LMS/RFS/43672

Surface Water Configuration Adaptive Management Plan Annual Report for the Rocky Flats Site, Colorado

Calendar Year 2022

February 2023

U.S. DEPARTMENT OF ENERGY | Legacy Management

This document has been designed for online viewing.

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Abbreviations

Am	americium
AMP	Adaptive Management Plan
AOC	Area of Concern
cfs	cubic feet per second
COU	Central Operable Unit
CY	calendar year
DOE	U.S. Department of Energy
FONSI	Finding of No Significant Impact
LM	Office of Legacy Management
µg/L	micrograms per liter
mg/L	milligrams per liter
nitrate	nitrate + nitrite as nitrogen
pCi/L	picocuries per liter
POC	Point of Compliance
POE	Point of Evaluation
Pu	plutonium
RFLMA	*Rocky Flats Legacy Management Agreement*
SID	South Interceptor Ditch
SPPTS	Solar Ponds Plume Treatment System
TSS	total suspended solids

1.0 Introduction

The proposed action assessed in the *Rocky Flats Site, Colorado, Surface Water Configuration Environmental Assessment* (DOE 2011) and the resulting Finding of No Significant Impact (FONSI) is to breach the remaining retention pond dams at the Rocky Flats Site, Colorado (Site), to allow surface water flow to return to approximately the same conditions that were present before construction of the retention ponds. From extensive water quality monitoring data and a thorough environmental review, and as stated in the FONSI, the U.S. Department of Energy (DOE) Office of Legacy Management has determined that the proposed action does not present a significant impact on the environment under the National Environmental Policy Act's evaluation criteria.

Some members of the public have commented that additional information must be collected before DOE implements the final steps of the proposed action. The additional information will help reduce uncertainty about whether completion of the proposed action will adversely impact the quality of water flowing from the Site into downstream communities. In response to the requests, DOE worked with neighboring community representatives and other interested stakeholders to develop and implement a *Surface Water Configuration Adaptive Management Plan for the Rocky Flats Site, Colorado* (DOE 2021), hereafter referred to as the Adaptive Management Plan (AMP), to provide additional information. The AMP group is composed of these representatives and stakeholders. The resulting AMP reflects DOE's long-term commitment to collect this additional information.

The AMP provides for a monitoring and data evaluation program to assist in deciding whether to implement the final steps of the proposed action (which includes breaching the terminal dams, initially planned for the 2018–2020 time frame) or to delay completion of the proposed action to gather additional information for evaluation. The terminal dams will be operated in a flow-through condition leading up to the completion of the proposed action, which will provide data similar to what can be expected after the breach. In addition to the AMP monitoring program, the AMP identifies certain performance indicators that DOE will consider in deciding whether to adjust the time frame for completing the proposed action.

This AMP annual report for calendar year (CY) 2022 is provided in accordance with the reporting requirements described in Section 5.0 of the AMP. Table 12, at the end of this report, includes all validated analytical data available as of January 16, 2023, including any validated data that were not tabulated in previous AMP reports.

In addition, to make data exchange as timely as possible, the monitoring summary sections below include all analytical data available as of January 15, 2023, including *unvalidated* analytical data (which are preliminary and subject to revision). Therefore, the evaluations in the monitoring summary sections that follow are not limited to the validated 2022 data tabulated in Table 12. Instead, the evaluations also consider any available unvalidated data, if appropriate.

The following monitoring objectives are addressed in this report:

- Predischarge monitoring
- Targeted groundwater monitoring
- Monitoring to evaluate flow-through operations at terminal ponds A-4, B-5, and C-2
- Storm-event monitoring
- Continuous flow-paced composite sampling to evaluate uranium transport
- Grab sampling for uranium in North and South Walnut Creeks
- Grab sampling for nitrate + nitrite as nitrogen in Walnut Creek

In this report, “plutonium” or “Pu” refers to plutonium-239 and plutonium-240, or $^{239}Pu + {}^{240}Pu$; “americium” or “Am” refers to americium-241 or ^{241}Am; and “nitrate” refers to nitrate + nitrite as nitrogen. In addition, the terms “activity” and “concentration” are used interchangeably for both Pu and Am to represent the amount of radioactivity or radioactive material per unit of water (i.e., picocuries per liter [pCi/L]).

2.0 AMP Highlights: Fourth Quarter CY 2022

- Four informal emails were transmitted to AMP participants providing notification that composite samples had been retrieved from the Point of Compliance (POC) on Woman Creek at the Central Operable Unit (COU) boundary.
- One informal email was transmitted to AMP participants providing notification that recent analytical data from the POCs had been validated and would soon be available through the Geospatial Environmental Mapping System (GEMS).
- During the fourth quarter of CY 2022, 19 samples were collected in support of AMP monitoring objectives.

3.0 Water Quality Monitoring

AMP monitoring objectives, locations, and sampling criteria are itemized in Table 2 of the AMP. Additional field implementation protocols for the AMP monitoring objectives can be found in *Additional Field Implementation Detail for Selected Monitoring Objectives at the Rocky Flats Site, Colorado* (DOE).

3.1 Predischarge Monitoring

This monitoring objective is intended to evaluate whether pond water from Ponds A-4, B-5, or C-2 would be expected to meet water quality standards at downstream monitoring locations before opening a valve to initiate a period of flow-through discharge. Predischarge samples would be collected at sampling locations A4POND on North Walnut Creek, B5POND on South Walnut Creek, and C2POND on Woman Creek before opening a valve. These sampling locations are shown in Figure 1.

Since Ponds A-4, B-5, and C-2 were operated in flow-through mode for all of CY 2022 (i.e., the valves were open throughout the year), no predischarge samples were collected.

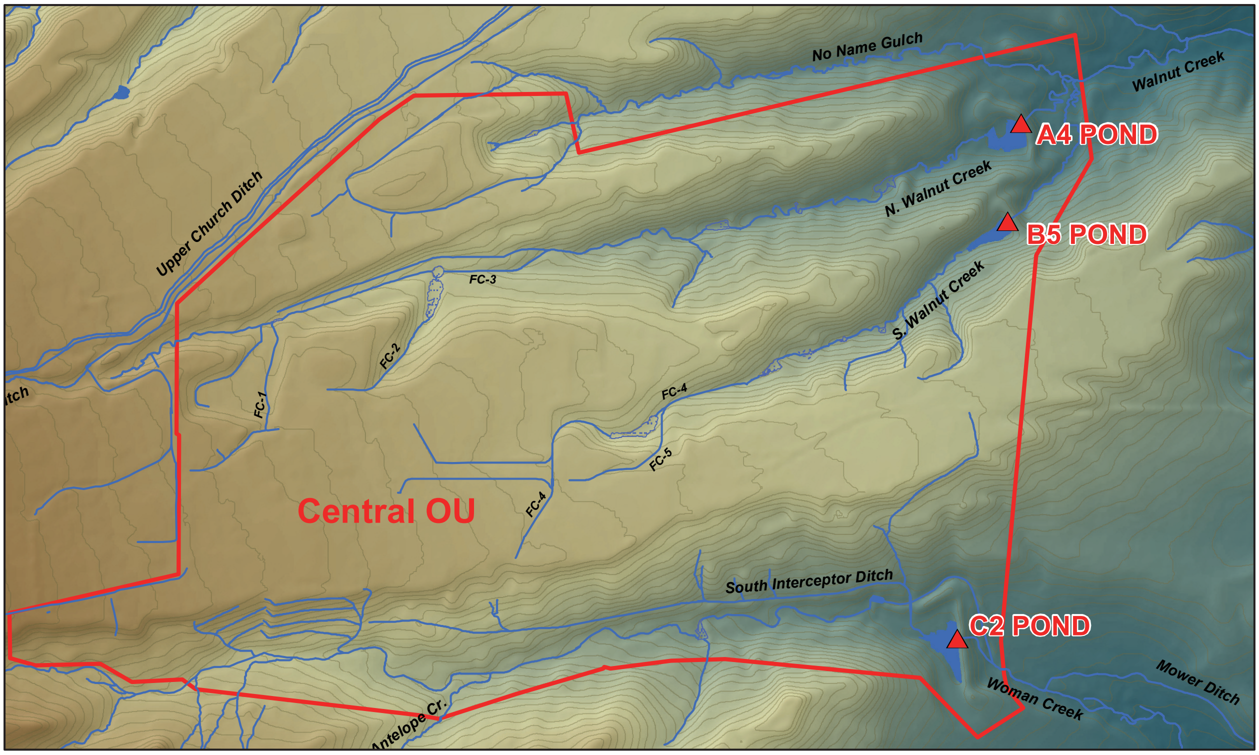


Figure 1. Rocky Flats Site Predischarge Monitoring Locations

3.2 Targeted Groundwater Monitoring

The AMP-targeted groundwater monitoring wells (Figure 2) are the same as the *Rocky Flats Legacy Management Agreement* (CDPHE et al. 2007) (RFLMA) Area of Concern (AOC) wells. Each AOC well is within a drainage and downgradient of a contaminant plume or group of contaminant plumes. Water quality data are collected to determine whether plumes may be discharging to surface water. These AOC wells are sampled semiannually in the second and fourth calendar quarters.

Data from these wells are evaluated in the RFLMA-required annual report, according to the flowchart in Figure 7 in Attachment 2 to the RFLMA (CDPHE et al. 2007). Analytical data undergo preliminary evaluation as data become available; this is necessary because of the strict timeline attached to “reportable conditions” for AOC wells. In accordance with and as defined in the RFLMA (CDPHE et al. 2007), if the data are confirmed to be valid and meet the requirements of a reportable condition, the reporting process under the RFLMA (CDPHE et al. 2007) is initiated. No reportable conditions were triggered by analytical results for samples collected from AOC wells in 2022.

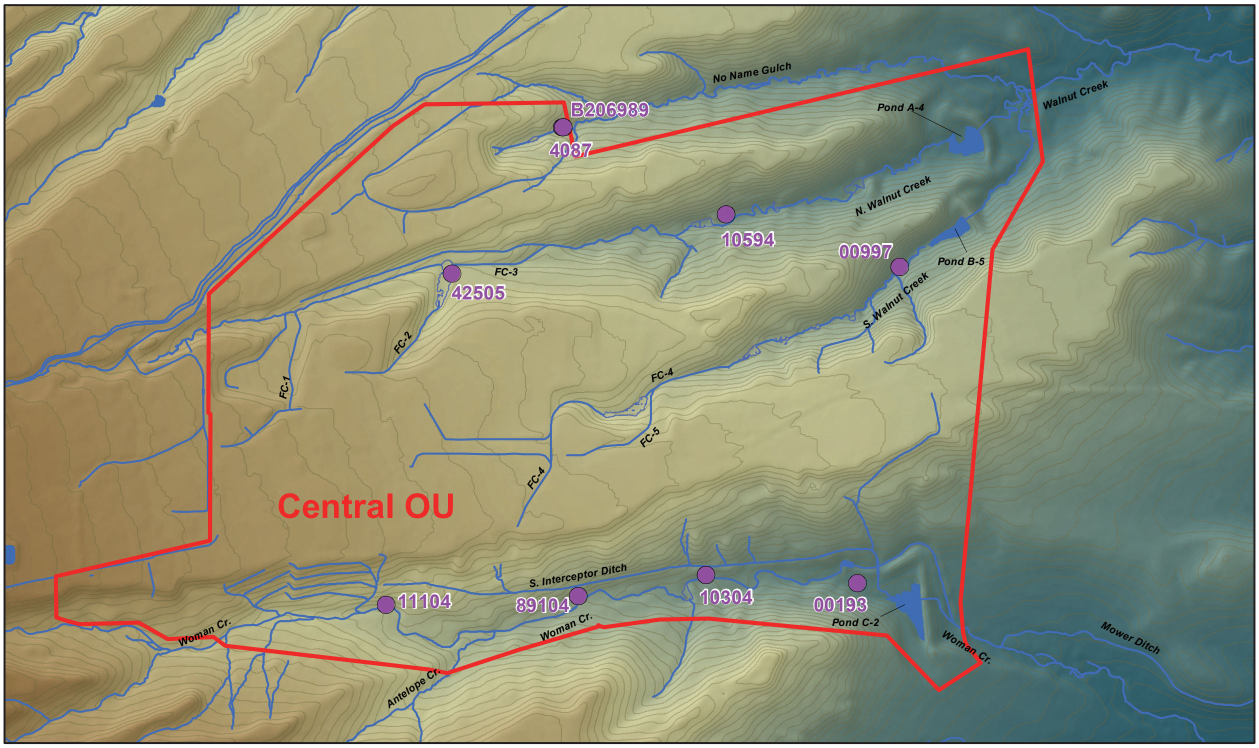
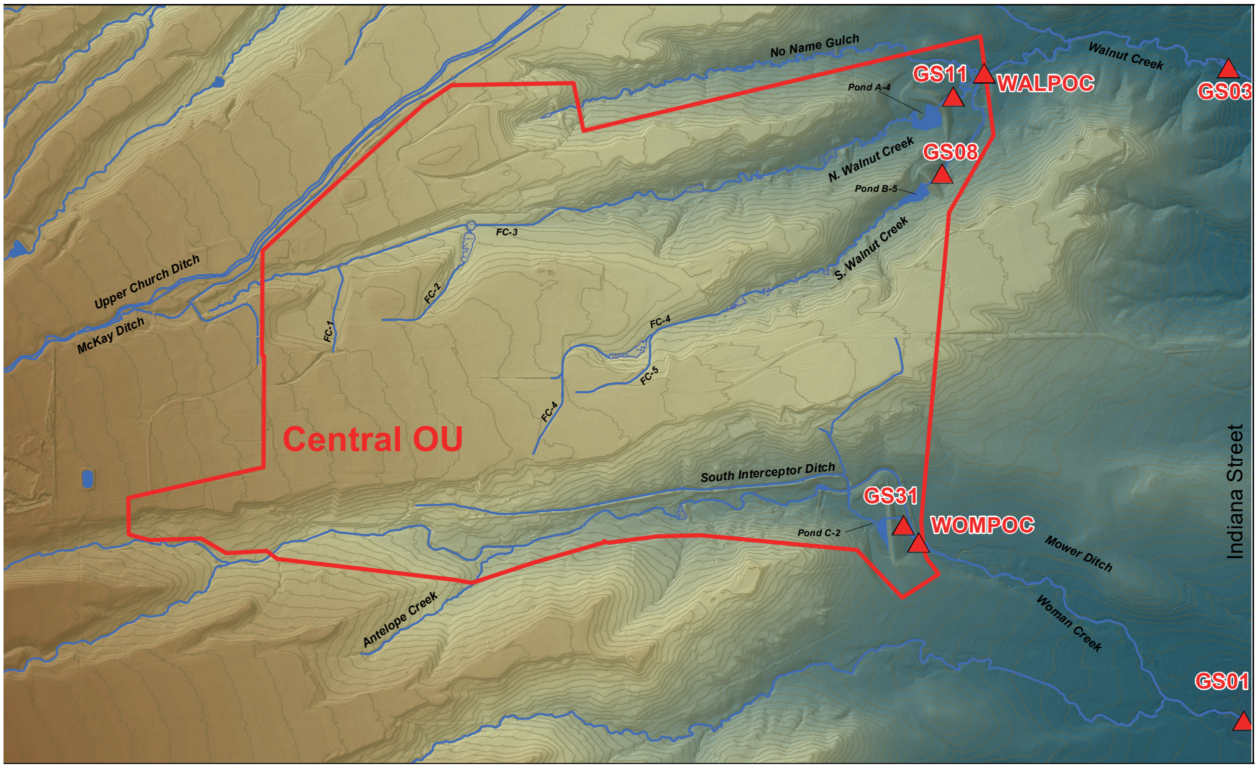


Figure 2. Targeted Groundwater Monitoring Locations

3.3 Monitoring to Evaluate Flow-Through Operations at Terminal Ponds A-4, B-5, and C-2

This objective involves collecting water quality data during flow-through operations to simulate post-breach conditions to determine if water leaving the COU will meet water quality standards after the terminal dams are breached. Samples for Pu, Am, and uranium analyses are collected as continuous flow-paced composites during all flow conditions; grab samples are collected for nitrate analyses. The specific locations are shown in Figure 3.



Note: Monitoring at locations GS01 and GS03 was discontinued on October 1, 2015.

Figure 3. Flow-Through Operations Monitoring Locations

The two locations at the COU boundary, WALPOC and WOMPOC, became POCs on September 28 and September 9, 2011, respectively.[1] At that time, locations GS03 and GS01 were also being operated as POCs and continued to be operated as POCs until September 28 and September 9, 2013, respectively. Following those dates and at the request of the AMP participants, locations GS03 and GS01 were operated as AMP monitoring locations for 2 years. Monitoring at both locations was discontinued on October 1, 2015.

Flow-through operation of Ponds A-4 and B-5 began on September 12, 2011, which was also the first day of flow at WALPOC. Flow-through operation of Pond C-2 began on November 7, 2011. WOMPOC first began measuring flow from Woman Creek on October 14, 2011.

During CY 2022, Pond A-4 (location GS11) discharged for only 13 days from June 1 to June 13, 2022; location GS11 was dry the remainder of the year. Pond B-5 (location GS08) discharged intermittently for 44 days from March 17 to June 7, 2022; location GS08 was dry the remainder of the year. As of January 15, 2023, locations GS08 and GS11 were dry.

Pond C-2 (location GS31) discharged intermittently from February 27 to June 5, 2022, was dry until November 14, 2022, and subsequently flowed the remainder of the year. As of January 15, 2023, location GS31 was flowing.

[1] Although WALPOC was officially designated as a RFLMA POC on September 28, 2011, operational testing and sampling began on September 9, 2011. Data collected during operational testing are used in the evaluation in this section.

Table 1 summarizes the flow and sampling conditions for each location as of January 15, 2023.

Table 1. Flow and Sampling Detail for Flow-Through Monitoring Locations

Location	Latest Flow[a]	Latest Available Composite Sample Results	Current Composite Sample Start Date (in progress)
GS08	Currently dry	1/18/2022–4/4/2022[b]	4/4/2022
GS11	Currently dry	6/16/2021–7/14/2021[c]	1/18/2022
WALPOC	Currently dry	1/18/2022–6/25/2022[d]	1/17/2023
GS31	Currently flowing	1/18/2022–3/20/22[e]	3/20/2022
WOMPOC	Currently flowing	10/25/2022–12/12/2022[f]	1/17/2023

Notes:
[a] As of January 15, 2023.
[b] Due to low flows, the GS08 composite sample started on April 4, 2022, is still in progress.
[c] Due to no flow, no samples were collected at GS11 from July 14, 2021, to January 18, 2022. Due to low flows, the composite sample started on January 18, 2022, is still in progress.
[d] Due to no flow, no samples were collected at WALPOC from June 25, 2022, to January 17, 2023.
[e] Due to low flows, the GS31 composite sample started on March 20, 2022, is still in progress.
[f] Analytical results for the WOMPOC composite sample for December 12, 2022, to January 17, 2023, are pending.

3.3.1 Walnut Creek Evaluation

Table 2 presents long-term volume-weighted averages in Walnut Creek for the postclosure batch release period[2] (October 2005 to September 2011) and the period since flow-through pond operations began (September 2011 to the present). Figure 4 through Figure 11 present the 30-day and 12-month rolling averages for each location, analyte, and time period.[3,4]

Compared to batch operations, as expected, the plots show increased variability and concentrations for all analytes at both outlet locations after initiation of flow-through operations. Concentrations for Pu and Am remain well below the 0.15 pCi/L water quality standard at all locations except GS08.[5]

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[2] Before the ponds were operated in a flow-through mode (the outlet valves are continuously left open) in September 2011, the ponds were operated in "batch release" mode. Under batch release mode, water was stored in each pond (the outlet valve was closed) generally over several months until the pond was partially filled (normally to 40%–60% of capacity). At that point, the outlet valve was temporarily opened (1–3 weeks) to discharge the stored water and lower the pond level to about 10% of capacity, at which point the outlet valve was closed to start another batch cycle.

[3] The RFLMA standards shown on these plots are for reference only. The RFLMA-required evaluation is location specific (i.e., at particular POCs and Points of Evaluation) and is not part of this AMP report. Evaluation of sampling results as required by the RFLMA (CDPHE et al. 2007) is routinely presented in other reports in accordance with the RFLMA reporting requirements.

[4] Due to the interruptions in automated sampling and the corresponding lack of analytical data for some periods during the unusual September 2013 flood, for comparison purposes, the start of the high runoff (which began late in the day on September 11, 2013) through its end on September 13, 2013, is not included in the evaluation in this section. Additionally, some data are estimated to enable the comparison herein; under RFLMA data evaluation protocols, these estimated data would not be included.

[5] The short-term increase at GS08 is the result of two consecutive samples collected in 2015.

During batch operations, water was accumulated in the ponds for several months, effectively mixing water of differing concentrations into a homogeneous volume. Therefore, flow-through 30-day averages show increased day-to-day variability since water is no longer batched and mixed before discharge. Conversely, flow-through 12-month rolling averages show month-to-month variability more comparable to that of batch operations.

Table 2. Volume-Weighted Averages for Walnut Creek Flow-Through Monitoring Locations

Walnut Creek: October 2005–September 2011 (Batch Release)

		Uranium (μg/L)		Pu-239,240 (pCi/L)		Am-241 (pCi/L)		NO3+NO2 as N (mg/L)	
	Location Code	Volume-Weighted Average	Sample Count	Volume-Weighted Average	Sample Count	Volume-Weighted Average	Sample Count	Volume-Weighted Average	Sample Count
Upstream	GS08 / GS11	8.8 / 7.6	33 / 36	0.004 / 0.004	33 / 36	0.003 / 0.003	33 / 36	2.79 [GS11 only]	36
Downstream	GS03	4.9	68	0.006	68	0.004	68	0.94	43

Walnut Creek: September 2011–Present (Flow-Through)

		Uranium (μg/L)		Pu-239,240 (pCi/L)		Am-241 (pCi/L)		NO3+NO2 as N (mg/L)	
	Location Code	Volume-Weighted Average	Sample Count	Volume-Weighted Average	Sample Count	Volume-Weighted Average	Sample Count	Volume-Weighted Average	Sample Count
Upstream	GS08 / GS11	9.8 / 10.1	87 / 74	0.023 / 0.021	87 / 74	0.014 / 0.012	87 / 74	4.98 [GS11 only]	72
↓	WALPOC	9.8	124	0.017	124	0.012	124	2.30	124
Downstream	GS03	5.6	44	0.016	43	0.011	43	2.04	40

Notes:

Sample counts fluctuate because composite sampling periods vary with water availability.

The summary includes all data available as of January 15, 2023; some recent data are not validated (i.e., are preliminary and subject to revision).

No Name Gulch is a tributary to Walnut Creek, just upstream of WALPOC; any water that flows in No Name Gulch and reaches Walnut Creek could affect water quality at WALPOC.

Monitoring at GS03 was discontinued on October 1, 2015.

Abbreviations:

μg/L = micrograms per liter
mg/L = milligrams per liter
N = nitrogen
NO_2 = nitrite
NO_3 = nitrate

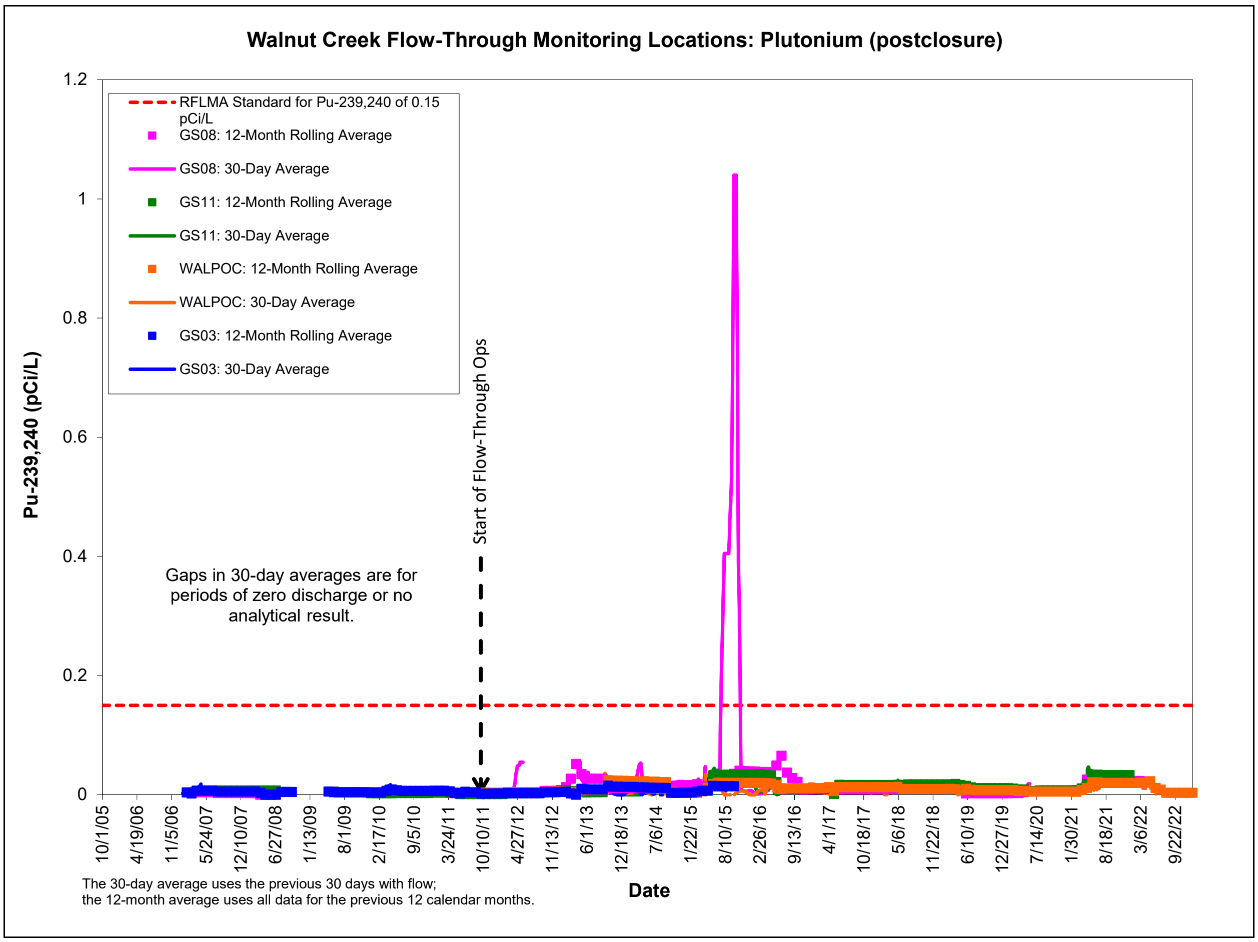
At GS08, two composite samples (7/6/2015–8/31/2015 and 8/31/2015–10/12/2015) showed higher than normal Pu and Am concentrations (Figure 4 through Figure 7). While concentrations at these levels have not been frequently observed since closure, similar concentrations were observed several times during the closure process. Plutonium and Am concentrations at GS08 have remained at more normal levels since October 2015.

Uranium and nitrate concentrations are variable in Walnut Creek due to the seasonal variation in groundwater seepage and direct runoff from storm events (Figure 8 through Figure 11). At the locations listed in Table 1, normally more than half the annual flow is measured from March through May. Runoff during this period reduces the proportion of groundwater in streamflows. Since uranium and nitrate in surface water at the Site generally originate with groundwater seepage to the creeks, the normal spring runoff reduces uranium and nitrate concentrations in streamflow.

Uranium and nitrate increases were also noted for several months following the September 2013 flood event. This extreme event resulted in extensive streambed scour and increased groundwater recharge. This recharge subsequently increased the volumes of groundwater reaching the creeks from seepage, thereby sustaining high base flow for an extended period. An extensive geochemistry study was conducted to examine the transport mechanisms associated with uranium and nitrate at the Site and the effects of the September 2013 flood. The report can be found at the Office of Legacy Management's (LM) Rocky Flats website (https://www.energy.gov/lm/rocky-flats-site-colorado). Updates to this report, completed in 2019 and 2021, can also be found at LM's Rocky Flats website.

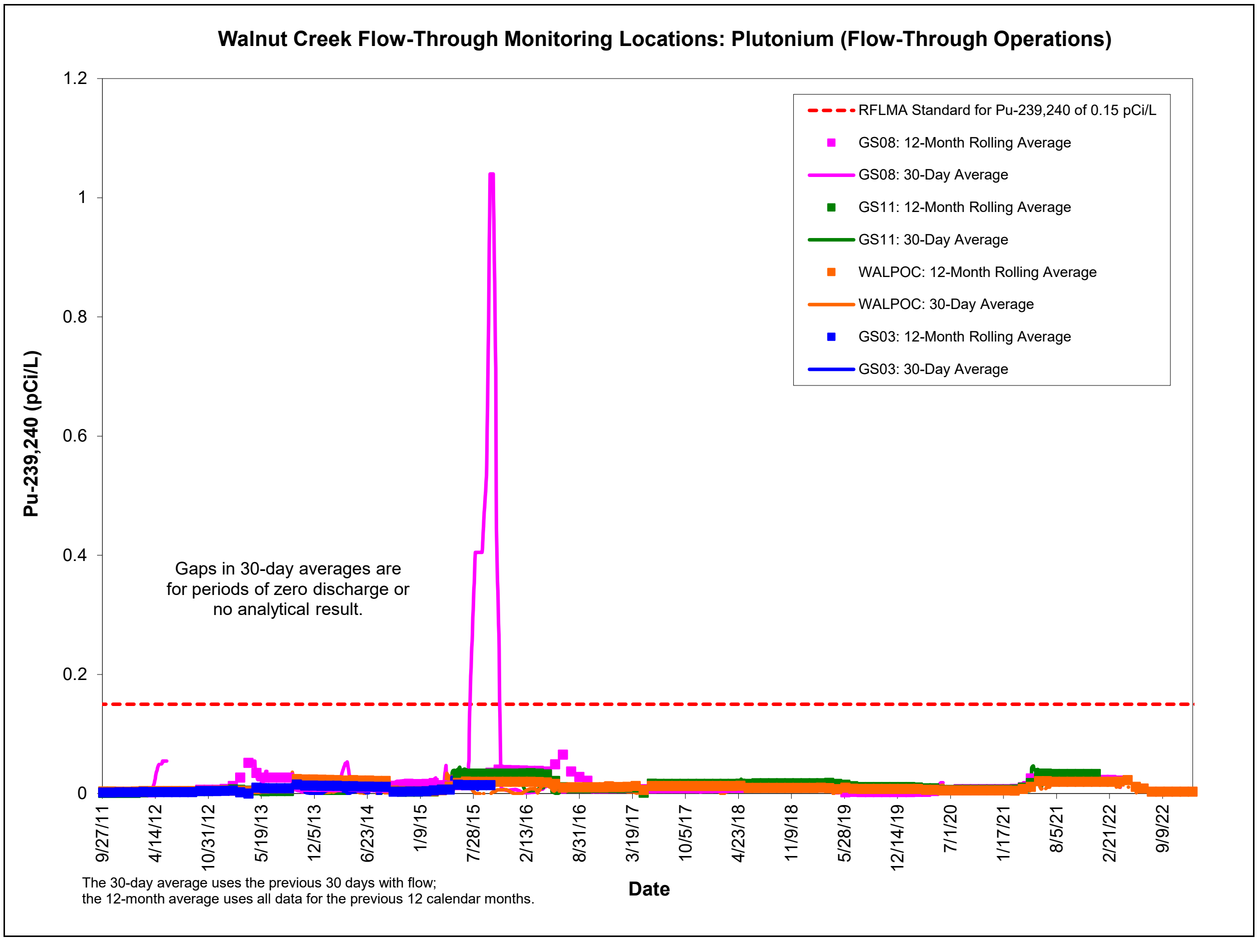
Concentrations of both uranium and nitrate in surface water also generally increase in the winter months. Because both constituents are associated with groundwater sources, uranium and nitrate concentrations in surface water increase when there is little surface runoff and groundwater makes up a larger portion of the streamflow. Also, natural biological activity that consumes nitrate slows down in the lower temperature winter months, thus increasing concentrations. Since geochemical conditions are naturally more oxidizing in the winter, uranium can become more mobile and concentrations can increase. These mechanisms were investigated in depth and described in the geochemistry study mentioned above.

Upgrades to nitrate treatment at the Solar Ponds Plume Treatment System (SPPTS) were completed in October 2016. Subsequently, a significant reduction of nitrate concentrations in North Walnut Creek was observed (Figure 10 and Figure 11).



