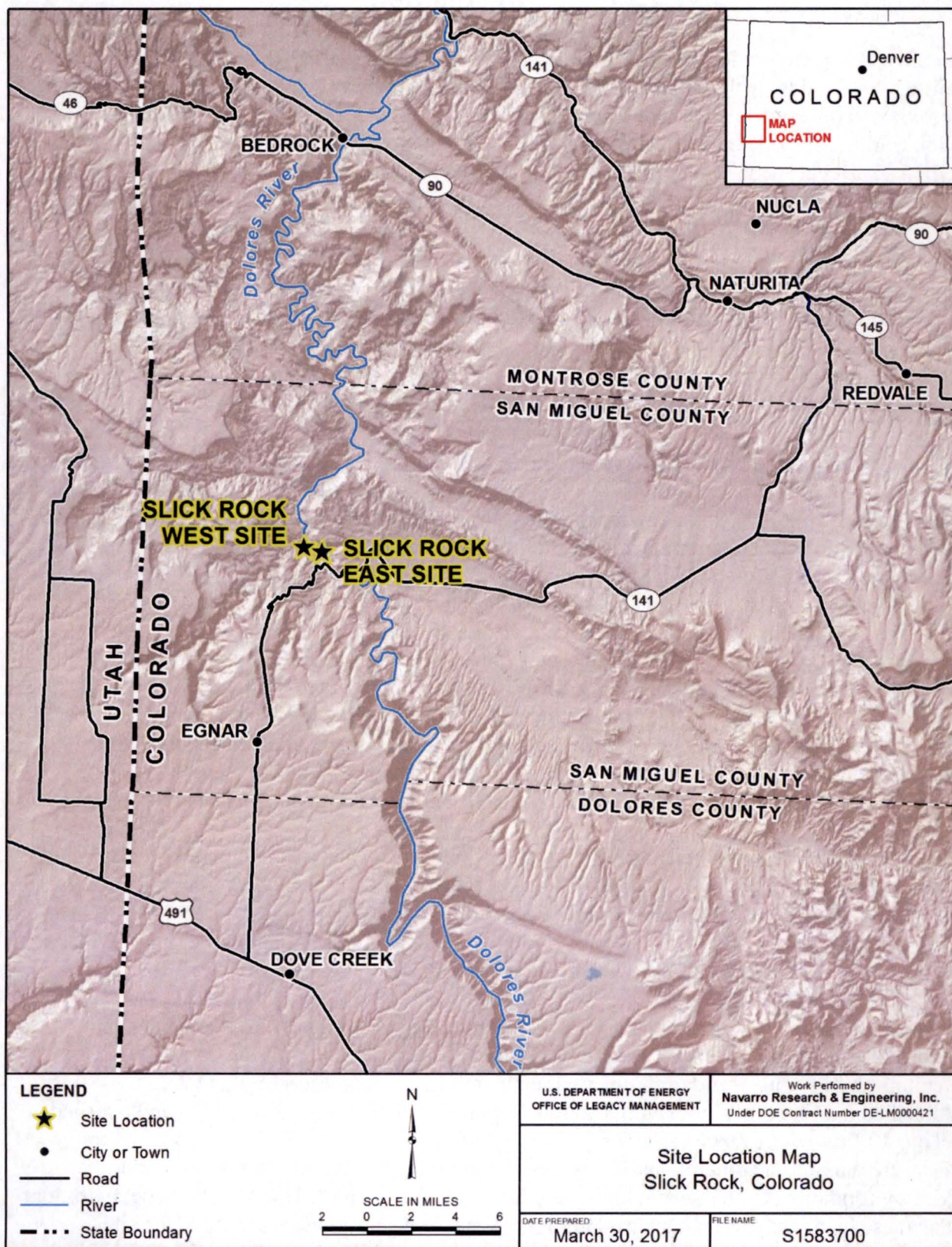


Figure 1. Slick Rock, Colorado, Processing Sites Location Map

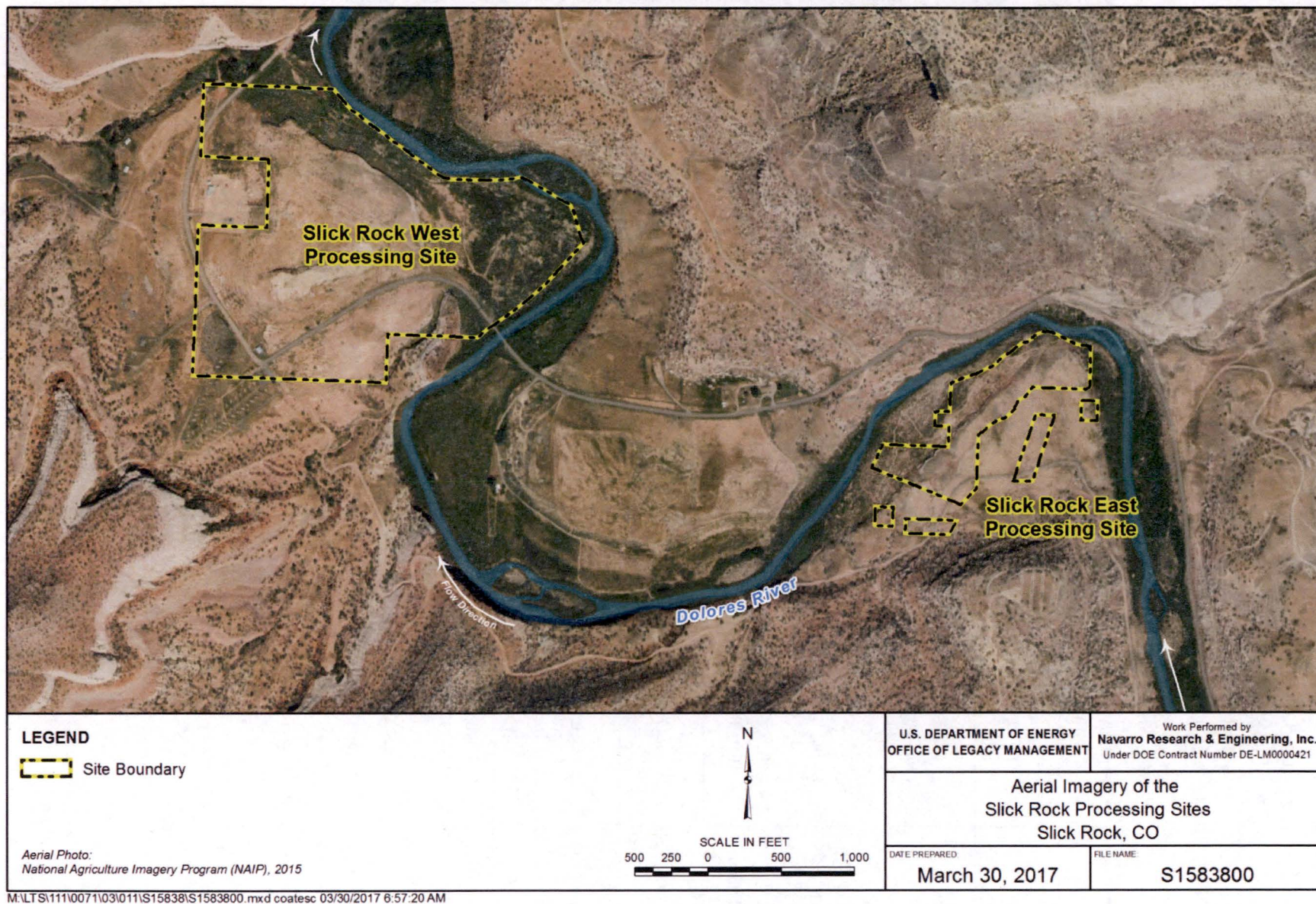


Figure 2. Aerial Photograph of the Slick Rock Processing Sites

Because selenium concentrations at SRW were not expected to decrease to levels below the 0.01 mg/L UMRCA MCL within 100 years, an alternate concentration limit (ACL) based on risks to human health of 0.18 mg/L was proposed for the SRW site in the draft GCAP (DOE 2006). After the State of Colorado implements institutional controls, DOE will reevaluate proposed ACLs using the 10 years of additional (2007–2017) water monitoring data collected since the draft GCAP was issued.

Table 1. Groundwater Benchmarks for COPCs at the SRE and SRW Sites

COPC ^a	Benchmark	Basis for Benchmark	Applicable Site	Applicable Wells ^b	Comment
Uranium	0.044 mg/L	UMTRCA MCL	SRE, SRW	All wells except SRW wells 0317 and 0319	The 0.044 mg/L standard is equivalent to the uranium standard of 30 pCi/L in 40 CFR 192.
Selenium	SRE: 0.01 mg/L SRW: 0.18 mg/L ^c	SRE: UMTRCA MCL SRW: Proposed ACL (DOE 2002)	SRE, SRW	SRE wells 0305 and 0307 and all SRW wells	The UMRCA MCL is less than the 0.05 mg/L SDWA MCL.
Manganese	3.5 mg/L ^d	Maximum background (as of March 2001)	SRW	All SRW wells except 0317 and 0319	Since 2001 (when the benchmark was established), manganese levels in background well 0300 have twice exceeded 3.5 mg/L. ^d
Molybdenum	0.10 mg/L	UMTRCA MCL	SRW	All SRW wells except 0319	Benchmark exceeded in six of the eight SRW wells currently monitored.
Nitrate as NO ₃	44.3 mg/L	UMTRCA MCL (NO ₃ equivalent)	SRW	All SRW wells except 0317 and 0319	The 44.3 mg/L standard is equivalent to the nitrate as nitrogen standard of 10 mg/L in 40 CFR 192.
²²⁶ Ra + ²²⁸ Ra	5 pCi/L	UMTRCA MCL	SRW	SRW well 0319	Analysis for radium in other SRW wells was discontinued after 2001 because values were below 5 pCi/L.
Benzene	0.005 mg/L	SDWA MCL	SRW	SRW well 0319	Most recent (2016) result in well 0319 was 3.2 mg/L.
Toluene	1 mg/L	SDWA MCL	SRW	SRW well 0319	Most recent result in well 0319 (0.7 mg/L) is below the MCL.
Ethylbenzene	0.7 mg/L	SDWA MCL	SRW	SRW well 0319	The 0.7 mg/L benchmark has never been exceeded in well 0319.
Xylenes	10 mg/L	SDWA MCL	SRW	SRW well 0319	The 10 mg/L benchmark has never been exceeded in well 0319.

Notes:

^a Constituents are listed in order of prevalence at the Slick Rock sites. For example, uranium is most prevalent at both sites, whereas radium (²²⁶Ra + ²²⁸Ra) is limited to the immediate vicinity of SRW well 0319.

^b Applicable wells are only those currently monitored. For historical results, refer to the SOWP (DOE 2002) and previous Verification Monitoring Reports.

^c The proposed ACL for selenium, 0.18 mg/L, was established in the SOWP (DOE 2002).

^d Manganese levels in upgradient background well 0300 have fluctuated, and on two occasions have exceeded the 3.5 mg/L benchmark established in the site Environmental Assessment (DOE 2003): 4.2 mg/L in August 2001 and 4.5 mg/L in September 2015. This variation should be acknowledged when comparing monitoring well results to the initial (3.5 mg/L) benchmark.

Abbreviations:

mg/L = milligrams per liter

pCi/L = picocuries per liter

2.0 Site Conditions

2.1 Hydrogeology

The hydrostratigraphic units at the Slick Rock sites are, in descending stratigraphic order, the Dolores River alluvium (Quaternary Period), the Salt Wash Member of the Morrison Formation, the Summerville Formation, the Entrada Sandstone, and the Navajo Sandstone (all Jurassic Period).

The Dolores River alluvium is the uppermost aquifer and is the only unit known to be affected by site-related contamination. The alluvial aquifer is unconfined and consists of unconsolidated material, primarily silty sands and silty sandy gravels with an occasional interbedded clay lens. The alluvium ranges from 15 to 20 feet (ft) in thickness and is laterally restricted by bedrock that forms the walls of the Dolores River canyon. In addition, the Dolores River floodplain is discontinuous and pinches out in areas where the river meets the canyon wall. Depth to groundwater in the alluvial aquifer ranges from 7 to 15 ft below ground surface. Groundwater flow generally follows the downstream direction of the Dolores River, which is the main source of recharge for the alluvial aquifer.

At the SRE site, the Salt Wash Member of the Morrison Formation and the Summerville Formation underlie the Dolores River alluvium. Because these formations in the site area consist of fine-grained, low-permeability material, they are considered aquitards that prevent contaminated groundwater in the alluvial aquifer from moving downward into deeper aquifers (DOE 2002).

At the SRW site, Entrada Sandstone underlies the Dolores River alluvium. This formation ranges from 40 to 60 ft in thickness in the floodplain area (DOE 2002). The Entrada aquifer is unconfined near the top of the unit (in contact with the alluvial aquifer), and it may be semi-confined near the bottom (in partial contact with the underlying Navajo aquifer). In wells completed in the Navajo Sandstone, groundwater has an upward vertical gradient with respect to water in the overlying Entrada, signifying that the Navajo aquifer discharges upward. The Entrada aquifer receives recharge from upgradient infiltration of precipitation, creating artesian pressure. Entrada groundwater has a slight upward vertical gradient with respect to water in the overlying alluvial aquifer, and hydraulic conductivity in the alluvial aquifer is two orders of magnitude greater than that of the Entrada. These conditions inhibit groundwater from flowing downward from the alluvial aquifer into underlying aquifers.

2.2 Groundwater Quality

2.2.1 SRE Site

Groundwater in the alluvium beneath the SRE site was contaminated as a result of former uranium-ore processing activities. Contamination is limited to the alluvial aquifer at the SRE site (Section 2.1) and COPCs are uranium and selenium (DOE 2002). Since 2000, when site monitoring began, uranium concentrations in wells 0303 and 0305 (wells with the highest concentrations) have averaged approximately 1 mg/L, exceeding the UMTRCA MCL of 0.044 mg/L.

Selenium has been elevated in only one well at the SRE site, well 0305 (historical range of 0.014–0.05 mg/L). Since 2006, selenium levels in this well have been fairly stable at about 0.02 mg/L, two times the UMTRCA groundwater standard of 0.01 mg/L, yet below the SDWA primary drinking water standard of 0.05 mg/L.

2.2.2 SRW Site

Former uranium-ore processing activities also contaminated the groundwater beneath the SRW site. COPCs in the alluvial aquifer at the SRW site are manganese, molybdenum, nitrate, selenium, uranium, radium ($^{226}\text{Ra} + ^{228}\text{Ra}$ combined), and BTEX. Contamination in the alluvial aquifer is contained within the site boundary, while radium and BTEX contamination is isolated to the region of one well (0319). The primary COPCs in the alluvial aquifer are molybdenum, nitrate, selenium, and uranium (refer to Section 4.0 for contaminant distributions and trends).

2.3 Surface Water Quality

The Dolores River is the only perennial surface water feature in the vicinity of the Slick Rock sites. Results from surface water sampling have demonstrated minimal impact to the Dolores River from site contamination.¹

2.4 Remediation Activities

Surface remediation at the Slick Rock sites began in 1995 and was completed in 1996. As part of the remediation process, uranium mill tailings and other residual radioactive materials associated with the former milling operations were relocated to the Slick Rock disposal cell (formerly called the Burro Canyon disposal cell), approximately 5 miles east of the Slick Rock processing sites. The sites were regraded with onsite material, and subsequent revegetation efforts have been successful.

2.5 Land and Water Use

Umetco Minerals Corporation currently owns the SRE and SRW sites. The SRE site is used for livestock grazing (it is not fenced). The majority of the SRW site is enclosed with a barbed-wire fence. Land between the two sites is privately owned; land use includes alfalfa production (fields irrigated with water pumped from the Dolores River), livestock grazing, and gravel-mining operations. There is no current use of alluvial groundwater beneath the former processing sites. There are also no known uses of groundwater from the Entrada Sandstone in the area near the SRE and SRW sites. Groundwater for domestic or agricultural use in the Slick Rock area is primarily supplied by groundwater from the Navajo Sandstone. Historically, wells completed in the Navajo Sandstone provided water for the milling operations and for the mill community at the SRW site.

¹ This stream segment of the Lower Dolores River Basin (Segment 2 or COGULD02) has the following use classifications: Agriculture, Aquatic Life Warm 1, Recreation E, and Water Supply. The classifications with the most restrictive water quality standards apply, in accordance with Volume 5 *Colorado Code of Regulations* Regulation 1002-35 (5 CCR 1002-35) (CDPHE 2016).

3.0 Monitoring Program

According to the draft GCAP, monitoring at the Slick Rock processing sites is to be performed annually for the first 10 years following NRC concurrence with the compliance strategy (DOE 2006). To date, NRC has not concurred with the GCAP because institutional controls have yet to be implemented by the State of Colorado. Despite the lack of concurrence by NRC, annual monitoring has been performed at the site since 2003. There was also sampling in 2000–2001 during site characterization efforts conducted in support of the SOWP. This section describes the monitoring programs for the SRE and SRW sites.

3.1 SRE Site

At the SRE site, the current monitoring network consists of eight monitoring wells and three surface water locations, shown in Figure 3. Table 2 lists each of these locations and describes the monitoring rationale and analytes measured.

Table 2. Monitoring Program at the SRE Site

ID	Matrix	Location ^a	Rationale/Comment	Analytes
0300	Groundwater	Upgradient	Upgradient (background) monitoring location for both SRE and SRW sites	Manganese, molybdenum, nitrate, selenium, and uranium
0303	Groundwater	Onsite	SRE uranium plume area	Uranium
0305	Groundwater	Onsite	SRE uranium plume area; selenium also above the UMTRCA MCL	Selenium and uranium
0307	Groundwater	Onsite	Uranium plume area; monitor selenium downgradient of well 0305	Selenium and uranium
0309	Groundwater	Onsite	Farthest downgradient well onsite	Uranium
0310	Groundwater	Offsite (across the Dolores River) ^b	Monitor migration of uranium between the SRE and SRW sites	Uranium
0311	Groundwater	Offsite (across river) ^b	Monitor migration of uranium between the SRE and SRW sites	Uranium
0312	Groundwater	Offsite (across the Dolores River) ^b	This well has not been sampled since September 2012 because it has been dry	Uranium
0696	Surface water	Upstream	Surface water background (inlet area)	Uranium
0692	Surface water	Adjacent to site	Location where the centroid of the uranium plume was predicted to intersect the river	Uranium
0700	Surface water	Downstream	Location established in 2005; located about 100 ft southwest of well 0309	Uranium

Notes:

^a The sampling locations in this table are listed first in order of matrix, and then by general flow direction (upgradient or upstream locations are listed first). Samples are to be collected annually as specified in the GCAP (DOE 2002).

^b Early characterization and modeling conducted for the SOWP indicated that a paleochannel might exist that connects the aquifer on each side of the Dolores River (DOE 2002). Therefore, wells 0310, 0311, and 0312 were installed in August 2000 to assess potential uranium migration offsite. Given the doubling of uranium concentrations in well 0311 between 2001 and 2004 (from 0.04 to 0.08 mg/L), sampling at wells 0310 and 0312 resumed in 2005 after a 4-year hiatus.