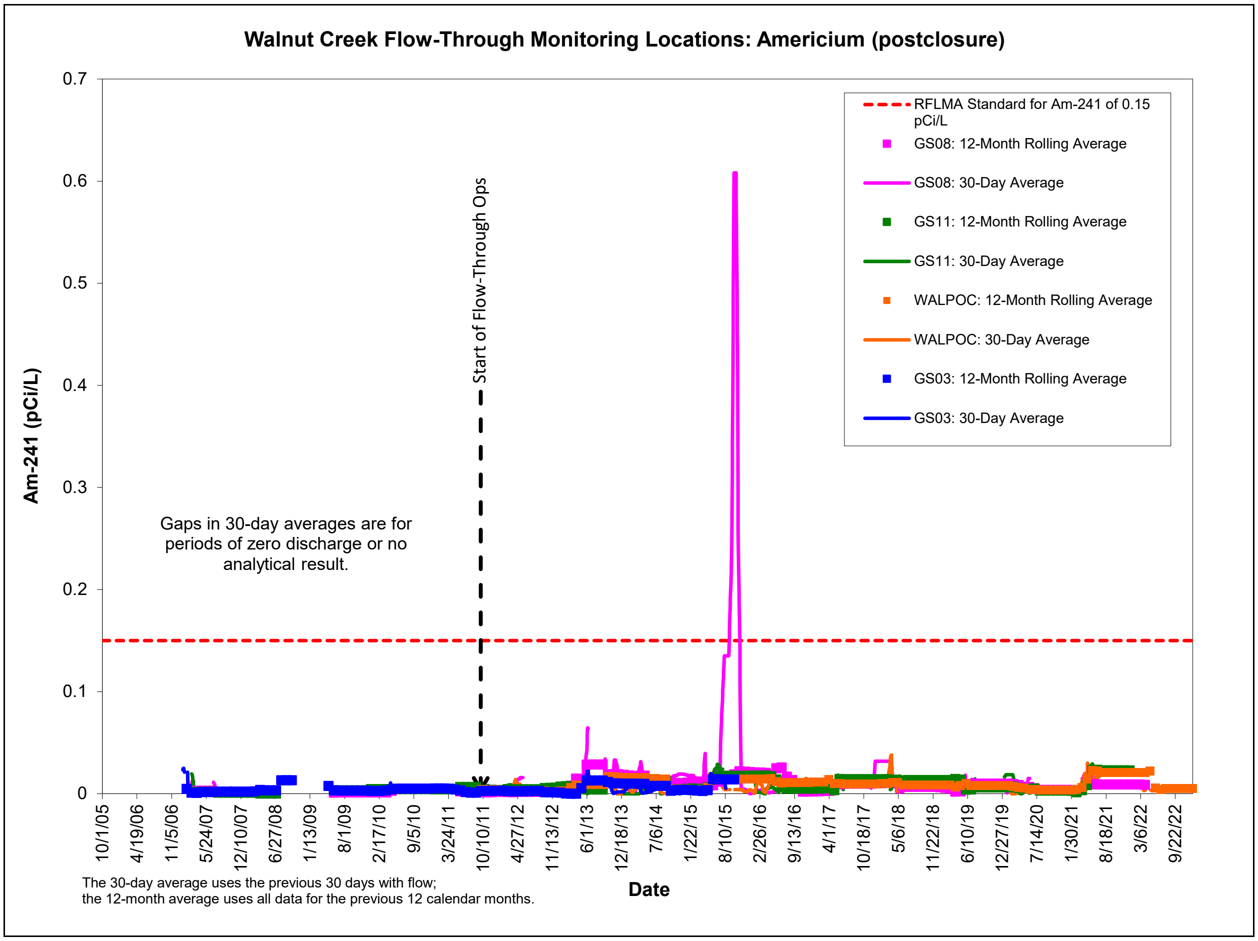
Note: Monitoring at GS03 was discontinued on October 1, 2015.

Figure 4. Rolling Plutonium Averages at Walnut Creek Flow-Through Locations: Postclosure Period



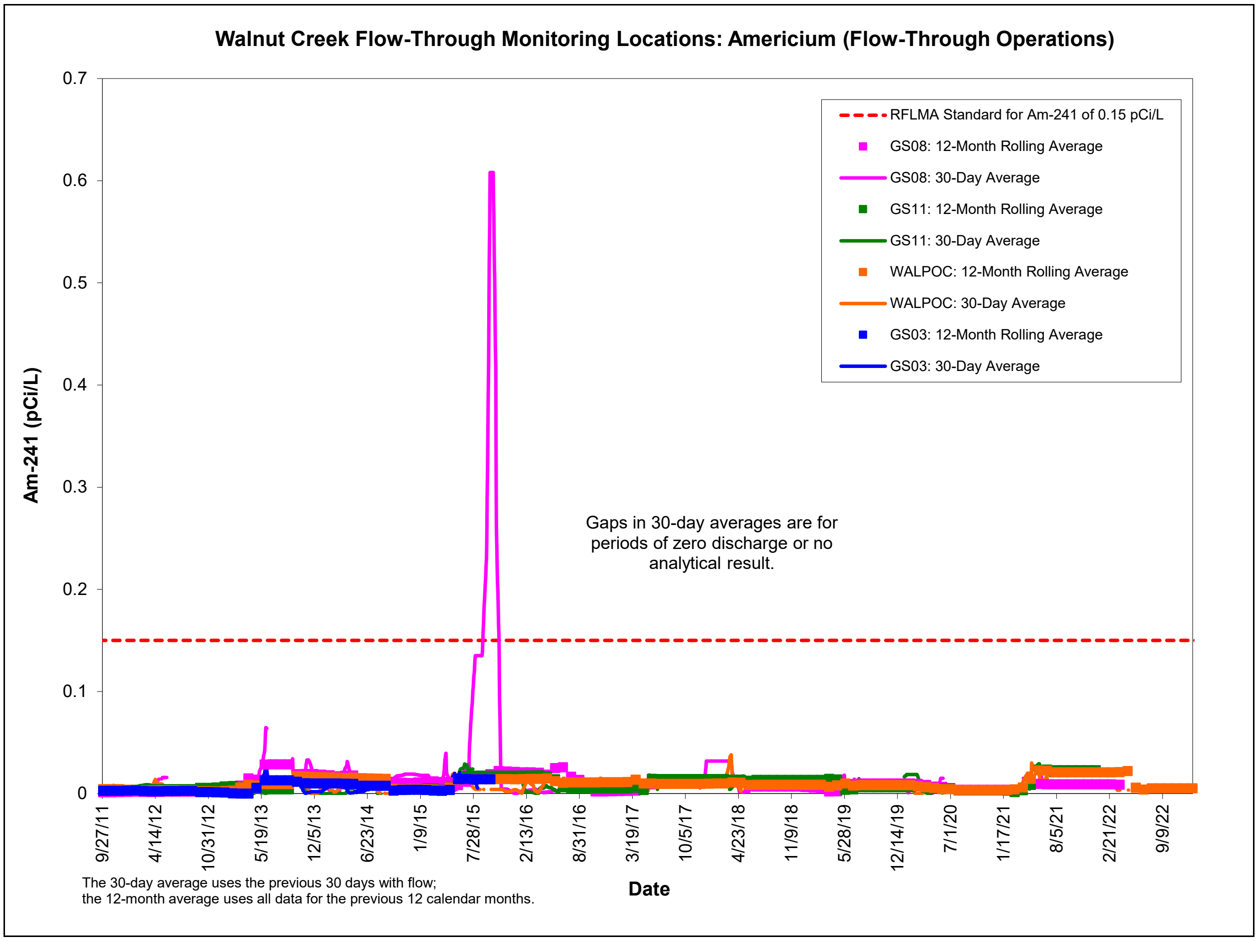
Note: Monitoring at GS03 was discontinued on October 1, 2015.

Figure 5. Rolling Plutonium Averages at Walnut Creek Flow-Through Locations: Flow-Through Period



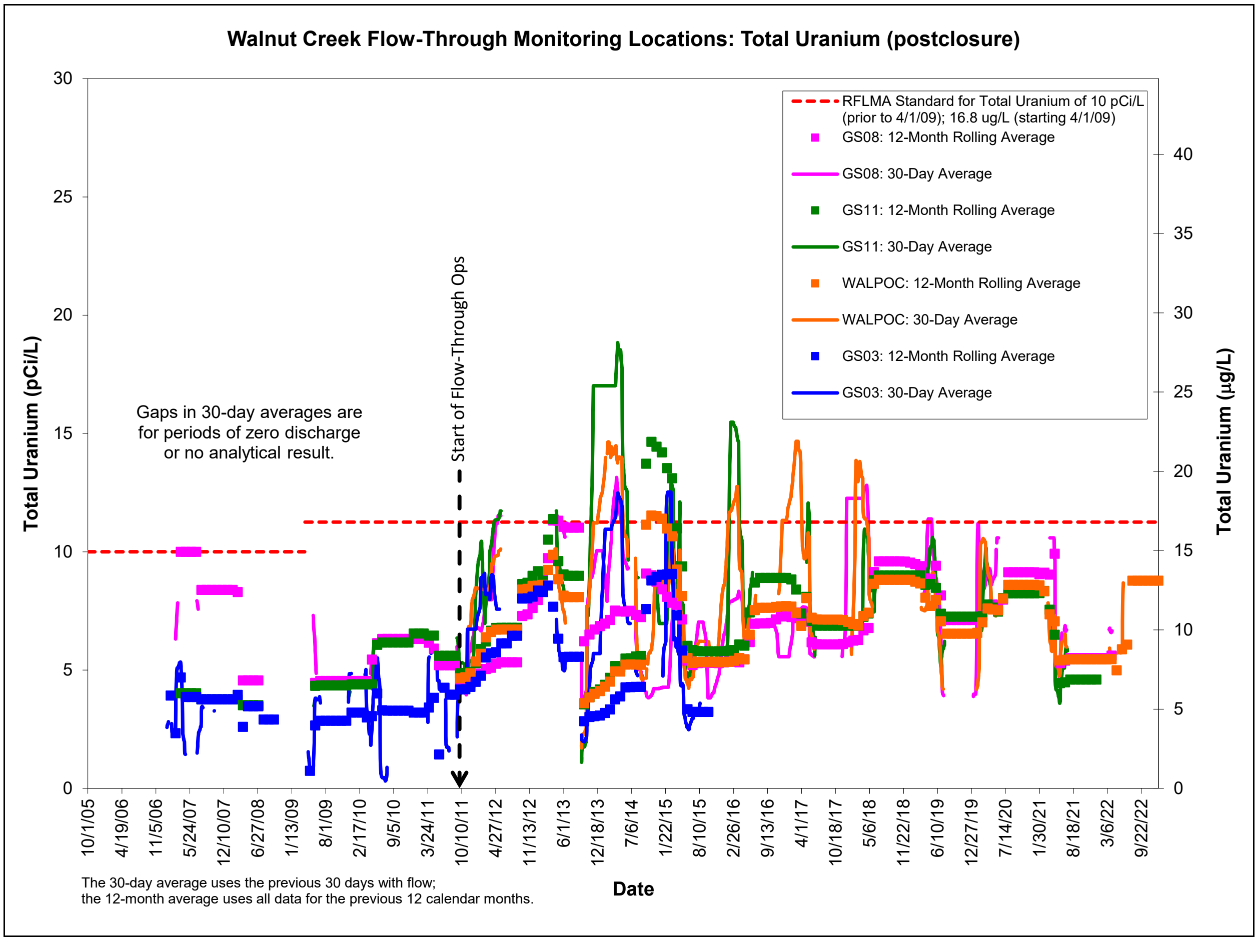
Note: Monitoring at GS03 was discontinued on October 1, 2015.

Figure 6. Rolling Americium Averages at Walnut Creek Flow-Through Locations: Postclosure Period



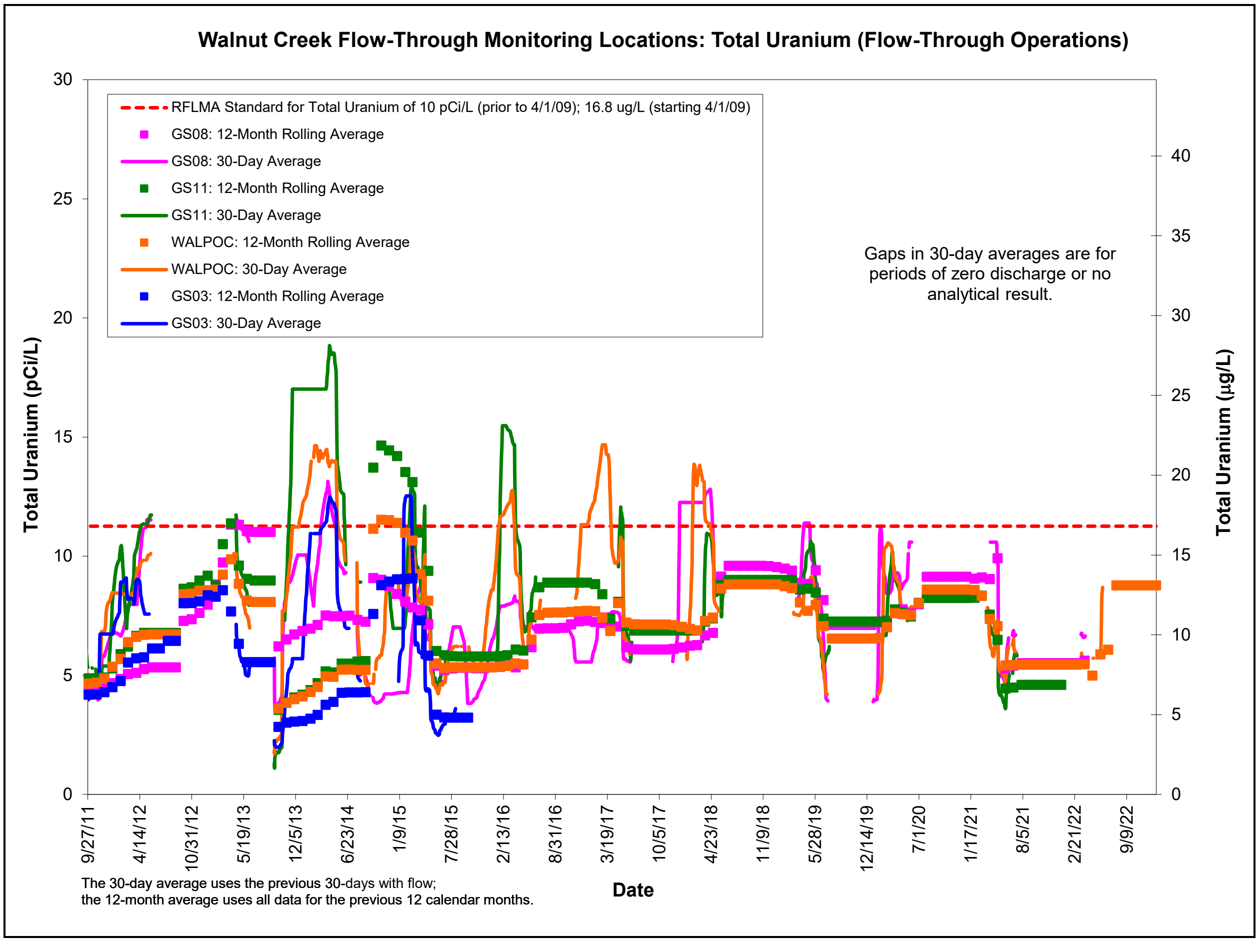
Note: Monitoring at GS03 was discontinued on October 1, 2015.

Figure 7. Rolling Americium Averages at Walnut Creek Flow-Through Locations: Flow-Through Period



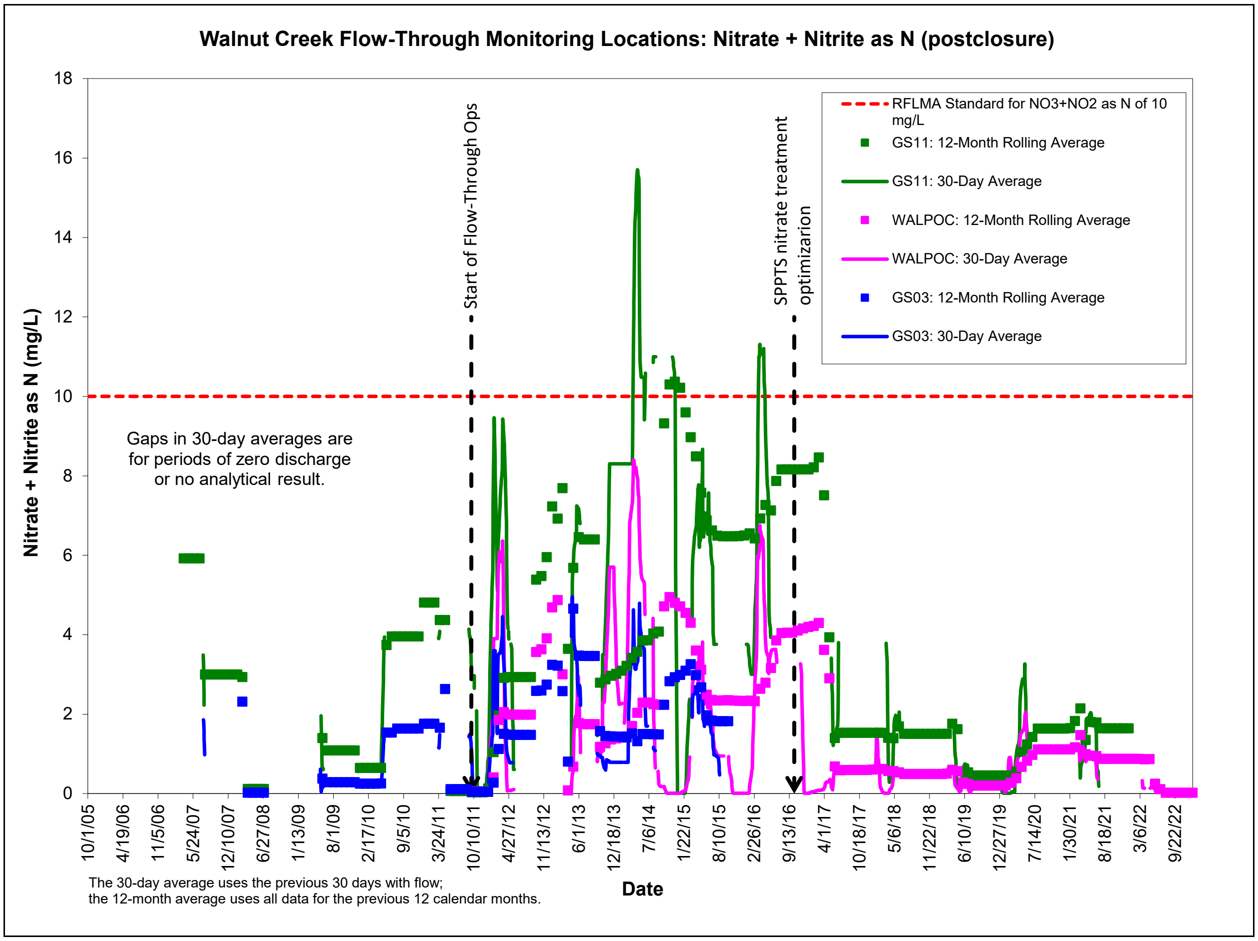
Notes: Monitoring at GS03 was discontinued on October 1, 2015. To show uranium units of both pCi/L and µg/L, the conversion 1 µg/L = 0.67 pCi/L is used.
Abbreviation: µg/L = micrograms per liter

Figure 8. Rolling Uranium Averages at Walnut Creek Flow-Through Locations: Postclosure Period



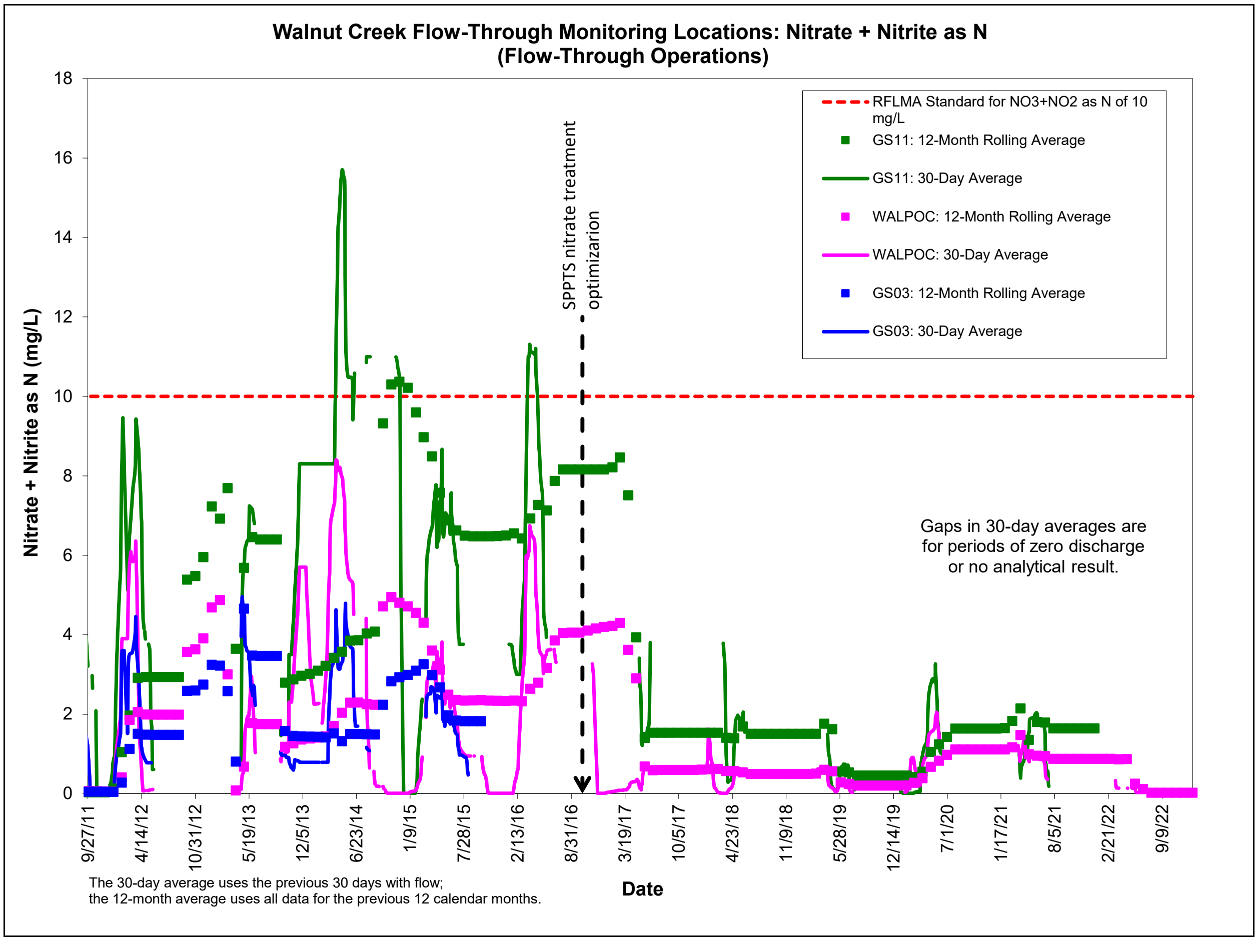
Notes: Monitoring at GS03 was discontinued on October 1, 2015. To show uranium units of both pCi/L and µg/L, the conversion 1 µg/L = 0.67 pCi/L is used.
Abbreviation: µg/L = micrograms per liter

Figure 9. Rolling Uranium Averages at Walnut Creek Flow-Through Locations: Flow-Through Period



Note: Monitoring at GS03 was discontinued on October 1, 2015.
Abbreviations: mg/L = milligrams per liter, N = nitrogen, NO_2 = nitrite, NO_3 = nitrate

Figure 10. Rolling Nitrate + Nitrite as Nitrogen Averages at Walnut Creek Flow-Through Locations: Postclosure Period



Note: Monitoring at GS03 was discontinued on October 1, 2015.
Abbreviations: mg/L = milligrams per liter, N = nitrogen, NO_2 = nitrite, NO_3 = nitrate

Figure 11. Rolling Nitrate + Nitrite as Nitrogen Averages at Walnut Creek Flow-Through Locations: Flow-Through Period

3.3.2 Woman Creek Evaluation

Table 3 presents long-term volume-weighted averages in Woman Creek for the postclosure batch release period (October 2005 to November 2011) and the period since flow-through pond operations began (November 2011 to the present). Figure 12 through Figure 17 present the 30-day and 12-month rolling averages for each location, analyte, and time period.[6]

Compared to batch operations, as expected, the plots show somewhat increased water quality variability for uranium, but concentrations remain below the applicable standard. As discussed for Walnut Creek, flow-through 30-day averages show increased day-to-day variability since water is no longer being batched and mixed before discharge. Conversely, flow-through 12-month rolling averages show month-to-month variability comparable to that of batch operations.

[6] The RFLMA standards shown on these plots are for reference only. The RFLMA-required evaluation is location specific (i.e., POCs and Points of Evaluation) and is not part of this AMP report. Evaluation of sampling results as required by the RFLMA (CDPHE et al. 2007) is routinely presented in other reports in accordance with the RFLMA reporting requirements.

For GS31 (outlet from Pond C-2), the significantly higher Pu and Am concentrations in 2015 are associated with the high runoff during spring 2015. These concentrations are a result of runoff from the South Interceptor Ditch (SID) passing through Pond C-2. This runoff, before entering Pond C-2, also resulted in reportable 12-month rolling Pu concentrations at Point of Evaluation (POE) SW027. A detailed discussion of the reportable condition and subsequent mitigating response can be found in the RFLMA quarterly reports for 2015. Plutonium and Am concentrations at GS31 since 2016 are significantly reduced compared to 2016 (as indicated by the 30-day average), and concentrations at the downstream POC (WOMPOC) remain well below the 0.15 pCi/L standard.

Table 3. Volume-Weighted Averages for Woman Creek Flow-Through Monitoring Locations

Woman Creek: October 2005–November 2011 (Batch Release)

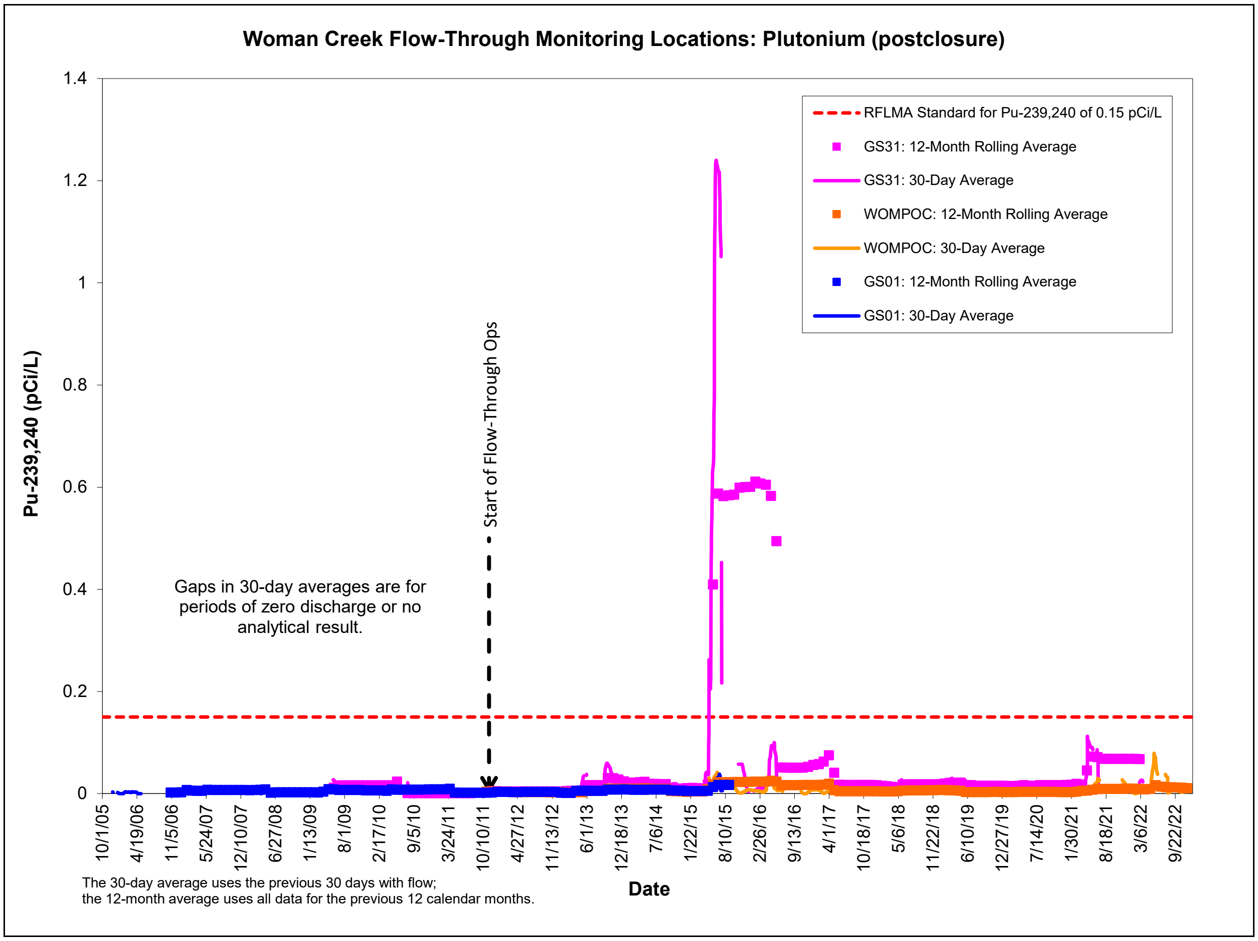
		Uranium (µg/L)		Pu-239,240 (pCi/L)		Am-241 (pCi/L)	
	Location Code	**Volume-Weighted Average**	**Sample Count**	**Volume-Weighted Average**	**Sample Count**	**Volume-Weighted Average**	**Sample Count**
Upstream	GS31	4.1	12	0.007	12	0.004	12
Downstream	GS01	2.3	95	0.007	95	0.004	95

Woman Creek: November 2011–Present (Flow-Through)

		Uranium (µg/L)		Pu-239,240 (pCi/L)		Am-241 (pCi/L)	
	Location Code	**Volume-Weighted Average**	**Sample Count**	**Volume-Weighted Average**	**Sample Count**	**Volume-Weighted Average**	**Sample Count**
Upstream	GS31	7.5	63	0.230	63	0.041	63
⬇	WOMPOC	2.1	167	0.014	167	0.007	167
Downstream	GS01	2.1	45	0.014	45	0.007	45

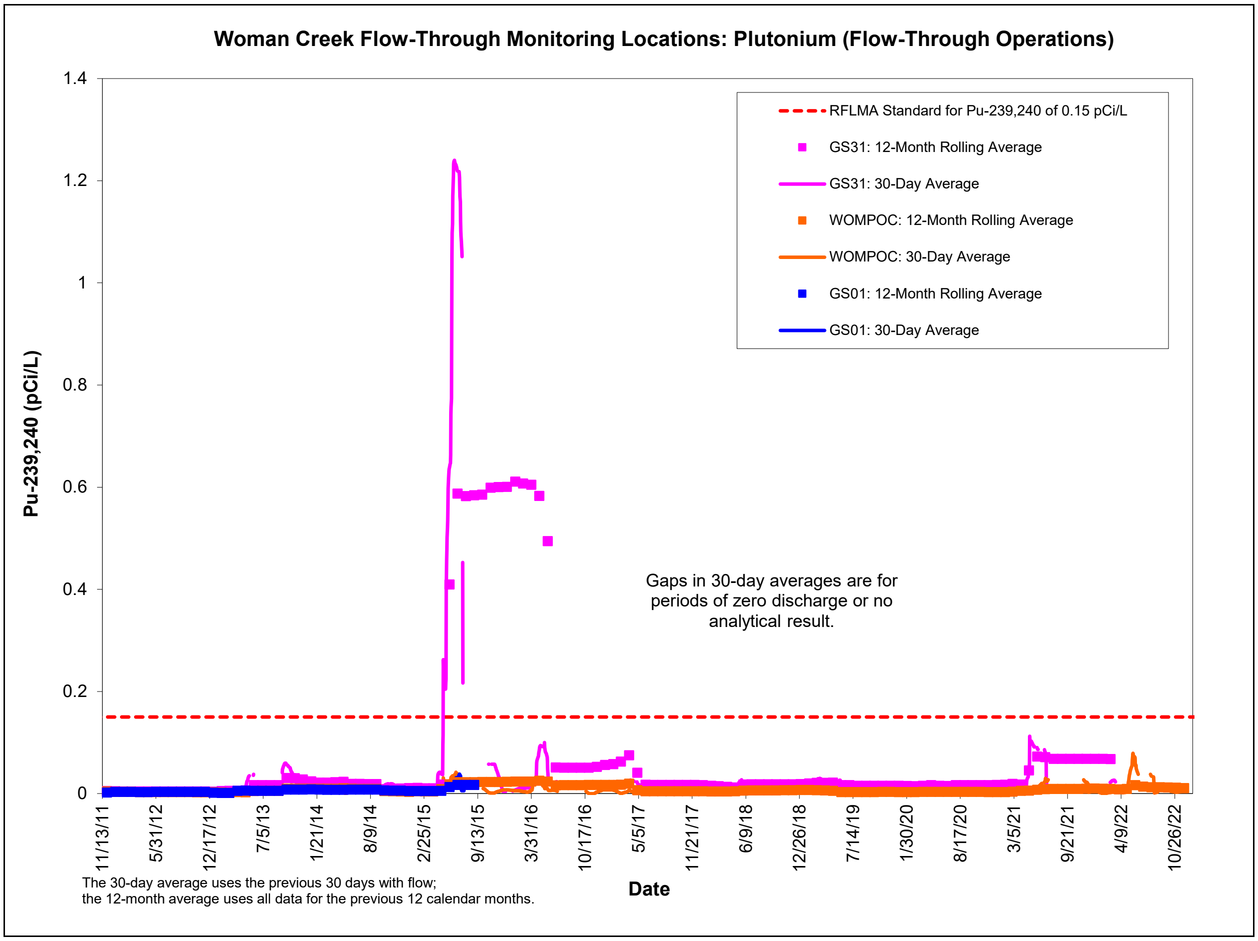
Notes:
Sample counts fluctuate because composite sampling periods vary with water availability.
Monitoring at GS01 was discontinued on October 1, 2015.

Abbreviation:
µg/L = micrograms per liter



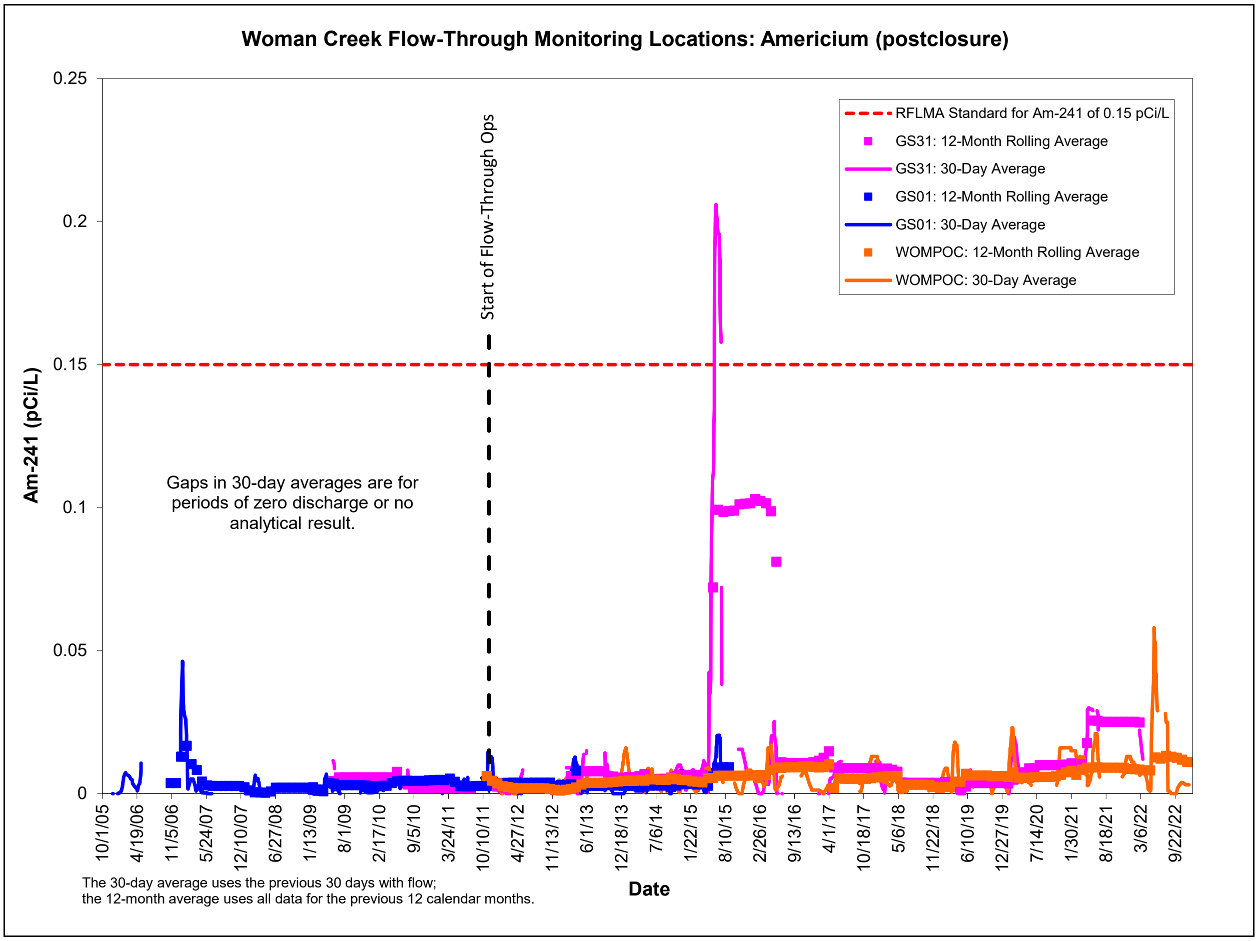
Note: Monitoring at GS01 was discontinued on October 1, 2015.

Figure 12. Rolling Plutonium Averages at Woman Creek Flow-Through Locations: Postclosure Period



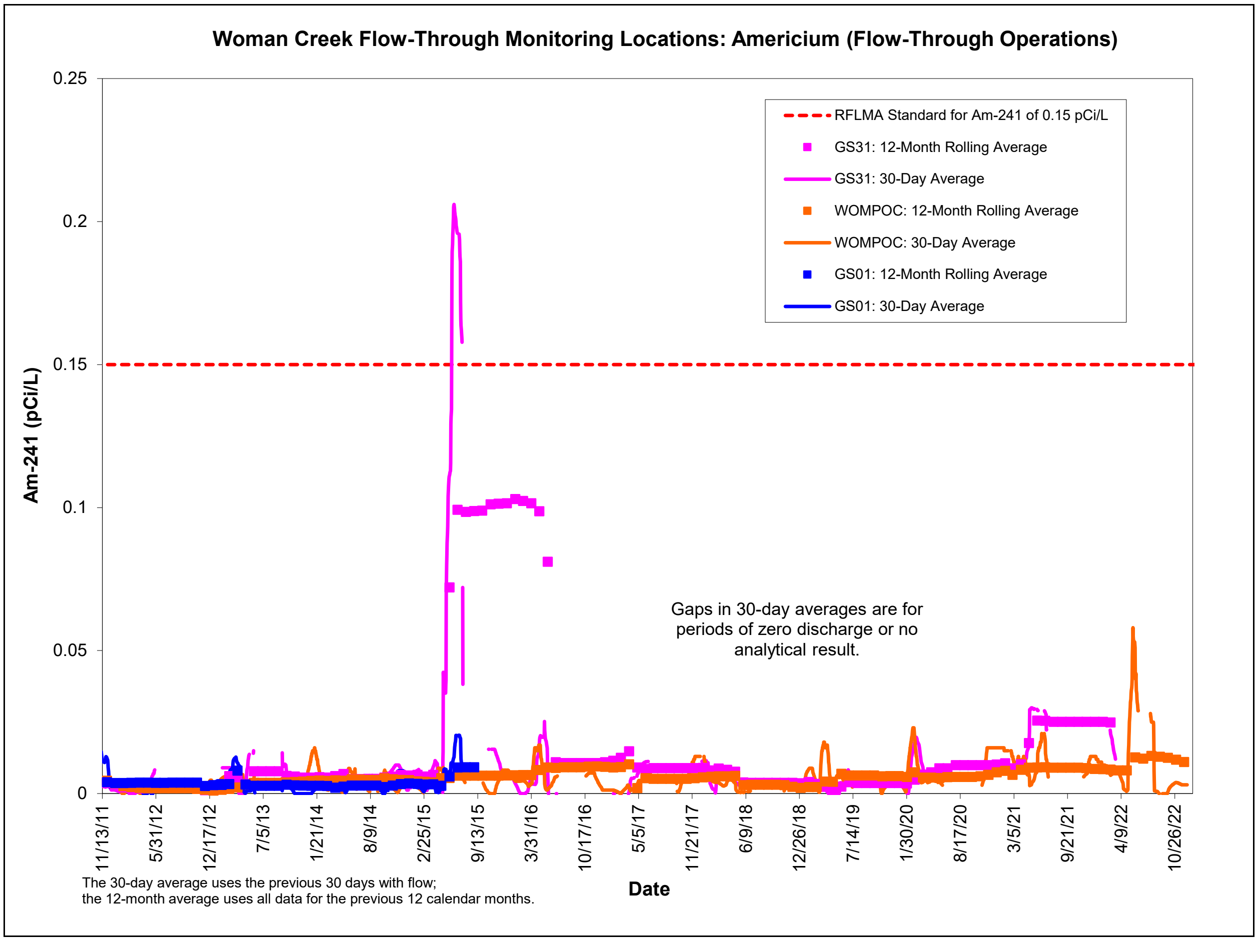
Note: Monitoring at GS01 was discontinued on October 1, 2015.

Figure 13. Rolling Plutonium Averages at Woman Creek Flow-Through Locations: Flow-Through Period



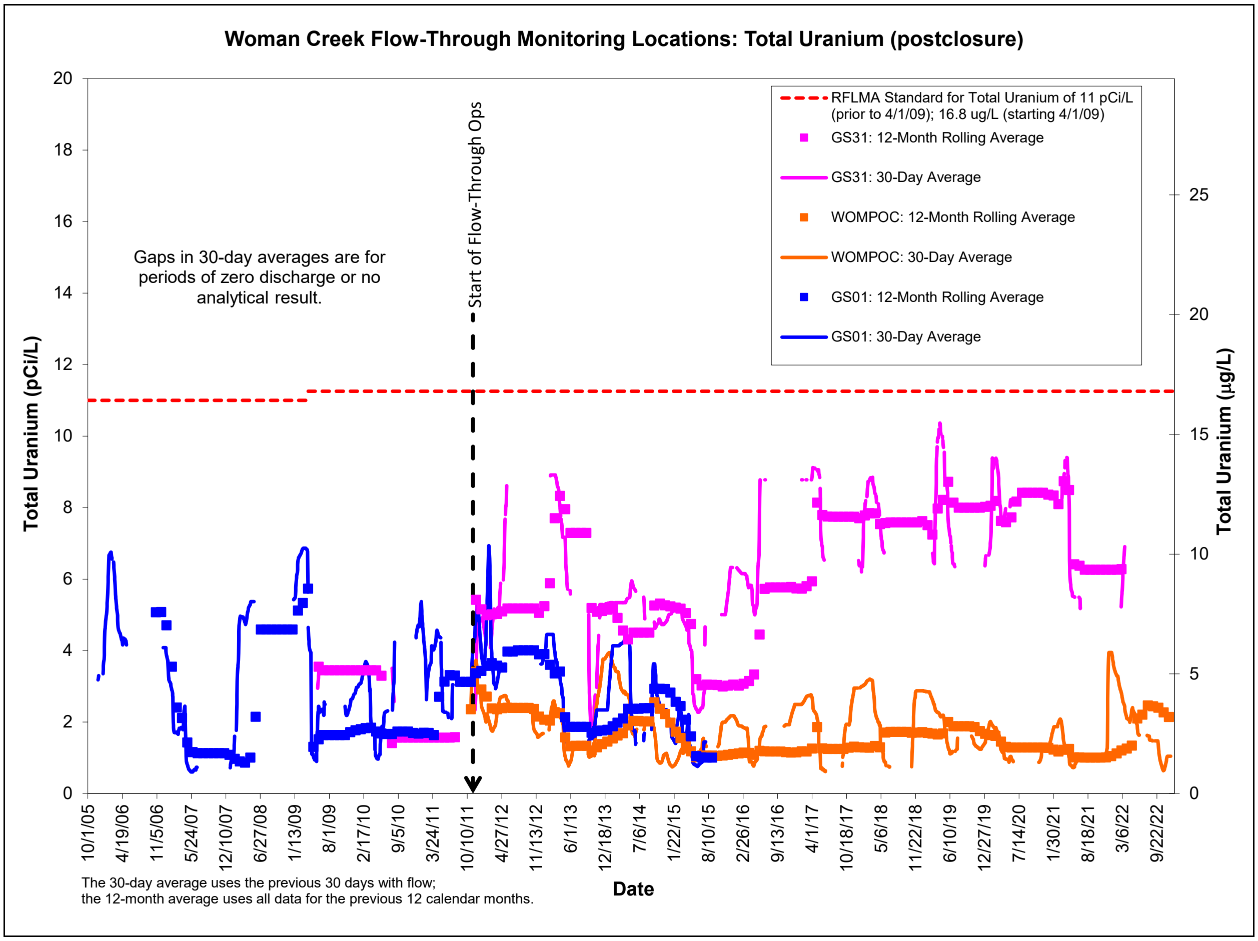
Note: Monitoring at GS01 was discontinued on October 1, 2015.

Figure 14. Rolling Americium Averages at Woman Creek Flow-Through Locations: Postclosure Period



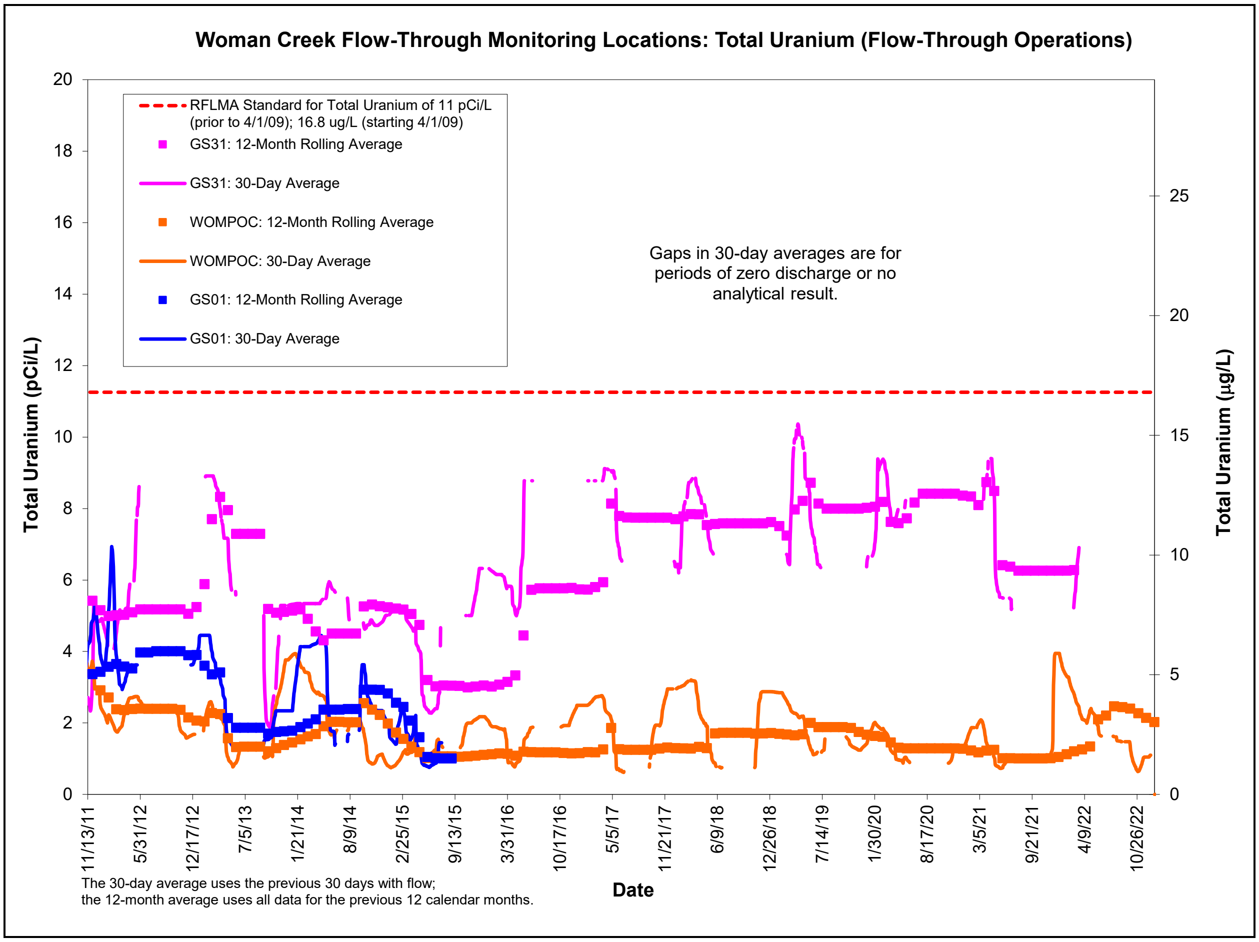
Note: Monitoring at GS01 was discontinued on October 1, 2015.

Figure 15. Rolling Americium Averages at Woman Creek Flow-Through Locations: Flow-Through Period



Notes: Monitoring at GS01 was discontinued on October 1, 2015. To show uranium units of both pCi/L and µg/L, the conversion 1 µg/L = 0.67 pCi/L is used.
Abbreviation: µg/L = micrograms per liter

Figure 16. Rolling Uranium Averages at Woman Creek Flow-Through Locations: Postclosure Period



Notes: Monitoring at GS01 was discontinued on October 1, 2015. To show uranium units of both pCi/L and µg/L, the conversion 1 µg/L = 0.67 pCi/L is used.
Abbreviation: µg/L = micrograms per liter

Figure 17. Rolling Uranium Averages at Woman Creek Flow-Through Locations: Flow-Through Period

3.4 Storm-Event Monitoring

This objective involves collecting water quality data to assess actinide and solids transport during runoff periods resulting from precipitation events. The intent is to evaluate whether significant correlations exist between flow rate and actinide concentrations and further describe short-term, event-driven variability. In addition, these data can be used to assess the effectiveness of ongoing revegetation and erosion control practices.

Location GS31, below the Pond C-2 outlet (Figure 18 and Figure 19), is used for storm-event monitoring. Storm-event monitoring equipment at GS31 was installed in spring 2012 to specifically evaluate water quality when runoff passes through Pond C-2 while being operated in a flow-through configuration. Samples are collected as time-paced sequential grabs using an automated sampler with a 24-bottle carousel. Grabs that were collected during the direct runoff period are then selected for analysis; grabs collected before or after direct runoff are discarded. The selected grabs are then composited for subsequent analysis. Where possible, the collected grabs are segregated as collected on the rising limb of the runoff hydrograph (when flows are increasing) or collected on the falling limb (when flows are decreasing). The first storm-event samples were collected during the September 2013 flood.

During 2022, there was no flow in the SID and no runoff events passed through GS31; no storm-event samples were collected. Analytical results for previous years are listed in Table 4. Hydrographs with sample events are given in Figure 20 through Figure 28.

Various correlations are plotted in Figure 29 through Figure 32 for the relatively few results available. Relationships are observed for Pu, Am, and uranium in comparison to flow rate. Figure 30 suggests increasing Pu and Am concentrations with increasing flow rate. Since Pu and Am move in association with suspended solids (i.e., soil particles), this relationship is expected because increased flow rate generally results in increased total suspended solids (TSS). However, Figure 32 shows no relationship between flow rate and TSS. Therefore, the increased concentrations may depend on the origin of the runoff for specific events. In other words, if an area with higher residual contamination, such as the 903 Lip Area, contributes a higher proportion of runoff during large runoff events, then an increase in concentrations would consequently be observed for higher flow rates.

Figure 31, in contrast, shows a correlation between *decreasing* uranium concentration and increasing flow rate. This water quality effect is observed at many locations on the Site because naturally occurring uranium from groundwater sources is diluted during runoff events.

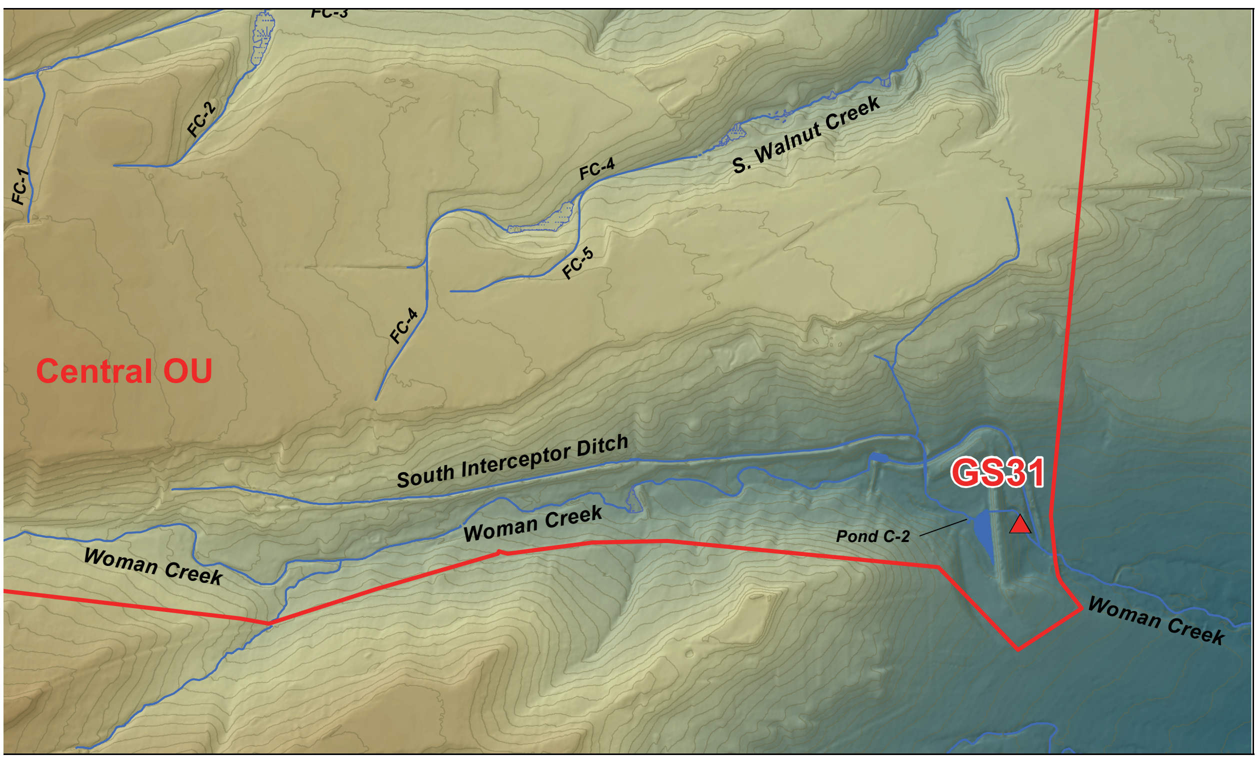


Figure 18. Storm-Event Monitoring Location GS31

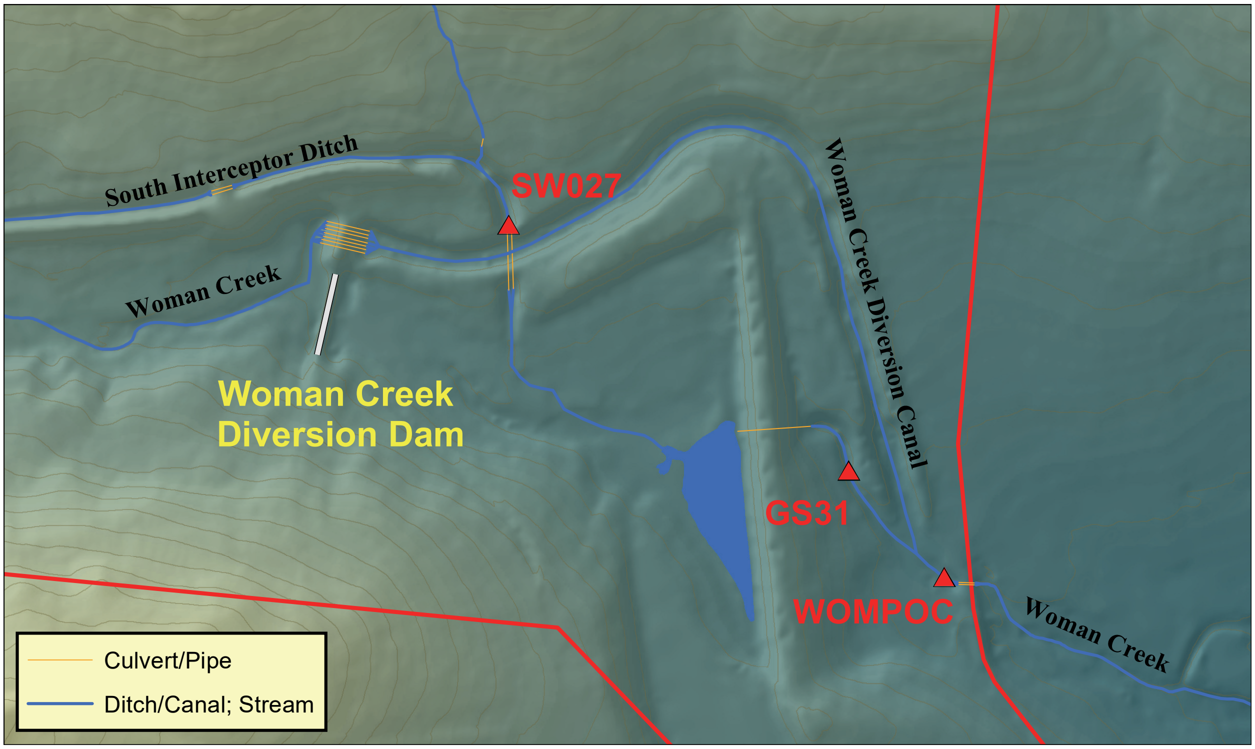


Figure 19. Detail Map for Storm-Event Monitoring Location GS31

Table 4. GS31 Storm-Event Sample Results

Sampling Date	Plutonium-239, 240 (pCi/L)	Americium-241 (pCi/L)	Uranium (µg/L)	TSS (mg/L)	Average Flow Rate (cfs)
9/12/2013[a]	0.037	0.006	1.41	NA	13.5
9/12/2013[b]	0.045	0.016	1.11	NA	14.7
4/17/2015	0.090	0.008	4.86	13.3	1.79
5/5/2015	0.011	0.003	5.17	8.8	0.57
5/19/2015	0.141	0.021	3.41	8.2	2.73
6/4/2015	2.590	0.717	2.72	NA	4.67
4/16/2016	0.073	0.023	7.54	9.2	2.78
5/3/2018	0.006	0.000	10.0	11.0	0.61
4/18/2020	0.011	0.005	9.92	31.7	0.38
5/3/2021 [rising limb]	0.126	0.030	8.69	7.0	2.51
5/3/2021 [falling limb]	0.216	0.000	4.77	2.8	1.75

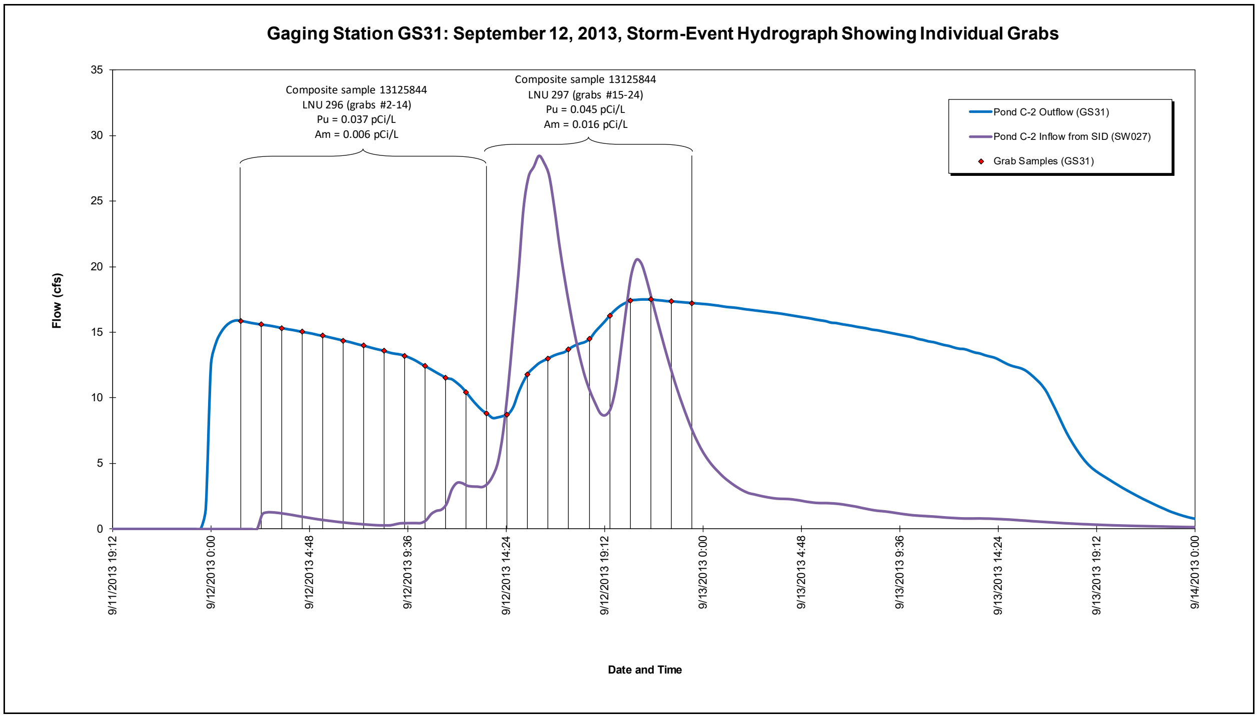
Notes:

[a] Sample includes significant quantities of water that flooded over the Woman Creek diversion dam into Pond C-2 when flows from the SID were minimal (see Figure 20).

[b] Sample includes significant quantities of water that flooded over the Woman Creek diversion dam into Pond C-2 when flows from the SID were also significant (see Figure 20).

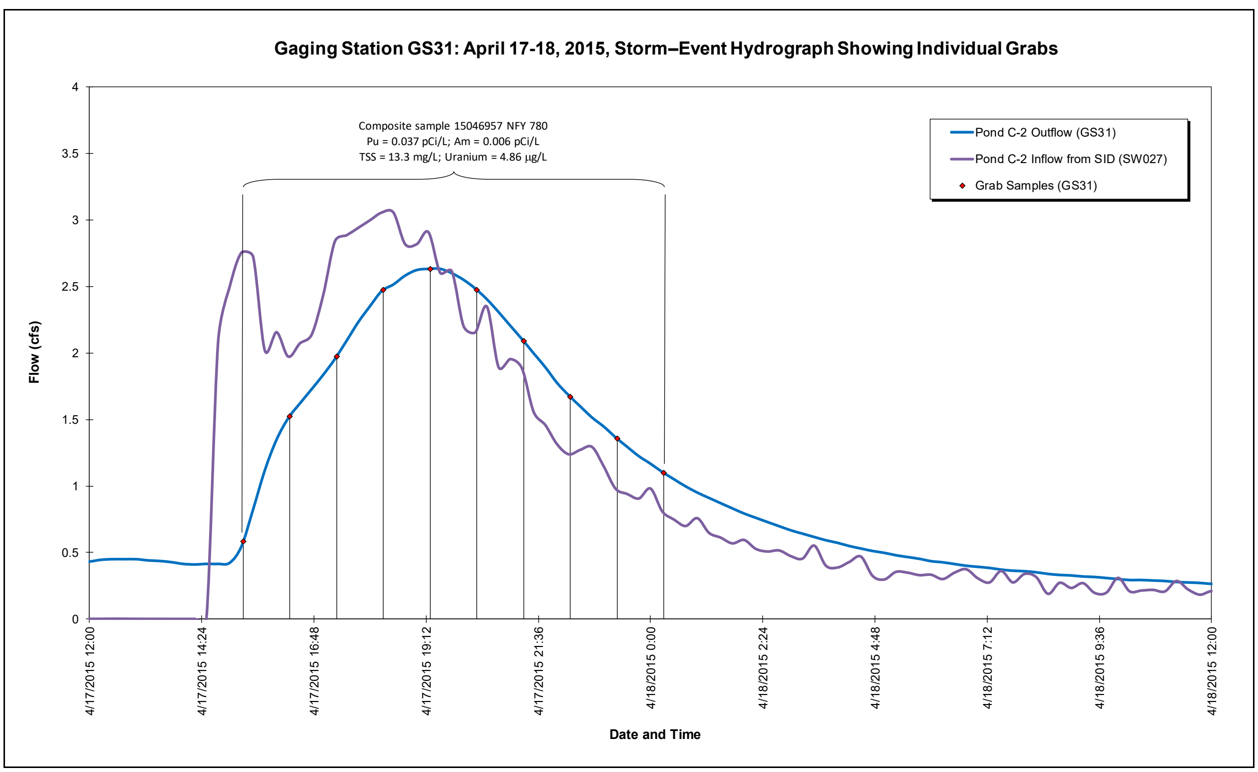
Abbreviations:

cfs = cubic feet per second
µg/L = micrograms per liter
mg/L = milligrams per liter
NA = not available



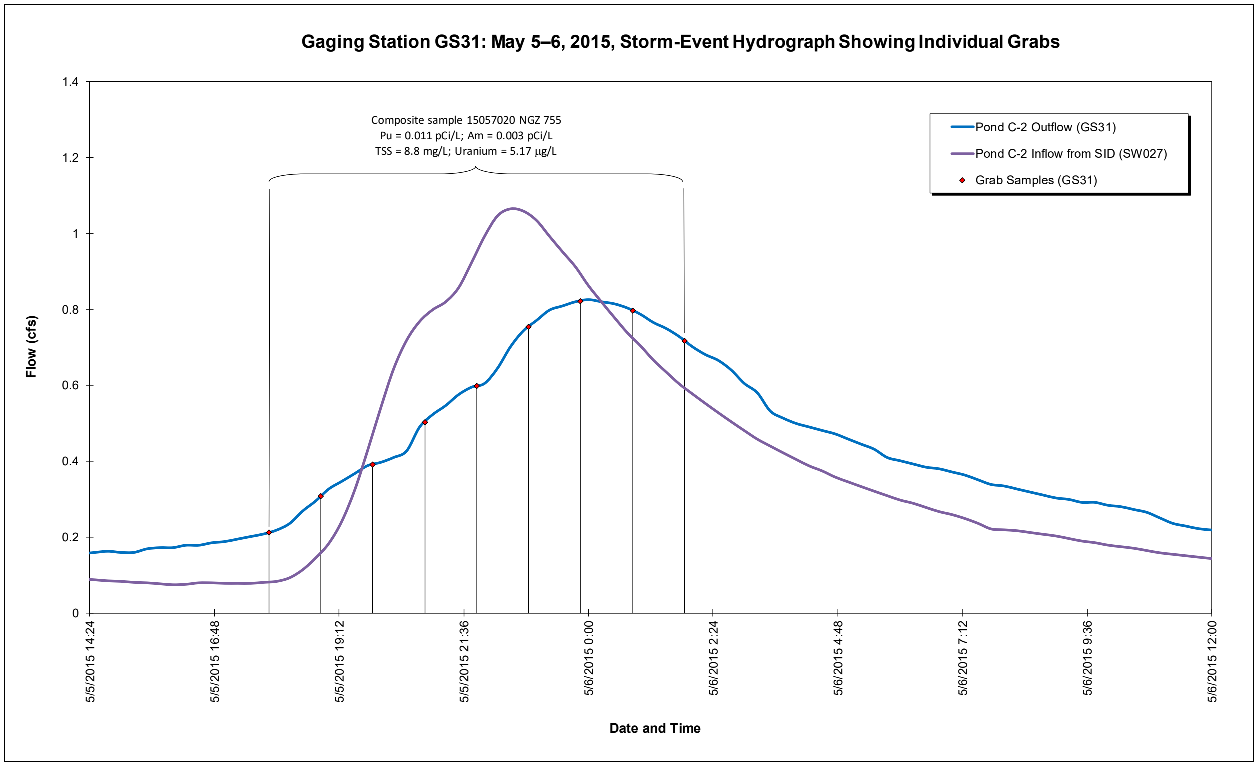
Abbreviation: cfs = cubic feet per second