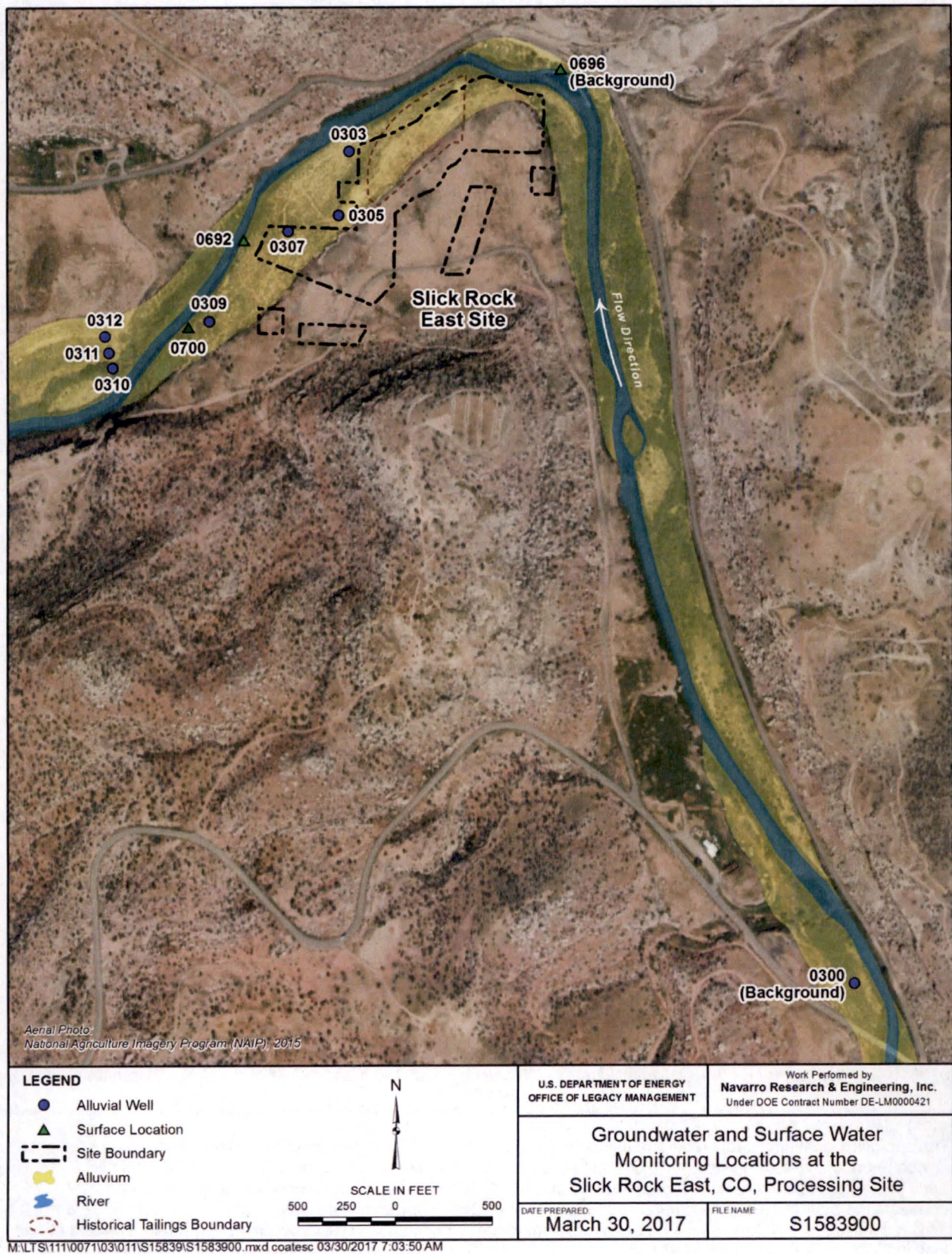


Figure 3. Groundwater and Surface Water Monitoring Locations at the SRE Site

3.2 SRW Site

At the SRW site, the monitoring network consists of nine monitoring wells and four surface water locations, shown in Figure 4. Table 3 lists each of these locations and describes the corresponding monitoring rationale and analytes measured.

Table 3. Monitoring Program at the SRW Site

ID	Matrix	Location ^a	Rationale	Analytes
0317	Groundwater	Onsite	Entrada Sandstone well—molybdenum exceeds UMTRCA MCL.	Molybdenum and selenium ^b
0318, 0318A	Groundwater	Onsite	Area of highest measured concentrations for several COPCs. Due to a broken well screen, well 0318 was abandoned and replaced with well 0318A in September 2010.	Manganese, molybdenum, nitrate, selenium, and uranium
0339	Groundwater	Onsite	Installed in September 2010 to better characterize the extent of elevated selenium in the eastern area of the former tailings pile.	Manganese, molybdenum, nitrate, selenium, and uranium
0340	Groundwater	Onsite	Installed in September 2010 (same rationale as for well 0339 above).	Manganese, molybdenum, nitrate, selenium, and uranium
0508	Groundwater	Onsite	High selenium, nitrate, molybdenum, and uranium.	Manganese, molybdenum, nitrate, selenium, and uranium
0510	Groundwater	Onsite	Edge of former tailings pile, high COPC concentrations.	Manganese, molybdenum, nitrate, selenium, and uranium
0319	Groundwater	Onsite	Hot spot for BTEX and radium.	BTEX, ²²⁶ Ra, ²²⁸ Ra, and selenium ^b
0320	Groundwater	Onsite	Farthest downgradient well onsite; monitor plume movement.	Manganese, molybdenum, nitrate, selenium, and uranium
0684	Groundwater	Offsite	Farthest downgradient well; purpose is to verify that contaminants are not migrating offsite.	Manganese, molybdenum, nitrate, selenium, and uranium
0693	Surface water	Upstream	Upstream SRW surface water location (but downstream of SRE).	Manganese, molybdenum, nitrate, selenium, and uranium
0347	Surface water	Adjacent to site	Predicted location where the centroid of the selenium plume intersects the river; potential point of exposure for selenium (DOE 2006).	Manganese, molybdenum, nitrate, selenium, and uranium
0349	Surface water	Adjacent to site	Predicted location where the centroids of contaminant plumes intersect the river. Potential point of exposure.	Manganese, molybdenum, nitrate, selenium, and uranium
0694	Surface water	Downstream	Potential for contaminant plumes to discharge to the river at this location.	Manganese, molybdenum, nitrate, selenium, and uranium

Notes:

^a The sampling locations in this table are listed first in order of matrix, and then by general flow direction (upgradient or upstream are listed first). Samples are to be collected annually as specified in the GCAP (DOE 2002).

^b In Entrada well 0317 and alluvial well 0319, monitoring for selenium resumed in 2010 after an 8-year hiatus.

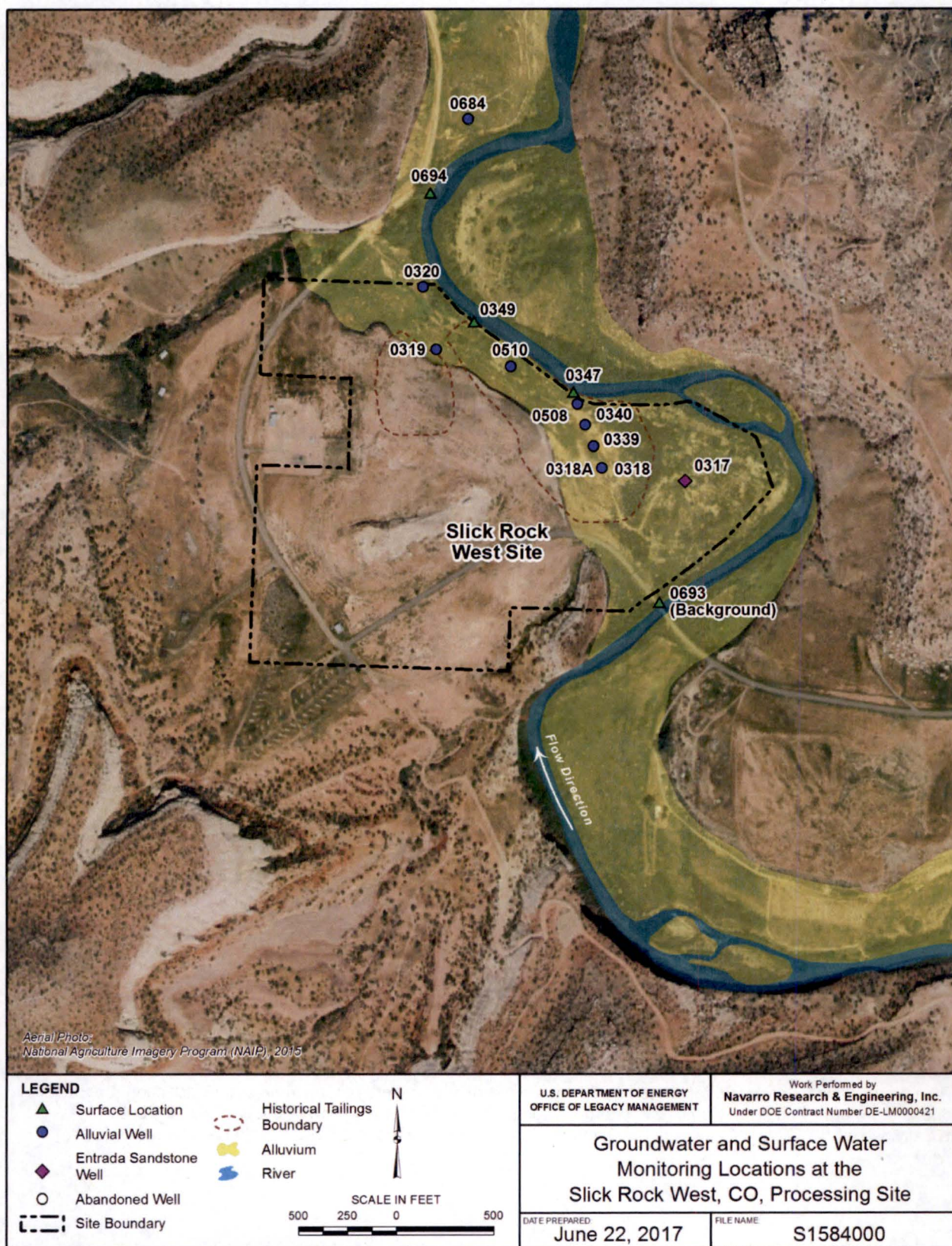


Figure 4. Groundwater and Surface Water Monitoring Locations at the SRW Site

4.0 Results of 2016 Monitoring

This section documents the results of groundwater and surface water monitoring conducted in 2016 for the SRE and SRW sites. Detailed analytical results for groundwater and surface water are provided in Appendixes A and B, respectively. Appendix C includes supporting static water level data and hydrographs. Additional information, including a data quality assessment and time-concentration graphs for all analytes and monitoring locations, is provided in the corresponding Data Validation Package (DOE 2017).

4.1 SRE Site Groundwater Monitoring Results

Apart from field parameters, uranium and selenium are the only constituents currently monitored at SRE, as levels of other constituents have been below respective benchmarks. Background well 0300 is an exception (other analytes are monitored) as this well also serves as the background location for SRW. While uranium is monitored at all SRE well locations, selenium is monitored at three wells (0300, 0305, and 0307). Recent and historical trends observed for each of these constituents are discussed below.

4.1.1 SRE Uranium

Figure 5 shows the historical distribution of uranium in currently active SRE wells, ordered from left to right by direction of groundwater flow (upgradient to downgradient). Graduated symbol plots of the distribution of uranium concentrations based on 2016 analytical results are shown in Figure 6. As has been the case historically, uranium concentrations are highest in SRE wells 0303, 0305, and 0307, located in the central portion of the SRE site just downgradient of the historical tailings boundary. Uranium concentrations in these wells and in well 0309 have also been the most variable. Time-concentration plots of uranium in SRE wells are shown in Figure 7.

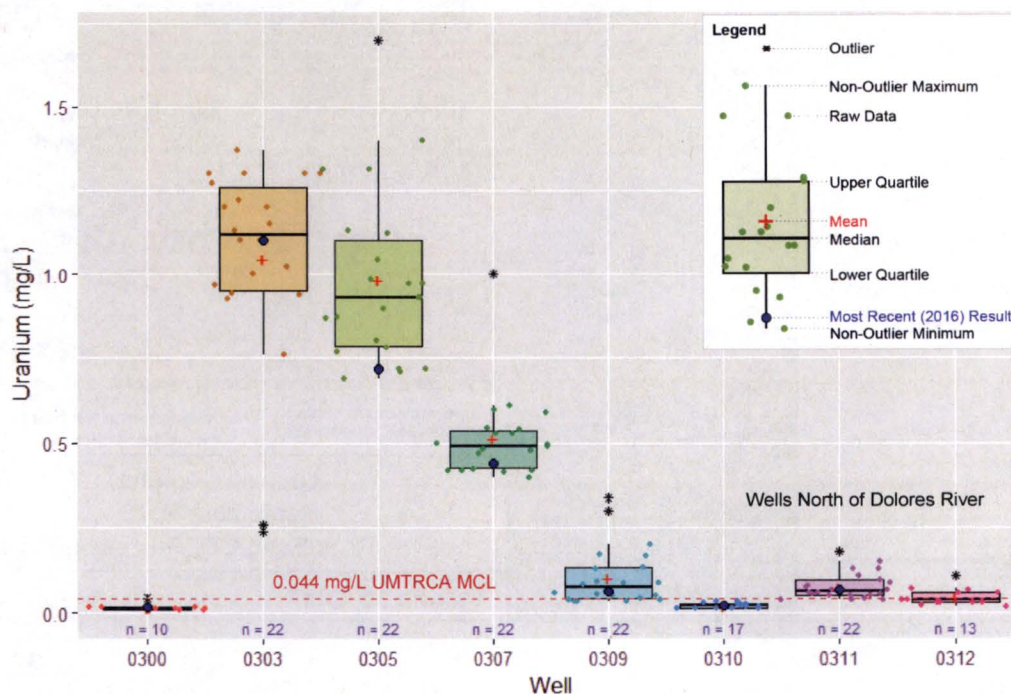


Figure 5. Uranium Distribution in SRE Wells

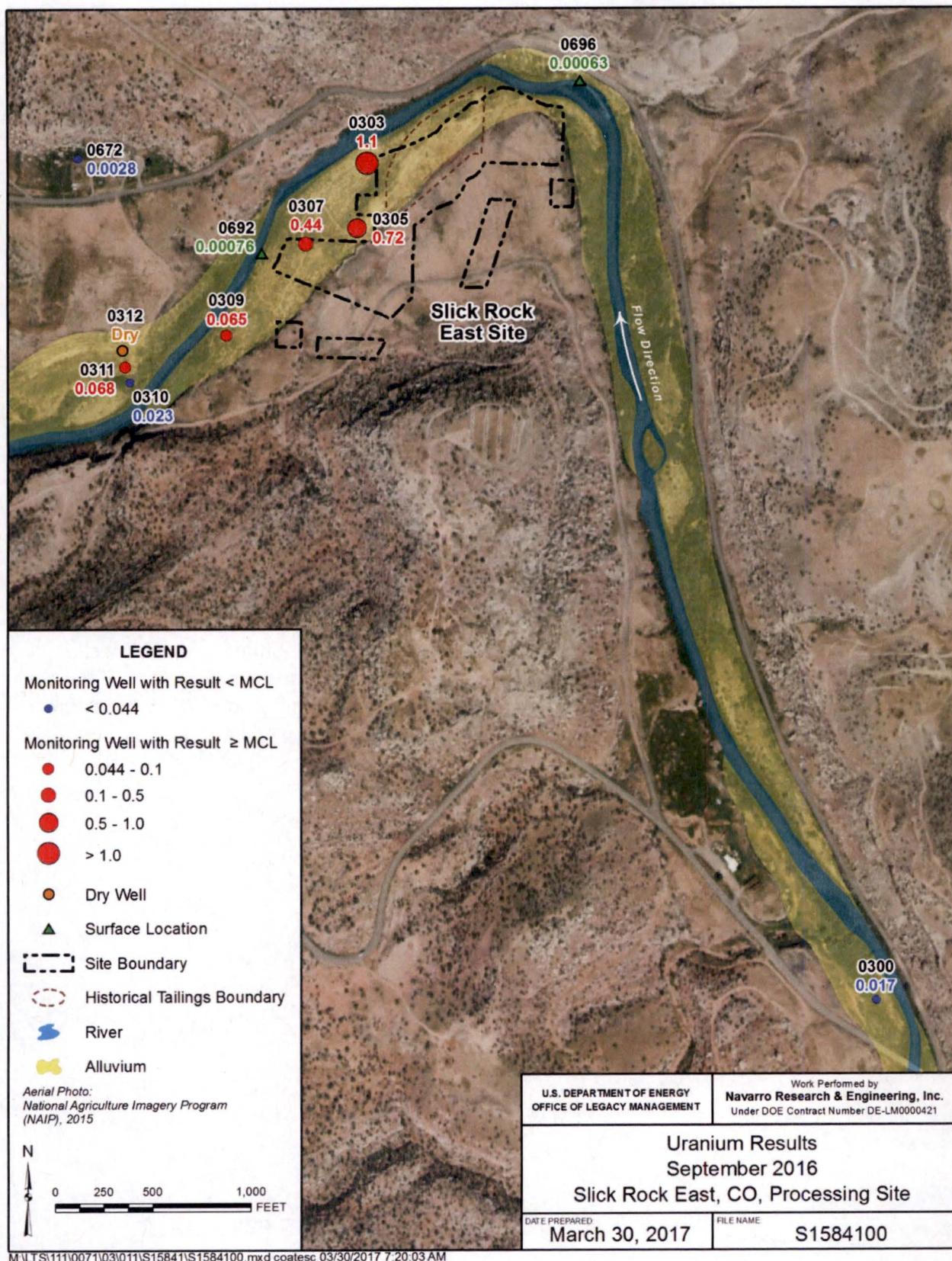
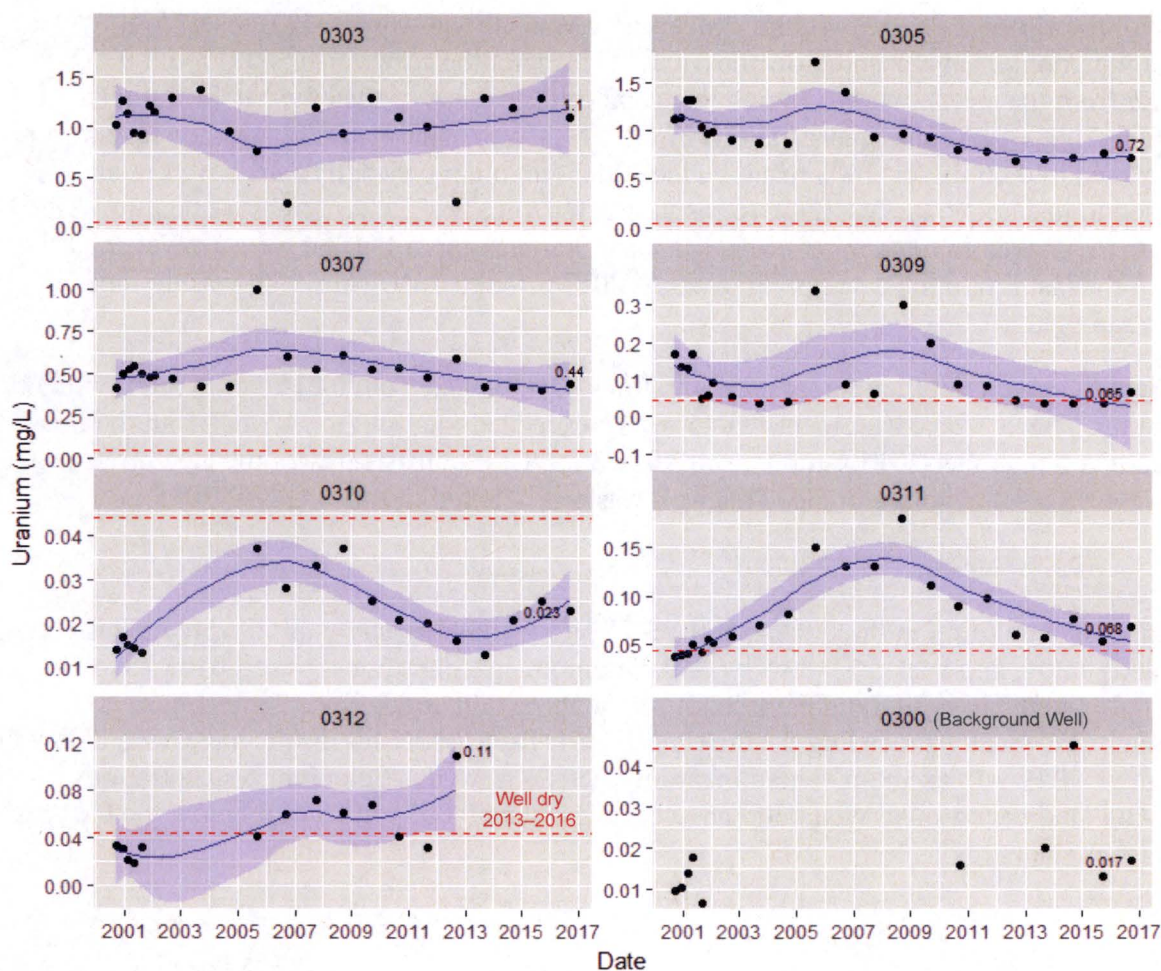


Figure 6. Uranium Distribution at SRE Monitoring Locations, September 2016



Notes:

— Blue line is LOESS local regression line; shaded area is the corresponding 95% pointwise confidence interval. The LOESS smoothing line is omitted from the plot for background location 0300 because of the gap in sampling between 2001 and 2010. The most recent results are labeled.
 --- Denotes the 0.044 mg/L UMTRCA MCL.