Figure 20. Storm-Event Hydrograph at GS31: September 12, 2013



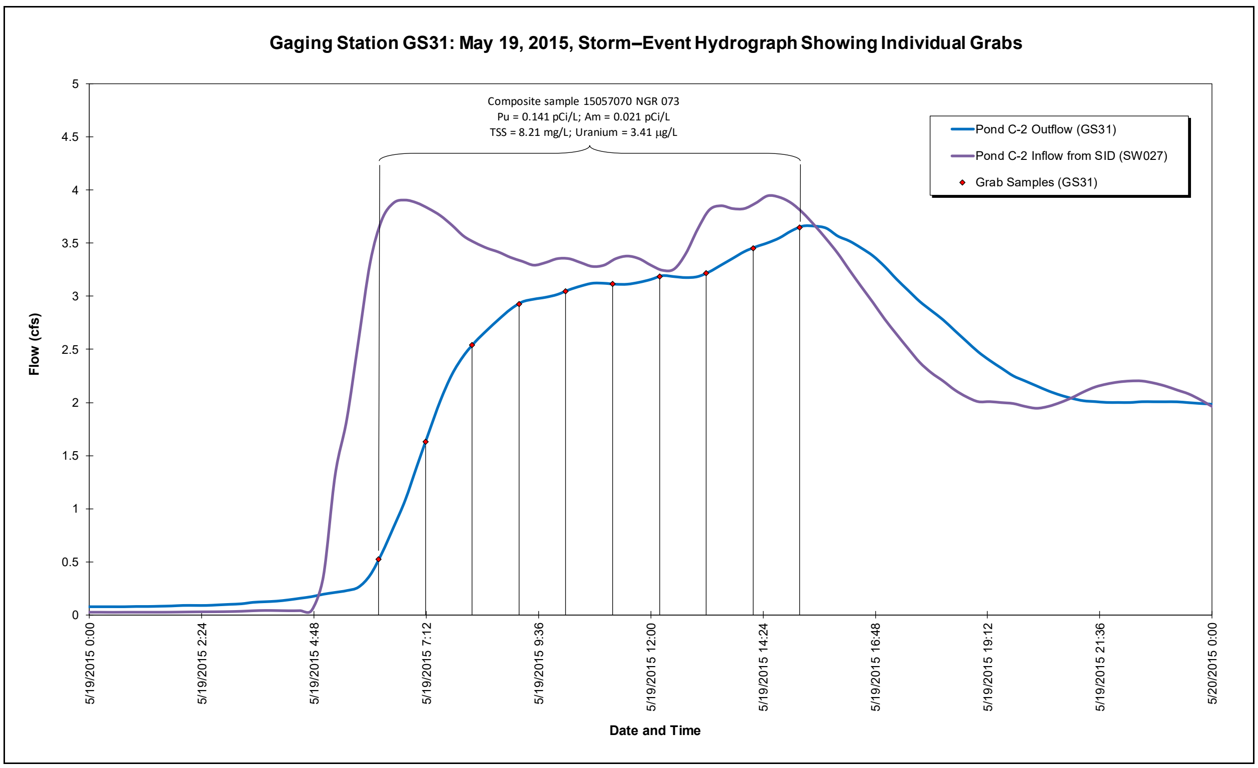
Abbreviations: cfs = cubic feet per second, μg/L = micrograms per liter, mg/L = milligrams per liter

Figure 21. Storm-Event Hydrograph at GS31: April 17–18, 2015



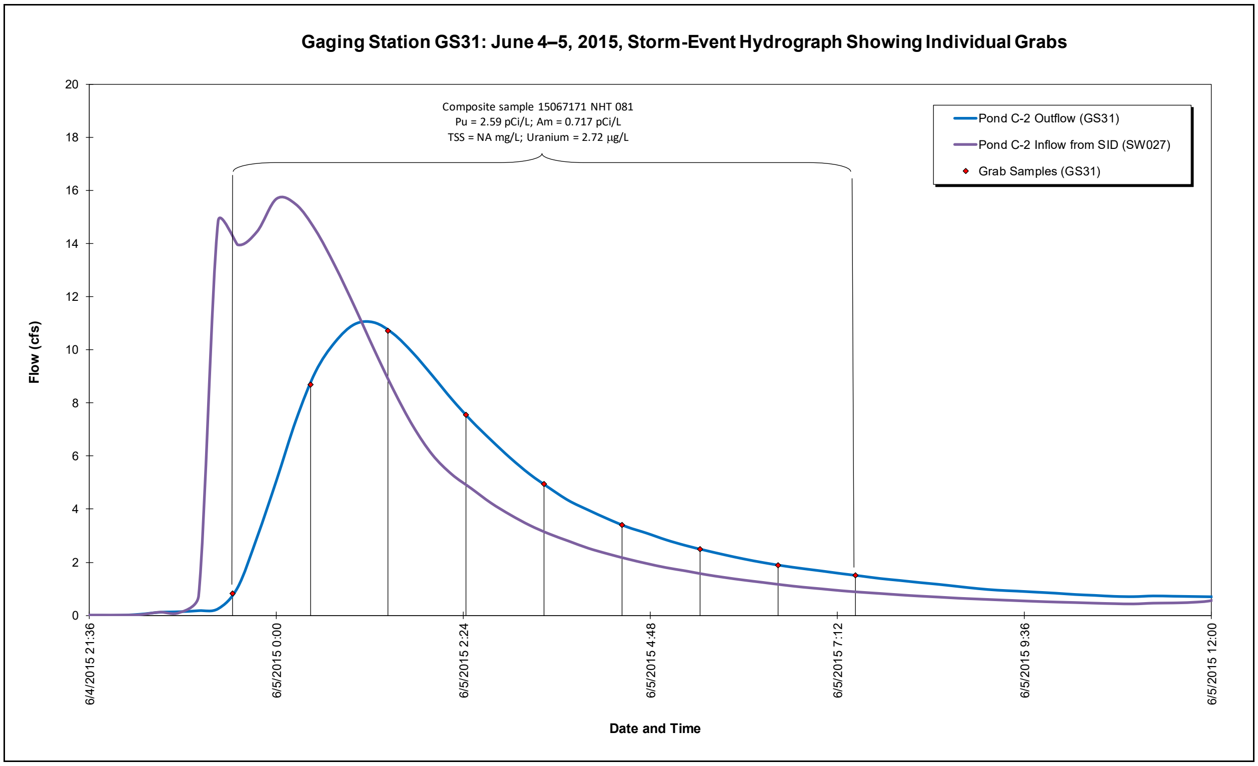
Abbreviations: cfs = cubic feet per second, µg/L = micrograms per liter, mg/L = milligrams per liter

Figure 22. Storm-Event Hydrograph at GS31: May 5–6, 2015



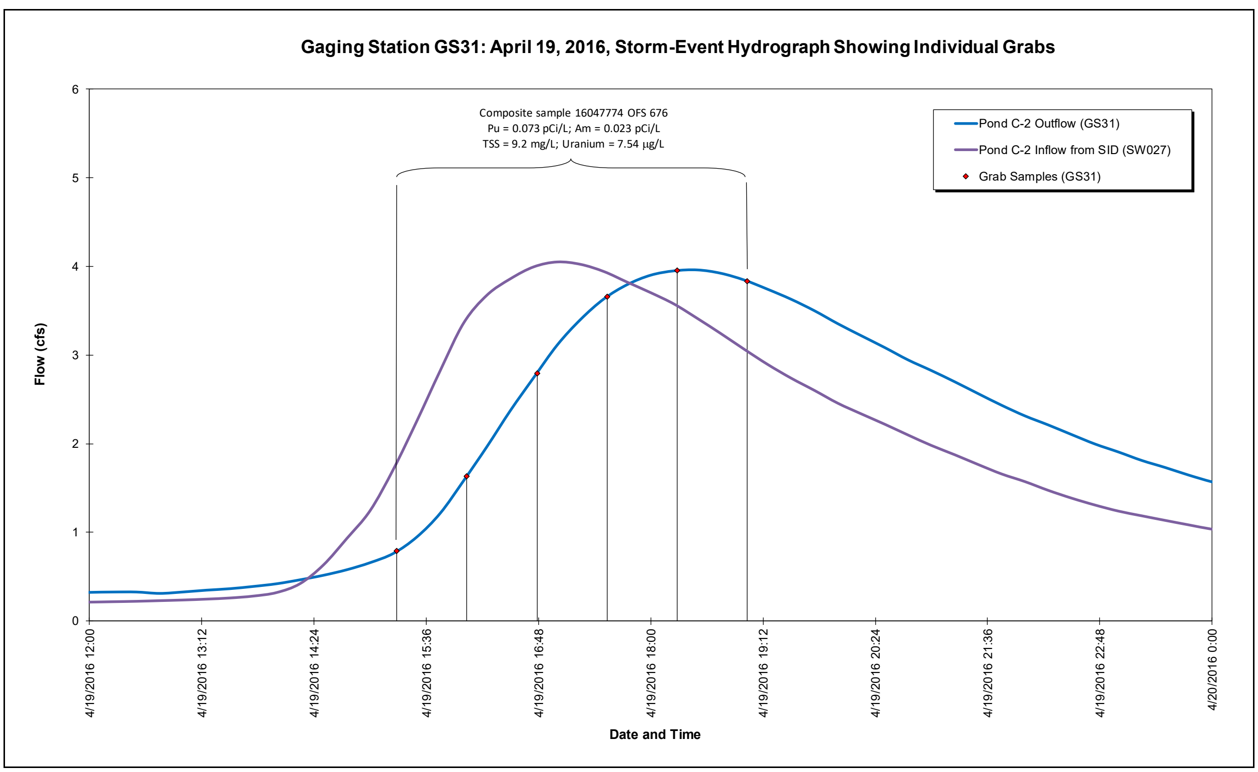
Abbreviations: cfs = cubic feet per second, µg/L = micrograms per liter, mg/L = milligrams per liter

Figure 23. Storm-Event Hydrograph at GS31: May 19, 2015



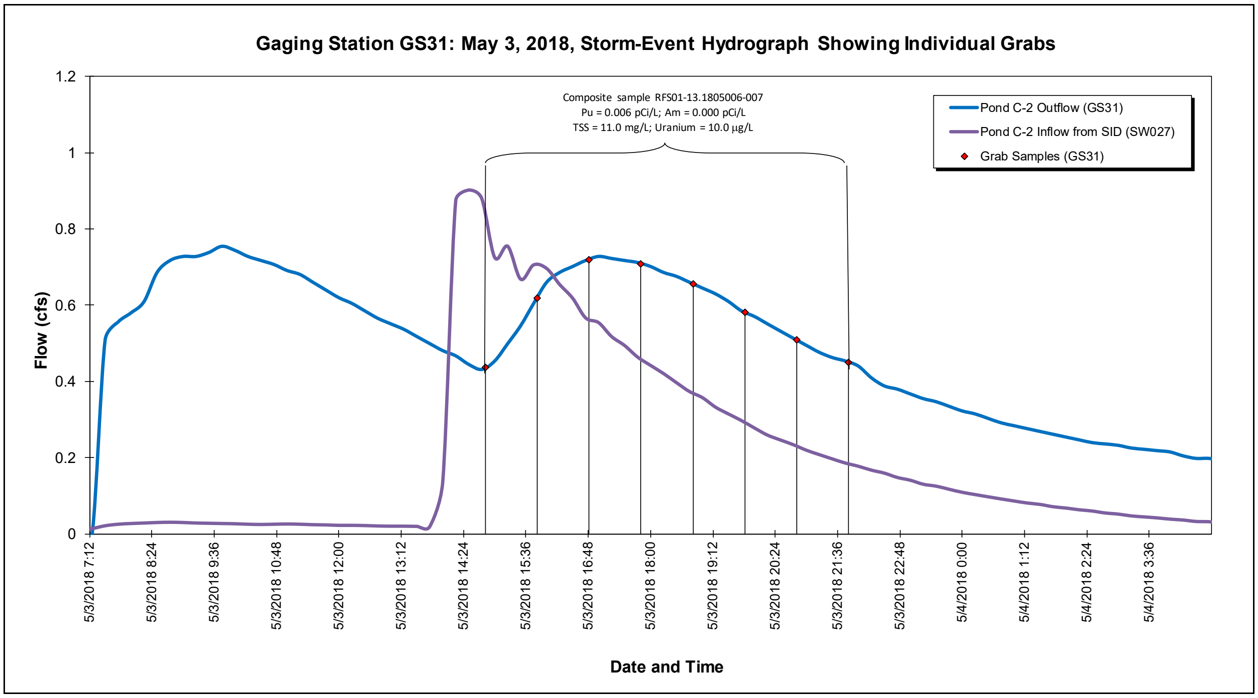
Abbreviations: cfs = cubic feet per second, μg/L = micrograms per liter, mg/L = milligrams per liter

Figure 24. Storm-Event Hydrograph at GS31: June 4–5, 2015



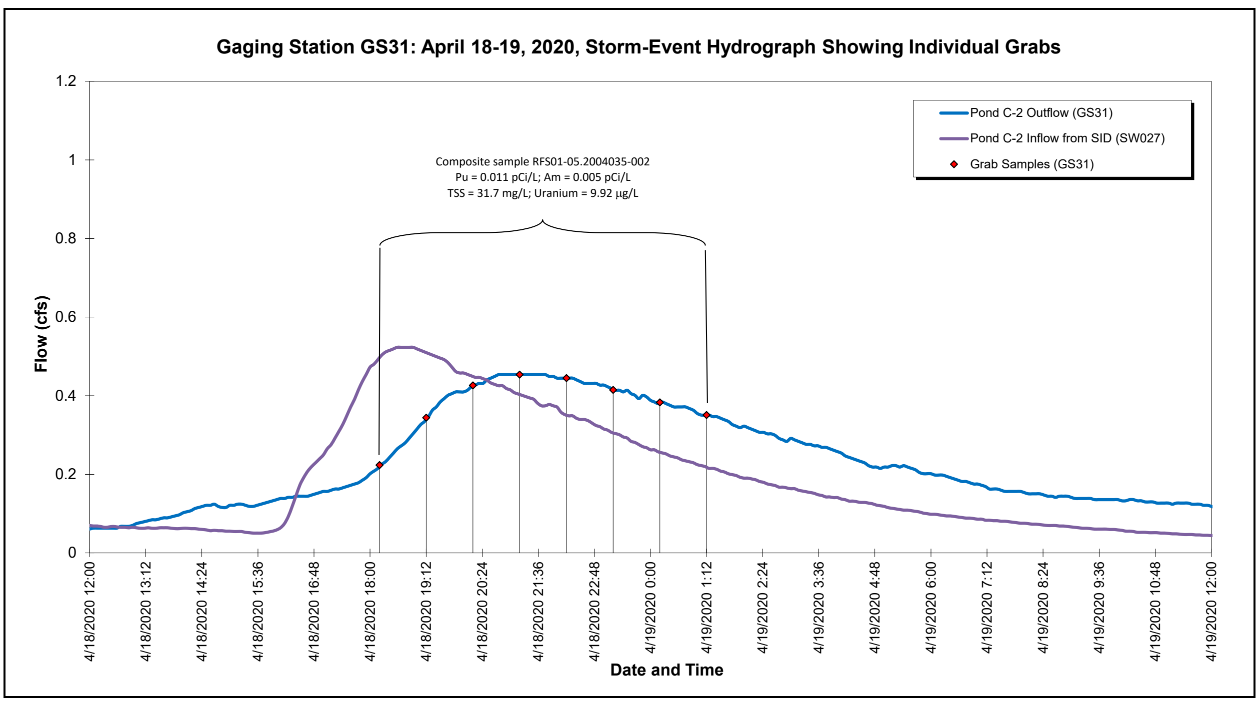
Abbreviations: cfs = cubic feet per second, μg/L = micrograms per liter, mg/L = milligrams per liter

Figure 25. Storm-Event Hydrograph at GS31: April 19, 2016



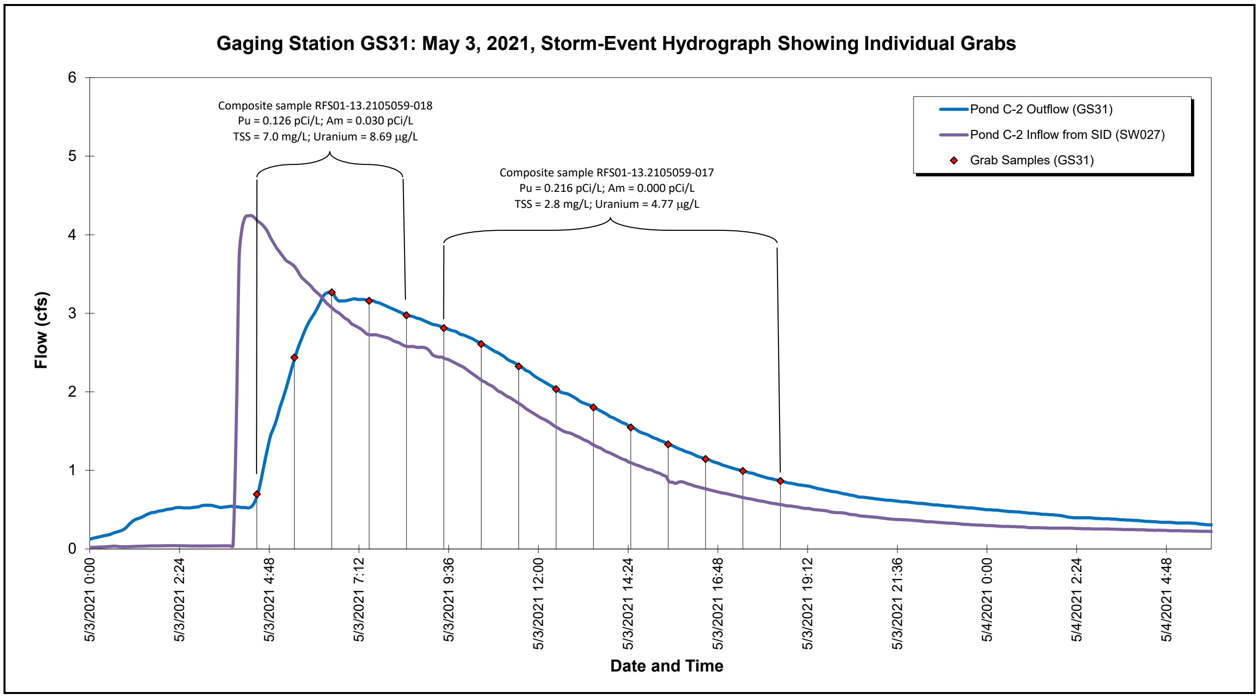
Abbreviations: cfs = cubic feet per second, µg/L = micrograms per liter, mg/L = milligrams per liter

Figure 26. Storm-Event Hydrograph at GS31: May 3, 2018



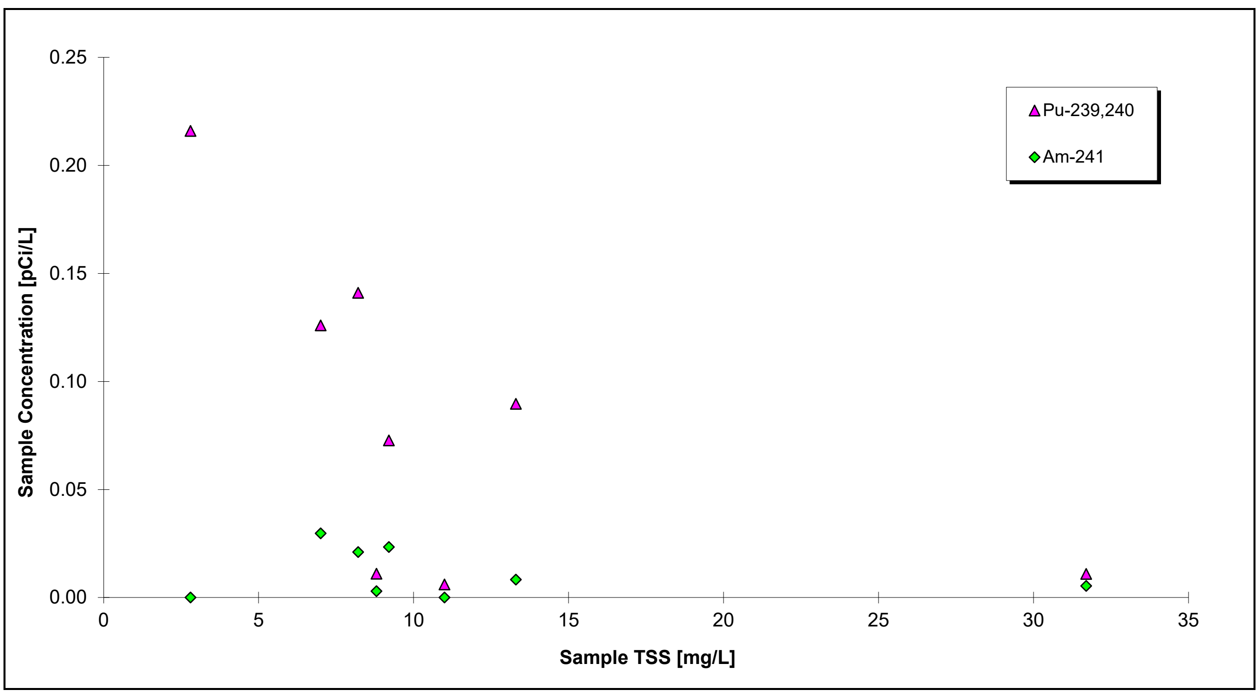
Abbreviations: cfs = cubic feet per second, µg/L = micrograms per liter, mg/L = milligrams per liter

Figure 27. Storm-Event Hydrograph at GS31: April 18–19, 2020



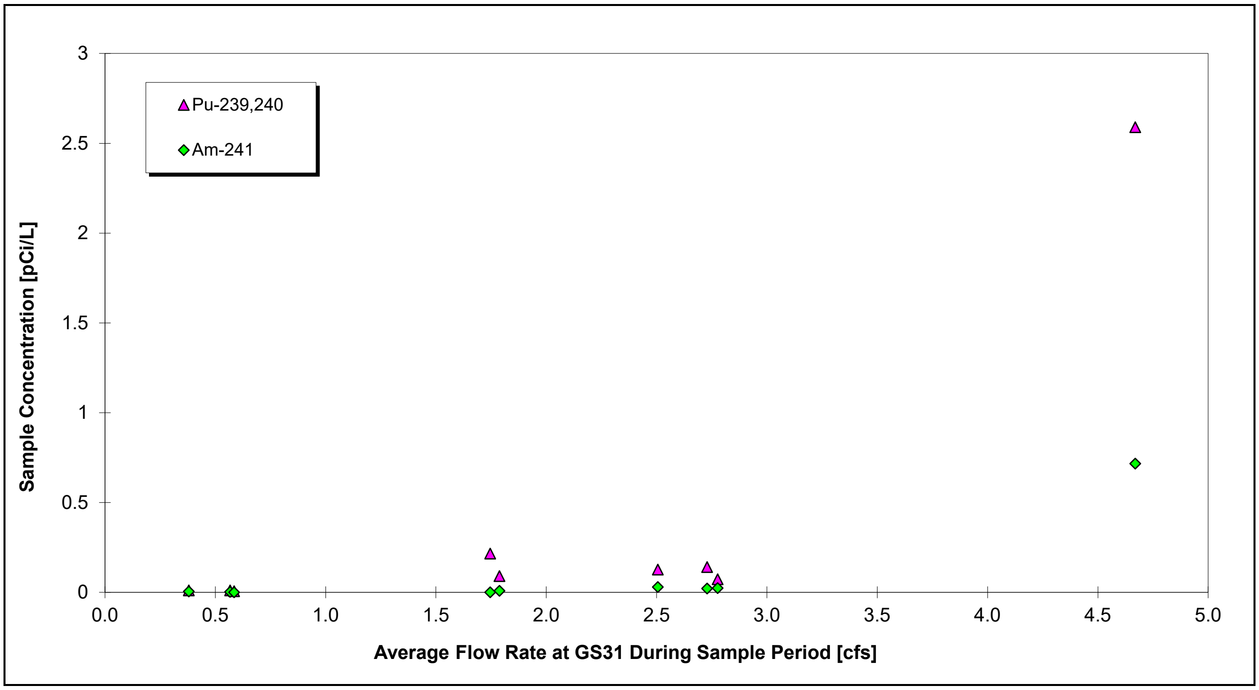
Abbreviations: cfs = cubic feet per second, µg/L = micrograms per liter, mg/L = milligrams per liter

Figure 28. Storm-Event Hydrograph at GS31: May 3, 2021



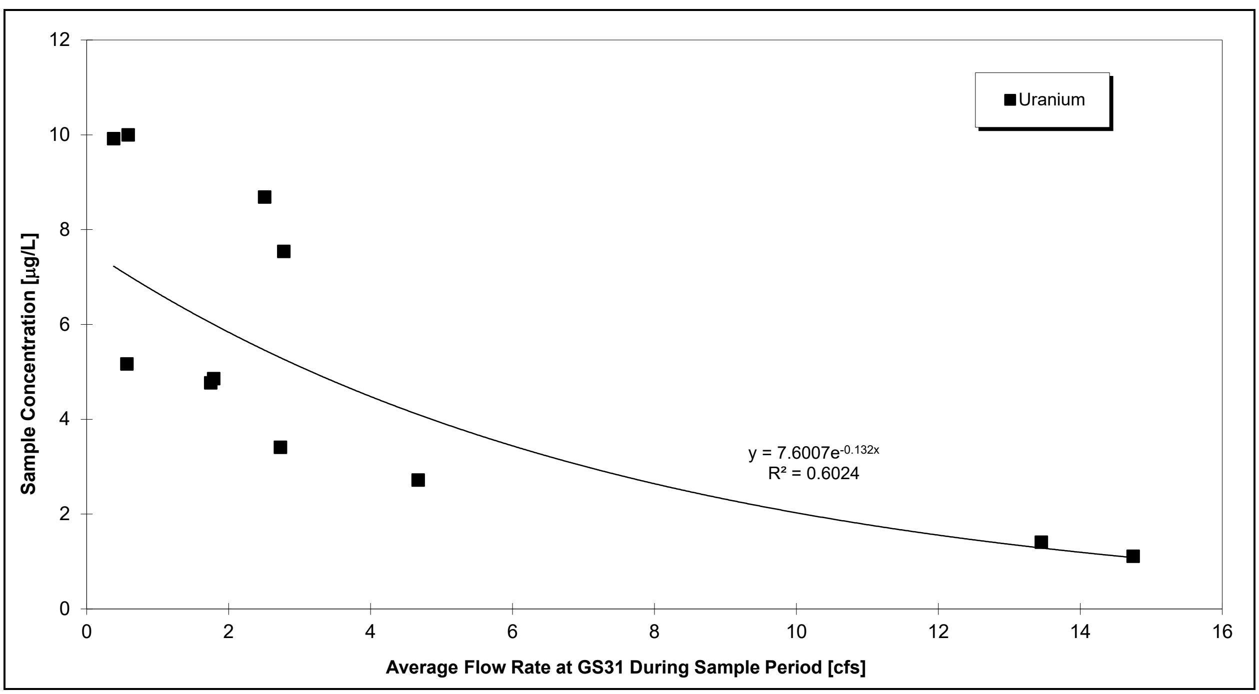
Abbreviation: mg/L = milligrams per liter

Figure 29. Plutonium and Americium Concentrations Versus Total Suspended Solids for GS31 Storm-Event Samples



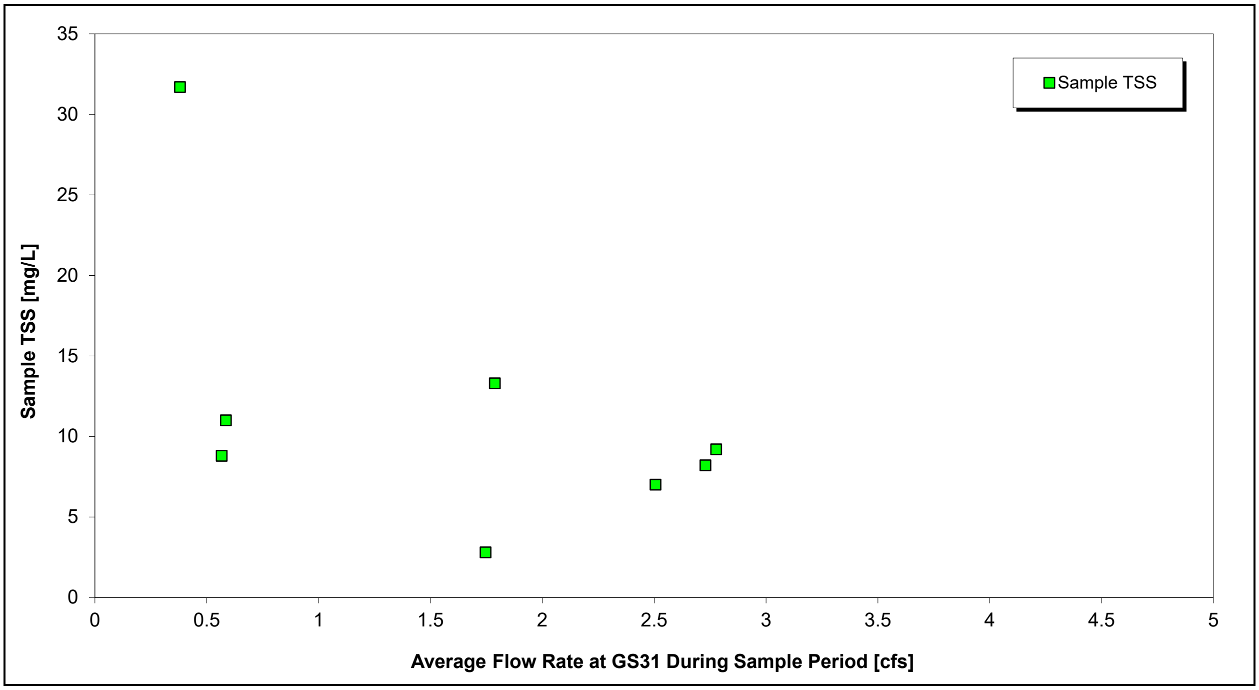
Note: The 2013 results are not shown since they were significantly diluted by Woman Creek water that flooded over the Woman Creek Diversion into Pond C-2.
Abbreviation: cfs = cubic feet per second

Figure 30. Plutonium and Americium Concentrations Versus Average Sample Flow Rate for GS31 Storm-Event Samples



Note: The 2013 results are not shown since they were significantly diluted by Woman Creek water that flooded over the Woman Creek Diversion into Pond C-2.
Abbreviations: cfs = cubic feet per second, µg/L = micrograms per liter

Figure 31. Uranium Concentrations Versus Average Sample Flow Rate for GS31 Storm-Event Samples



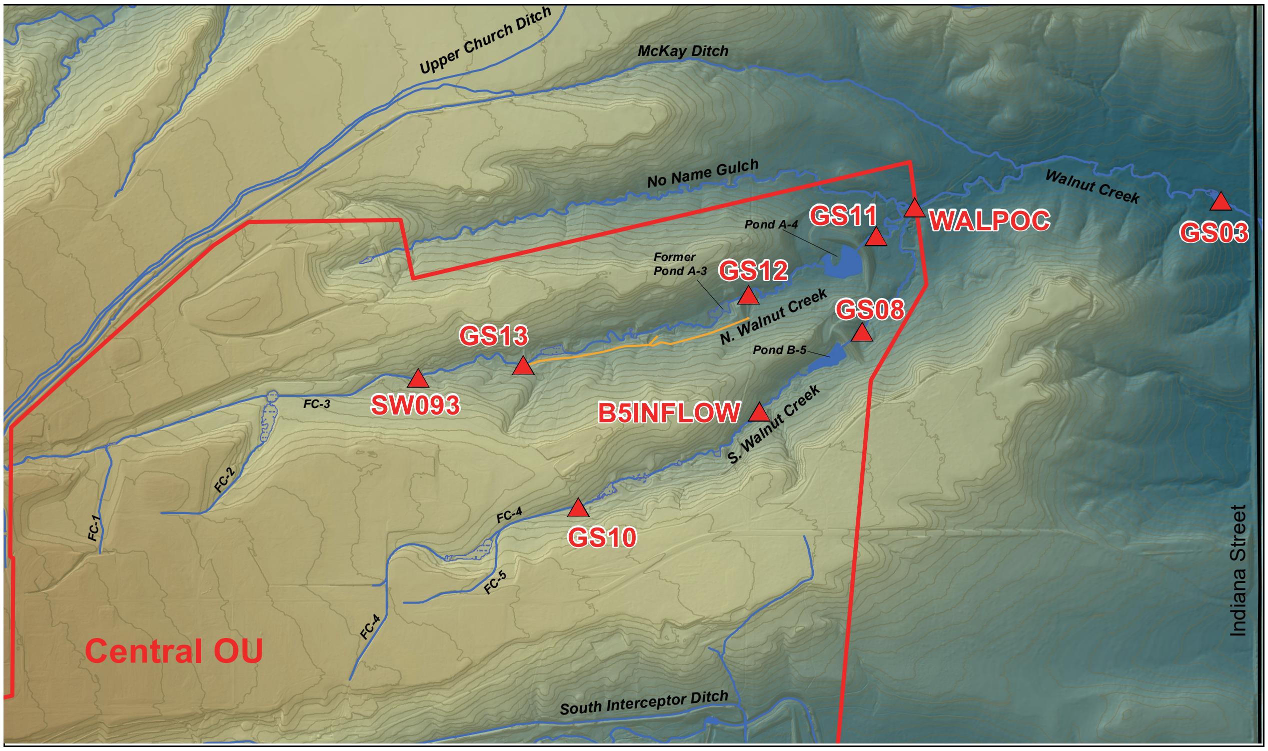
Abbreviations: cfs = cubic feet per second, mg/L = milligrams per liter

Figure 32. Total Suspended Solids Versus Average Sample Flow Rate for GS31 Storm-Event Samples

3.5 Continuous Flow-Paced Composite Sampling to Evaluate Uranium Transport

This monitoring objective is intended to evaluate the in-stream transport of uranium, specifically for Ponds A-4 and B-5, by assessing correlations, patterns, variability, and loading. The monitoring locations being used to support this objective are shown in Figure 33. Samples are collected as continuous flow-paced composites during all flow conditions. Sampling for this monitoring objective began on March 10, 2010, in North Walnut Creek and on June 16, 2010, in South Walnut Creek. Monitoring location WALPOC began operational testing on September 9, 2011. Monitoring at GS03 was discontinued on October 1, 2015. Therefore, this evaluation uses three time periods: March 10, 2010, to October 1, 2015; June 16, 2010, to October 1, 2015; and September 9, 2011, to the present.[7]

[7] Most recent evaluation period uses all data available as of January 15, 2023.



Notes: The orange line shows the location of the A-Series Bypass Pipeline, which goes around former Ponds A-1, A-2, and A-3. See text for additional information. Monitoring at GS03 was discontinued on October 1, 2015.

Figure 33. Continuous Flow-Paced Composite Sampling Locations in Walnut Creek

Starting on October 13, 2011, water in North Walnut Creek was diverted around Pond A-3 and former Ponds A-1 and A-2 to support the Dam A-3 breach construction. This diverted water was routed through the A-Series Bypass Pipeline from location GS13 to just below Pond A-3 (near location GS12) until March 21, 2012. During this period, it is assumed that the quality and quantity of water when it entered the pipeline were the same as when it exited the pipeline.[8] Therefore, data collected at GS13 and GS12 during this period have been combined to effectively summarize water quality *entering* Pond A-4 and not water quality *exiting* Pond A-3.

Table 5 through Table 7 show summary statistics for the three time periods described above. The data show long-term concentrations below the uranium standard (16.8 micrograms per liter [µg/L]) at all locations. In addition, all locations show concentrations well below the 30 µg/L drinking water maximum contaminant level for uranium. Figure 34 uses proportional symbols to map the uranium concentrations since September 9, 2011 (see Table 7 for values).[9]

[8] This assumption was confirmed by grab samples taken at GS13 and location A4INFLOW during use of the pipeline; A4INFLOW is just upstream of Pond A-4.

[9] Due to interruptions in automated sampling and the corresponding lack of analytical data for some periods during the unusual September 2013 flood, for comparison purposes, the start of the high runoff (which began late in the day on September 11, 2013) through its end on September 13, 2013, is not included in the evaluation in this section. Additionally, some data are estimated to enable the comparison herein; under normal RFLMA data evaluation protocols, these estimated data would not be included.

Table 5. Summary Statistics for Uranium Continuous Flow-Paced Composite Sampling: March 10, 2010, to October 1, 2015

South Walnut Creek

	Location Code	Volume-Weighted Average (µg/L)	Sample Count
Upstream	GS10*	13.7	104
Downstream	GS08	8.9	61

North Walnut Creek

Volume-Weighted Average (µg/L)	Sample Count	Location Code	
6.6	90	SW093*	Upstream
10.2	76	GS13*	⬇
12.8	80	GS12	⬇
9.2	53	GS11	Downstream

Walnut Creek

Location Code	Volume-Weighted Average	Sample Count
GS03	5.5	74

Notes:

Sample counts fluctuate because composite sampling periods vary with water availability.

Monitoring at GS03 was discontinued on October 1, 2015.

* Data for GS10, SW093, and GS13 are currently acquired through the routine RFLMA-required monitoring at these locations.

Table 6. Summary Statistics for Uranium Continuous Flow-Paced Composite Sampling: June 16, 2010, to October 1, 2015

South Walnut Creek

	Location Code	Volume-Weighted Average (µg/L)	Sample Count
Upstream	GS10*	13.7	95
⬇	B5INFLOW	10.3	62
Downstream	GS08	8.8	51

North Walnut Creek

Volume-Weighted Average (µg/L)	Sample Count	Location Code	
6.5	77	SW093*	Upstream
10.5	65	GS13*	⬇
13.2	67	GS12	⬇
9.1	44	GS11	Downstream

Walnut Creek

Location Code	Volume-Weighted Average	Sample Count
GS03	5.4	58

Notes:

Sample counts fluctuate because composite sampling periods vary with water availability.

Monitoring at GS03 was discontinued on October 1, 2015.

B5INFLOW was installed on June 16, 2010.

* Data for GS10, SW093, and GS13 are currently acquired through the routine RFLMA-required monitoring at these locations.

Table 7. Summary Statistics for Uranium Continuous Flow-Paced Composite Sampling: Starting September 9, 2011

South Walnut Creek

	Location Code	Volume-Weighted Average (µg/L)	Sample Count
Upstream	GS10*	13.0	179
⬇	B5INFLOW	11.5	102
Downstream	GS08	9.6	91

North Walnut Creek

Volume-Weighted Average (µg/L)	Sample Count	Location Code	
6.1	121	SW093*	Upstream
9.3	106	GS13*	⬇
12.9	99	GS12	⬇
10.0	78	GS11	Downstream

Walnut Creek

Location Code	Volume-Weighted Average	Sample Count
WALPOC*	9.7	128

Notes:

Sample counts fluctuate because composite sampling periods vary with water availability.

The summary includes all data available as of January 15, 2023; some recent data are not validated (i.e., are preliminary and subject to revision).

* Data for GS10, SW093, GS13, and WALPOC are currently acquired through the routine RFLMA-required monitoring at these locations.

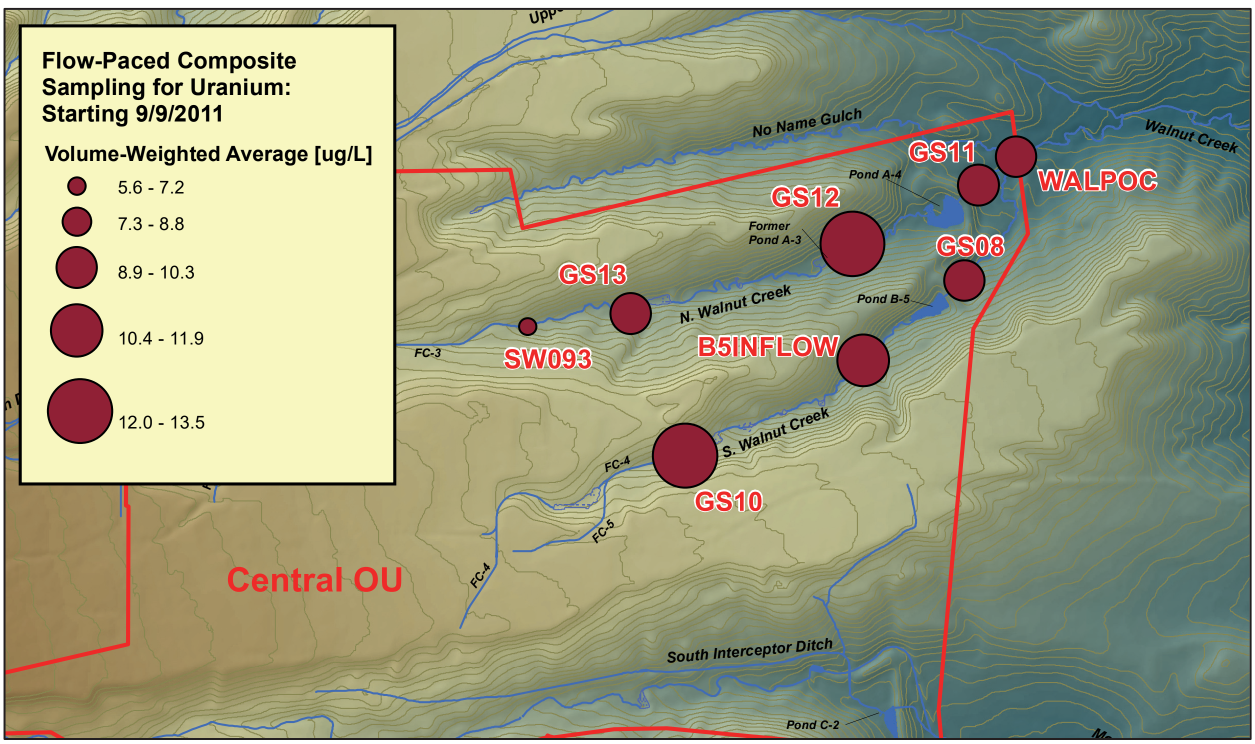
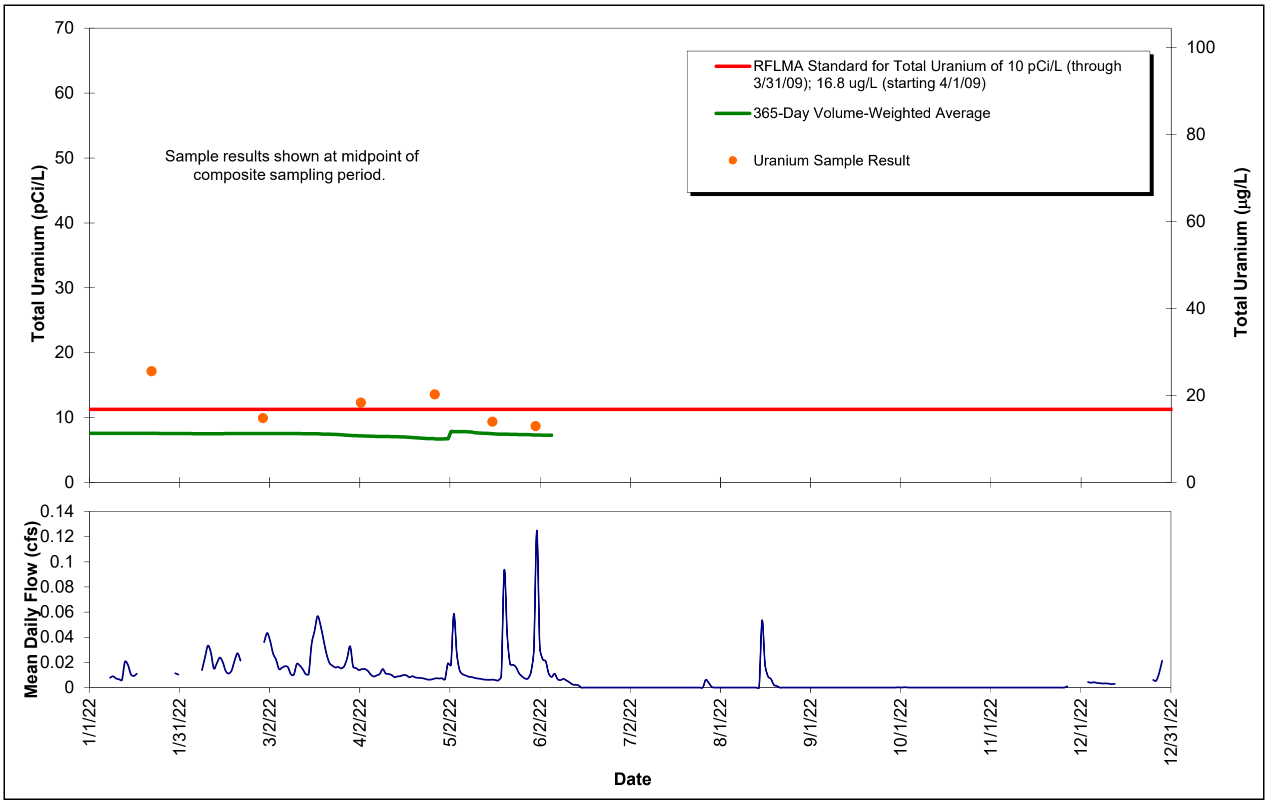


Figure 34. Map Showing Volume-Weighted Average Uranium Concentrations for Samples Collected Since September 9, 2011

Figure 35 through Figure 50 show plots of composite sample results and the 365-day volume-weighted rolling averages at each location.[10] The 365-day rolling average differs from the 12-month rolling average used for RFLMA evaluation in that the 365-day rolling average is calculated for each day, while the 12-month rolling average is calculated only for the last day of each month. The plots also show the corresponding hydrograph at each location showing the mean daily flow in cubic feet per second (cfs). The plots clearly show the significant variability in sample results. In general, the higher concentrations are during periods of base flow with very little runoff (i.e., winter) and during periods when the natural geochemistry is more favorable for uranium transport.

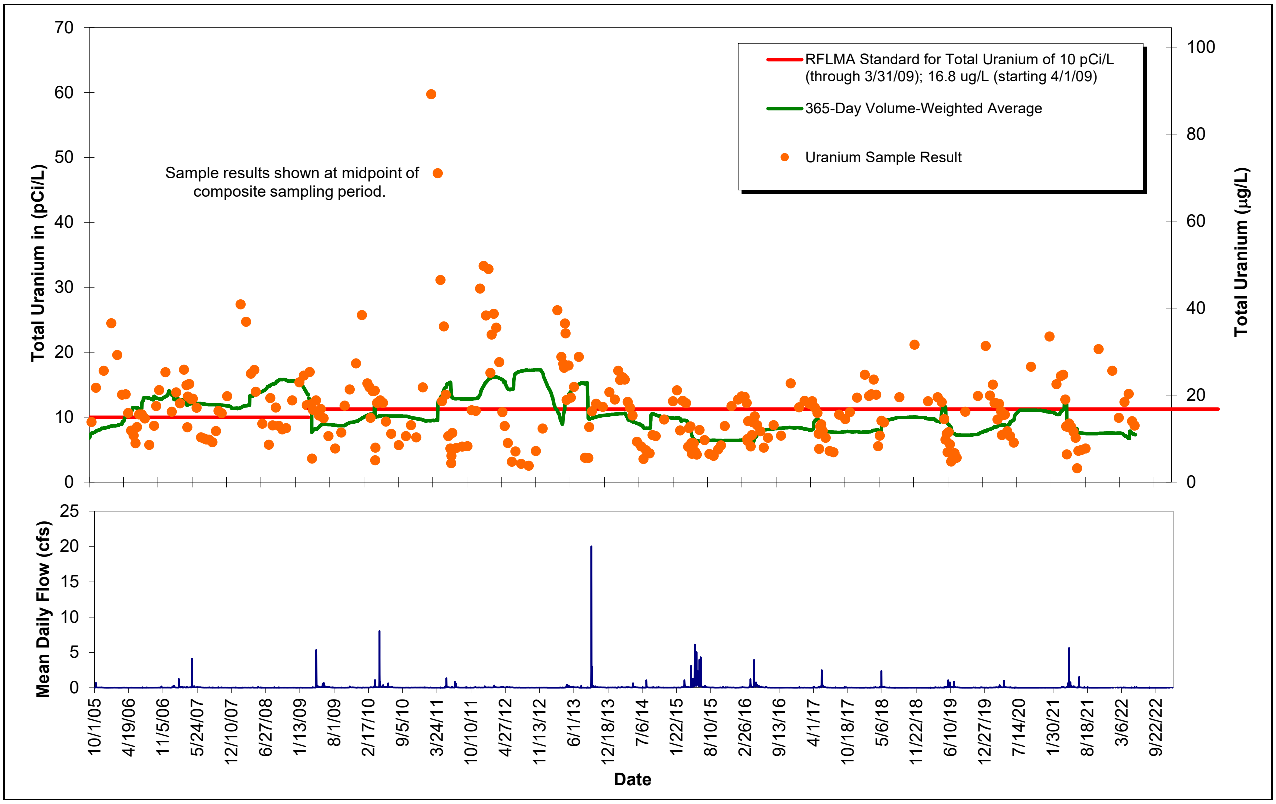
As mentioned earlier, an extensive geochemistry study has been completed that examines the transport mechanisms associated with uranium and nitrate at the Site and the effects of the September 2013 flood. The report can be found at LM's Rocky Flats website (https://www.energy.gov/lm/rocky-flats-site-colorado). Updates to this report, completed in 2019 and 2021, can also be found at LM's Rocky Flats website.



Notes: The composite sample started on June 7, 2022, is still in progress as of January 15, 2023. To show uranium units of both pCi/L and µg/L, the conversion 1 µg/L = 0.67 pCi/L is used.

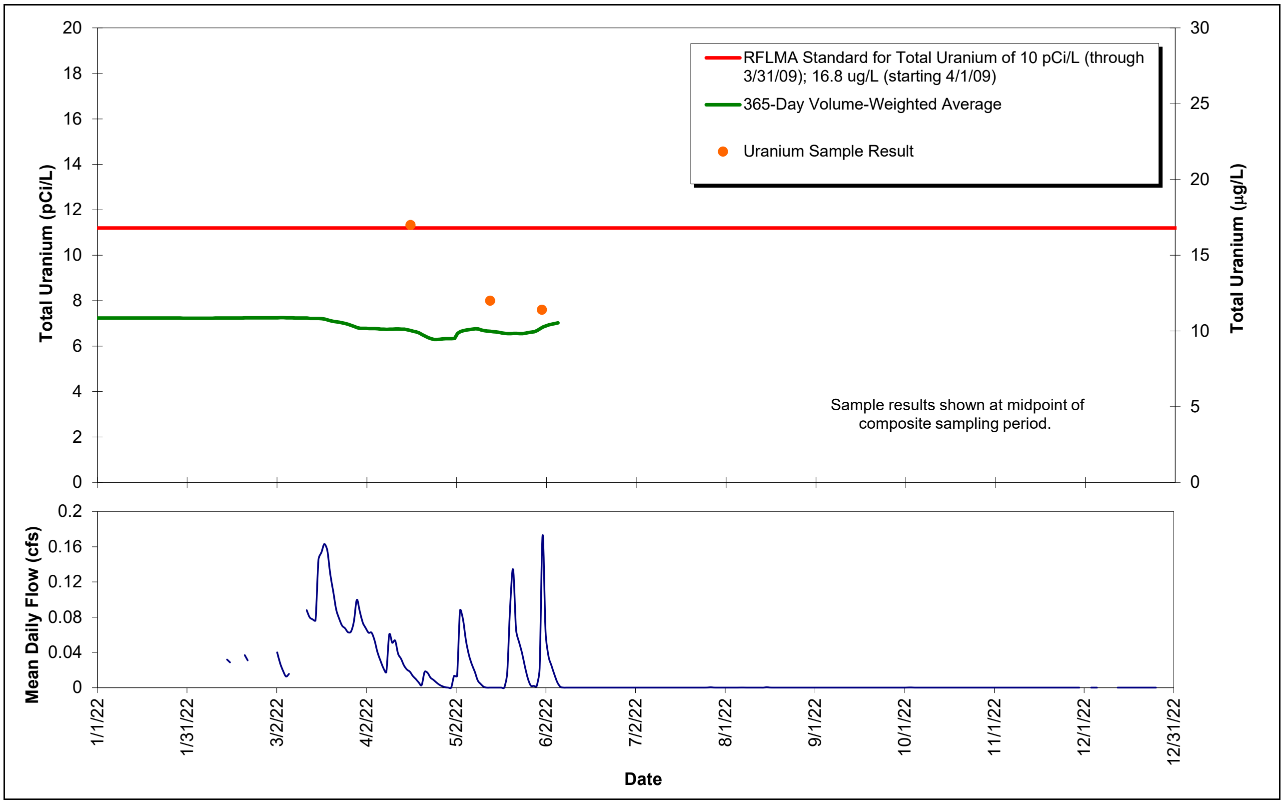
Figure 35. Composite Sample Uranium Results and Rolling 365-Day Averages at GS10: CY 2022

[10] The RFLMA standards shown on these plots are for reference only. The RFLMA-required evaluation is location specific (i.e., POCs, POEs) and is not part of this AMP report. Evaluation of sampling results as required by the RFLMA (CDPHE et al. 2007) is routinely presented in other reports in accordance with the RFLMA reporting requirements. To show uranium units of both pCi/L and µg/L, the conversion 1 µg = 0.67 pCi is used.



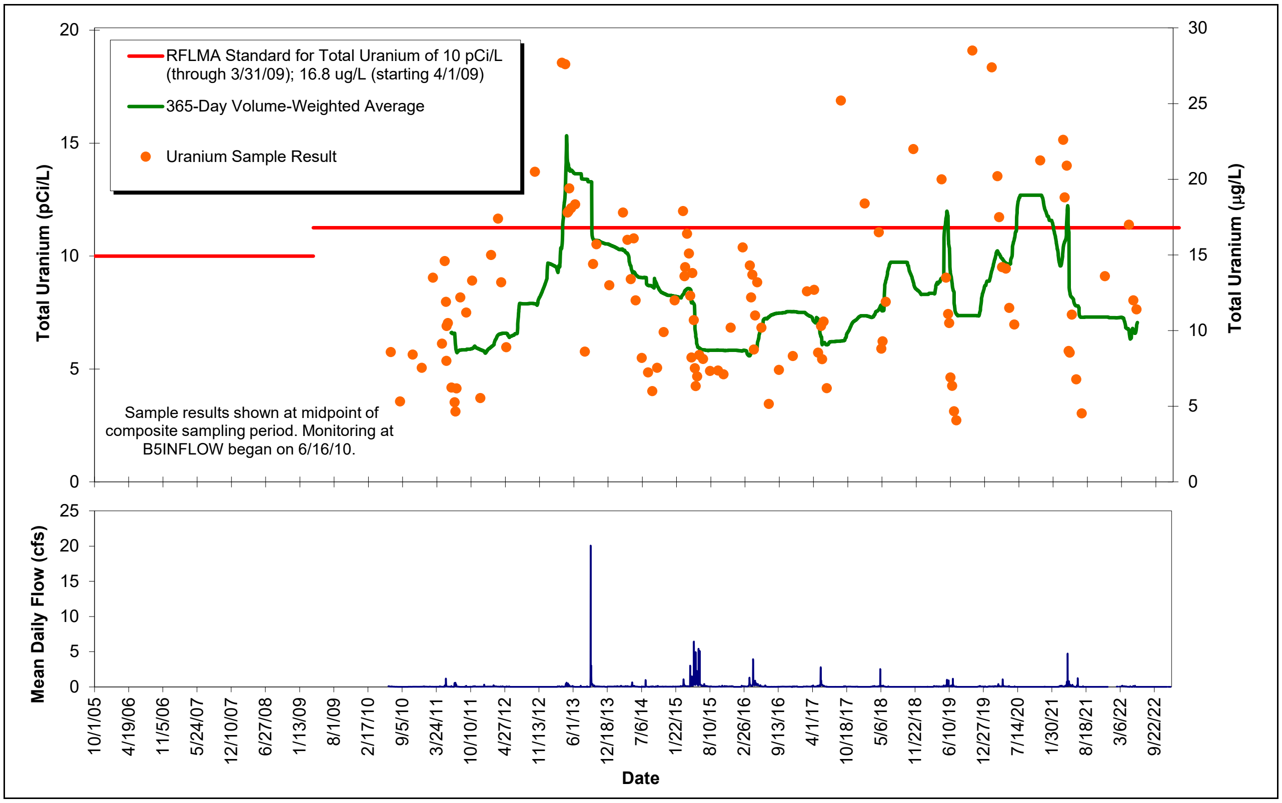
Notes: The composite sample started on June 7, 2022, is still in progress as of January 15, 2023. To show uranium units of both pCi/L and µg/L, the conversion 1 µg/L = 0.67 pCi/L is used.

Figure 36. Composite Sample Uranium Results and Rolling 365-Day Averages at GS10: Postclosure



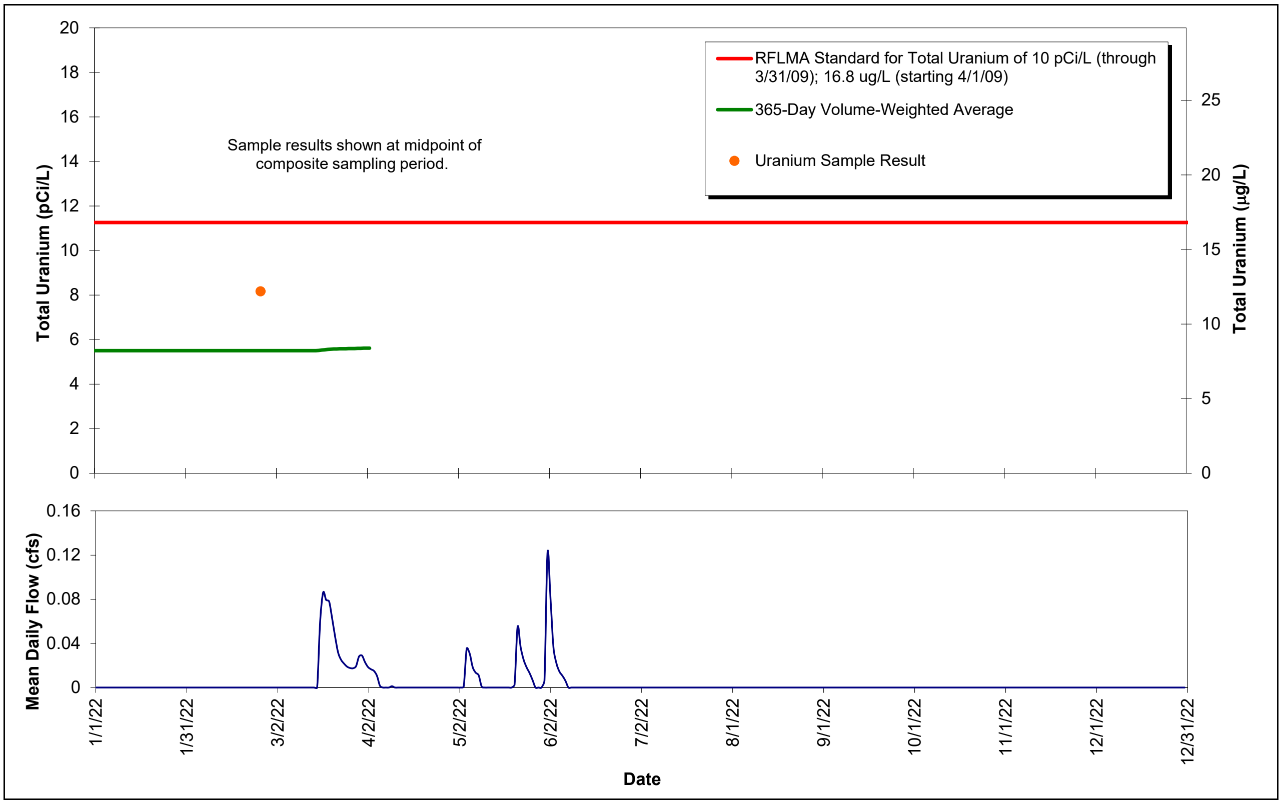
Notes: Due to low flows, the composite sample started on June 7, 2022, is still in progress as of January 15, 2023. To show uranium units of both pCi/L and µg/L, the conversion 1 µg/L = 0.67 pCi/L is used.

Figure 37. Composite Sample Uranium Results and Rolling 365-Day Averages at B5INFLOW: CY 2022



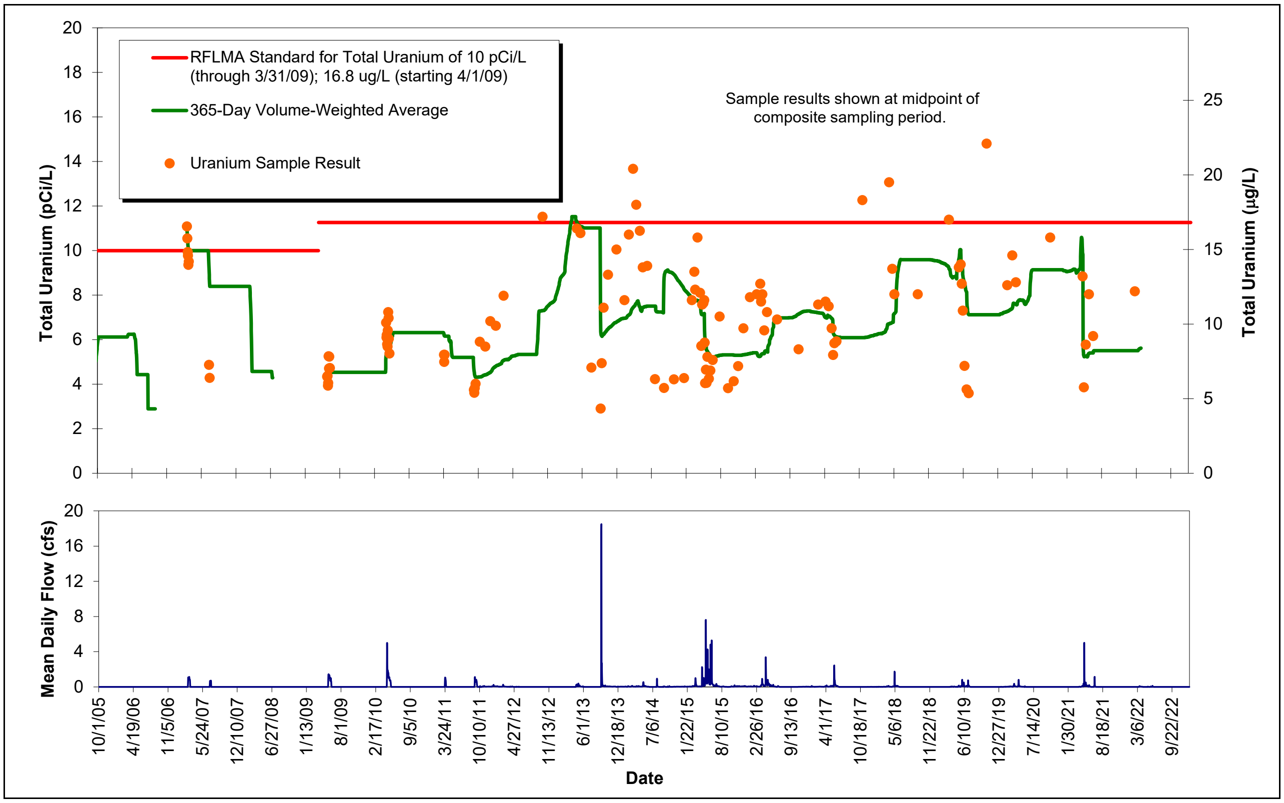
Notes: Due to low flows, the composite sample started on June 7, 2022, is still in progress as of January 15, 2023. To show uranium units of both pCi/L and µg/L, the conversion 1 µg/L = 0.67 pCi/L is used.

Figure 38. Composite Sample Uranium Results and Rolling 365-Day Averages at B5INFLOW: Postclosure



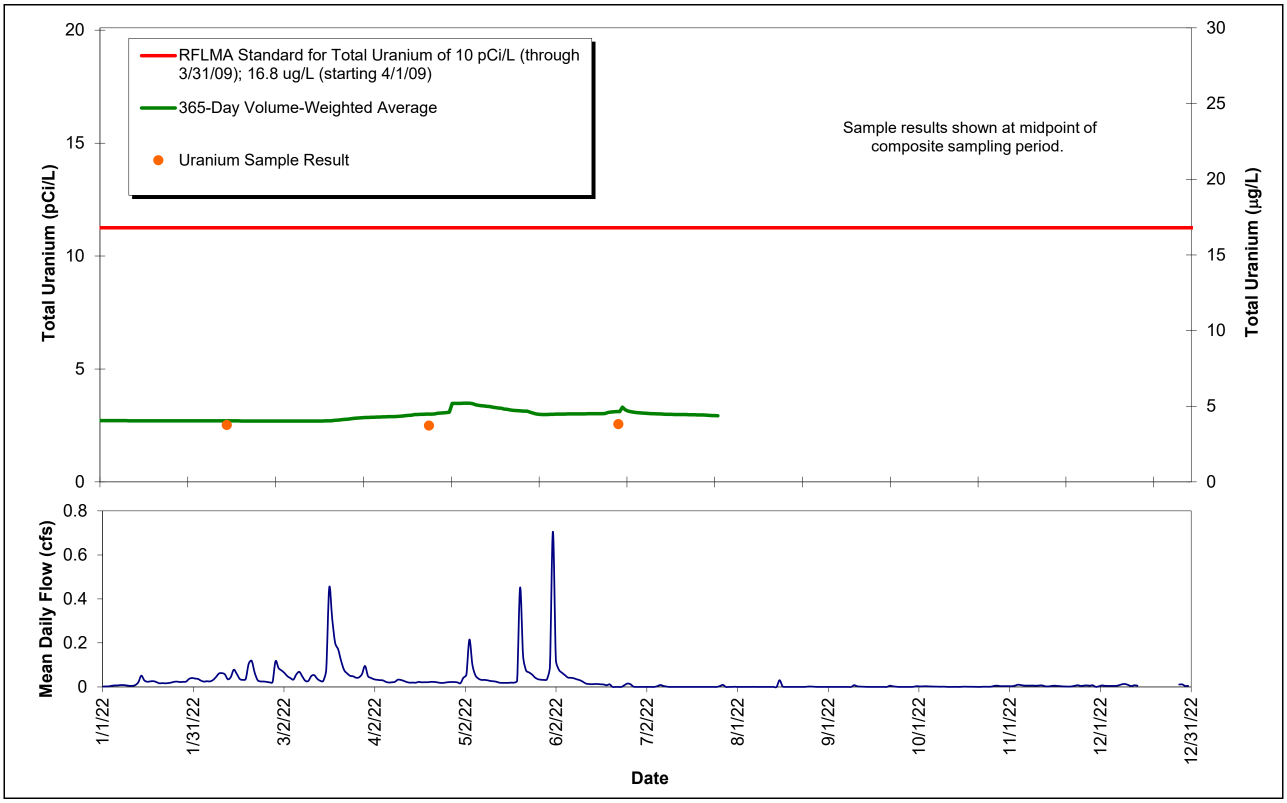
Notes: Due to low flows, the composite sample started on April 4, 2022, is still in progress as of January 15, 2023. To show uranium units of both pCi/L and µg/L, the conversion 1 µg/L = 0.67 pCi/L is used.