Figure 7. Uranium Concentrations in SRE Wells, 2000–Present

In Figure 7, the data are partitioned such that the y-axis is unique to each well. For those wells with sufficient data, a non-parametric smoothing method or locally weighted regression—“LOESS” (not to be confused with the geologic term)—is used. With this smoothing approach, overall trends in the data are more apparent and not obscured by “noise,” as is the case in some traditional time-concentration plots.²

Uranium concentrations continue to be elevated in central-plume-area wells 0303, 0305, and 0307, just downgradient of the historical tailings boundary (Figure 6, Figure 7). Apart from low (outlier) measurements in 2006 and 2012, uranium concentrations in SRE well 0303 have been relatively stable at about 1 mg/L. Uranium concentrations in well 0305 have ranged from 0.7 to 0.8 mg/L since 2010, while levels in well 0307 have been stable at about 0.5 mg/L since 2000. Farther downgradient at well 0309, uranium concentrations have ranged from 0.04 mg/L, just below the MCL, to 0.065 mg/L (most recent) since 2012.

² Figure 7 and subsequent similar “facet” plot figures were developed using R Version 3.3.3 (R Core Team 2017) and the ggplot2 package, Version 2.2.1 (Wickham 2016).

North of the Dolores River, uranium concentrations in alluvial well 0310 (closest to the river), although variable, have been below the MCL. This is not the case in wells 0311 and 0312 (farther from the river), where uranium concentrations have exceeded the MCL. Initially (in 2000–2001), uranium concentrations in well 0311 were <0.044 mg/L, but then levels more than tripled to 0.15 mg/L (2005 result). Since 2005, uranium concentrations have gradually declined to just above the MCL (2016 result was 0.07 mg/L). The last measurement in well 0312 (0.11 mg/L), taken in September 2012, is a historical maximum for that well. However, at the time of the last four annual sampling events—2013 through 2016—the well was dry and could not be sampled.

At upgradient well 0300, uranium concentrations have ranged from 0.01 to 0.02 mg/L with one exception. The 2014 measurement (0.045 mg/L) exceeded the UMTRCA MCL, but the subsequent September 2015 sample result (0.013 mg/L) is consistent with the general (0.01–0.02 mg/L) historical trend. This well was redeveloped in early August 2015.

4.1.2 SRE Selenium

Selenium is monitored in three wells at the SRE site: 0305 (the only well in which it has been elevated), 0307, and background well 0300. Selenium concentrations in well 0305 have ranged from 0.014 to 0.046 mg/L, and have stabilized at about 0.02 mg/L since 2006 (Figure 8). Although historically exceeding the 0.01 mg/L UMTRCA MCL, all results have been below the 0.05 mg/L SDWA maximum contaminant level (SDWA MCL). Selenium concentrations in well 0307 and background well 0300 have been less than 0.005 mg/L, well below the 0.01 mg/L UMTRCA standard.

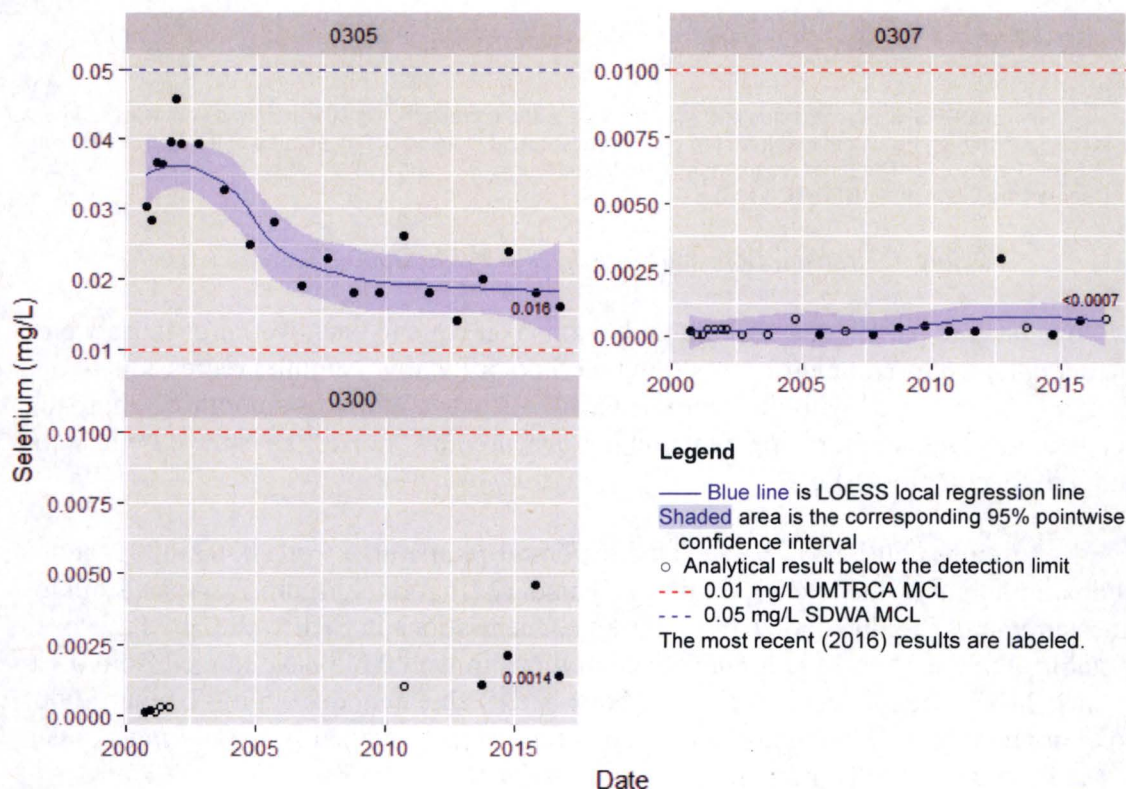


Figure 8. Selenium Concentrations over Time in SRE Wells 0300, 0305, and 0307

4.2 SRW Site Groundwater Monitoring Results

The two COPCs common to both Slick Rock sites are uranium and selenium. Other constituents monitored at the SRW site include manganese, molybdenum, and nitrate. BTEX, ^{226}Ra , and ^{228}Ra are monitored at a single SRW well, 0319, as this is the only location where these constituents have been elevated.

4.2.1 SRW Uranium

Uranium concentrations have consistently exceeded the 0.044 mg/L UMTRCA MCL in only two SRW wells—wells 0508 and 0510 (Figure 9). Since 2006, uranium concentrations in well 0508 have decreased to levels slightly exceeding the MCL (2016 result was 0.07 mg/L). To the north, in well 0510, uranium levels remain generally stable at about 0.1 mg/L. In well 0318|0318A, uranium concentrations have remained at about 0.03 mg/L (below the MCL) for the last 10–11 years. Levels in nearby wells 0339 and 0340 are similar (0.03–0.04 mg/L in 2016). Uranium concentrations in remaining wells 0320 and 0684 have been consistently below the MCL (0.01–0.02 mg/L). Figure 10 plots the most recent (September 2016) uranium results for all SRW wells along with Dolores River surface water monitoring results (discussed in Section 4.3).

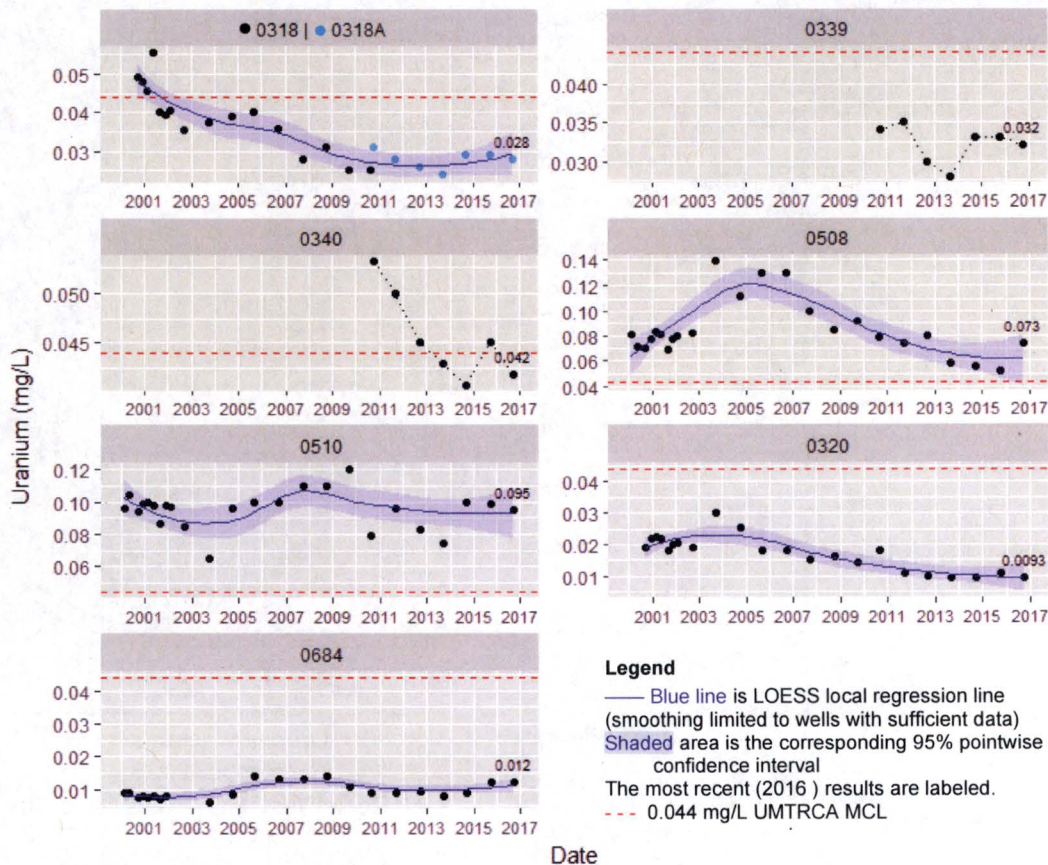


Figure 9. Uranium Concentrations over Time in SRW Monitoring Wells

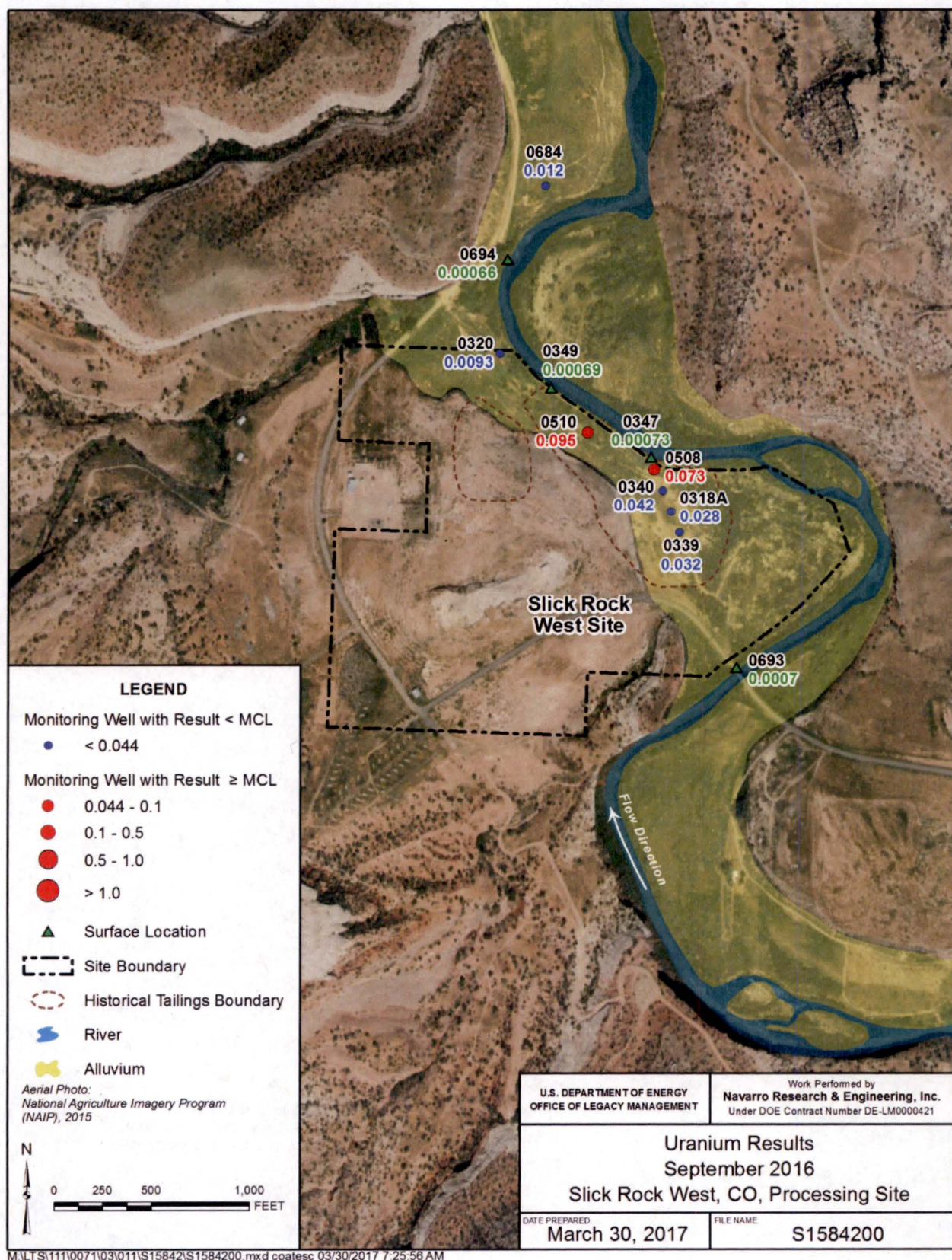
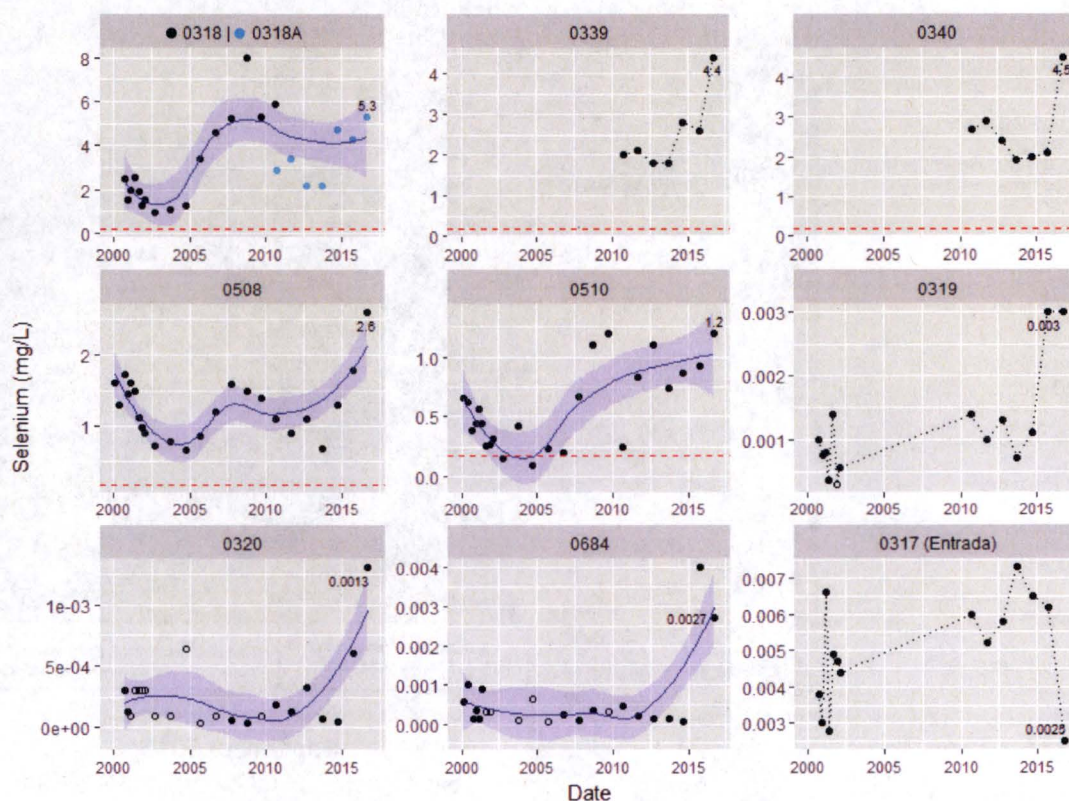


Figure 10. Uranium Distribution at the SRW Site, September 2016

4.2.2 SRW Selenium

Figure 11 plots selenium concentrations over time in all SRW wells. Figure 12 maps the most recent (September 2016) monitoring results for both groundwater and surface water samples. Selenium has been historically elevated in SRW alluvial wells within the easternmost former tailings area: wells 0318|0318A (where the highest levels have been measured), 0508, 0510, and recently installed wells 0339 and 0340. For the first few years following the installation of replacement well 0318A in 2010, selenium levels in that well declined somewhat, to 2–3 mg/L. In the last few years, selenium levels in well 0318A have rebounded to about 5 mg/L, similar to recent concentrations in adjacent wells 0339 and 0340 (4.4–4.5 mg/L).

Selenium levels in wells 0508 and 0510 have increased in the last several years to historical maximum concentrations in 2016 (2.6 and 1.2 mg/L, respectively). Although increases are also apparent in wells 0319, 0320, and 0684, selenium concentrations in these wells have always been below the 0.01 mg/L UMTRCA MCL. In 2010, to verify the extent of the selenium plume, DOE resumed monitoring for selenium at alluvial well 0319 (previously sampled only for BTEX and radium) and Entrada well 0317. As shown in Figure 11 below, selenium levels in both levels are low (0.003 mg/L). For all SRW alluvial wells with a >10-year monitoring history, selenium concentrations measured in 2016 are higher (although in some cases just slightly), than those measured in 2000, the start of the monitoring period.



Notes:

— Blue line is LOESS local regression line (omitted for wells with limited data or large gaps in sampling);
 shaded area is the corresponding 95% pointwise confidence interval; --- 0.18 mg/L ACL for SRW site (not shown for wells with historical results below 0.01 mg/L); ○ is analytical result below the detection limit.
 The most recent (2016) results are labeled to facilitate review.

Figure 11. Selenium Concentrations over Time in SRW Wells

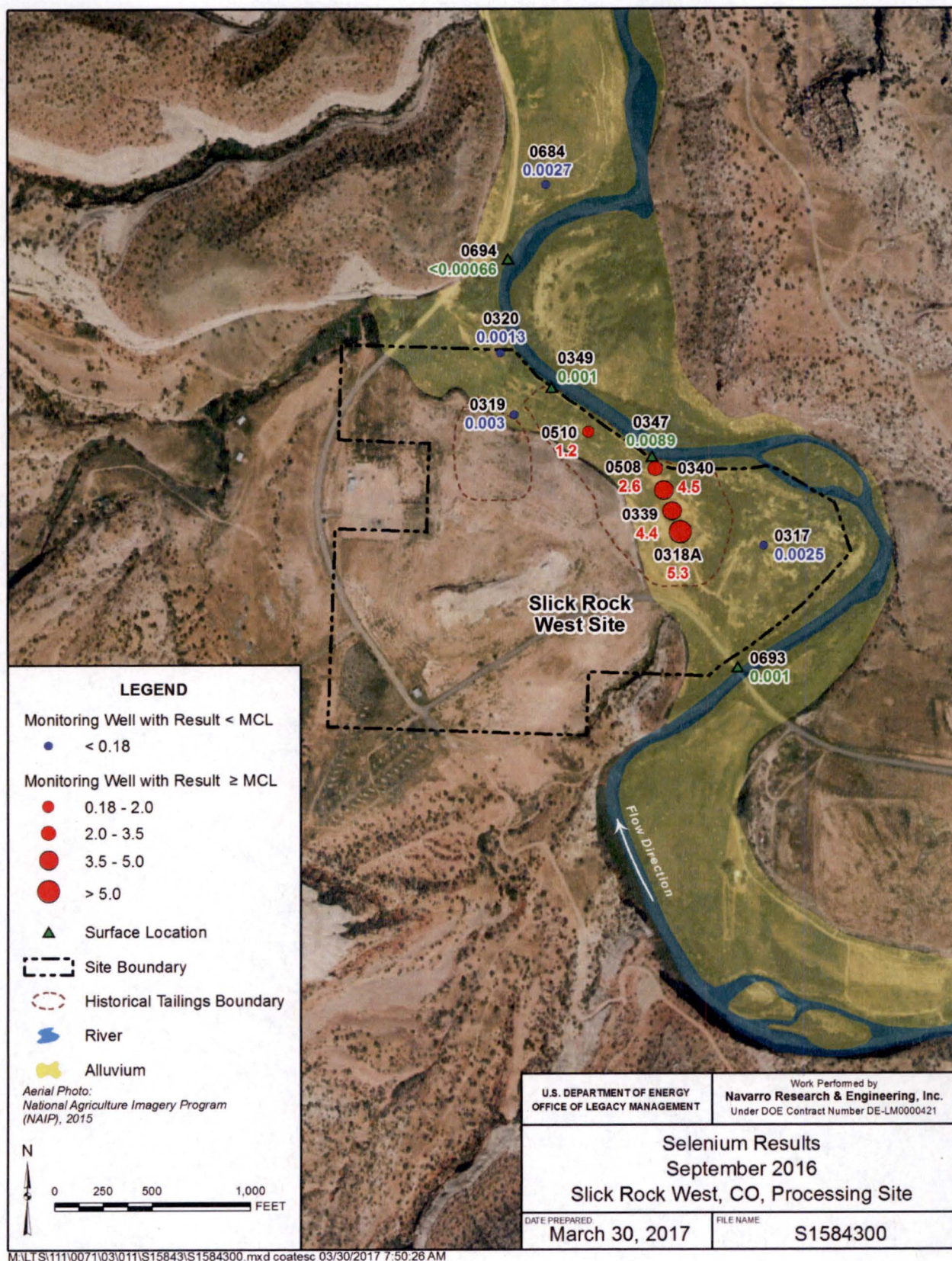
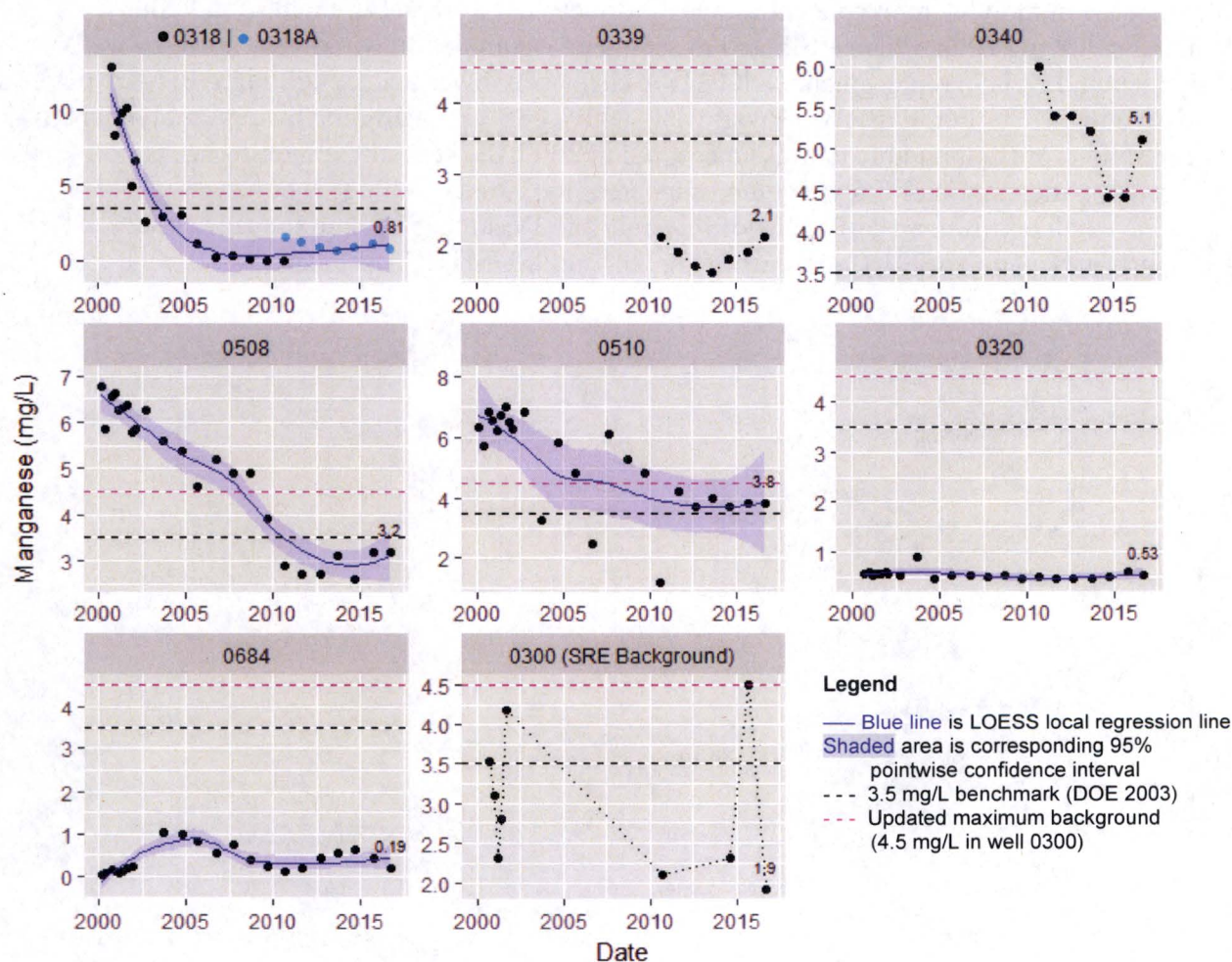


Figure 12. Selenium Distribution at the SRW Site, September 2016

4.2.3 Manganese

Manganese levels measured in SRW wells in September 2016 ranged from 0.19 to 5.1 mg/L. Although concentrations in tailings area wells 0318|0318A, 0340, 0508, and 0510 have been elevated relative to the corresponding 3.5 mg/L benchmark (see Table 1, note “d”), levels have since declined and are now comparable to or less than background (Figure 13). Manganese concentrations in northernmost alluvial wells 0320 and 0684 have always been low (≤ 1 mg/L) relative to the background benchmark.



Note:

The LOESS smoothing line is omitted for wells with limited data or large gaps in sampling.

Figure 13. Manganese Concentrations over Time at the SRW Site

4.2.4 Molybdenum

Figure 14 plots molybdenum concentrations over time at currently monitored SRW wells. This constituent has been elevated in all SRW alluvial wells except downgradient well 0320 and offsite (northernmost) well 0684, where levels have been stable at about 0.01 mg/L since monitoring began in 2000. In wells within the historical tailings area—0318/0318A, 0339, 0340, 0508, and 0510—molybdenum concentrations have been fairly stable at about 1 to 1.5 mg/L, one order of magnitude above the UMTRCA MCL, for several years.

The increase in molybdenum concentrations in former well 0318 between 2004 and 2008 (peaking at 4.8 mg/L) has been attributed to sediment accumulation within the damaged well.³ Molybdenum levels in replacement well 0318A have been lower but are still high (0.7–1.7 mg/L) relative to the MCL. For all SRW alluvial wells with a >10-year sampling history, molybdenum concentrations are comparable to those measured in 2000, the start of the monitoring period (Figure 14). Attenuation of molybdenum is apparent in Entrada well 0317, however, where levels have halved: from an early peak of 0.32 mg/L in December 2000 to the current level of 0.17 mg/L in September 2016, approaching the 0.1 mg/L UMTRCA standard.

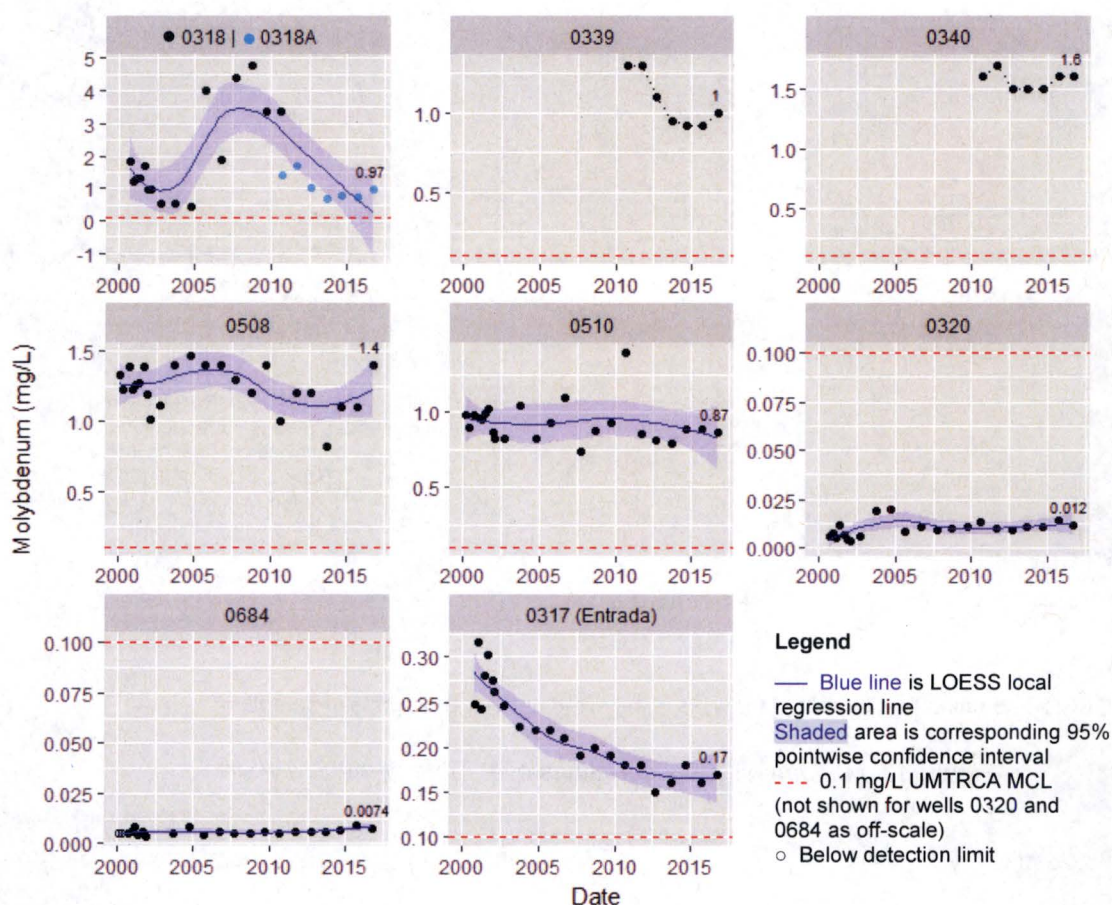


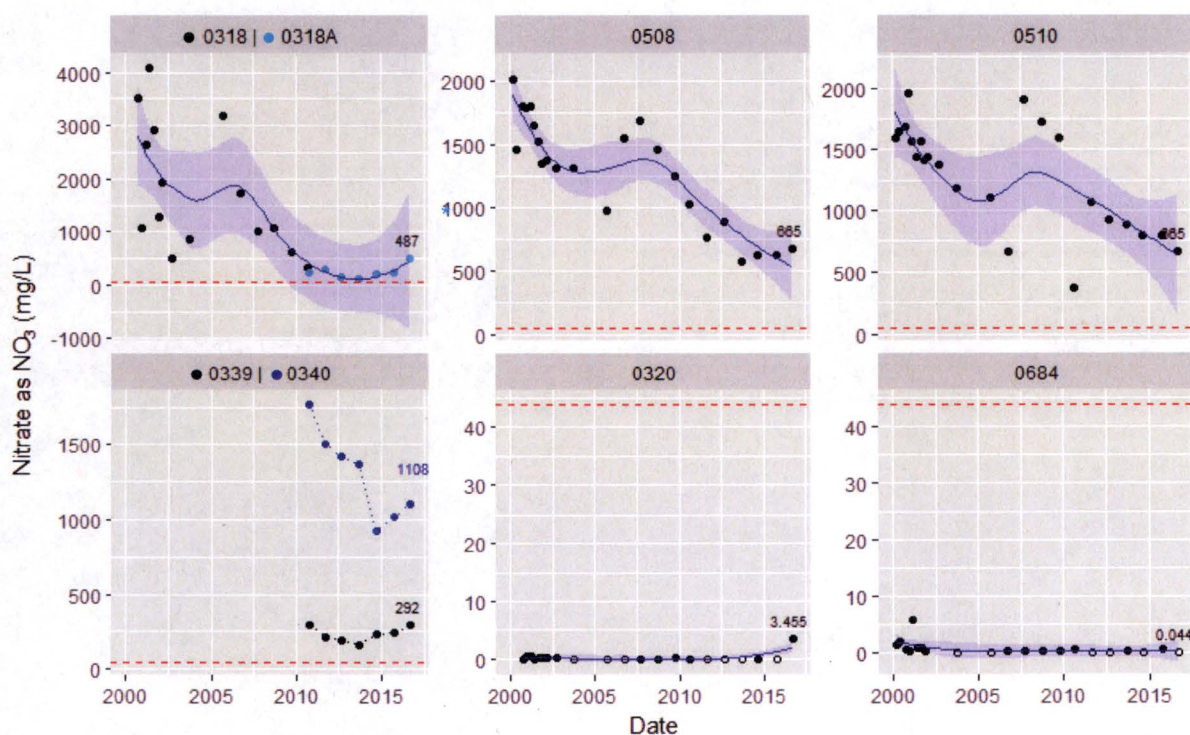
Figure 14. Molybdenum Concentrations over Time in SRW Wells with Elevated Concentrations

³ Because of the sediment accumulation, it was not possible to sample from within the screened interval. Rather, samples were collected from within the uppermost blank casing near the top of the water table.

4.2.5 Nitrate

Figure 15 shows nitrate (as NO_3) concentrations over time at currently monitored SRW wells. Since 2000, nitrate levels have declined in all alluvial wells within the historical tailings boundary: 0318|0318A, 0508, and 0510. Those in well 0318|0318A have declined by about an order of magnitude: from a peak of 4090 mg/L in 2001 to 200–500 mg/L in recent years. Downward trends are also apparent for well 0508—2010 mg/L baseline versus the current 665 mg/L—and well 0510, where concentrations have more than halved (from 1600 to 665 mg/L). Despite these declines, nitrate levels are still substantially above the 44.3 mg/L benchmark in these former tailings area wells.

Nitrate concentrations in wells 0339 and 0340, installed downgradient of well 0318A in 2010, have also exceeded the UMRCA MCL. Levels in well 0339 have ranged from 159–292 mg/L, while those in well 0339 have been higher. Between 2010 and 2014, nitrate concentrations in well 0340 declined from 1772 to 930 mg/L, but have increased since then (Figure 15). Nitrate levels in downgradient well 0320 and northernmost offsite well 0684 continue to be well below the 44.3 mg/L benchmark; no trending is apparent. Concentrations in these wells have ranged from 0.02 to 3.5 mg/L (most recent result) and 0.02–5.7 mg/L, respectively.



Notes:

— Blue line is LOESS local regression line (omitted for wells with limited data); shaded area is the corresponding 95% pointwise confidence interval; --- 44 mg/L benchmark (= 10 mg/L nitrate as nitrogen [N]); ○ is analytical result below the detection limit.