Figure 39. Composite Sample Uranium Results and Rolling 365-Day Averages at GS08: CY 2022



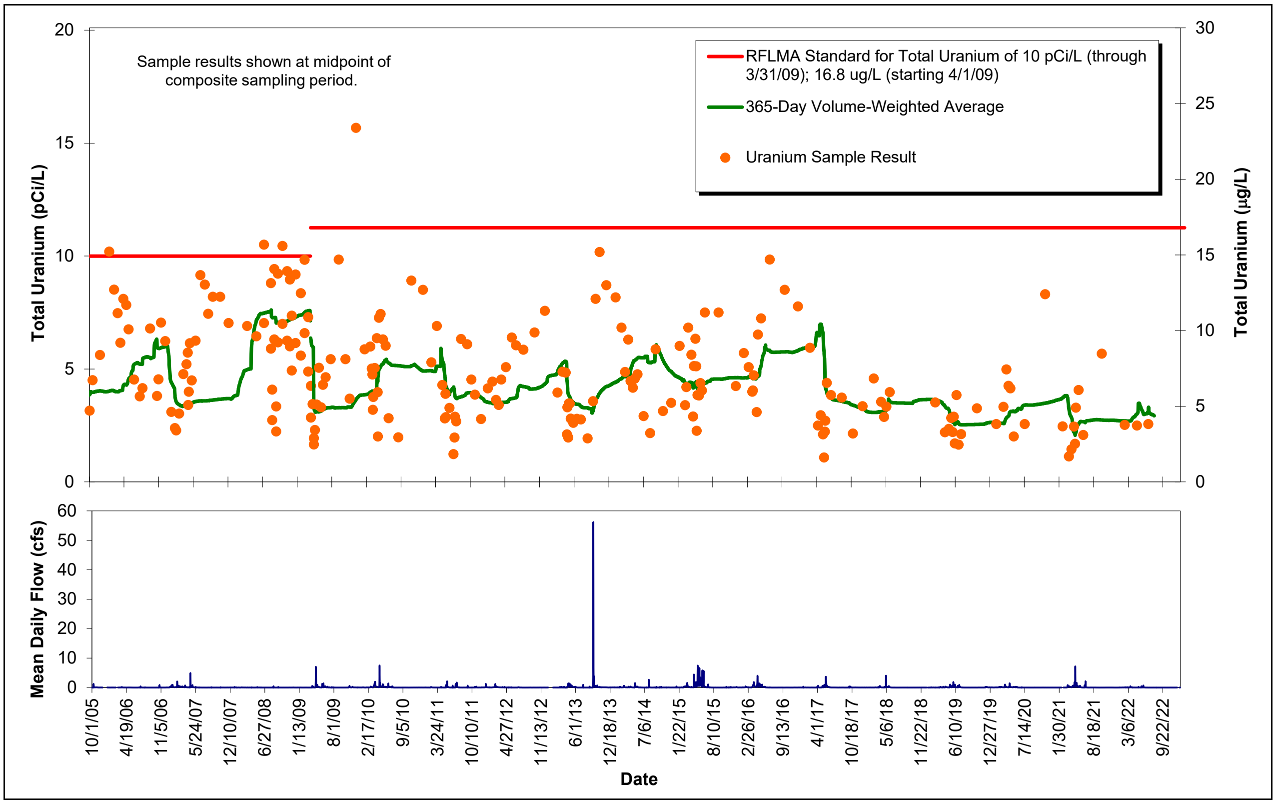
Notes: Due to low flows, the composite sample started on April 4, 2022, is still in progress as of January 15, 2023. To show uranium units of both pCi/L and µg/L, the conversion 1 µg/L = 0.67 pCi/L is used.

Figure 40. Composite Sample Uranium Results and Rolling 365-Day Averages at GS08: Postclosure



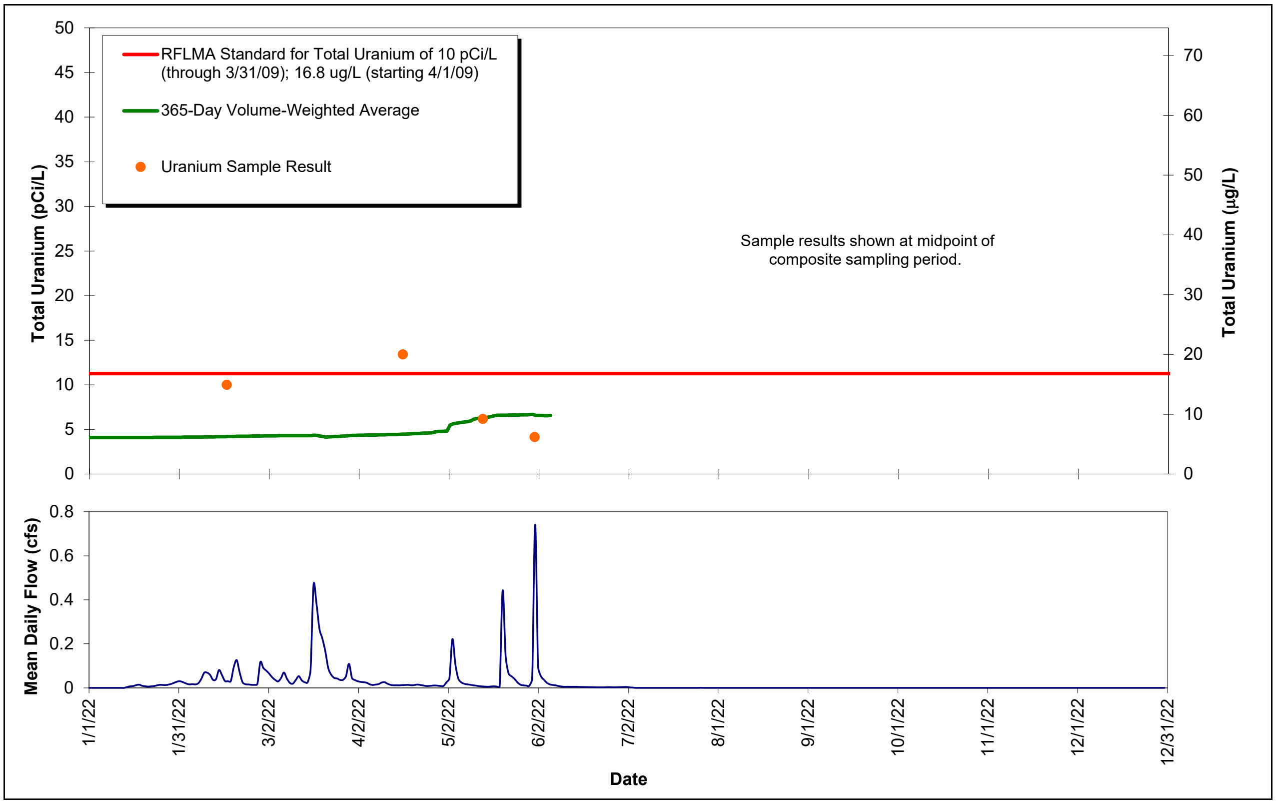
Notes: Due to low flows, the composite sample started on August 4, 2022, is still in progress as of January 15, 2023. To show uranium units of both pCi/L and µg/L, the conversion 1 µg/L = 0.67 pCi/L is used.

Figure 41. Composite Sample Uranium Results and Rolling 365-Day Averages at SW093: CY 2022



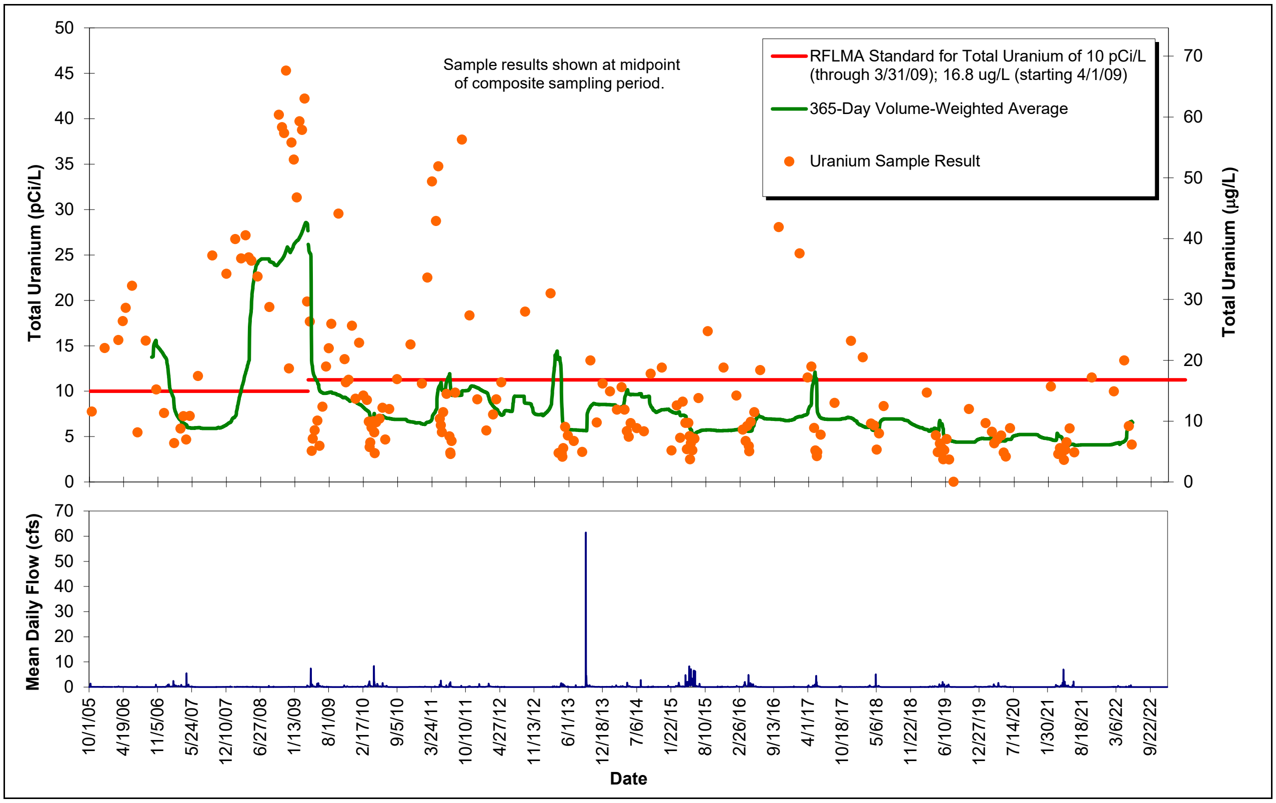
Notes: Due to low flows, the composite sample started on August 4, 2022, is still in progress as of January 15, 2023. To show uranium units of both pCi/L and µg/L, the conversion 1 µg/L = 0.67 pCi/L is used.

Figure 42. Composite Sample Uranium Results and Rolling 365-Day Averages at SW093: Postclosure



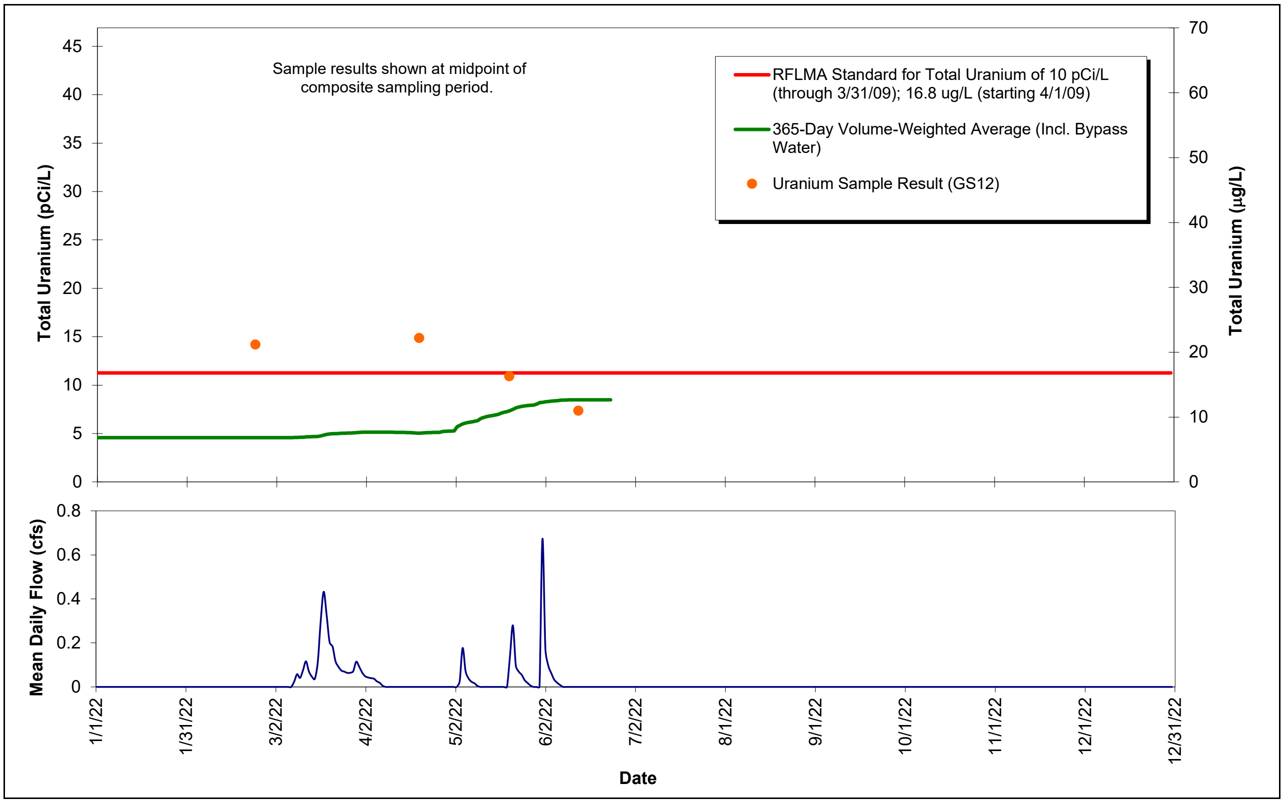
Notes: Due to low flows, the composite sample started on June 7, 2022, is still in progress as of January 15, 2023. To show uranium units of both pCi/L and µg/L, the conversion 1 µg/L = 0.67 pCi/L is used.

Figure 43. Composite Sample Uranium Results and Rolling 365-Day Averages at GS13: CY 2022



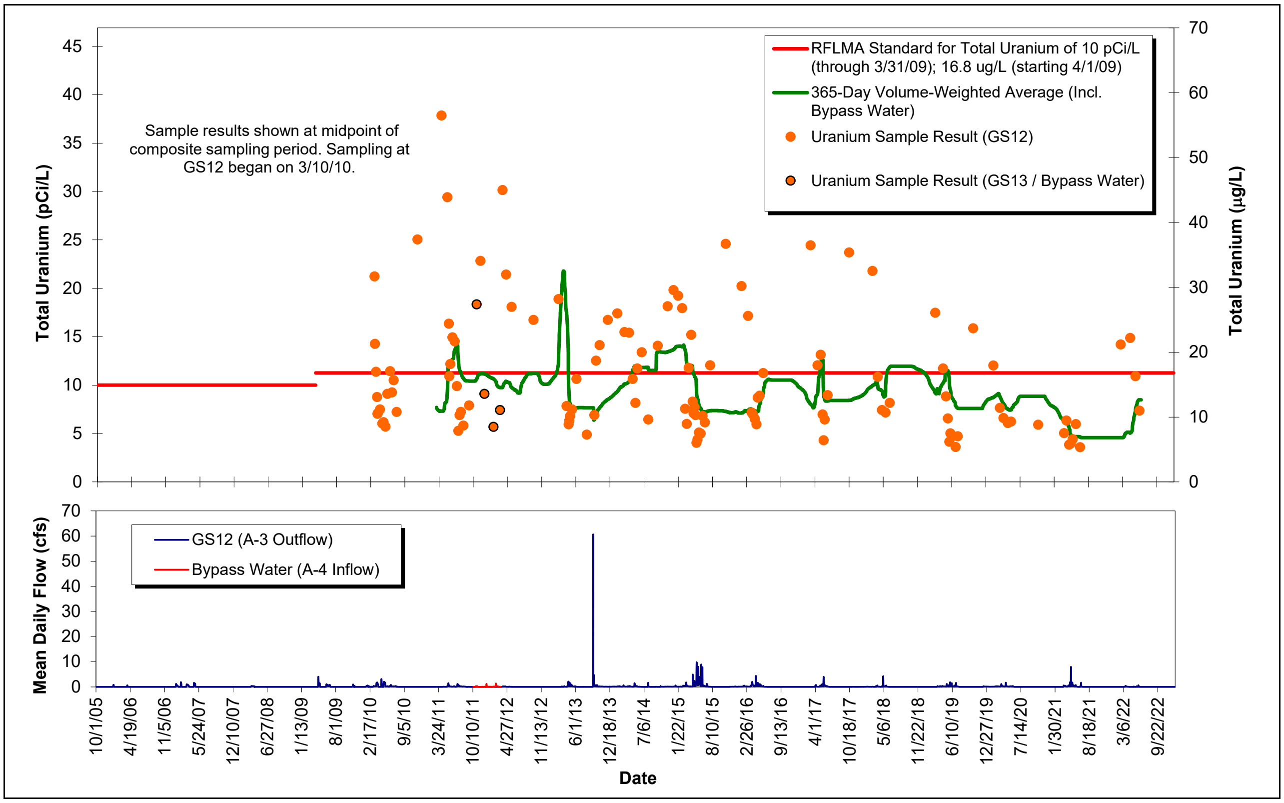
Notes: Due to low flows, the composite sample started on June 7, 2022, is still in progress as of January 15, 2023. To show uranium units of both pCi/L and µg/L, the conversion 1 µg/L = 0.67 pCi/L is used.

Figure 44. Composite Sample Uranium Results and Rolling 365-Day Averages at GS13: Postclosure



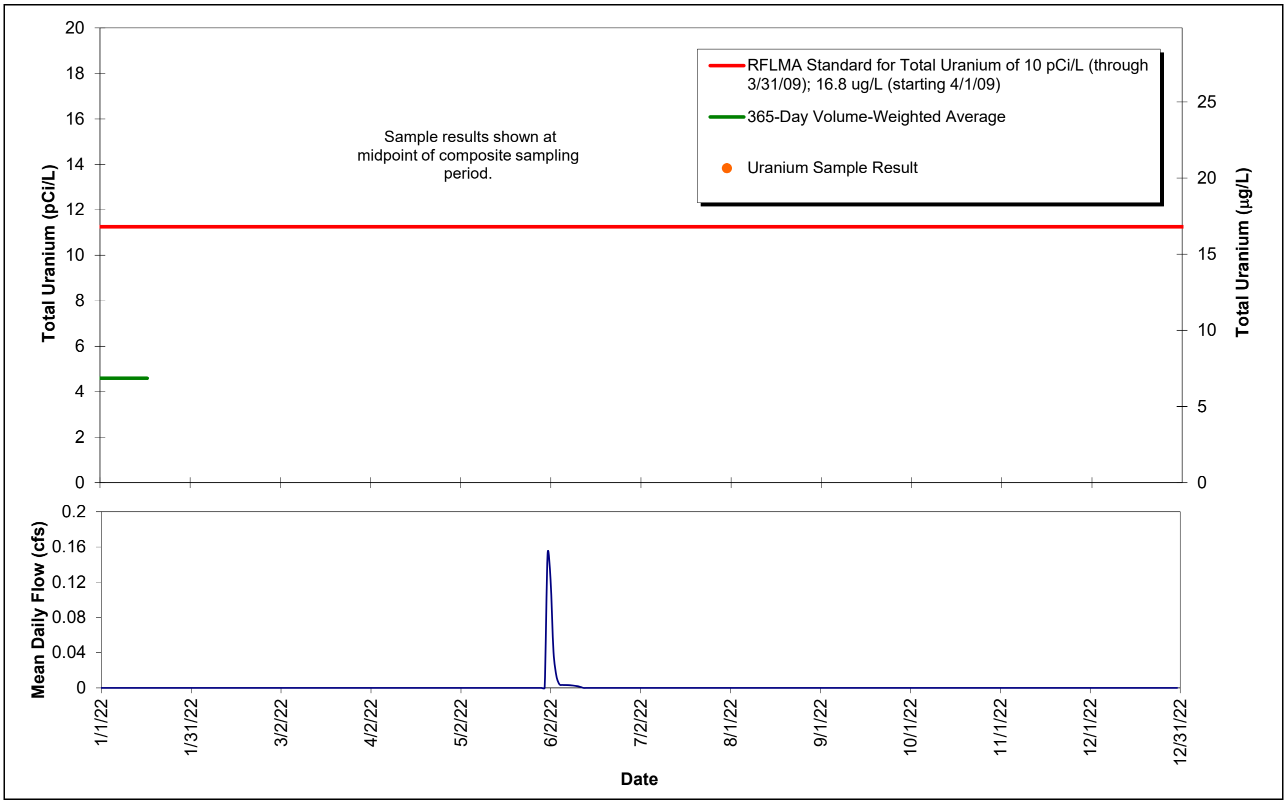
Notes: Due to low flows, the composite sample started on June 25, 2022, is still in progress as of January 15, 2023. To show uranium units of both pCi/L and µg/L, the conversion 1 µg/L = 0.67 pCi/L is used.

Figure 45. Composite Sample Uranium Results and Rolling 365-Day Averages at GS12: CY 2022



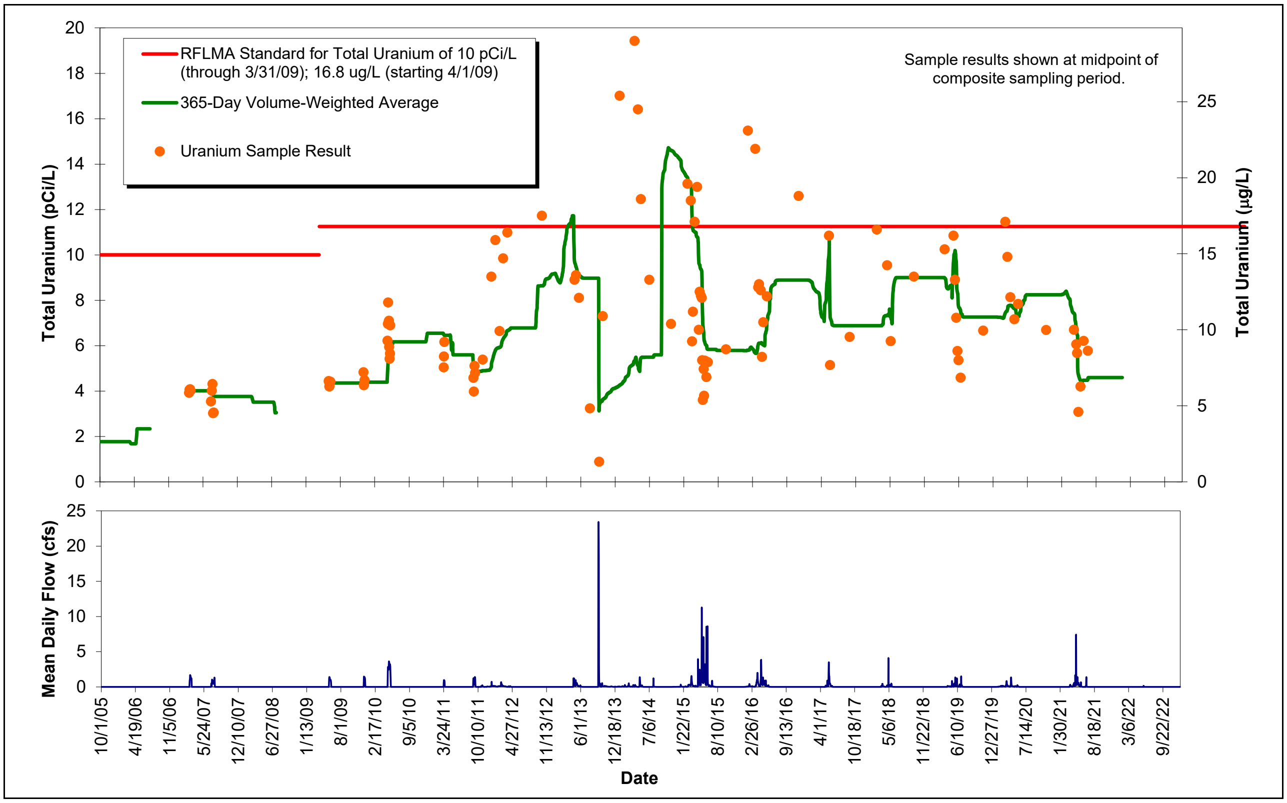
Notes: Due to low flows, the composite sample started on June 25, 2022, is still in progress as of January 15, 2023. To show uranium units of both pCi/L and µg/L, the conversion 1 µg/L = 0.67 pCi/L is used.

Figure 46. Composite Sample Uranium Results and Rolling 365-Day Averages at GS12 (A-4 Inflow): Postclosure



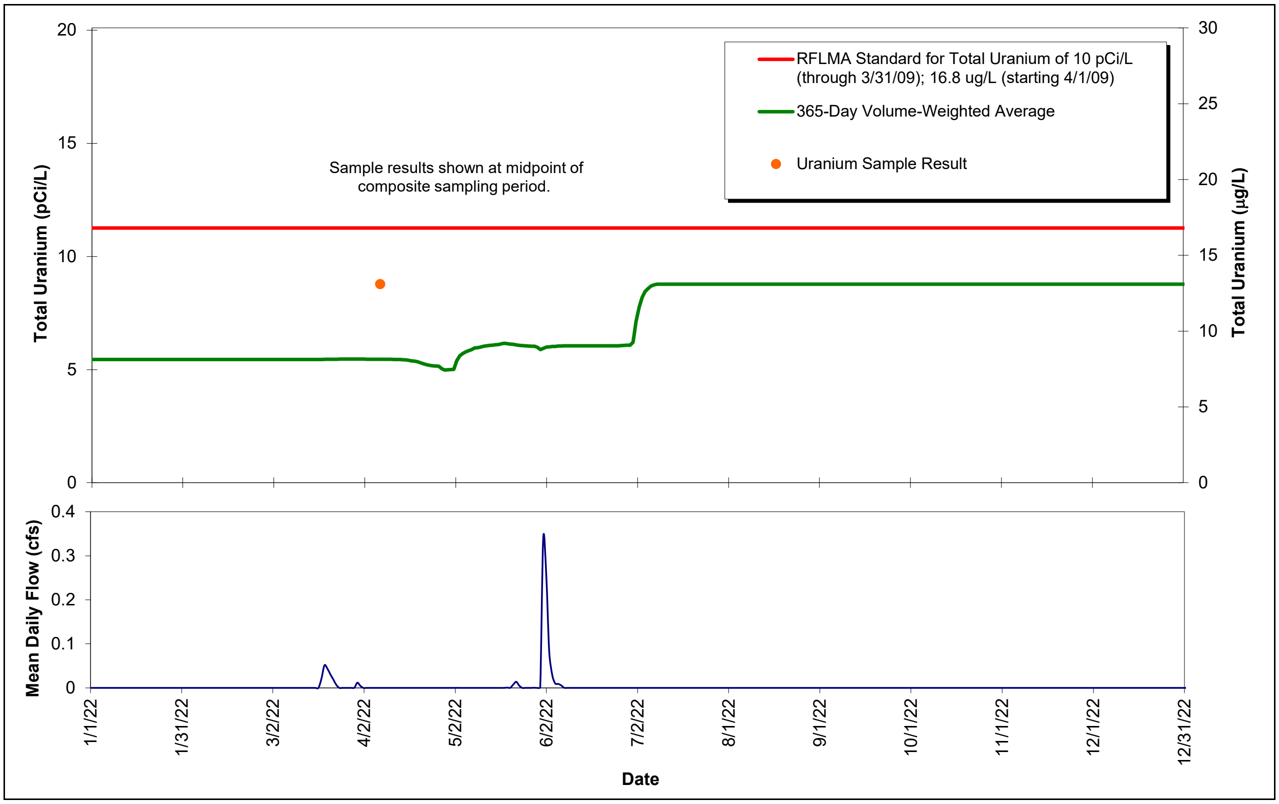
Notes: Due to low flows, the composite sample started on January 18, 2022, is still in progress as of January 15, 2023. To show uranium units of both pCi/L and µg/L, the conversion 1 µg/L = 0.67 pCi/L is used.

Figure 47. Composite Sample Uranium Results and Rolling 365-Day Averages at GS11: CY 2022



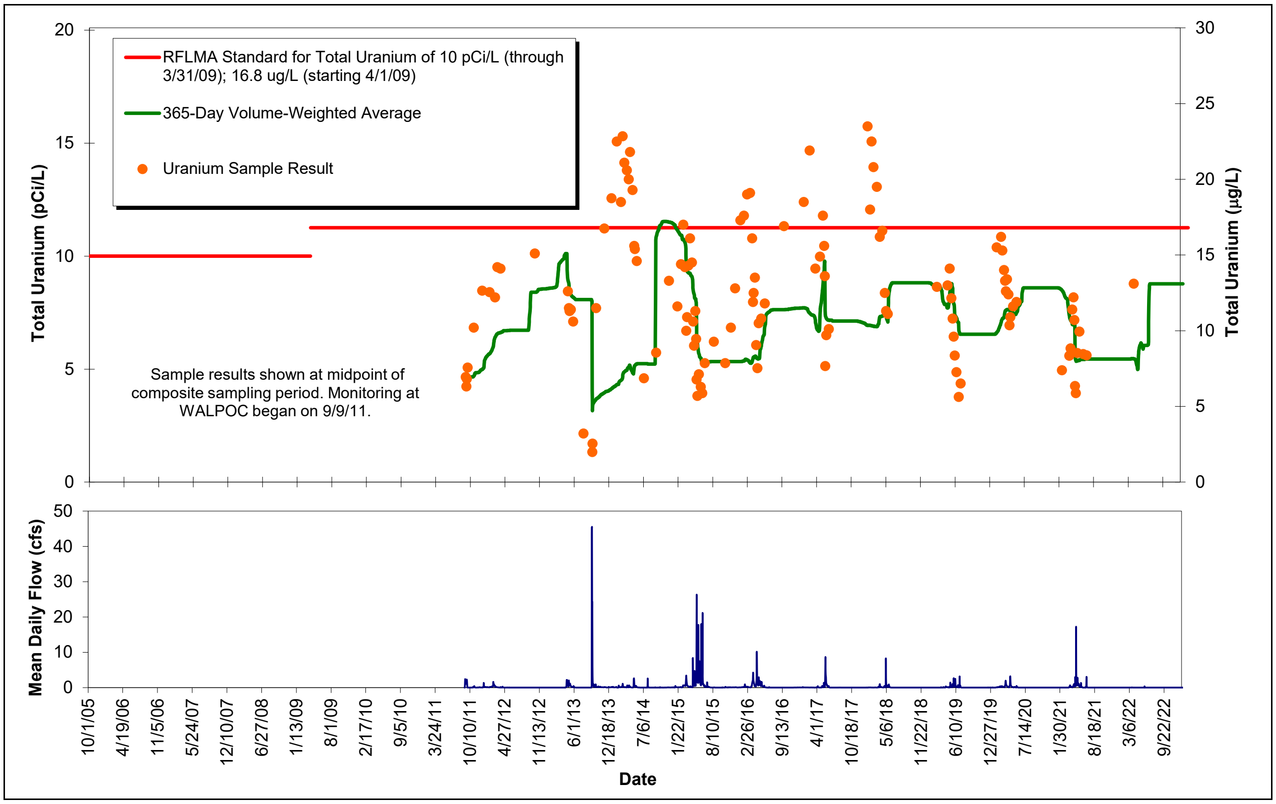
Notes: Due to low flows, the composite sample started on January 18, 2022, is still in progress as of January 15, 2023. To show uranium units of both pCi/L and µg/L, the conversion 1 µg/L = 0.67 pCi/L is used.

Figure 48. Composite Sample Uranium Results and Rolling 365-Day Averages at GS11: Postclosure



Note: To show uranium units of both pCi/L and µg/L, the conversion 1 µg/L = 0.67 pCi/L is used.

Figure 49. Composite Sample Uranium Results and Rolling 365-Day Averages at WALPOC: CY 2022

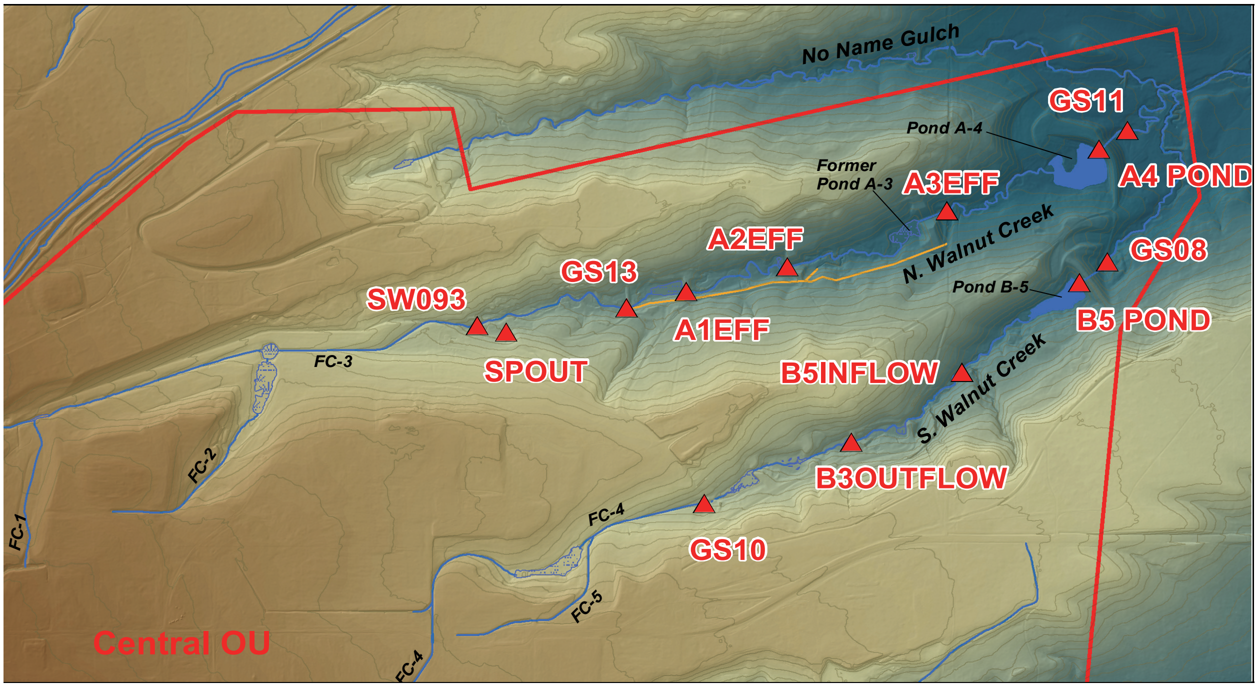


Note: To show uranium units of both pCi/L and µg/L, the conversion 1 µg/L = 0.67 pCi/L is used.

Figure 50. Composite Sample Uranium Results and Rolling 365-Day Averages at WALPOC: Postclosure

3.6 Grab Sampling for Uranium in North and South Walnut Creeks

This monitoring objective is primarily intended to evaluate the transport of uranium in North and South Walnut Creeks by assessing correlations, patterns, variability, and loading. This objective is also intended to help define the relative impact of the SPPTS on surface water quality in North Walnut Creek. Samples were collected biweekly as grabs; as of December 2021, uranium grabs are collected monthly. Figure 51 presents the uranium grab sampling locations in North and South Walnut Creeks. Sampling for this monitoring objective began on January 27, 2010, at most locations.



Notes: The orange line shows the location of the A-Series Bypass Pipeline, which goes around former Ponds A-1, A-2, and A-3. Location A3EFF is collocated with GS12 (A3EFF is the grab sampling location, and GS12 is the automated composite sampling location).

Figure 51. Uranium Grab Sampling Locations in North and South Walnut Creeks

Starting on October 13, 2011, water in North Walnut Creek was diverted around Pond A-3 and former Ponds A-1 and A-2 to support the Dam A-3 breach construction. This diverted water was routed through the A-Series Bypass Pipeline from GS13 to just below Pond A-3 (near A3EFF) until March 21, 2012. During this period, it is assumed that the water quality and quantity were the same when the water entered the pipeline as when it exited the pipeline.[11] Therefore, data collected at GS13 and A3EFF during this period have been combined to effectively summarize water quality *entering* Pond A-4 and not water quality *exiting* Pond A-3.

Table 8 shows summary statistics for the uranium grab sampling in North and South Walnut Creeks. Since flow-paced composite samples essentially "average" water quality fluctuations, the grab sample results show more variability than the composite sample results, as expected. Grab samples are generally collected during fair weather base-flow periods when uranium is more likely to be present at higher concentrations. Continuous flow-paced composite sample results are a better representation of actual longer-term uranium concentrations; by design, automated composite sampling collects samples continuously during all flow conditions, including intense, high-volume runoff periods when uranium concentrations are generally lower.

[11] This assumption has been confirmed by grab samples taken at GS13 and A4INFLOW; A4INFLOW is just upstream of Pond A-4.

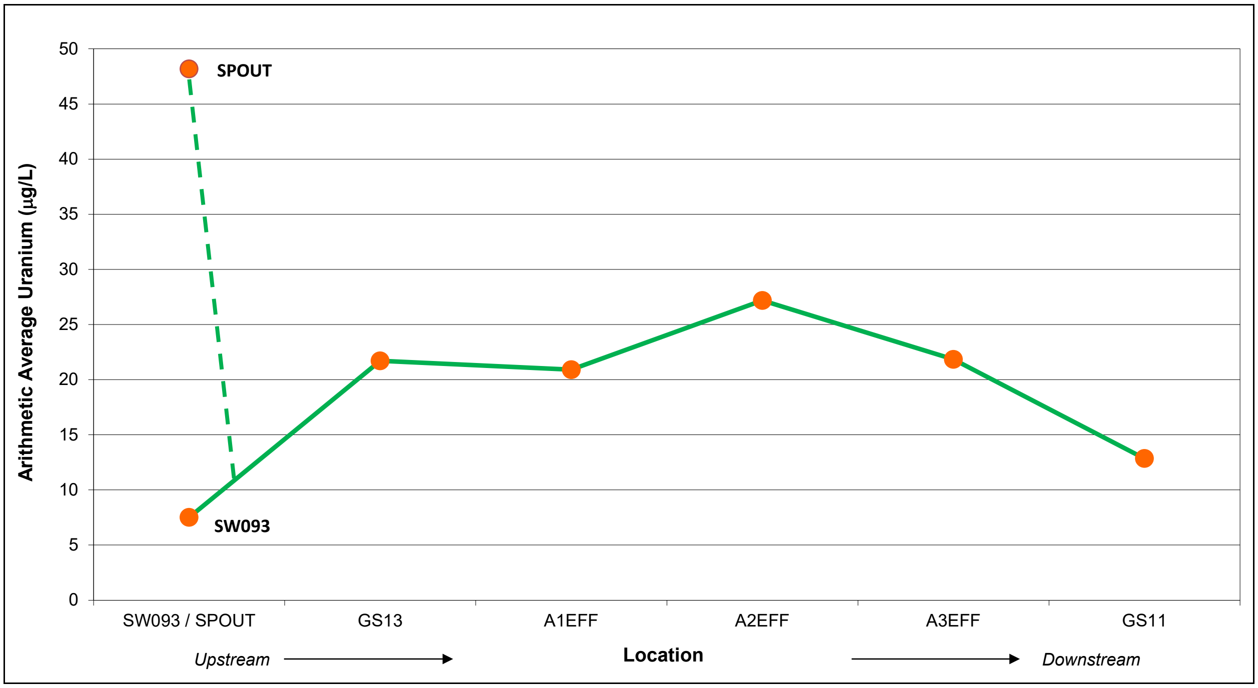
Table 8. Summary Statistics for Uranium Grab Sampling in North and South Walnut Creeks for the Period Starting January 27, 2010

North Walnut Creek		Uranium (ug/L)			
	Location Code	**Average**	**Sample Count**	**85th Percentile**	**50th Percentile**
Upstream	SW093	7.46	291	11.0	6.80
⬇	SPOUT*	48.2	304	65.0	48.5
⬇	GS13	21.7	224	36.6	17.5
⬇	A1EFF	20.9	170	32.0	15.0
⬇	A2EFF	27.2	161	42.0	24.0
⬇	A3EFF (A-4 inflow)	21.8	150	34.0	21.0
⬇	A4 POND	11.3	149	17.0	9.80
Downstream	GS11	12.8	51	17.0	12.0

South Walnut Creek		Uranium (ug/L)			
	Location Code	**Average**	**Sample Count**	**85th Percentile**	**50th Percentile**
Upstream	GS10	16.0	282	23.0	16.0
⬇	B3OUTFLOW	16.4	197	24.0	16.0
⬇	B5INFLOW	14.2	189	20.0	14.0
⬇	B5 POND	8.46	147	12.1	7.30
Downstream	GS08	10.6	80	15.0	10.0

Notes:
Sample counts vary because some locations are periodically dry.
The summary includes all data available as of January 15, 2023; some recent data are not validated (i.e., are preliminary and subject to revision).
Uranium grab sampling data at GS11 and GS08 start on April 30, 2015. AMP uranium grab sampling at Pond A-4 and Pond B-5 was discontinued on October 31, 2015.
* SPOUT is the treated effluent monitoring location for the SPPTS. SPOUT is not in North Walnut Creek but flows into a belowground discharge gallery south of North Walnut Creek between monitoring locations SW093 and GS13.

Grab samples do, however, give a good portrayal of spatial water quality variation (i.e., upstream to downstream). Figure 52 and Figure 53 show the spatial variation of average uranium concentrations in North and South Walnut Creeks. Both plots show noticeable variation, with concentrations both increasing and decreasing between locations. As mentioned earlier, an extensive geochemistry study has been completed that examines the transport mechanisms associated with uranium and nitrate at the Site and the effects of the September 2013 flood. The report can be found at LM's Rocky Flats website (https://www.energy.gov/lm/rocky-flats-site-colorado). Updates to this report, completed in 2019 and 2021, can also be found at LM's Rocky Flats website.



Note: SPOUT is the treated effluent monitoring location for the SPPTS. SPOUT is not in North Walnut Creek but flows into a belowground discharge gallery south of North Walnut Creek between monitoring locations SW093 and GS13.

Figure 52. Arithmetic Average Uranium Concentrations at North Walnut Creek Grab Locations

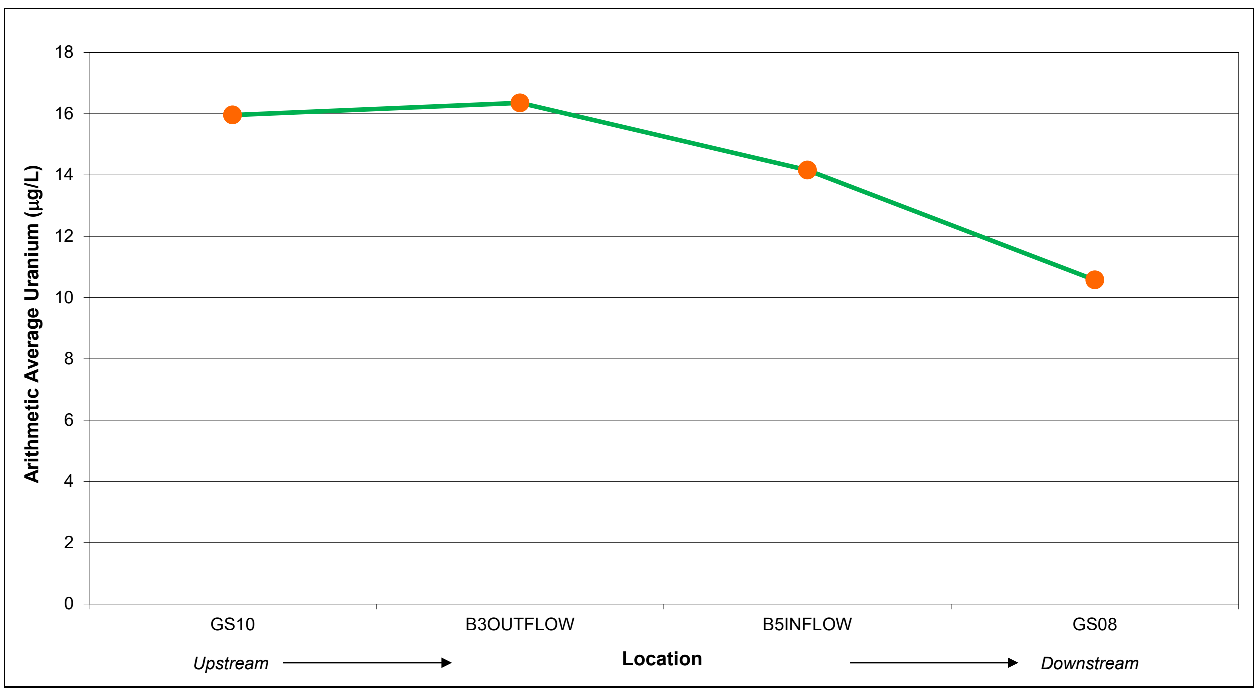
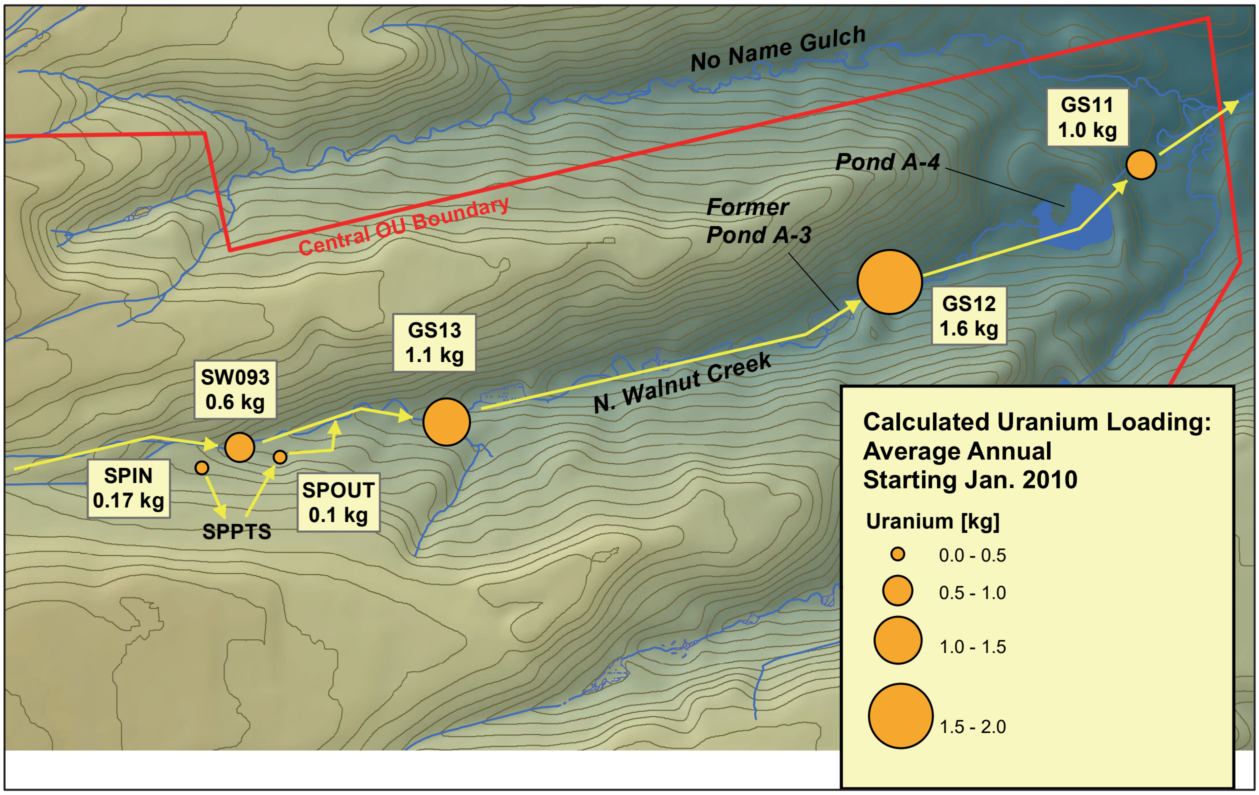


Figure 53. Arithmetic Average Uranium Concentrations at South Walnut Creek Grab Locations

The map in Figure 54 shows the calculated average annual uranium loads in North Walnut Creek since January 2010 (using all available sample results as of January 15, 2023).[12] While the SPPTS removes approximately 40% of the uranium load in the water it collects, the loads at both the system influent (SPIN) and system effluent (SPOUT) are small compared to the loads (predominantly natural uranium) at other locations in North Walnut Creek. Even though the SPPTS concentrations are higher than the creek concentrations, the much larger creek flow volumes yield significantly larger loads. In fact, the load at SPOUT is calculated to be approximately 9% of the load at GS13.



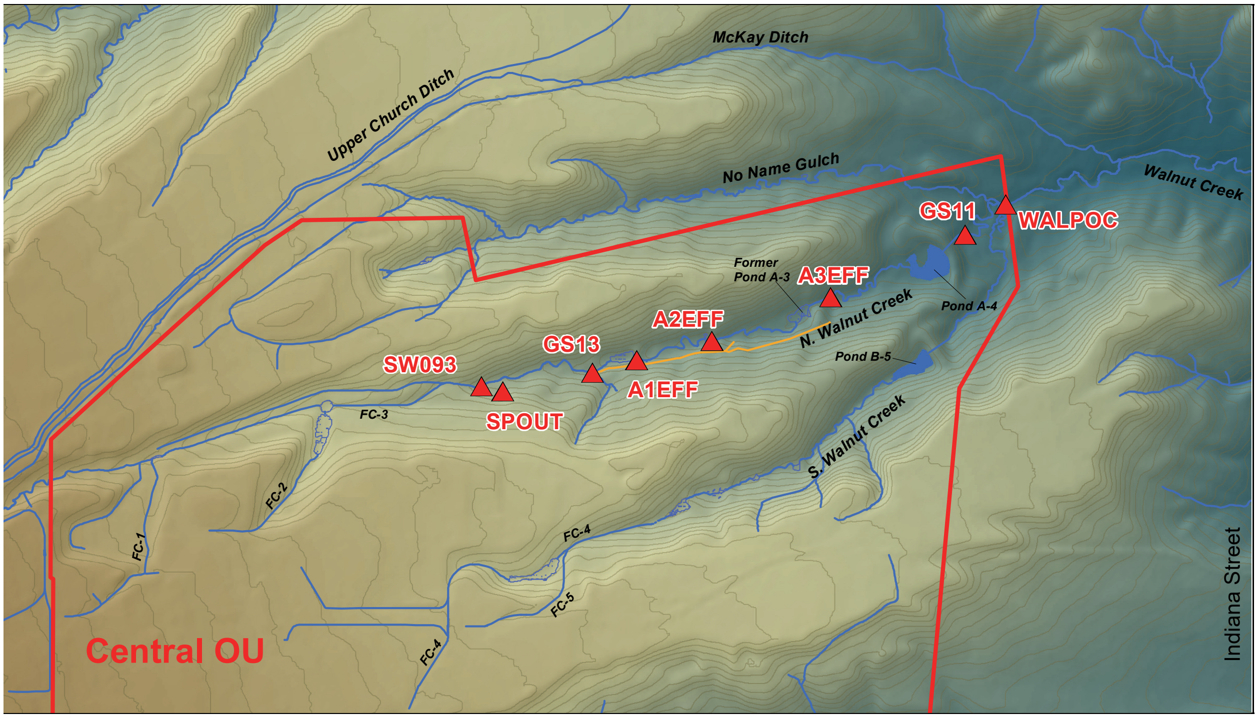
Notes: Uranium loads at SW093, GS13, GS12, and GS11 are calculated using results from flow-paced composites (see Section 3.5). Uranium loads at SPIN and SPOUT are calculated using results from grab sampling related to this AMP objective and other treatment system optimization efforts. Arrows indicate general flow routing.
Abbreviation: kg = kilograms

Figure 54. Map Showing Calculated Uranium Loads in North Walnut Creek Since January 2010

[12] Uranium loads are only calculated for locations with flow volume measurement. Grab sample uranium concentrations are used for locations SPIN and SPOUT; continuous flow-paced sample uranium concentrations are used for SW093, GS13, GS12, and GS11.

3.7 Grab Sampling for Nitrate + Nitrite as Nitrogen in Walnut Creek

This monitoring objective is primarily intended to evaluate the transport of nitrate in North Walnut Creek and Walnut Creek by assessing correlations, patterns, variability, and loading.[13] This objective is also intended to help define the relative impacts of the SPPTS on surface water quality in North Walnut Creek. Samples are currently collected biweekly as grabs (Figure 55). Sampling for this monitoring objective at most locations began on January 27, 2010. WALPOC started operational testing in September 2011.



Notes: The orange line shows the location of the A-Series Bypass Pipeline, which goes around former Ponds A-1, A-2, and A-3. A3EFF is collocated with GS12 (A3EFF is the grab sampling location, and GS12 is the automated composite sampling location).

Figure 55. Nitrate + Nitrite as Nitrogen Grab Sampling Locations in North Walnut and Walnut Creeks

This evaluation is performed for three different time periods in recognition of the WALPOC operational testing started in September 2011 and the implementation of improved nitrate treatment at the SPPTS in late October 2016. The different time periods are:

- January 27, 2010, to November 1, 2016.
- September 9, 2011, to November 1, 2016.
- November 1, 2016, to the present.

[13] All of the nitrate + nitrite in the environment at the site is contamination originating from past plant operations. Unlike uranium, there is no natural source of nitrate + nitrite.

Starting on October 13, 2011, water in North Walnut Creek was diverted around Pond A-3 and former Ponds A-1 and A-2 to drain Pond A-3 in preparation for the Dam A-3 breach. This diverted water was routed through the A-Series Bypass Pipeline from GS13 to just below Pond A-3 (near A3EFF) until March 21, 2012. During this period, it is assumed that the water quality and quantity were the same when the water entered the pipeline as when it exited the pipeline.[14] Therefore, data collected at GS13 and A3EFF during this period have been combined to effectively summarize water quality *entering* Pond A-4 and not water quality *exiting* Pond A-3.

Table 9 shows summary statistics for the nitrate + nitrite as nitrogen grab sampling in North Walnut Creek for the period January 27, 2010, to November 1, 2016. These grab samples are collected during fair weather base-flow periods when nitrate is more likely to be present at higher concentrations (because the source is groundwater). These grab samples also give a good portrayal of spatial nitrate variation (i.e., upstream to downstream). Figure 56 shows the spatial variation (upstream to downstream) of average nitrate concentrations in North Walnut Creek. The plot shows a measurable increase between SW093 (upstream of Solar Ponds influence) and GS13 (downstream of Solar Ponds influence). However, farther downstream, the reduction of nitrate through natural processes is apparent.

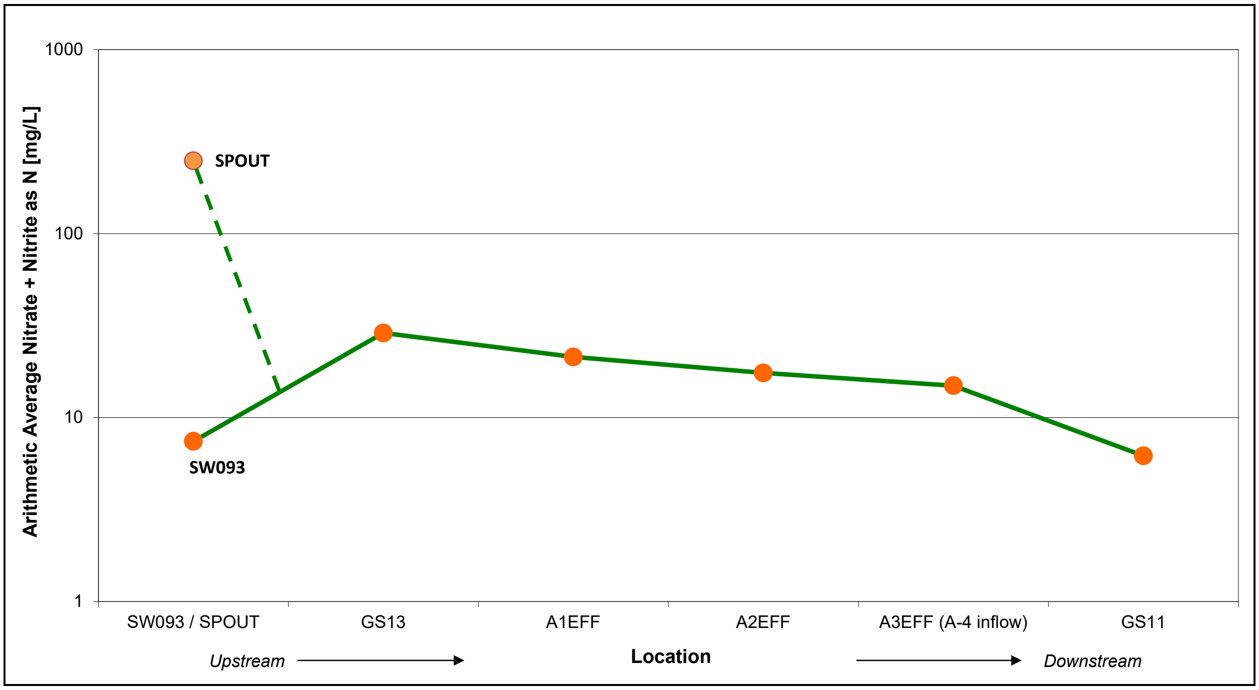
Table 9. Summary Statistics for Nitrate + Nitrite as Nitrogen Grab Sampling in North Walnut Creek for January 27, 2010, to November 1, 2016

North Walnut Creek		**Nitrate+Nitrite as N (mg/L)**			
	Location Code	**Average**	**Sample Count**	**85th Percentile**	**50th Percentile**
Upstream	SW093	7.42	163	13.4	3.40
🡇	SPOUT*	248	164	420	260
🡇	GS13	28.8	149	50.0	26.0
🡇	A1EFF	21.3	106	40.0	19.0
🡇	A2EFF	17.5	102	36.0	15.0
🡇	A3EFF (A-4 inflow)	14.9	102	30.7	12.0
Downstream	GS11	6.20	72	10.1	6.70

Notes:
Sample counts vary because some locations are periodically dry.
Data for the period May 1, 2010, to March 28, 2011, at GS11 include results from short-duration composite samples collected during batch-discharge operations.
* SPOUT is the treated effluent monitoring location for the SPPTS. SPOUT is not in North Walnut Creek but flows into a belowground discharge gallery south of North Walnut Creek between monitoring locations SW093 and GS13.

Abbreviations:
mg/L = milligrams per liter
N = nitrogen

[14] This assumption has been confirmed by grab samples taken at GS13 and A4INFLOW; A4INFLOW is just upstream of Pond A-4.



Notes: Concentrations are shown on a logarithmic scale. SPOUT is the treated effluent monitoring location for the SPPTS. SPOUT is not in North Walnut Creek but flows into a belowground discharge gallery south of North Walnut Creek between monitoring locations SW093 and GS13. Data for May 1, 2010, to March 28, 2011, at GS11 include results from short-duration composite samples collected during batch-discharge pond operations.
Abbreviations: mg/L = milligrams per liter, N = nitrogen

Figure 56. Arithmetic Average Nitrate + Nitrite as Nitrogen Concentrations at North Walnut Creek and Walnut Creek Grab Locations for January 27, 2010, to November 1, 2016

Table 10 shows summary statistics for the nitrate + nitrite as nitrogen grab sampling in North Walnut Creek and lower Walnut Creek (WALPOC) for September 1, 2011, to November 1, 2016. Figure 57 shows the spatial variation (upstream to downstream) of average nitrate concentrations in North Walnut Creek for this period. As with the pattern discussed above for January 27, 2010, to November 1, 2016, the plot shows a measurable increase between SW093 (upstream of Solar Ponds influence) and GS13 (downstream of Solar Ponds influence). However, farther downstream, the reduction of nitrate through natural processes is apparent.

Table 10. Summary Statistics for Nitrate + Nitrite as Nitrogen Grab Sampling in North Walnut Creek and Walnut Creek for September 1, 2011, to November 1, 2016

North Walnut Creek		**Nitrate+Nitrite as N (mg/L)**			
	Location Code	**Average**	**Sample Count**	**85th Percentile**	**50th Percentile**
Upstream	SW093	7.67	122.0	14.8	3.10
⬇	SPOUT*	300	114	440	310
⬇	GS13	31.3	113	52.0	26.0
⬇	A1EFF	25.1	71.0	42.3	21.0
⬇	A2EFF	20.0	75.0	39.0	17.5
⬇	A3EFF (A-4 inflow)	16.0	56.0	30.4	16.0
⬇	GS11	6.68	59.0	10.8	7.15
Downstream	WALPOC	2.77	83.0	5.73	2.50

Notes:
Sample counts vary because some locations are periodically dry.
* SPOUT is the treated effluent monitoring location for the SPPTS. SPOUT is not in North Walnut Creek but flows into a belowground discharge gallery south of North Walnut Creek between monitoring locations SW093 and GS13.

Abbreviations:
mg/L = milligrams per liter
N = nitrogen

Notes: Concentrations are shown on a logarithmic scale. SPOUT is the treated effluent monitoring location for the SPPTS. SPOUT is not in North Walnut Creek but flows into a belowground discharge gallery south of North Walnut Creek between monitoring locations SW093 and GS13.
Abbreviations: mg/L = milligrams per liter, N = nitrogen

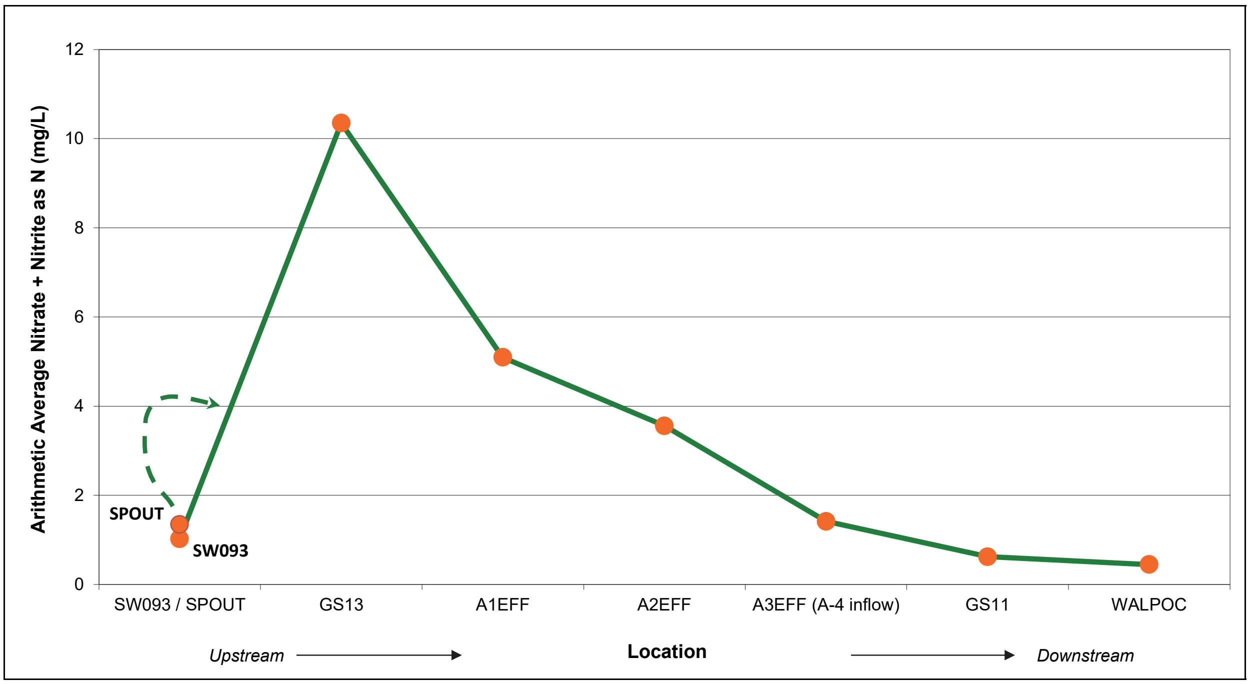
Figure 57. Arithmetic Average Nitrate + Nitrite as Nitrogen Concentrations at North Walnut Creek and Walnut Creek Grab Locations for September 1, 2011, to November 1, 2016

Table 11 shows summary statistics for the nitrate + nitrite as nitrogen grab sampling in North Walnut Creek and lower Walnut Creek (WALPOC) since November 1, 2016 (using all sample results available as of January 15, 2023). Figure 58 shows the spatial variation (upstream to downstream) of average nitrate concentrations for this time period.