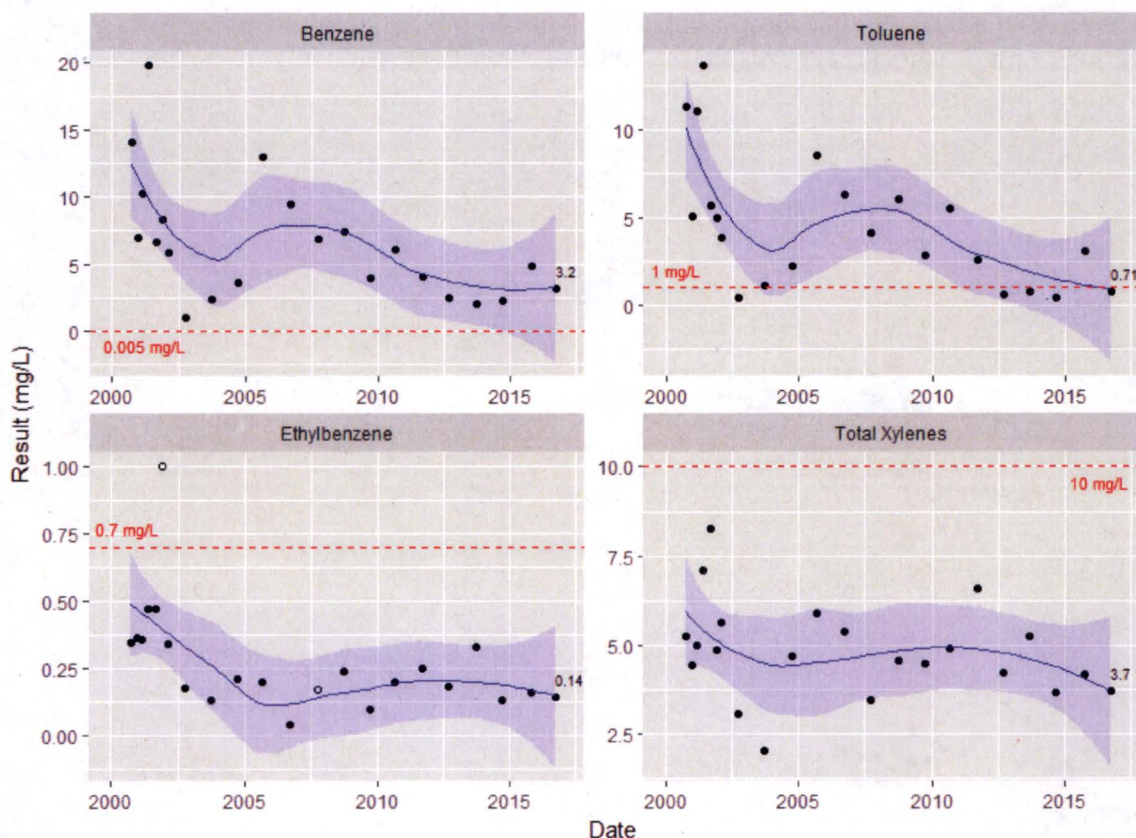
*Nitrate concentrations in well 0318A (●), difficult to discern in this figure given initial highly elevated levels in colocated former well 0318, have ranged from 106–487 mg/L. Given insufficient data for smoothing, nitrate results for more recently installed wells 0339 and 0340 are plotted together in this figure. For all wells, the most recent (2016) results are labeled to facilitate review.

Figure 15. Nitrate (as NO_3) Concentrations over Time in SRW Wells

4.2.6 BTEX (Well 0319)

During site characterization activities conducted for the SOWP (DOE 2002), a localized aromatic hydrocarbon plume was identified in the area of alluvial well 0319 (Figure 4), where light nonaqueous phase liquid had been identified. This is the only SRW well currently monitored for BTEX.⁴ As shown in Figure 16, benzene is the only constituent that has consistently exceeded the corresponding SDWA MCL. Although concentrations have varied over time with no apparent trend, benzene levels have stabilized somewhat since 2010, averaging about 3.5 mg/L. These recent levels are nearly 2 orders of magnitude above the 0.005 mg/L SDWA MCL drinking water standard. However, because there is no exposure to alluvial groundwater at the site, these exceedances pose no human health risk.

Concentrations of toluene have declined since 2000, from a maximum of 13.7 mg/L to 0.7 mg/L (2016 result), which is below the 1 mg/L SDWA MCL. Detectable levels of ethylbenzene and total xylenes have never exceeded corresponding benchmarks in well 0319 groundwater samples.



Notes:

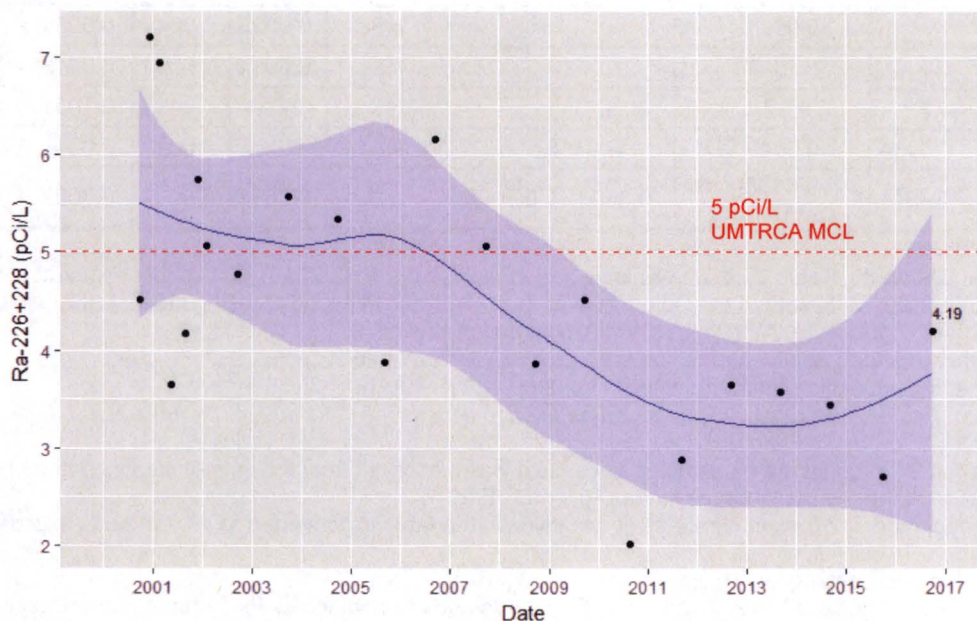
— Blue line is LOESS local regression line; shaded area is the corresponding 95% pointwise confidence interval; ○ is analytical result below the detection limit; --- denotes the SDWA MCLs listed in Table 1.

Figure 16. BTEX Concentrations over Time in SRW Well 0319

⁴ During initial site characterization activities, nine other SRW wells, in addition to well 0319, were monitored for BTEX: 0320, 0326, and 0332–0338 (7 wells). In 2000–2001, elevated levels were detected in wells 0332 and 0333, located within 100 ft of well 0319 to the south and southwest. Because the maximum benzene concentration was in well 0319 (nearly 20 mg/L), this well is the focus of continued monitoring. Wells 0332–0338 have since been decommissioned.

4.2.7 ^{226}Ra and ^{228}Ra (Well 0319)

Although ^{226}Ra and ^{228}Ra have been detected in other wells, their presence above the 5 picocuries per liter (pCi/L) UMTRCA MCL has historically been limited to well 0319, which is also the BTEX hotspot. Figure 17, which plots $^{226}\text{Ra} + ^{228}\text{Ra}$ concentrations in well 0319 over time, shows that radium levels have been below 5 pCi/L since 2008.



Notes:

— Blue line is LOESS local regression line; shaded area is the corresponding 95% pointwise confidence interval. The most recent (2016) result is labeled.

Figure 17. Concentrations of $^{226}\text{Ra} + ^{228}\text{Ra}$ (Combined) in SRW Well 0319

4.3 Surface Water Monitoring Results (Both SRE and SRW Sites)

Based on annual surface water sampling conducted since 2000 and comparison to corresponding surface water standards, there has been no apparent impact to the Dolores River from historical milling activities at the Slick Rock former processing sites. At most Dolores River monitoring locations, CDPHE water quality benchmarks were not exceeded in 2016 (Table 4), consistent with historical results. An exception is the selenium concentration measured at SRW river location 0349 (0.0089 mg/L), which exceeds the corresponding chronic CDPHE benchmark for aquatic life (0.0046 mg/L). This result is below corresponding acute and agricultural standards however (0.02 mg/L).

One Dolores River location, SRE surface location 0700, could not be sampled because it was inaccessible at the time of sampling due to the density of vegetation along the bank of the river (DOE 2017).

Table 4. Comparison of 2016 COPC Concentrations in the Dolores River to CDPHE Benchmarks

COPC	CDPHE Benchmark ^a (mg/L)		Lower Dolores River Location						
			SRE Site			SRW Site			
			0696 Bkgd.	0692	0700 ^b	0693 Bkgd.	0347	0349	0694
	Acute	Chronic	2016 Result (mg/L)						
Manganese	—	0.05	—	—	NS	0.0029	0.0045	0.0059	0.0045
Molybdenum	—	0.16 (T)	—	—	NS	0.0014	0.0044	0.0013	0.0011
Nitrate as NO ₃	44.3 ^c		—	—	NS	<0.044	0.049	0.106	<0.044
Selenium	0.0184	0.0046	—	—	NS	0.001	0.009 ^d	0.001	0.0007
Uranium	TVS ^e	0.0168–0.03 (SWDA) (T) ^f	0.0006	0.0008	NS	0.0007	0.0007	0.0007	0.0007

Notes:

^a From CDPHE Regulation 35, Table 35.6, unless indicated otherwise (CDPHE 2016). Applicable segment is Segment 2 (COGULD02): Mainstem of the Dolores River from Highway 141 road crossing near Slick Rock to the Colorado/Utah border, Agriculture, Aquatic Life, WS-I, Recreation E, WS.

https://www.colorado.gov/pacific/sites/default/files/35_2016%2806%29-header.pdf

https://www.colorado.gov/pacific/sites/default/files/35_2016%2806%29-Appendix35-1_.pdf

Within LM, Google, Firefox, and other browsers can be used to access the links above, but Microsoft Internet Explorer cannot.

^b SRE surface location 0700 could not be sampled because it was inaccessible at the time of sampling because of the density of vegetation along the bank of the Dolores River (DOE 2016).

^c CDPHE (2016) benchmark is 10 mg/L nitrate as N; the value in the table is converted to 44.3 mg/L to express nitrate as NO₃.

^d Result exceeds the corresponding CDPHE benchmark.

^e TVS refers to numerical criteria set forth in the Basic Standards and Methodologies for Surface Water (first link of those listed in note 'a' above).

^f The uranium standard is a range, from the CDPHE Water Quality Control Commission's health-based value (0.0168 mg/L) to the SDWA MCL (0.03 mg/L). The acute TVS value for uranium is a function of hardness: $\text{Acute} = e^{(1.1021[\ln(\text{hardness})] + 2.7088)}$. Hardness is not analyzed in the Dolores River samples so the chronic criterion is used.

Abbreviations:

— = not applicable or not sampled for that analyte

Bkgd. = background

N = nitrogen

NS = not sampled

T = total recoverable

TVS = table value standard

WS = water supply

WS-I = warm stream temperature tier one

5.0 Natural Flushing Assessment

In support of the SOWP for the Slick Rock site, a groundwater flow and transport model was developed to evaluate whether natural flushing would reduce concentrations of site COPCs in the alluvial aquifer to levels below benchmark values within 100 years (DOE 2002). Because modeling predicted that site COPCs would be below benchmarks within 50 years, natural flushing was selected as a compliance strategy. This section evaluates the status of natural flushing for the Slick Rock former processing sites by plotting actual versus predicted concentrations for modeled constituents in the target wells, SRE well 0305 and SRW well 0508.

5.1 SRE Site

Figure 18 plots uranium concentrations in SRE well 0305 versus groundwater model predictions. Uranium concentrations, although having slightly decreased since 2000, are not attenuating as rapidly as predicted. Actual concentrations, 0.7–0.8 mg/L since 2010, are more than an order of magnitude above predicted values. The current linear trendline (all data since 2000) indicates that uranium levels would decline to the MCL by August 2039. However, as shown in Figure 18, uranium levels have stabilized since 2010. If the linear trend is recalculated to include only recent data (2010–2016), the time projected to reach the 0.044 mg/L MCL increases by another 60 years (predicted MCL intercept of August 2099).

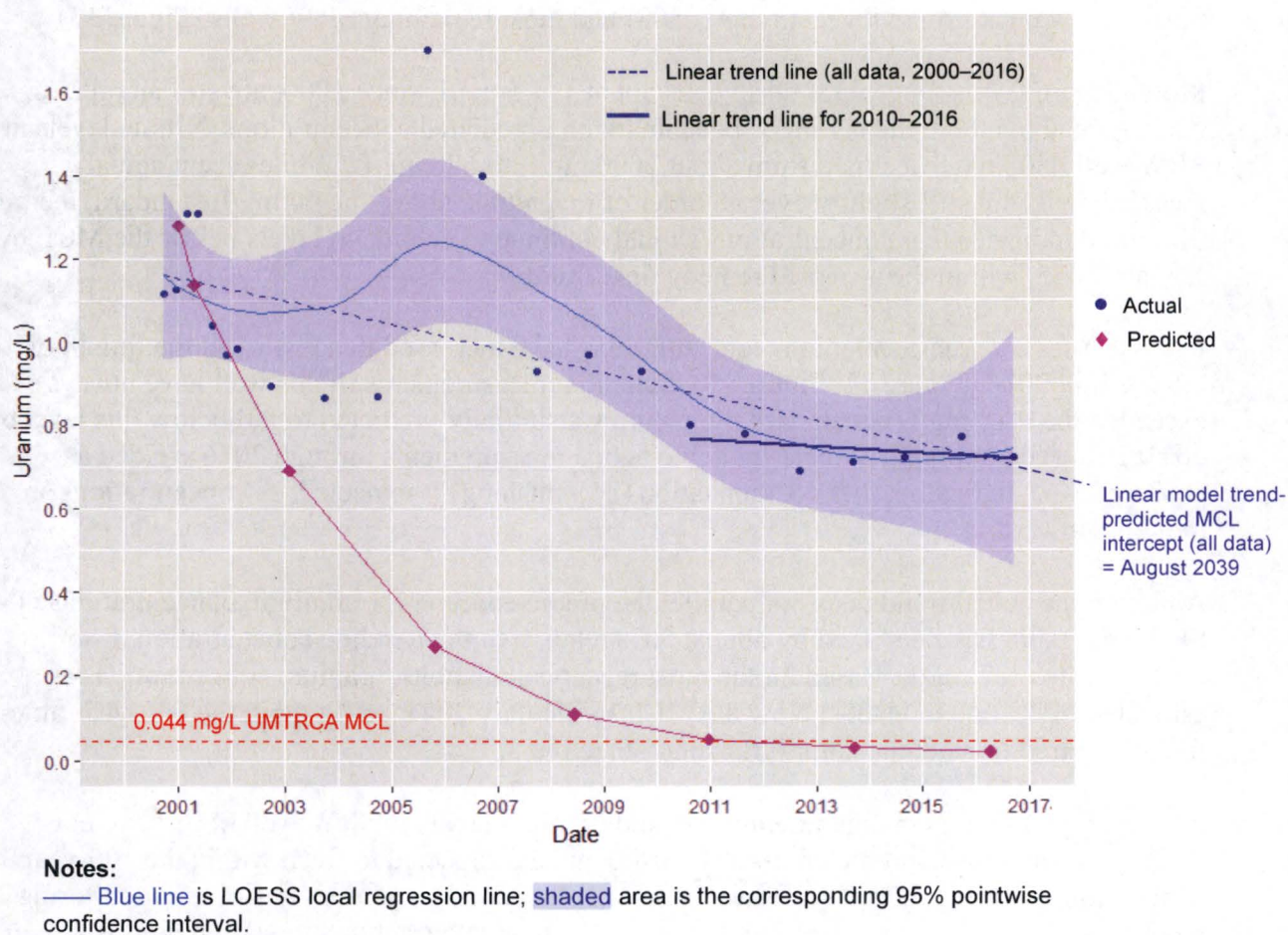


Figure 18. Actual Versus Predicted Uranium Concentrations in SRE Well 0305

The model-predicted uranium trend shown in Figure 18 is based on results from a 2001 modeling effort. At that time, the soil-water distribution coefficient (K_d) was used to represent the primary mechanisms controlling uranium transport in groundwater. Since then, research conducted at other sites such as the Riverton, Wyoming and Rifle, Colorado processing sites has found that there are other physical and geochemical processes that control uranium transport in groundwater, and that uranium plumes may persist beyond previous predictions based on K_d alone (Dam et al. 2015). The Riverton and Rifle sites are similar to the Slick Rock site in that both are underlain by alluvium and are located adjacent to rivers. While the mechanisms controlling uranium transport at these sites may not be identical, it is likely that the transport mechanisms present at the Slick Rock processing site are more complex than those assumed during the modeling assessment performed in 2001. Future revisions of the draft GCAP will include updated information on potential uranium transport mechanisms based on relevant work performed at other sites.

5.2 SRW Site

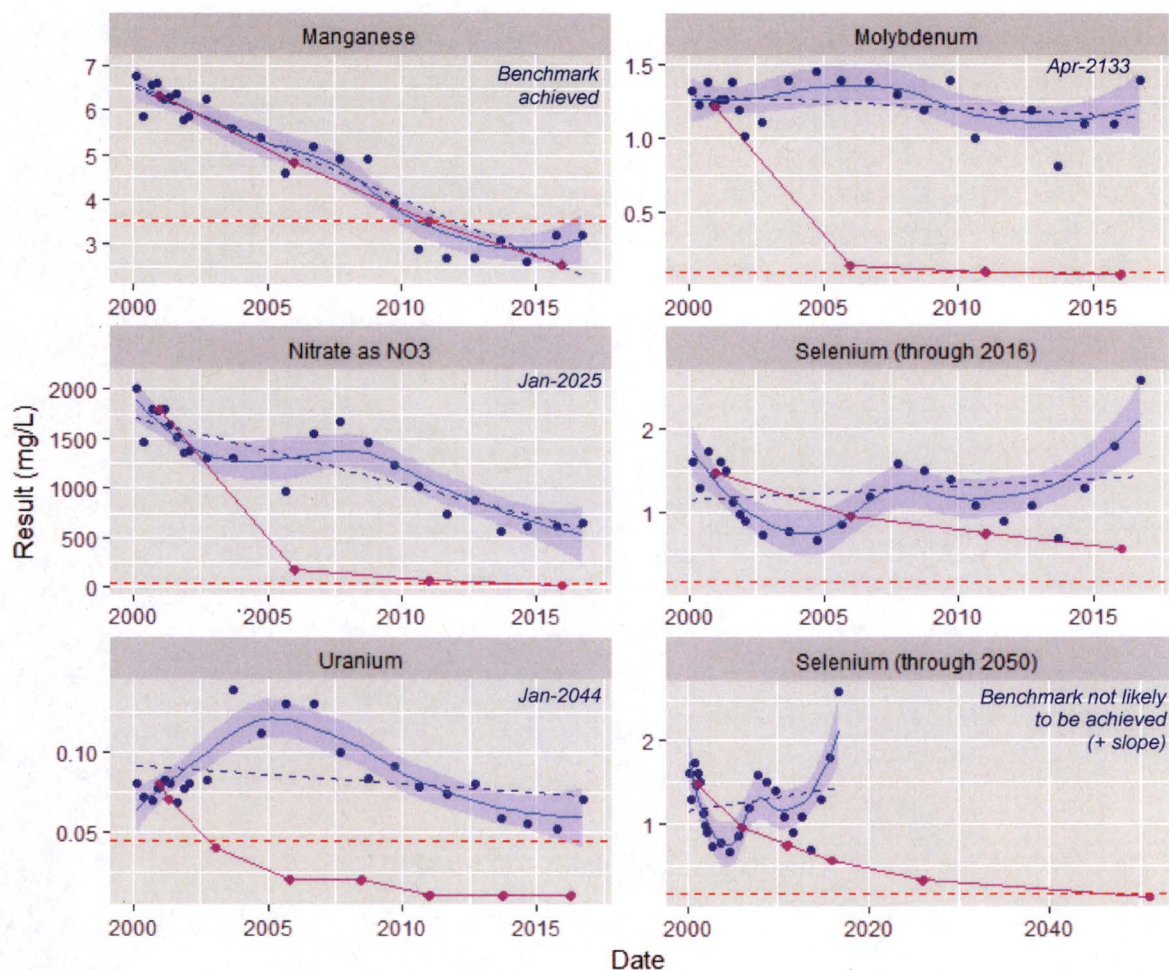
Figure 19 plots measured concentrations of manganese, molybdenum, nitrate, selenium, and uranium in SRW well 0508 versus model predictions. Except for selenium, concentrations of all these parameters had been predicted to decline to levels below corresponding benchmarks by 2016. Based on actual data, this has occurred only for manganese, for which there is close agreement between actual measurements and predicted values. Manganese concentrations have fallen below background levels in this (0508) and most remaining SRW wells (Figure 13).

Molybdenum levels, in general fairly constant at 1–1.5 mg/L since 2000, are still an order of magnitude above both the 0.1 mg/L benchmark and predicted concentrations. Nitrate levels in SRW well 0508 have declined from about 2000 mg/L to 670 mg/L. While recent actual measurements are still slightly over an order of magnitude above the 44 mg/L standard, the trend for nitrate indicates that concentrations should continue to decline to levels below the MCL by January 2025, within the accepted remedy time frame.

In the last several years, selenium concentrations have increased to a historical maximum of 2.6 mg/L in 2016 (Figure 11, Figure 19). Selenium measurements in this well have always exceeded the 0.18 mg/L benchmark. Selenium was initially predicted to fall below this level by 2051. However, applying a linear model to actual measurements through 2016 yielded a positive slope, indicating that no attenuation (i.e., flushing) is expected, as concentrations are trending upward.

Although the actual trend does not parallel the predicted trend for uranium, concentrations in SRW well 0508 have declined by almost 50% relative to the baseline concentration, from 0.13 mg/L to 0.07 mg/L. Based on the most recent calculations, uranium concentrations are estimated to decline to levels below the MCL by January 2044, well within the 100-year time frame required to meet the natural flushing objective.

In summary, although manganese, nitrate, and uranium levels in SRW well 0508 have not declined as quickly as predicted, these constituents are expected to flush within the 100-year remedy time frame (Figure 19). However, as concluded in last year's verification monitoring report (DOE 2016), selenium and molybdenum seem recalcitrant to attenuation by flushing in this and other SRW alluvial wells.



Notes:

• Actual; ♦ predicted; — blue line is LOESS local regression line; shaded region is corresponding 95% point-wise confidence interval; - - - corresponding benchmark listed in Table 1.

For molybdenum, nitrate, and uranium, the date listed in the upper right corner of each plot (e.g., Jan-2025) denotes the updated linear model trend-projected-benchmark intercept based on actual measurements through September 2016 (i.e., the time when contaminant concentrations are predicted to decline to levels below corresponding benchmarks).

Similar predictions are not made for manganese (the benchmark has been met) or selenium, for which the 0.18 mg/L ACL benchmark will not likely be achieved based on the positive slope of the linear regression line calculated for the current (2000–2016) data set.

Figure 19. Predicted Versus Actual Concentrations of SRW COCs in SRW Well 0508

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6.0 Conclusions

6.1 Status of Site Compliance

Although the 100-year time frame established in 40 CFR 192 does not commence until NRC approves the GCAP (DOE 2006), data presented in Sections 4.0 and 5.0 suggest that some constituents are not attenuating as initially predicted using groundwater modeling (DOE 2002). For example, no attenuation of uranium is apparent in SRE plume area wells, as levels have remained generally stable (0.5–1 mg/L) since monitoring began in 2000. In SRW wells, groundwater concentrations of uranium, selenium, molybdenum, and nitrate remain elevated within the site's historical tailings boundary. Uranium and nitrate levels have decreased in some wells, but little to no attenuation is apparent for molybdenum and selenium in wells completed in the Dolores River alluvium since 2000. Selenium appears most recalcitrant to attenuation. In all SRW wells completed in alluvium with a >10-year monitoring history, selenium concentrations are greater than levels measured 16 years ago. Manganese concentrations in SRW wells are now comparable to or less than the 3.5 mg/L background benchmark. In SRW well 0319, although benzene levels have declined somewhat relative to baseline (2000) conditions, concentrations still exceed the SDWA MCL. This is not the case for remaining BTEX constituents (toluene, ethylbenzene, and total xylenes): in 2016, levels were all below corresponding MCLs. Concentrations of $^{226}\text{Ra} + ^{228}\text{Ra}$ (combined) in SRW well 0319 have been below the 5 pCi/L benchmark since 2008.

6.2 Recommendations

Annual verification monitoring of groundwater from designated monitoring wells and surface water locations, and from newer wells 0339 and 0340, should continue as specified in the draft final GCAP (DOE 2006). Annual monitoring is planned for 10 years after NRC concurrence with the GCAP, after which monitoring requirements will be reevaluated.

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Appendix A

Groundwater Quality Data by Parameter

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GENERAL WATER QUALITY DATA BY PARAMETER (USEE205) FOR SITE SRK06, Slick Rock East Processing Site
 REPORT DATE: 3/22/2017 4:31 pm

PARAMETER	UNITS	LOCATION CODE	LOC TYPE, SUBTYPE	SAMPLE: DATE	ID	DEPTH RANGE (FT BLS)	RESULT	QUALIFIERS: LAB DATA QA	DETECTION LIMIT	UN-CERTAINTY
Alkalinity, Total (As CaCO3)	mg/L	0300	WL	09/20/2016	N001	9.50 - 19.50	611	F #	-	-
	mg/L	0303	WL	09/20/2016	N001	4.30 - 14.30	481	F #	-	-
	mg/L	0305	WL	09/20/2016	N001	8.70 - 18.70	440	F #	-	-
	mg/L	0307	WL	09/20/2016	N001	4.40 - 14.40	729	F #	-	-
	mg/L	0309	WL	09/20/2016	N001	10.20 - 20.20	787	F #	-	-
	mg/L	0310	WL	09/20/2016	N001	14.70 - 19.70	197	F #	-	-
	mg/L	0311	WL	09/20/2016	N001	14.10 - 19.10	276	F #	-	-
	mg/L	0672	WL, DOM	09/21/2016	N001		254	#	-	-
	mg/L	0692	SL, RIV	09/20/2016	N001	0.00 - 0.00	97	#	-	-
	mg/L	0696	SL, RIV	09/21/2016	N001	0.00 - 0.00	103	#	-	-
Manganese	mg/L	0300	WL	09/20/2016	N001	9.50 - 19.50	1.9	F #	0.00011	-
	mg/L	0300	WL	09/20/2016	N002	9.50 - 19.50	2	F #	0.00011	-
	mg/L	0672	WL, DOM	09/21/2016	N001		0.0004 J	#	0.00011	-
Molybdenum	mg/L	0300	WL	09/20/2016	N001	9.50 - 19.50	0.0064	F #	0.00032	-
	mg/L	0300	WL	09/20/2016	N002	9.50 - 19.50	0.0055	F #	0.00032	-
	mg/L	0672	WL, DOM	09/21/2016	N001		0.00098 J	#	0.00032	-
Nitrate + Nitrite as Nitrogen	mg/L	0300	WL	09/20/2016	N001	9.50 - 19.50	0.015	F #	0.01	-
	mg/L	0300	WL	09/20/2016	N002	9.50 - 19.50	0.01 U	F #	0.01	-
Oxidation Reduction Potential	mV	0300	WL	09/20/2016	N001	9.50 - 19.50	-75.9	F #	-	-
	mV	0303	WL	09/20/2016	N001	4.30 - 14.30	-85.5	F #	-	-
	mV	0305	WL	09/20/2016	N001	8.70 - 18.70	46.9	F #	-	-
	mV	0307	WL	09/20/2016	N001	4.40 - 14.40	-77.2	F #	-	-
	mV	0309	WL	09/20/2016	N001	10.20 - 20.20	-112.8	F #	-	-
	mV	0310	WL	09/20/2016	N001	14.70 - 19.70	-76.0	F #	-	-

GENERAL WATER QUALITY DATA BY PARAMETER (USEE205) FOR SITE SRK06, Slick Rock East Processing Site
 REPORT DATE: 3/22/2017 4:31 pm

PARAMETER	UNITS	LOCATION CODE	LOC TYPE, SUBTYPE	SAMPLE: DATE	ID	DEPTH RANGE (FT BLS)	RESULT	QUALIFIERS: LAB DATA QA	DETECTION LIMIT	UN-CERTAINTY
Oxidation Reduction Potential	mV	0311	WL	09/20/2016	N001	14.10 - 19.10	55.1	F #	-	-
	mV	0672	WL, DOM	09/21/2016	N001		48.4	#	-	-
	mV	0692	SL, RIV	09/20/2016	N001	0.00 - 0.00	-29.0	#	-	-
	mV	0696	SL, RIV	09/21/2016	N001	0.00 - 0.00	43.8	#	-	-
pH	s.u.	0300	WL	09/20/2016	N001	9.50 - 19.50	6.89	F #	-	-
	s.u.	0303	WL	09/20/2016	N001	4.30 - 14.30	7.17	F #	-	-
	s.u.	0305	WL	09/20/2016	N001	8.70 - 18.70	7.11	F #	-	-
	s.u.	0307	WL	09/20/2016	N001	4.40 - 14.40	7.18	F #	-	-
	s.u.	0309	WL	09/20/2016	N001	10.20 - 20.20	7.40	F #	-	-
	s.u.	0310	WL	09/20/2016	N001	14.70 - 19.70	7.14	F #	-	-
	s.u.	0311	WL	09/20/2016	N001	14.10 - 19.10	6.92	F #	-	-
	s.u.	0672	WL, DOM	09/21/2016	N001		8.04	#	-	-
	s.u.	0692	SL, RIV	09/20/2016	N001	0.00 - 0.00	8.53	#	-	-
	s.u.	0696	SL, RIV	09/21/2016	N001	0.00 - 0.00	8.28	#	-	-
Radium-226	pCi/L	0300	WL	09/20/2016	N001	9.50 - 19.50	0.344	F #	0.11	± 0.16
	pCi/L	0300	WL	09/20/2016	N002	9.50 - 19.50	0.184	FJ #	0.12	± 0.11
Radium-228	pCi/L	0300	WL	09/20/2016	N001	9.50 - 19.50	0.593	FJ #	0.56	± 0.39
	pCi/L	0300	WL	09/20/2016	N002	9.50 - 19.50	0.796	FJ #	0.46	± 0.37
Selenium	mg/L	0300	WL	09/20/2016	N001	9.50 - 19.50	0.0014	F #	0.00066	-
	mg/L	0300	WL	09/20/2016	N002	9.50 - 19.50	0.0012	F #	0.00066	-
	mg/L	0305	WL	09/20/2016	N001	8.70 - 18.70	0.016	F #	0.00066	-
	mg/L	0307	WL	09/20/2016	N001	4.40 - 14.40	0.00066 U	F #	0.00066	-
	mg/L	0672	WL, DOM	09/21/2016	N001		0.0012	#	0.00066	-
Specific Conductance	umhos/cm	0300	WL	09/20/2016	N001	9.50 - 19.50	7954	F #	-	-

GENERAL WATER QUALITY DATA BY PARAMETER (USEE205) FOR SITE SRK06, Slick Rock East Processing Site
 REPORT DATE: 3/22/2017 4:31 pm

PARAMETER	UNITS	LOCATION CODE	LOC TYPE, SUBTYPE	SAMPLE: DATE	ID	DEPTH RANGE (FT BLS)	RESULT	QUALIFIERS: LAB DATA QA	DETECTION LIMIT	UN-CERTAINTY
Specific Conductance	umhos/cm	0303	WL	09/20/2016	N001	4.30 - 14.30	3235	F #	-	-
	umhos/cm	0305	WL	09/20/2016	N001	8.70 - 18.70	3028	F #	-	-
	umhos/cm	0307	WL	09/20/2016	N001	4.40 - 14.40	5222	F #	-	-
	umhos/cm	0309	WL	09/20/2016	N001	10.20 - 20.20	2802	F #	-	-
	umhos/cm	0310	WL	09/20/2016	N001	14.70 - 19.70	916	F #	-	-
	umhos/cm	0311	WL	09/20/2016	N001	14.10 - 19.10	1596	F #	-	-
	umhos/cm	0672	WL, DOM	09/21/2016	N001		523	#	-	-
	umhos/cm	0692	SL, RIV	09/20/2016	N001	0.00 - 0.00	374	#	-	-
	umhos/cm	0696	SL, RIV	09/21/2016	N001	0.00 - 0.00	364	#	-	-
Temperature	C	0300	WL	09/20/2016	N001	9.50 - 19.50	16.26	F #	-	-
	C	0303	WL	09/20/2016	N001	4.30 - 14.30	19.12	F #	-	-
	C	0305	WL	09/20/2016	N001	8.70 - 18.70	18.15	F #	-	-
	C	0307	WL	09/20/2016	N001	4.40 - 14.40	15.64	F #	-	-
	C	0309	WL	09/20/2016	N001	10.20 - 20.20	15.49	F #	-	-
	C	0310	WL	09/20/2016	N001	14.70 - 19.70	14.08	F #	-	-
	C	0311	WL	09/20/2016	N001	14.10 - 19.10	16.05	F #	-	-
	C	0672	WL, DOM	09/21/2016	N001		18.62	#	-	-
	C	0692	SL, RIV	09/20/2016	N001	0.00 - 0.00	18.32	#	-	-
	C	0696	SL, RIV	09/21/2016	N001	0.00 - 0.00	19.98	#	-	-
Turbidity	NTU	0300	WL	09/20/2016	N001	9.50 - 19.50	1.92	F #	-	-
	NTU	0303	WL	09/20/2016	N001	4.30 - 14.30	4.84	F #	-	-
	NTU	0305	WL	09/20/2016	N001	8.70 - 18.70	6.55	F #	-	-
	NTU	0307	WL	09/20/2016	N001	4.40 - 14.40	8.62	F #	-	-
	NTU	0309	WL	09/20/2016	N001	10.20 - 20.20	4.69	F #	-	-
	NTU	0310	WL	09/20/2016	N001	14.70 - 19.70	1.33	F #	-	-

GENERAL WATER QUALITY DATA BY PARAMETER (USEE205) FOR SITE SRK06, Slick Rock East Processing Site
 REPORT DATE: 3/22/2017 4:31 pm

PARAMETER	UNITS	LOCATION CODE	LOC TYPE, SUBTYPE	SAMPLE: DATE	ID	DEPTH RANGE (FT BLS)	RESULT	QUALIFIERS: LAB DATA QA	DETECTION LIMIT	UN- CERTAINTY
Turbidity	NTU	0311	WL	09/20/2016	N001	14.10 - 19.10	3.74	F #	-	-
	NTU	0672	WL, DOM	09/21/2016	N001		1.15	#	-	-
	NTU	0692	SL, RIV	09/20/2016	N001	0.00 - 0.00	19.6	#	-	-
	NTU	0696	SL, RIV	09/21/2016	N001	0.00 - 0.00	19.1	#	-	-
Uranium	mg/L	0300	WL	09/20/2016	N001	9.50 - 19.50	0.017	F #	1.2E-05	-
	mg/L	0300	WL	09/20/2016	N002	9.50 - 19.50	0.016	F #	1.2E-05	-
	mg/L	0303	WL	09/20/2016	N001	4.30 - 14.30	1.1	F #	0.00012	-
	mg/L	0305	WL	09/20/2016	N001	8.70 - 18.70	0.72	F #	1.2E-05	-
	mg/L	0307	WL	09/20/2016	N001	4.40 - 14.40	0.44	F #	1.2E-05	-
	mg/L	0309	WL	09/20/2016	N001	10.20 - 20.20	0.065	F #	1.2E-05	-
	mg/L	0310	WL	09/20/2016	N001	14.70 - 19.70	0.023	F #	1.2E-05	-
	mg/L	0311	WL	09/20/2016	N001	14.10 - 19.10	0.068	F #	1.2E-05	-
	mg/L	0672	WL, DOM	09/21/2016	N001		0.0028	#	1.2E-05	-
	mg/L	0692	SL, RIV	09/20/2016	0001	0.00 - 0.00	0.00076	#	1.2E-05	-
	mg/L	0696	SL, RIV	09/21/2016	0001	0.00 - 0.00	0.00063	#	1.2E-05	-

GENERAL WATER QUALITY DATA BY PARAMETER (USEE205) FOR SITE SRK06, Slick Rock East Processing Site
REPORT DATE: 3/22/2017 4:31 pm

PARAMETER	UNITS	LOCATION CODE	LOC TYPE, SUBTYPE	SAMPLE: DATE	ID	DEPTH RANGE (FT BLS)	RESULT	QUALIFIERS: LAB DATA QA	DETECTION LIMIT	UN- CERTAINTY
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RECORDS: SELECTED FROM USEE200 WHERE site_code='SRK06' AND (data_validation_qualifiers IS NULL OR data_validation_qualifiers NOT LIKE '%R%' AND data_validation_qualifiers NOT LIKE '%X%') AND DATE_SAMPLED between #1/1/2016# and #1/1/2017#

SAMPLE ID CODES: 000X = Filtered sample. N00X = Unfiltered sample. X = replicate number.

LOCATION TYPES: SL SURFACE LOCATION WL WELL

LOCATION SUBTYPES: DOM Domestic Well RIV River

LAB QUALIFIERS:

- * Replicate analysis not within control limits.
- + Correlation coefficient for MSA < 0.995.
- > Result above upper detection limit.
- A TIC is a suspected aldol-condensation product.
- B Inorganic: Result is between the IDL and CRDL. Organic & Radiochemistry: 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
- M GFAA duplicate injection precision not met.
- 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.
- S Result determined by method of standard addition (MSA).
- U Analytical result below detection limit.
- W Post-digestion spike outside control limits while sample absorbance < 50% of analytical spike absorbance.
- X Laboratory defined qualifier, see case narrative.
- Y Laboratory defined qualifier, see case narrative.
- 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. | N Presumptive evidence that analyte is present. The analyte is "tentatively identified". | 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.

GENERAL WATER QUALITY DATA BY PARAMETER (USEE205) FOR SITE SRK05, Slick Rock West Processing Site
 REPORT DATE: 3/22/2017 4:32 pm

PARAMETER	UNITS	LOCATION CODE	LOC TYPE, SUBTYPE	SAMPLE: DATE	ID	DEPTH RANGE (FT BLS)	RESULT	QUALIFIERS: LAB DATA QA	DETECTION LIMIT	UN-CERTAINTY
Alkalinity, Total (As CaCO3)	mg/L	0317	WL	09/21/2016	N001	19.46 - 39.52	278	F #	-	-
	mg/L	0318A	WL	09/21/2016	N001	9.20 - 14.20	264	F #	-	-
	mg/L	0319	WL	09/21/2016	N001	4.55 - 14.58	926	F #	-	-
	mg/L	0320	WL	09/21/2016	N001	4.92 - 9.96	365	F #	-	-
	mg/L	0339	WL	09/21/2016	N001	11.00 - 14.00	262	F #	-	-
	mg/L	0340	WL	09/21/2016	N001	6.51 - 11.51	249	F #	-	-
	mg/L	0347	SL, RIV	09/21/2016	N001	0.00 - 0.00	115	#	-	-
	mg/L	0349	SL, RIV	09/21/2016	N001	0.00 - 0.00	112	#	-	-
	mg/L	0508	WL	09/21/2016	N001	1.01 - 11.01	285	F #	-	-
	mg/L	0510	WL	09/21/2016	N001	4.92 - 13.92	314	F #	-	-
	mg/L	0684	WL	09/21/2016	N001	11.00 - 21.00	226	F #	-	-
	mg/L	0693	SL, RIV	09/21/2016	N001	0.00 - 0.00	108	#	-	-
	mg/L	0694	SL, RIV	09/21/2016	N001	0.00 - 0.00	102	#	-	-
Benzene	ug/L	0319	WL	09/21/2016	N001	4.55 - 14.58	3200	F #	60	-
Ethylbenzene	ug/L	0319	WL	09/21/2016	N001	4.55 - 14.58	140	J F #	60	-
m,p-Xylene	ug/L	0319	WL	09/21/2016	N001	4.55 - 14.58	3000	F #	60	-
Manganese	mg/L	0318A	WL	09/21/2016	N001	9.20 - 14.20	0.81	F #	0.00011	-
	mg/L	0318A	WL	09/21/2016	N002	9.20 - 14.20	0.85	F #	0.00011	-
	mg/L	0320	WL	09/21/2016	N001	4.92 - 9.96	0.53	F #	0.00011	-
	mg/L	0339	WL	09/21/2016	N001	11.00 - 14.00	2.1	F #	0.00011	-
	mg/L	0340	WL	09/21/2016	N001	6.51 - 11.51	5.1	F #	0.00011	-
	mg/L	0347	SL, RIV	09/21/2016	0001	0.00 - 0.00	0.0045	J #	0.00011	-
	mg/L	0349	SL, RIV	09/21/2016	0001	0.00 - 0.00	0.0059	#	0.00011	-
	mg/L	0508	WL	09/21/2016	N001	1.01 - 11.01	3.2	F #	0.00011	-
	mg/L	0510	WL	09/21/2016	N001	4.92 - 13.92	3.8	F #	0.00011	-

GENERAL WATER QUALITY DATA BY PARAMETER (USEE205) FOR SITE SRK05, Slick Rock West Processing Site
 REPORT DATE: 3/22/2017 4:32 pm

PARAMETER	UNITS	LOCATION CODE	LOC TYPE, SUBTYPE	SAMPLE: DATE	ID	DEPTH RANGE (FT BLS)	RESULT	QUALIFIERS: LAB DATA QA	DETECTION LIMIT	UN-CERTAINTY
Manganese	mg/L	0684	WL	09/21/2016	N001	11.00 - 21.00	0.19	F #	0.00011	-
	mg/L	0693	SL, RIV	09/21/2016	0001	0.00 - 0.00	0.0029	J #	0.00011	-
	mg/L	0694	SL, RIV	09/21/2016	0001	0.00 - 0.00	0.0045	J #	0.00011	-
Molybdenum	mg/L	0317	WL	09/21/2016	N001	19.46 - 39.52	0.17	F #	0.00032	-
	mg/L	0318A	WL	09/21/2016	N001	9.20 - 14.20	0.97	F #	0.00032	-
	mg/L	0318A	WL	09/21/2016	N002	9.20 - 14.20	0.98	F #	0.00032	-
	mg/L	0320	WL	09/21/2016	N001	4.92 - 9.96	0.012	F #	0.00032	-
	mg/L	0339	WL	09/21/2016	N001	11.00 - 14.00	1	F #	0.00032	-
	mg/L	0340	WL	09/21/2016	N001	6.51 - 11.51	1.6	F #	0.00032	-
	mg/L	0347	SL, RIV	09/21/2016	0001	0.00 - 0.00	0.0044	J #	0.00032	-
	mg/L	0349	SL, RIV	09/21/2016	0001	0.00 - 0.00	0.0013	J J #	0.00032	-
	mg/L	0508	WL	09/21/2016	N001	1.01 - 11.01	1.4	F #	0.00032	-
	mg/L	0510	WL	09/21/2016	N001	4.92 - 13.92	0.87	F #	0.00032	-
	mg/L	0684	WL	09/21/2016	N001	11.00 - 21.00	0.0074	F #	0.00032	-
	mg/L	0693	SL, RIV	09/21/2016	0001	0.00 - 0.00	0.0014	J J #	0.00032	-
	mg/L	0694	SL, RIV	09/21/2016	0001	0.00 - 0.00	0.0011	J #	0.00032	-
Nitrate + Nitrite as Nitrogen	mg/L	0318A	WL	09/21/2016	N001	9.20 - 14.20	110	F #	5	-
	mg/L	0318A	WL	09/21/2016	N002	9.20 - 14.20	110	F #	1	-
	mg/L	0320	WL	09/21/2016	N001	4.92 - 9.96	0.78	F #	0.01	-
	mg/L	0339	WL	09/21/2016	N001	11.00 - 14.00	66	F #	0.5	-
	mg/L	0340	WL	09/21/2016	N001	6.51 - 11.51	250	F #	10	-
	mg/L	0347	SL, RIV	09/21/2016	0001	0.00 - 0.00	0.011	#	0.01	-
	mg/L	0349	SL, RIV	09/21/2016	0001	0.00 - 0.00	0.024	#	0.01	-
	mg/L	0508	WL	09/21/2016	N001	1.01 - 11.01	150	F #	10	-
	mg/L	0510	WL	09/21/2016	N001	4.92 - 13.92	150	F #	1	-

GENERAL WATER QUALITY DATA BY PARAMETER (USEE205) FOR SITE SRK05, Slick Rock West Processing Site
 REPORT DATE: 3/22/2017 4:32 pm

PARAMETER	UNITS	LOCATION CODE	LOC TYPE, SUBTYPE	SAMPLE: DATE	ID	DEPTH RANGE (FT BLS)	RESULT	QUALIFIERS: LAB DATA QA	DETECTION LIMIT	UN-CERTAINTY
Nitrate + Nitrite as Nitrogen	mg/L	0684	WL	09/21/2016	N001	11.00 - 21.00	0.01	U F #	0.01	-
	mg/L	0693	SL, RIV	09/21/2016	0001	0.00 - 0.00	0.01	U #	0.01	-
	mg/L	0694	SL, RIV	09/21/2016	0001	0.00 - 0.00	0.01	U #	0.01	-
Oxidation Reduction Potential	mV	0317	WL	09/21/2016	N001	19.46 - 39.52	97.1	F #	-	-
	mV	0318A	WL	09/21/2016	N001	9.20 - 14.20	84.6	F #	-	-
	mV	0319	WL	09/21/2016	N001	4.55 - 14.58	-119.2	F #	-	-
	mV	0320	WL	09/21/2016	N001	4.92 - 9.96	-73.8	F #	-	-
	mV	0339	WL	09/21/2016	N001	11.00 - 14.00	120.1	F #	-	-
	mV	0340	WL	09/21/2016	N001	6.51 - 11.51	150.8	F #	-	-
	mV	0347	SL, RIV	09/21/2016	N001	0.00 - 0.00	77.1	#	-	-
	mV	0349	SL, RIV	09/21/2016	N001	0.00 - 0.00	5.0	#	-	-
	mV	0508	WL	09/21/2016	N001	1.01 - 11.01	145.3	F #	-	-
	mV	0510	WL	09/21/2016	N001	4.92 - 13.92	144.4	F #	-	-
	mV	0684	WL	09/21/2016	N001	11.00 - 21.00	82.8	F #	-	-
	mV	0693	SL, RIV	09/21/2016	N001	0.00 - 0.00	-38.0	#	-	-
	mV	0694	SL, RIV	09/21/2016	N001	0.00 - 0.00	26.0	#	-	-
o-Xylene	ug/L	0319	WL	09/21/2016	N001	4.55 - 14.58	670	F #	60	-
pH	s.u.	0317	WL	09/21/2016	N001	19.46 - 39.52	7.28	F #	-	-
	s.u.	0318A	WL	09/21/2016	N001	9.20 - 14.20	6.97	F #	-	-
	s.u.	0319	WL	09/21/2016	N001	4.55 - 14.58	6.98	F #	-	-
	s.u.	0320	WL	09/21/2016	N001	4.92 - 9.96	7.08	F #	-	-
	s.u.	0339	WL	09/21/2016	N001	11.00 - 14.00	6.94	F #	-	-
	s.u.	0340	WL	09/21/2016	N001	6.51 - 11.51	6.75	F #	-	-
	s.u.	0347	SL, RIV	09/21/2016	N001	0.00 - 0.00	8.17	#	-	-
	s.u.	0349	SL, RIV	09/21/2016	N001	0.00 - 0.00	8.15	#	-	-

GENERAL WATER QUALITY DATA BY PARAMETER (USEE205) FOR SITE SRK05, Slick Rock West Processing Site
 REPORT DATE: 3/22/2017 4:32 pm

PARAMETER	UNITS	LOCATION CODE	LOC TYPE, SUBTYPE	SAMPLE: DATE	ID	DEPTH RANGE (FT BLS)	RESULT	QUALIFIERS: LAB DATA QA	DETECTION LIMIT	UN-CERTAINTY
pH	s.u.	0508	WL	09/21/2016	N001	1.01 - 11.01	6.86	F #	-	-
	s.u.	0510	WL	09/21/2016	N001	4.92 - 13.92	6.71	F #	-	-
	s.u.	0684	WL	09/21/2016	N001	11.00 - 21.00	6.93	F #	-	-
	s.u.	0693	SL, RIV	09/21/2016	N001	0.00 - 0.00	8.33	#	-	-
	s.u.	0694	SL, RIV	09/21/2016	N001	0.00 - 0.00	8.38	#	-	-
Radium-226	pCi/L	0319	WL	09/21/2016	N001	4.55 - 14.58	1.96	F #	0.16	± 0.56
Radium-228	pCi/L	0319	WL	09/21/2016	N001	4.55 - 14.58	2.23	F #	0.54	± 0.68
Selenium	mg/L	0317	WL	09/21/2016	N001	19.46 - 39.52	0.0025	F #	0.00066	-
	mg/L	0318A	WL	09/21/2016	N001	9.20 - 14.20	5.3	F #	0.00066	-
	mg/L	0318A	WL	09/21/2016	N002	9.20 - 14.20	5.3	F #	0.00066	-
	mg/L	0319	WL	09/21/2016	N001	4.55 - 14.58	0.003	F #	0.00066	-
	mg/L	0320	WL	09/21/2016	N001	4.92 - 9.96	0.0013	F #	0.00066	-
	mg/L	0339	WL	09/21/2016	N001	11.00 - 14.00	4.4	F #	0.00066	-
	mg/L	0340	WL	09/21/2016	N001	6.51 - 11.51	4.5	F #	0.00066	-
	mg/L	0347	SL, RIV	09/21/2016	0001	0.00 - 0.00	0.0089	J #	0.00066	-
	mg/L	0349	SL, RIV	09/21/2016	0001	0.00 - 0.00	0.001	J #	0.00066	-
	mg/L	0508	WL	09/21/2016	N001	1.01 - 11.01	2.6	F #	0.00066	-
	mg/L	0510	WL	09/21/2016	N001	4.92 - 13.92	1.2	F #	0.00066	-
	mg/L	0684	WL	09/21/2016	N001	11.00 - 21.00	0.0027	F #	0.00066	-
	mg/L	0693	SL, RIV	09/21/2016	0001	0.00 - 0.00	0.001	J #	0.00066	-
	mg/L	0694	SL, RIV	09/21/2016	0001	0.00 - 0.00	0.00066	U #	0.00066	-
Specific Conductance	umhos/cm	0317	WL	09/21/2016	N001	19.46 - 39.52	2736	F #	-	-
	umhos/cm	0318A	WL	09/21/2016	N001	9.20 - 14.20	2585	F #	-	-
	umhos/cm	0319	WL	09/21/2016	N001	4.55 - 14.58	3214	F #	-	-
	umhos/cm	0320	WL	09/21/2016	N001	4.92 - 9.96	890	F #	-	-

GENERAL WATER QUALITY DATA BY PARAMETER (USEE205) FOR SITE SRK05, Slick Rock West Processing Site
 REPORT DATE: 3/22/2017 4:32 pm

PARAMETER	UNITS	LOCATION CODE	LOC TYPE, SUBTYPE	SAMPLE: DATE	ID	DEPTH RANGE (FT BLS)	RESULT	QUALIFIERS: LAB DATA QA	DETECTION LIMIT	UN- CERTAINTY
Specific Conductance	umhos/cm	0339	WL	09/21/2016	N001	11.00 - 14.00	2197	F #	-	-
	umhos/cm	0340	WL	09/21/2016	N001	6.51 - 11.51	3960	F #	-	-
	umhos/cm	0347	SL, RIV	09/21/2016	N001	0.00 - 0.00	377	#	-	-
	umhos/cm	0349	SL, RIV	09/21/2016	N001	0.00 - 0.00	369	#	-	-
	umhos/cm	0508	WL	09/21/2016	N001	1.01 - 11.01	3270	F #	-	-
	umhos/cm	0510	WL	09/21/2016	N001	4.92 - 13.92	3476	F #	-	-
	umhos/cm	0684	WL	09/21/2016	N001	11.00 - 21.00	956	F #	-	-
	umhos/cm	0693	SL, RIV	09/21/2016	N001	0.00 - 0.00	365	#	-	-
	umhos/cm	0694	SL, RIV	09/21/2016	N001	0.00 - 0.00	364	#	-	-
Temperature	C	0317	WL	09/21/2016	N001	19.46 - 39.52	13.77	F #	-	-
	C	0318A	WL	09/21/2016	N001	9.20 - 14.20	17.28	F #	-	-
	C	0319	WL	09/21/2016	N001	4.55 - 14.58	18.59	F #	-	-
	C	0320	WL	09/21/2016	N001	4.92 - 9.96	15.91	F #	-	-
	C	0339	WL	09/21/2016	N001	11.00 - 14.00	16.51	F #	-	-
	C	0340	WL	09/21/2016	N001	6.51 - 11.51	18.19	F #	-	-
	C	0347	SL, RIV	09/21/2016	N001	0.00 - 0.00	17.71	#	-	-
	C	0349	SL, RIV	09/21/2016	N001	0.00 - 0.00	19.88	#	-	-
	C	0508	WL	09/21/2016	N001	1.01 - 11.01	18.50	F #	-	-
	C	0510	WL	09/21/2016	N001	4.92 - 13.92	17.21	F #	-	-
	C	0684	WL	09/21/2016	N001	11.00 - 21.00	14.24	F #	-	-
	C	0693	SL, RIV	09/21/2016	N001	0.00 - 0.00	22.82	#	-	-
	C	0694	SL, RIV	09/21/2016	N001	0.00 - 0.00	19.26	#	-	-
	C	0694	SL, RIV	09/21/2016	N001	0.00 - 0.00	19.26	#	-	-
Toluene	ug/L	0319	WL	09/21/2016	N001	4.55 - 14.58	710	F #	60	-
Turbidity	NTU	0317	WL	09/21/2016	N001	19.46 - 39.52	1.91	F #	-	-
	NTU	0318A	WL	09/21/2016	N001	9.20 - 14.20	8.63	F #	-	-

GENERAL WATER QUALITY DATA BY PARAMETER (USEE205) FOR SITE SRK05, Slick Rock West Processing Site
 REPORT DATE: 3/22/2017 4:32 pm

PARAMETER	UNITS	LOCATION CODE	LOC TYPE, SUBTYPE	SAMPLE: DATE	ID	DEPTH RANGE (FT BLS)	RESULT	QUALIFIERS: LAB DATA QA	DETECTION LIMIT	UN-CERTAINTY
Turbidity	NTU	0319	WL	09/21/2016	N001	4.55 - 14.58	5.72	F #	-	-
	NTU	0320	WL	09/21/2016	N001	4.92 - 9.96	1.99	F #	-	-
	NTU	0339	WL	09/21/2016	N001	11.00 - 14.00	6.39	F #	-	-
	NTU	0340	WL	09/21/2016	N001	6.51 - 11.51	8.69	F #	-	-
	NTU	0347	SL, RIV	09/21/2016	N001	0.00 - 0.00	18.7	#	-	-
	NTU	0349	SL, RIV	09/21/2016	N001	0.00 - 0.00	242	#	-	-
	NTU	0508	WL	09/21/2016	N001	1.01 - 11.01	2.25	F #	-	-
	NTU	0510	WL	09/21/2016	N001	4.92 - 13.92	3.18	F #	-	-
	NTU	0684	WL	09/21/2016	N001	11.00 - 21.00	1.29	F #	-	-
	NTU	0693	SL, RIV	09/21/2016	N001	0.00 - 0.00	67.4	#	-	-
	NTU	0694	SL, RIV	09/21/2016	N001	0.00 - 0.00	50.5	#	-	-
Uranium	mg/L	0318A	WL	09/21/2016	N001	9.20 - 14.20	0.028	F #	1.2E-05	-
	mg/L	0318A	WL	09/21/2016	N002	9.20 - 14.20	0.028	F #	1.2E-05	-
	mg/L	0320	WL	09/21/2016	N001	4.92 - 9.96	0.0093	F #	1.2E-05	-
	mg/L	0339	WL	09/21/2016	N001	11.00 - 14.00	0.032	F #	1.2E-05	-
	mg/L	0340	WL	09/21/2016	N001	6.51 - 11.51	0.042	F #	1.2E-05	-
	mg/L	0347	SL, RIV	09/21/2016	0001	0.00 - 0.00	0.00073	#	1.2E-05	-
	mg/L	0349	SL, RIV	09/21/2016	0001	0.00 - 0.00	0.00069	#	1.2E-05	-
	mg/L	0508	WL	09/21/2016	N001	1.01 - 11.01	0.073	F #	1.2E-05	-
	mg/L	0510	WL	09/21/2016	N001	4.92 - 13.92	0.095	F #	1.2E-05	-
	mg/L	0684	WL	09/21/2016	N001	11.00 - 21.00	0.012	F #	1.2E-05	-
	mg/L	0693	SL, RIV	09/21/2016	0001	0.00 - 0.00	0.0007	#	1.2E-05	-
	mg/L	0694	SL, RIV	09/21/2016	0001	0.00 - 0.00	0.00066	#	1.2E-05	-

GENERAL WATER QUALITY DATA BY PARAMETER (USEE205) FOR SITE SRK05, Slick Rock West Processing Site
REPORT DATE: 3/22/2017 4:32 pm

PARAMETER	UNITS	LOCATION CODE	LOC TYPE, SUBTYPE	SAMPLE: DATE ID	DEPTH RANGE (FT BLS)	RESULT	QUALIFIERS: LAB DATA QA	DETECTION LIMIT	UN-CERTAINTY
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RECORDS: SELECTED FROM USEE200 WHERE site_code='SRK05' AND (data_validation_qualifiers IS NULL OR data_validation_qualifiers NOT LIKE '%R%' AND data_validation_qualifiers NOT LIKE '%X%') AND DATE_SAMPLED between #1/1/2016# and #1/1/2017#

SAMPLE ID CODES: 000X = Filtered sample. N00X = Unfiltered sample. X = replicate number.

LOCATION TYPES: SL SURFACE LOCATION WL WELL

LOCATION SUBTYPES: RIV River

LAB QUALIFIERS:

- * Replicate analysis not within control limits.
- + Correlation coefficient for MSA < 0.995.
- > Result above upper detection limit.
- A TIC is a suspected aldol-condensation product.
- B Inorganic: Result is between the IDL and CRDL. Organic & Radiochemistry: 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
- M GFAA duplicate injection precision not met.
- 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.
- S Result determined by method of standard addition (MSA).
- U Analytical result below detection limit.
- W Post-digestion spike outside control limits while sample absorbance < 50% of analytical spike absorbance.
- X Laboratory defined qualifier, see case narrative.
- Y Laboratory defined qualifier, see case narrative.
- 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. | N Presumptive evidence that analyte is present. The analyte is "tentatively identified". | 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.

Appendix B

Surface Water Quality Data by Parameter

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SURFACE WATER QUALITY DATA BY PARAMETER (USEE800) FOR SITE SRK06, Slick Rock East Processing Site
 REPORT DATE: 3/22/2017 4:36 pm

PARAMETER	UNITS	LOCATION CODE	SAMPLE: DATE	ID	RESULT	QUALIFIERS: LAB DATA QA	DETECTION LIMIT	UN- CERTAINTY
Alkalinity, Total (As CaCO ₃)	mg/L	0692	09/20/2016	N001	97		#	-
	mg/L	0696	09/21/2016	N001	103		#	-
Oxidation Reduction Potential	mV	0692	09/20/2016	N001	-29.0		#	-
	mV	0696	09/21/2016	N001	43.8		#	-
pH	s.u.	0692	09/20/2016	N001	8.53		#	-
	s.u.	0696	09/21/2016	N001	8.28		#	-
Specific Conductance	umhos/cm	0692	09/20/2016	N001	374		#	-
	umhos/cm	0696	09/21/2016	N001	364		#	-
Temperature	C	0692	09/20/2016	N001	18.32		#	-
	C	0696	09/21/2016	N001	19.98		#	-
Turbidity	NTU	0692	09/20/2016	N001	19.6		#	-
	NTU	0696	09/21/2016	N001	19.1		#	-
Uranium	mg/L	0692	09/20/2016	0001	0.0007		#	1.2E-05
	mg/L	0696	09/21/2016	0001	0.0006		#	1.2E-05

SURFACE WATER QUALITY DATA BY PARAMETER (USEE800) FOR SITE SRK06, Slick Rock East Processing Site
 REPORT DATE: 3/22/2017 4:36 pm

PARAMETER	UNITS	LOCATION CODE	SAMPLE: DATE ID	RESULT	QUALIFIERS: LAB DATA QA	DETECTION LIMIT	UN- CERTAINTY
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RECORDS: SELECTED FROM USEE800 WHERE site_code='SRK06' AND (data_validation_qualifiers IS NULL OR data_validation_qualifiers NOT LIKE '%R%' AND data_validation_qualifiers NOT LIKE '%X%') AND DATE_SAMPLED between #1/1/2016# and #1/1/2017#

SAMPLE ID CODES: 000X = Filtered sample. N00X = Unfiltered sample. X = replicate number.

LAB QUALIFIERS:

- * Replicate analysis not within control limits.
- + Correlation coefficient for MSA < 0.995.
- > Result above upper detection limit.
- A TIC is a suspected aldol-condensation product.
- B Inorganic: Result is between the IDL and CRDL. Organic & Radiochemistry: 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
- M GFAA duplicate injection precision not met.
- 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.
- S Result determined by method of standard addition (MSA).
- U Analytical result below detection limit.
- W Post-digestion spike outside control limits while sample absorbance < 50% of analytical spike absorbance.
- X Laboratory defined qualifier, see case narrative.
- Y Laboratory defined qualifier, see case narrative.
- 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. |
| N Presumptive evidence that analyte is present. The analyte is "tentatively identified". | 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.

SURFACE WATER QUALITY DATA BY PARAMETER (USEE800) FOR SITE SRK05, Slick Rock West Processing Site
 REPORT DATE: 3/22/2017 4:37 pm

PARAMETER	UNITS	LOCATION CODE	SAMPLE: DATE	ID	RESULT	QUALIFIERS: LAB DATA QA	DETECTION LIMIT	UN- CERTAINTY
Alkalinity, Total (As CaCO3)	mg/L	0347	09/21/2016	N001	115		#	-
	mg/L	0349	09/21/2016	N001	112		#	-
	mg/L	0693	09/21/2016	N001	108		#	-
	mg/L	0694	09/21/2016	N001	102		#	-
Manganese	mg/L	0347	09/21/2016	0001	0.0045	J	#	0.00011
	mg/L	0349	09/21/2016	0001	0.0059		#	0.00011
	mg/L	0693	09/21/2016	0001	0.0029	J	#	0.00011
	mg/L	0694	09/21/2016	0001	0.0045	J	#	0.00011
Molybdenum	mg/L	0347	09/21/2016	0001	0.0044	J	#	0.00032
	mg/L	0349	09/21/2016	0001	0.0013	J J	#	0.00032
	mg/L	0693	09/21/2016	0001	0.0014	J J	#	0.00032
	mg/L	0694	09/21/2016	0001	0.0011	J	#	0.00032
Nitrate + Nitrite as Nitrogen	mg/L	0347	09/21/2016	0001	0.011		#	0.01
	mg/L	0349	09/21/2016	0001	0.024		#	0.01
	mg/L	0693	09/21/2016	0001	0.01	U	#	0.01
	mg/L	0694	09/21/2016	0001	0.01	U	#	0.01
Oxidation Reduction Potential	mV	0347	09/21/2016	N001	77.1		#	-
	mV	0349	09/21/2016	N001	5.0		#	-
	mV	0693	09/21/2016	N001	-38.0		#	-
	mV	0694	09/21/2016	N001	26.0		#	-
pH	s.u.	0347	09/21/2016	N001	8.17		#	-
	s.u.	0349	09/21/2016	N001	8.15		#	-
	s.u.	0693	09/21/2016	N001	8.33		#	-
	s.u.	0694	09/21/2016	N001	8.38		#	-
Selenium	mg/L	0347	09/21/2016	0001	0.0089	J	#	0.00066
	mg/L	0349	09/21/2016	0001	0.001	J J	#	0.00066
	mg/L	0693	09/21/2016	0001	0.001	J	#	0.00066
	mg/L	0694	09/21/2016	0001	0.0006	U	#	0.00066
Specific Conductance	umhos/cm	0347	09/21/2016	N001	377		#	-
	umhos/cm	0349	09/21/2016	N001	369		#	-
	umhos/cm	0693	09/21/2016	N001	365		#	-
	umhos/cm	0694	09/21/2016	N001	364		#	-
Temperature	C	0347	09/21/2016	N001	17.71		#	-
	C	0349	09/21/2016	N001	19.88		#	-
	C	0693	09/21/2016	N001	22.82		#	-

SURFACE WATER QUALITY DATA BY PARAMETER (USEE800) FOR SITE SRK05, Slick Rock West Processing Site
REPORT DATE: 3/22/2017 4:37 pm

PARAMETER	UNITS	LOCATION CODE	SAMPLE: DATE	ID	RESULT	QUALIFIERS: LAB DATA QA	DETECTION LIMIT	UN-CERTAINTY
Temperature	C	0694	09/21/2016	N001	19.26		#	-
Turbidity	NTU	0347	09/21/2016	N001	18.7		#	-
	NTU	0349	09/21/2016	N001	242		#	-
	NTU	0693	09/21/2016	N001	67.4		#	-
	NTU	0694	09/21/2016	N001	50.5		#	-
Uranium	mg/L	0347	09/21/2016	0001	0.0007		#	1.2E-05
	mg/L	0349	09/21/2016	0001	0.0006		#	1.2E-05
	mg/L	0693	09/21/2016	0001	0.0007		#	1.2E-05
	mg/L	0694	09/21/2016	0001	0.0006		#	1.2E-05

RECORDS: SELECTED FROM USEE800 WHERE site_code='SRK05' AND (data_validation_qualifiers IS NULL OR data_validation_qualifiers NOT LIKE '%R%' AND data_validation_qualifiers NOT LIKE '%X%') AND DATE_SAMPLED between #1/1/2016# and #1/1/2017#

SAMPLE ID CODES: 000X = Filtered sample. N00X = Unfiltered sample. X = replicate number.

LAB QUALIFIERS:

- * Replicate analysis not within control limits.
- + Correlation coefficient for MSA < 0.995.
- > Result above upper detection limit.
- A TIC is a suspected aldol-condensation product.
- B Inorganic: Result is between the IDL and CRDL. Organic & Radiochemistry: 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
- M GFAA duplicate injection precision not met.
- 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.
- S Result determined by method of standard addition (MSA).
- U Analytical result below detection limit.
- W Post-digestion spike outside control limits while sample absorbance < 50% of analytical spike absorbance.
- X Laboratory defined qualifier, see case narrative.
- Y Laboratory defined qualifier, see case narrative.
- Z Laboratory defined qualifier, see case narrative.

DATA QUALIFIERS:

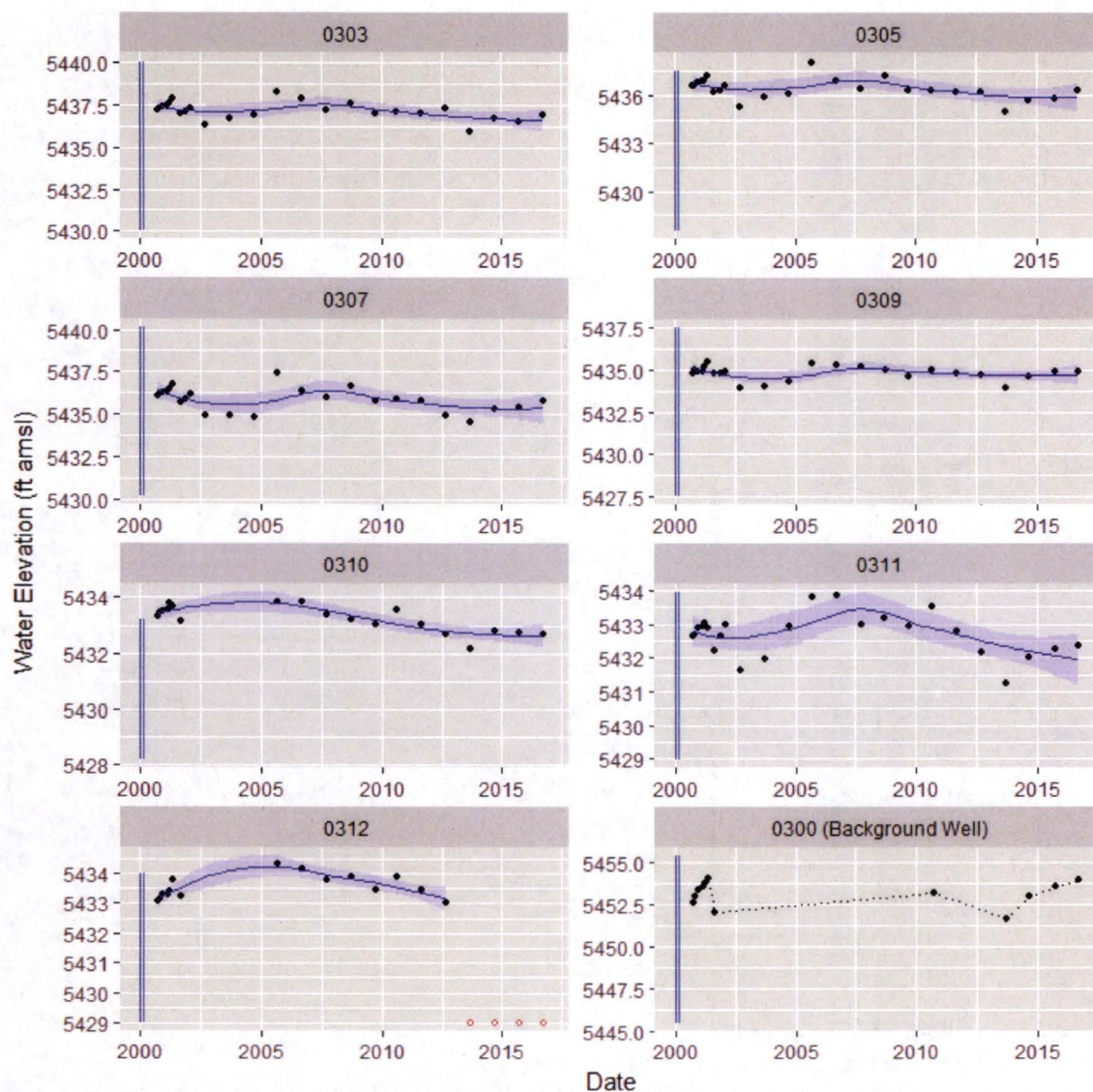
- F Low flow sampling method used.
- J Estimated value.
- N Presumptive evidence that analyte is present. The analyte is "tentatively identified".
- R Unusable result.
- X Location is undefined.
- G Possible grout contamination, pH > 9.
- L Less than 3 bore volumes purged prior to sampling.
- Q Qualitative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

QA QUALIFIER: # = validated according to Quality Assurance guidelines.

Appendix C

Hydrographs and Static Water Level Data

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Notes:

— Blue line is LOESS local regression line.

Shaded area is corresponding 95% pointwise confidence interval.

The LOESS smoothing line is omitted from the plot for background location 0300 because of the gap in sampling between 2001 and 2010.

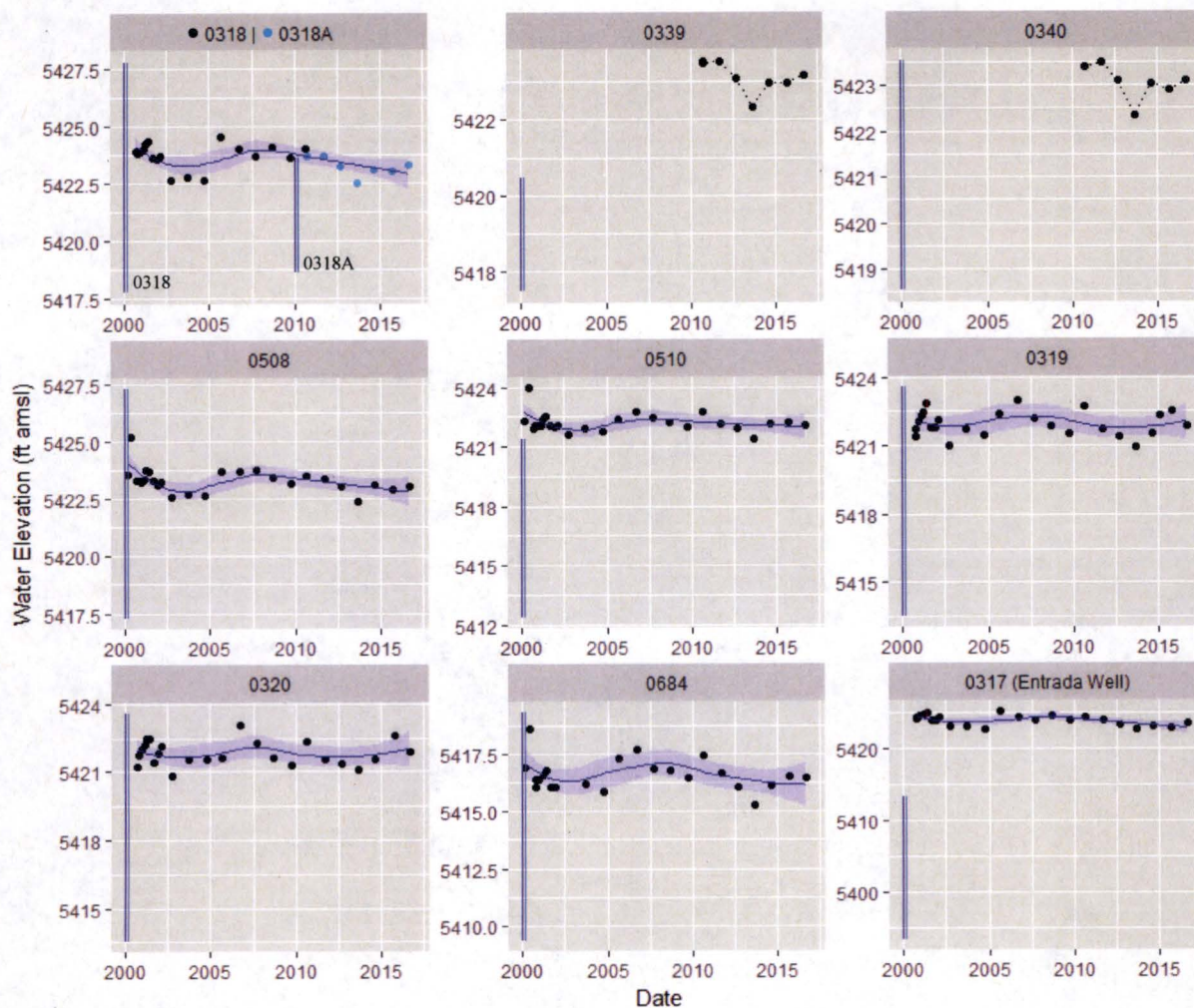
|| Vertical lines along left y-axis denote the screened interval.

⬆ Denotes that the well was dry or had insufficient water to sample (assigned values = screen bottom elevation).

Abbreviation:

ft amsl = feet above mean sea level

Figure C-1. Hydrographs for SRE Processing Site Wells



Notes:

— Blue line is LOESS local regression line.

Shaded area is corresponding 95% pointwise confidence interval.

Wells 0318A, 0339 and 0340 were installed on September 28, 2010 (well 0318A replaced abandoned well 0318); the LOESS smoothing line is omitted for wells 0339 and 0340 due to lack of data.

Alluvial wells are listed in general order of distance from site source area.

|| Vertical lines along left y-axis denote the screened interval.

Abbreviation:

ft amsl = feet above mean sea level

Figure C-2. Hydrographs for SRW Processing Site Wells