Table 11. Summary Statistics for Nitrate + Nitrite as Nitrogen Grab Sampling in North Walnut Creek and Walnut Creek for November 1, 2016, to Present

North Walnut Creek		Nitrate+Nitrite as N (mg/L)			
	Location Code	**Average**	**Sample Count**	**85th Percentile**	**50th Percentile**
Upstream	SW093	1.04	134	2.00	0.52
🡇	SPOUT*	1.36	145	0.15	0.01
🡇	GS13	10.4	85	16.8	6.80
🡇	A1EFF	5.11	63	8.53	4.60
🡇	A2EFF	3.57	59	5.19	2.70
🡇	A3EFF (A-4 inflow)	1.43	48	3.69	0.55
🡇	GS11	0.63	46	1.44	0.22
Downstream	WALPOC	0.46	73	1.09	0.20

Notes:
Sample counts vary because some locations are periodically dry.
The summary includes all data available as of January 15, 2023; some recent data are not validated (i.e., are preliminary and subject to revision).
* SPOUT is the treated effluent monitoring location for the SPPTS. SPOUT is not in North Walnut Creek but flows into a belowground discharge gallery south of North Walnut Creek between monitoring locations SW093 and GS13.



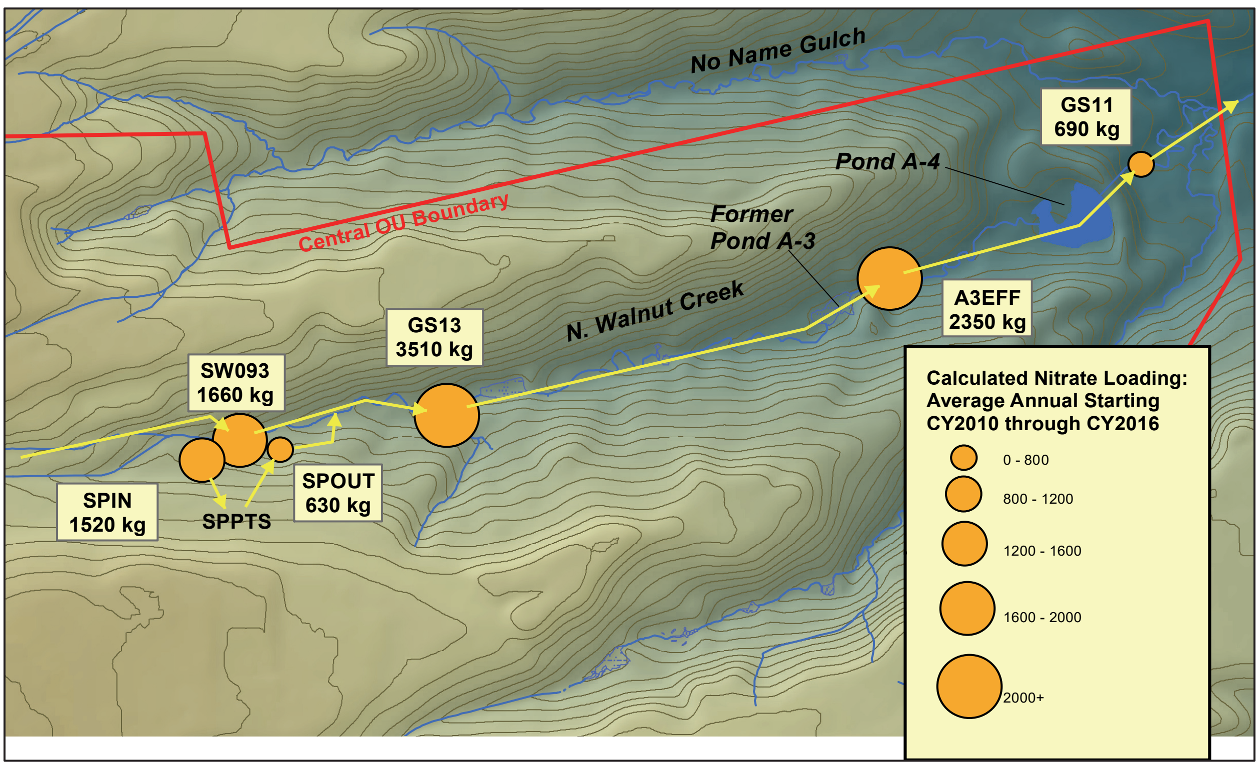
Notes: SPOUT is the treated effluent monitoring location for the SPPTS. SPOUT is not in North Walnut Creek but flows into a belowground discharge gallery south of North Walnut Creek between monitoring locations SW093 and GS13. The summary includes all data available as of January 15, 2023; some recent data are not validated (i.e., are preliminary and subject to revision).

Figure 58. Arithmetic Average Nitrate + Nitrite as Nitrogen Concentrations at North Walnut Creek and Walnut Creek Grab Locations for November 1, 2016, to Present

The positive effects of the successful optimization of nitrate treatment at the SPPTS can clearly be seen in the data. Average concentrations at almost every location are below 10 milligrams per liter (mg/L) nitrate + nitrite as nitrogen. As for the previously discussed periods, the plot shows a measurable increase between SW093 (upstream of Solar Ponds influence) and GS13 (downstream of Solar Ponds influence). However, farther downstream, the reduction of nitrate through natural processes is apparent.

The map in Figure 59 shows the calculated average annual nitrate + nitrite as nitrogen loads in North Walnut Creek for the period January 2010 through December 2016.[15] Although the SPPTS removed approximately 58% of the nitrate load in the water it collected during this time frame, the loads at both the system influent (SPIN) and effluent (SPOUT) are only a portion of the loads in North Walnut Creek. As with uranium, the SPPTS nitrate concentrations are higher than the creek concentrations, but the much larger creek flow volumes yield significantly larger loads. In fact, the nitrate load at SPOUT is estimated to be only about 18% of the load in North Walnut Creek at GS13.

It should be noted, however, that the grab samples collected in the creek are likely biased toward higher concentrations since they are generally collected during base-flow periods. In other words, high-volume runoff events with relatively lower concentrations are underrepresented in the average creek concentrations calculated from grab sample results. Therefore, the amount of nitrate + nitrite as nitrogen at creek locations is very likely overestimated. An evaluation using both grab sample and composite sample nitrate results, in conjunction with measurements of the natural reduction of nitrate in unpreserved samples, suggests that the creek concentrations are overestimated by 25%–30%. Assuming this is the case, the relative contribution from the SPPTS to North Walnut Creek would be 20%–25%.

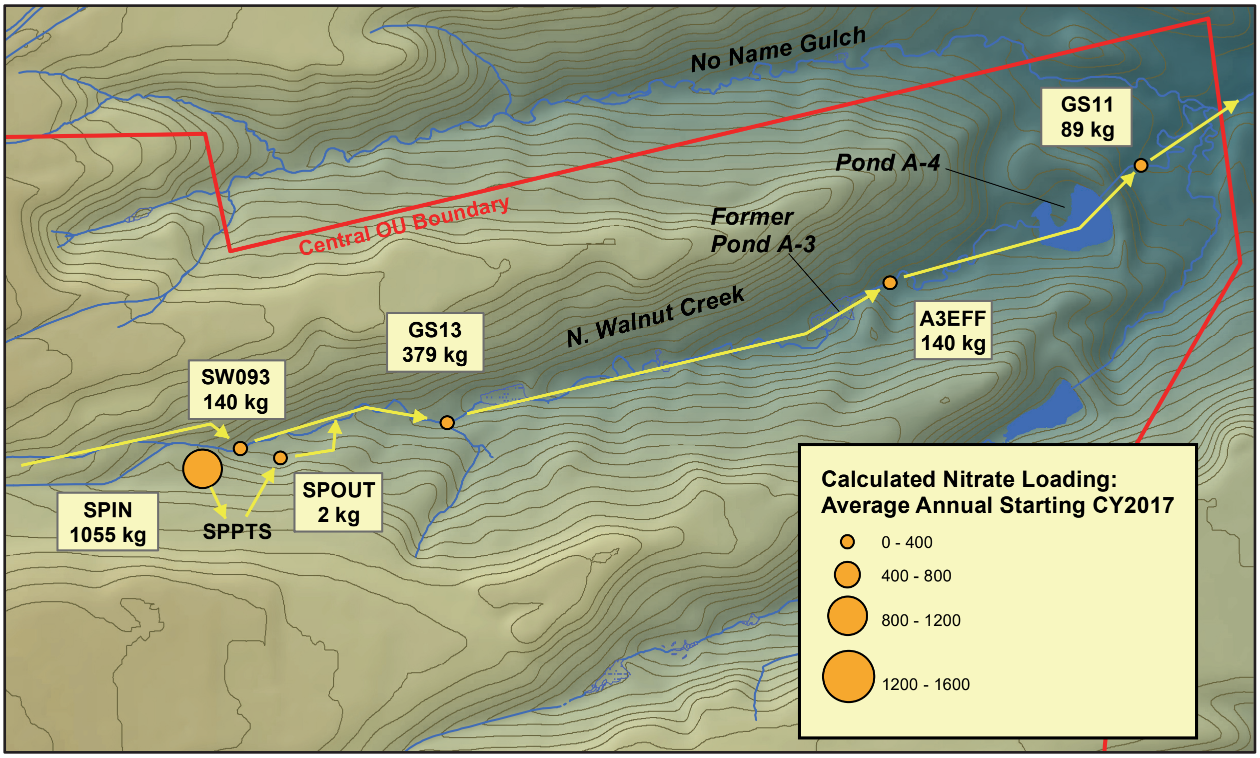


Notes: Loads at SW093, GS13, and GS11 are calculated using results from flow-paced composites (Section 3.5). Loads at A3EFF are calculated using grab sample results and flow measurements from GS12 (collocated with A3EFF). Loads at SPIN and SPOUT are calculated using results from grab sampling related to this AMP objective and other treatment system optimization efforts. Arrows indicate general flow routing.
Abbreviation: kg = kilograms

Figure 59. Map Showing Calculated Average Annual Nitrate + Nitrite as Nitrogen Loads in North Walnut Creek: 2010 through 2016

[15] Loads are calculated only for locations with flow volume measurement. The loading analysis is given by calendar year for ease of calculation and to allow for stabilization of nitrate concentrations following the SPPTS upgrades.

The map in Figure 60 shows the estimated average annual total nitrate + nitrite as nitrogen loads in North Walnut Creek for the period starting in 2017 (using all available sample results as of January 15, 2023).[16] The SPPTS removes more than 99% of the nitrate load from the water it collects. Since successful optimization of the nitrate treatment at the SPPTS in October 2016, the nitrate loads in North Walnut Creek have been significantly reduced.



Notes: Loads at SW093, GS13, and GS11 are calculated using results from flow-paced composites (Section 3.5). Loads at A3EFF are calculated using grab sample results and flow measurements from GS12 (collocated with A3EFF). Loads at SPIN and SPOUT are calculated using results from grab sampling related to this AMP objective and other treatment system optimization efforts. Arrows indicate general flow routing.
Abbreviation: kg = kilograms

Figure 60. Map Showing Calculated Average Annual Nitrate + Nitrite as Nitrogen Loads in North Walnut Creek Since January 2017

4.0 Analytical Data: Fourth Quarter CY 2022

Table 12, "Analytical Results for Water Samples," is available at the end of this report.

Table 13, "Water Sampling Events: Fourth Quarter CY 2022," is available at the end of this report.

[16] Loads are calculated only for locations with flow volume measurement.

5.0 References

CDPHE (Colorado Department of Public Health and Environment), DOE (U.S. Department of Energy), and EPA (U.S. Environmental Protection Agency), 2007. *Rocky Flats Legacy Management Agreement*, executed on March 14, Attachment 2 updated December 2018.

DOE (U.S. Department of Energy), 2011. *Rocky Flats Site, Colorado, Surface Water Configuration Environmental Assessment*, DOE/EA-1747, LMS/RFS/S06335, Office of Legacy Management, May.

DOE (U.S. Department of Energy), 2021. *Surface Water Configuration Adaptive Management Plan for the Rocky Flats Site, Colorado,* Rev. 5.0, LMS/RFS/S07698, Office of Legacy Management, December.

DOE (U.S. Department of Energy), 2022. *Additional Field Implementation Detail for Selected Monitoring Objectives at the Rocky Flats Site, Colorado,* Rev. 4.0, LMS/RFS/S08202, Office of Legacy Management, September.

Table 12. Analytical Results for Water Samples

LOCATION CODE	LOCATION TYPE	DATE SAMPLED	SAMPLE CODE	CAS	ANALYTE	FILTRATION STATUS	RESULT	UNITS	LAB QUALIFIERS	SAMPLE TYPE	DETECTION LIMIT	UNCER-TAINTY	DATA VALIDATION QUALIFIERS	COLLECTION METHOD	LAB CODE
00193	WL	10/18/22	RFS01-10.2209052-001	71-55-6	1,1,1-Trichloroethane	N	0.39	ug/L	U	F	0.39		FQ	G	STD
00193	WL	10/18/22	RFS01-10.2209052-001	79-34-5	1,1,2,2-Tetrachloroethane	N	0.21	ug/L	U	F	0.21		FQ	G	STD
00193	WL	10/18/22	RFS01-10.2209052-001	79-00-5	1,1,2-Trichloroethane	N	0.27	ug/L	U	F	0.27		FQ	G	STD
00193	WL	10/18/22	RFS01-10.2209052-001	75-35-4	1,1-Dichloroethene	N	0.23	ug/L	U	F	0.23		FQ	G	STD
00193	WL	10/18/22	RFS01-10.2209052-001	120-82-1	1,2,4-Trichlorobenzene	N	0.58	ug/L	U	F	0.58		FQ	G	STD
00193	WL	10/18/22	RFS01-10.2209052-001	95-50-1	1,2-Dichlorobenzene	N	0.37	ug/L	U	F	0.37		FQ	G	STD
00193	WL	10/18/22	RFS01-10.2209052-001	107-06-2	1,2-Dichloroethane	N	0.54	ug/L	U	F	0.54		FQ	G	STD
00193	WL	10/18/22	RFS01-10.2209052-001	78-87-5	1,2-Dichloropropane	N	0.52	ug/L	U	F	0.52		FQ	G	STD
00193	WL	10/18/22	RFS01-10.2209052-001	541-73-1	1,3-Dichlorobenzene	N	0.33	ug/L	U	F	0.33		FQ	G	STD
00193	WL	10/18/22	RFS01-10.2209052-001	106-46-7	1,4-Dichlorobenzene	N	0.39	ug/L	U	F	0.39		FQ	G	STD
00193	WL	10/18/22	RFS01-10.2209052-001	71-43-2	Benzene	N	0.31	ug/L	U	F	0.31		FQ	G	STD
00193	WL	10/18/22	RFS01-10.2209052-001	75-25-2	Bromoform	N	1.2	ug/L	U	F	1.2		FQ	G	STD
00193	WL	10/18/22	RFS01-10.2209052-001	56-23-5	Carbon tetrachloride	N	0.57	ug/L	U	F	0.57		FQ	G	STD
00193	WL	10/18/22	RFS01-10.2209052-001	108-90-7	Chlorobenzene	N	0.42	ug/L	U	F	0.42		FQ	G	STD
00193	WL	10/18/22	RFS01-10.2209052-001	67-66-3	Chloroform	N	0.36	ug/L	U	F	0.36		FQ	G	STD
00193	WL	10/18/22	RFS01-10.2209052-001	74-87-3	Chloromethane	N	0.75	ug/L	U	F	0.75		FQ	G	STD
00193	WL	10/18/22	RFS01-10.2209052-001	156-59-2	cis-1,2-Dichloroethene	N	0.32	ug/L	U	F	0.32		FQ	G	STD
00193	WL	10/18/22	RFS01-10.2209052-001	100-41-4	Ethylbenzene	N	0.3	ug/L	U	F	0.3		FQ	G	STD
00193	WL	10/18/22	RFS01-10.2209052-001	87-68-3	Hexachlorobutadiene	N	1.2	ug/L	U	F	1.2		FQ	G	STD
00193	WL	10/18/22	RFS01-10.2209052-001	75-09-2	Methylene chloride	N	0.94	ug/L	U	F	0.94		FQ	G	STD
00193	WL	10/18/22	RFS01-10.2209052-001	91-20-3	Naphthalene	N	0.63	ug/L	U	F	0.63		FQ	G	STD
00193	WL	10/18/22	RFS01-10.2209052-001	100-42-5	Styrene	N	0.36	ug/L	U	F	0.36		FQ	G	STD
00193	WL	10/18/22	RFS01-10.2209052-001	127-18-4	Tetrachloroethene	N	0.4	ug/L	U	F	0.4		FQ	G	STD
00193	WL	10/18/22	RFS01-10.2209052-001	108-88-3	Toluene	N	0.32	ug/L	U	F	0.32		FQ	G	STD
00193	WL	10/18/22	RFS01-10.2209052-001	1330-20-7	Total Xylenes	N	0.33	ug/L	U	F	0.33		FQ	G	STD
00193	WL	10/18/22	RFS01-10.2209052-001	156-60-5	trans-1,2-Dichloroethene	N	0.37	ug/L	U	F	0.37		FQ	G	STD
00193	WL	10/18/22	RFS01-10.2209052-001	79-01-6	Trichloroethene	N	0.3	ug/L	U	F	0.3		FQ	G	STD
00193	WL	10/18/22	RFS01-10.2209052-001	7440-61-1	Uranium	Y	79	ug/L		F	0.05		FQ	G	STD
00193	WL	10/18/22	RFS01-10.2209052-001	75-01-4	Vinyl chloride	N	0.51	ug/L	U	F	0.51		FQ	G	STD
4087	WL	10/17/22	RFS01-10.2209052-027	71-55-6	1,1,1-Trichloroethane	N	0.39	ug/L	U	F	0.39		FQ	G	STD
4087	WL	10/17/22	RFS01-10.2209052-027	79-34-5	1,1,2,2-Tetrachloroethane	N	0.21	ug/L	U	F	0.21		FQ	G	STD
4087	WL	10/17/22	RFS01-10.2209052-027	79-00-5	1,1,2-Trichloroethane	N	0.27	ug/L	U	F	0.27		FQ	G	STD
4087	WL	10/17/22	RFS01-10.2209052-027	75-35-4	1,1-Dichloroethene	N	0.23	ug/L	U	F	0.23		FQ	G	STD
4087	WL	10/17/22	RFS01-10.2209052-027	120-82-1	1,2,4-Trichlorobenzene	N	0.58	ug/L	U	F	0.58		FQ	G	STD
4087	WL	10/17/22	RFS01-10.2209052-027	95-50-1	1,2-Dichlorobenzene	N	0.37	ug/L	U	F	0.37		FQ	G	STD
4087	WL	10/17/22	RFS01-10.2209052-027	107-06-2	1,2-Dichloroethane	N	0.54	ug/L	U	F	0.54		FQ	G	STD
4087	WL	10/17/22	RFS01-10.2209052-027	78-87-5	1,2-Dichloropropane	N	0.52	ug/L	U	F	0.52		FQ	G	STD
4087	WL	10/17/22	RFS01-10.2209052-027	541-73-1	1,3-Dichlorobenzene	N	0.33	ug/L	U	F	0.33		FQ	G	STD
4087	WL	10/17/22	RFS01-10.2209052-027	106-46-7	1,4-Dichlorobenzene	N	0.39	ug/L	U	F	0.39		FQ	G	STD
4087	WL	10/17/22	RFS01-10.2209052-027	71-43-2	Benzene	N	0.31	ug/L	U	F	0.31		FQ	G	STD
4087	WL	10/17/22	RFS01-10.2209052-027	75-25-2	Bromoform	N	1.2	ug/L	U	F	1.2		FQ	G	STD
4087	WL	10/17/22	RFS01-10.2209052-027	56-23-5	Carbon tetrachloride	N	0.57	ug/L	U	F	0.57		FQ	G	STD
4087	WL	10/17/22	RFS01-10.2209052-027	108-90-7	Chlorobenzene	N	0.42	ug/L	U	F	0.42		FQ	G	STD
4087	WL	10/17/22	RFS01-10.2209052-027	67-66-3	Chloroform	N	0.36	ug/L	U	F	0.36		FQ	G	STD
4087	WL	10/17/22	RFS01-10.2209052-027	74-87-3	Chloromethane	N	0.75	ug/L	U	F	0.75		FQ	G	STD
4087	WL	10/17/22	RFS01-10.2209052-027	156-59-2	cis-1,2-Dichloroethene	N	0.32	ug/L	U	F	0.32		FQ	G	STD
4087	WL	10/17/22	RFS01-10.2209052-027	100-41-4	Ethylbenzene	N	0.3	ug/L	U	F	0.3		FQ	G	STD
4087	WL	10/17/22	RFS01-10.2209052-027	87-68-3	Hexachlorobutadiene	N	1.2	ug/L	U	F	1.2		FQ	G	STD
4087	WL	10/17/22	RFS01-10.2209052-027	75-09-2	Methylene chloride	N	0.94	ug/L	U	F	0.94		FQ	G	STD
4087	WL	10/17/22	RFS01-10.2209052-027	91-20-3	Naphthalene	N	0.63	ug/L	U	F	0.63		FQ	G	STD
4087	WL	10/17/22	RFS01-10.2209052-027	NO3+NO2 AS N	Nitrate + Nitrite as Nitrogen	N	0.044	mg/L	U	F	0.044		FQ	G	STD
4087	WL	10/17/22	RFS01-10.2209052-027	100-42-5	Styrene	N	0.36	ug/L	U	F	0.36		FQ	G	STD
4087	WL	10/17/22	RFS01-10.2209052-027	127-18-4	Tetrachloroethene	N	0.4	ug/L	U	F	0.4		FQ	G	STD
4087	WL	10/17/22	RFS01-10.2209052-027	108-88-3	Toluene	N	0.32	ug/L	U	F	0.32		FQ	G	STD
4087	WL	10/17/22	RFS01-10.2209052-027	1330-20-7	Total Xylenes	N	0.33	ug/L	U	F	0.33		FQ	G	STD
4087	WL	10/17/22	RFS01-10.2209052-027	156-60-5	trans-1,2-Dichloroethene	N	0.37	ug/L	U	F	0.37		FQ	G	STD
4087	WL	10/17/22	RFS01-10.2209052-027	79-01-6	Trichloroethene	N	0.3	ug/L	U	F	0.3		FQ	G	STD
4087	WL	10/17/22	RFS01-10.2209052-027	7440-61-1	Uranium	Y	28	ug/L		F	0.05		FQ	G	STD
4087	WL	10/17/22	RFS01-10.2209052-027	75-01-4	Vinyl chloride	N	0.51	ug/L	U	F	0.51		FQ	G	STD
10304	WL	10/18/22	RFS01-10.2209052-010	71-55-6	1,1,1-Trichloroethane	N	0.39	ug/L	U	F	0.39		F	G	STD
10304	WL	10/18/22	RFS01-10.2209052-076	71-55-6	1,1,1-Trichloroethane	N	0.39	ug/L	U	D	0.39		F	G	STD
10304	WL	10/18/22	RFS01-10.2209052-010	79-34-5	1,1,2,2-Tetrachloroethane	N	0.21	ug/L	U	F	0.21		F	G	STD
10304	WL	10/18/22	RFS01-10.2209052-076	79-34-5	1,1,2,2-Tetrachloroethane	N	0.21	ug/L	U	D	0.21		F	G	STD
10304	WL	10/18/22	RFS01-10.2209052-010	79-00-5	1,1,2-Trichloroethane	N	0.27	ug/L	U	F	0.27		F	G	STD
10304	WL	10/18/22	RFS01-10.2209052-076	79-00-5	1,1,2-Trichloroethane	N	0.27	ug/L	U	D	0.27		F	G	STD
10304	WL	10/18/22	RFS01-10.2209052-010	75-35-4	1,1-Dichloroethene	N	0.23	ug/L	U	F	0.23		F	G	STD
10304	WL	10/18/22	RFS01-10.2209052-076	75-35-4	1,1-Dichloroethene	N	0.23	ug/L	U	D	0.23		F	G	STD
10304	WL	10/18/22	RFS01-10.2209052-010	120-82-1	1,2,4-Trichlorobenzene	N	0.58	ug/L	U	F	0.58		F	G	STD
10304	WL	10/18/22	RFS01-10.2209052-076	120-82-1	1,2,4-Trichlorobenzene	N	0.58	ug/L	U	D	0.58		F	G	STD
10304	WL	10/18/22	RFS01-10.2209052-010	95-50-1	1,2-Dichlorobenzene	N	0.37	ug/L	U	F	0.37		F	G	STD
10304	WL	10/18/22	RFS01-10.2209052-076	95-50-1	1,2-Dichlorobenzene	N	0.37	ug/L	U	D	0.37		F	G	STD

Table 12. Analytical Results for Water Samples

LOCATION CODE	LOCATION TYPE	DATE SAMPLED	SAMPLE CODE	CAS	ANALYTE	FILTRATION STATUS	RESULT	UNITS	LAB QUALIFIERS	SAMPLE TYPE	DETECTION LIMIT	UNCER-TAINTY	DATA VALIDATION QUALIFIERS	COLLECTION METHOD	LAB CODE
10304	WL	10/18/22	RFS01-10.2209052-010	107-06-2	1,2-Dichloroethane	N	0.54	ug/L	U	F	0.54		F	G	STD
10304	WL	10/18/22	RFS01-10.2209052-076	107-06-2	1,2-Dichloroethane	N	0.54	ug/L	U	D	0.54		F	G	STD
10304	WL	10/18/22	RFS01-10.2209052-010	78-87-5	1,2-Dichloropropane	N	0.52	ug/L	U	F	0.52		F	G	STD
10304	WL	10/18/22	RFS01-10.2209052-076	78-87-5	1,2-Dichloropropane	N	0.52	ug/L	U	D	0.52		F	G	STD
10304	WL	10/18/22	RFS01-10.2209052-010	541-73-1	1,3-Dichlorobenzene	N	0.33	ug/L	U	F	0.33		F	G	STD
10304	WL	10/18/22	RFS01-10.2209052-076	541-73-1	1,3-Dichlorobenzene	N	0.33	ug/L	U	D	0.33		F	G	STD
10304	WL	10/18/22	RFS01-10.2209052-010	106-46-7	1,4-Dichlorobenzene	N	0.39	ug/L	U	F	0.39		F	G	STD
10304	WL	10/18/22	RFS01-10.2209052-076	106-46-7	1,4-Dichlorobenzene	N	0.39	ug/L	U	D	0.39		F	G	STD
10304	WL	10/18/22	RFS01-10.2209052-010	71-43-2	Benzene	N	0.31	ug/L	U	F	0.31		F	G	STD
10304	WL	10/18/22	RFS01-10.2209052-076	71-43-2	Benzene	N	0.31	ug/L	U	D	0.31		F	G	STD
10304	WL	10/18/22	RFS01-10.2209052-010	75-25-2	Bromoform	N	1.2	ug/L	U	F	1.2		F	G	STD
10304	WL	10/18/22	RFS01-10.2209052-076	75-25-2	Bromoform	N	1.2	ug/L	U	D	1.2		F	G	STD
10304	WL	10/18/22	RFS01-10.2209052-010	56-23-5	Carbon tetrachloride	N	0.57	ug/L	U	F	0.57		F	G	STD
10304	WL	10/18/22	RFS01-10.2209052-076	56-23-5	Carbon tetrachloride	N	0.57	ug/L	U	D	0.57		F	G	STD
10304	WL	10/18/22	RFS01-10.2209052-010	108-90-7	Chlorobenzene	N	0.42	ug/L	U	F	0.42		F	G	STD
10304	WL	10/18/22	RFS01-10.2209052-076	108-90-7	Chlorobenzene	N	0.42	ug/L	U	D	0.42		F	G	STD
10304	WL	10/18/22	RFS01-10.2209052-010	67-66-3	Chloroform	N	0.36	ug/L	U	F	0.36		F	G	STD
10304	WL	10/18/22	RFS01-10.2209052-076	67-66-3	Chloroform	N	0.36	ug/L	U	D	0.36		F	G	STD
10304	WL	10/18/22	RFS01-10.2209052-010	74-87-3	Chloromethane	N	0.75	ug/L	U	F	0.75		F	G	STD
10304	WL	10/18/22	RFS01-10.2209052-076	74-87-3	Chloromethane	N	0.75	ug/L	U	D	0.75		F	G	STD
10304	WL	10/18/22	RFS01-10.2209052-010	156-59-2	cis-1,2-Dichloroethene	N	0.32	ug/L	U	F	0.32		F	G	STD
10304	WL	10/18/22	RFS01-10.2209052-076	156-59-2	cis-1,2-Dichloroethene	N	0.32	ug/L	U	D	0.32		F	G	STD
10304	WL	10/18/22	RFS01-10.2209052-010	100-41-4	Ethylbenzene	N	0.3	ug/L	U	F	0.3		F	G	STD
10304	WL	10/18/22	RFS01-10.2209052-076	100-41-4	Ethylbenzene	N	0.3	ug/L	U	D	0.3		F	G	STD
10304	WL	10/18/22	RFS01-10.2209052-010	87-68-3	Hexachlorobutadiene	N	1.2	ug/L	U	F	1.2		F	G	STD
10304	WL	10/18/22	RFS01-10.2209052-076	87-68-3	Hexachlorobutadiene	N	1.2	ug/L	U	D	1.2		F	G	STD
10304	WL	10/18/22	RFS01-10.2209052-010	75-09-2	Methylene chloride	N	0.94	ug/L	U	F	0.94		F	G	STD
10304	WL	10/18/22	RFS01-10.2209052-076	75-09-2	Methylene chloride	N	0.94	ug/L	U	D	0.94		F	G	STD
10304	WL	10/18/22	RFS01-10.2209052-010	91-20-3	Naphthalene	N	0.63	ug/L	U	F	0.63		F	G	STD
10304	WL	10/18/22	RFS01-10.2209052-076	91-20-3	Naphthalene	N	0.63	ug/L	U	D	0.63		F	G	STD
10304	WL	10/18/22	RFS01-10.2209052-010	NO3+NO2 AS N	Nitrate + Nitrite as Nitrogen	N	0.044	mg/L	U	F	0.044		F	G	STD
10304	WL	10/18/22	RFS01-10.2209052-076	NO3+NO2 AS N	Nitrate + Nitrite as Nitrogen	N	0.044	mg/L	U	D	0.044		F	G	STD
10304	WL	10/18/22	RFS01-10.2209052-010	100-42-5	Styrene	N	0.36	ug/L	U	F	0.36		F	G	STD
10304	WL	10/18/22	RFS01-10.2209052-076	100-42-5	Styrene	N	0.36	ug/L	U	D	0.36		F	G	STD
10304	WL	10/18/22	RFS01-10.2209052-010	127-18-4	Tetrachloroethene	N	0.4	ug/L	U	F	0.4		F	G	STD
10304	WL	10/18/22	RFS01-10.2209052-076	127-18-4	Tetrachloroethene	N	0.4	ug/L	U	D	0.4		F	G	STD
10304	WL	10/18/22	RFS01-10.2209052-010	108-88-3	Toluene	N	0.32	ug/L	U	F	0.32		F	G	STD
10304	WL	10/18/22	RFS01-10.2209052-076	108-88-3	Toluene	N	0.32	ug/L	U	D	0.32		F	G	STD
10304	WL	10/18/22	RFS01-10.2209052-010	1330-20-7	Total Xylenes	N	0.33	ug/L	U	F	0.33		F	G	STD
10304	WL	10/18/22	RFS01-10.2209052-076	1330-20-7	Total Xylenes	N	0.33	ug/L	U	D	0.33		F	G	STD
10304	WL	10/18/22	RFS01-10.2209052-010	156-60-5	trans-1,2-Dichloroethene	N	0.37	ug/L	U	F	0.37		F	G	STD
10304	WL	10/18/22	RFS01-10.2209052-076	156-60-5	trans-1,2-Dichloroethene	N	0.37	ug/L	U	D	0.37		F	G	STD
10304	WL	10/18/22	RFS01-10.2209052-010	79-01-6	Trichloroethene	N	2.7	ug/L		F	0.3		F	G	STD
10304	WL	10/18/22	RFS01-10.2209052-076	79-01-6	Trichloroethene	N	2.4	ug/L		D	0.3		F	G	STD
10304	WL	10/18/22	RFS01-10.2209052-010	7440-61-1	Uranium	Y	12	ug/L		F	0.05		F	G	STD
10304	WL	10/18/22	RFS01-10.2209052-076	7440-61-1	Uranium	Y	9.7	ug/L		D	0.05		F	G	STD
10304	WL	10/18/22	RFS01-10.2209052-010	75-01-4	Vinyl chloride	N	0.51	ug/L	U	F	0.51		F	G	STD
10304	WL	10/18/22	RFS01-10.2209052-076	75-01-4	Vinyl chloride	N	0.51	ug/L	U	D	0.51		F	G	STD
11104	WL	10/17/22	RFS01-10.2209052-012	71-55-6	1,1,1-Trichloroethane	N	0.39	ug/L	U	F	0.39		F	G	STD
11104	WL	10/17/22	RFS01-10.2209052-012	79-34-5	1,1,2,2-Tetrachloroethane	N	0.21	ug/L	U	F	0.21		F	G	STD
11104	WL	10/17/22	RFS01-10.2209052-012	79-00-5	1,1,2-Trichloroethane	N	0.27	ug/L	U	F	0.27		F	G	STD
11104	WL	10/17/22	RFS01-10.2209052-012	75-35-4	1,1-Dichloroethene	N	0.23	ug/L	U	F	0.23		F	G	STD
11104	WL	10/17/22	RFS01-10.2209052-012	120-82-1	1,2,4-Trichlorobenzene	N	0.58	ug/L	U	F	0.58		F	G	STD
11104	WL	10/17/22	RFS01-10.2209052-012	95-50-1	1,2-Dichlorobenzene	N	0.37	ug/L	U	F	0.37		F	G	STD
11104	WL	10/17/22	RFS01-10.2209052-012	107-06-2	1,2-Dichloroethane	N	0.54	ug/L	U	F	0.54		F	G	STD
11104	WL	10/17/22	RFS01-10.2209052-012	78-87-5	1,2-Dichloropropane	N	0.52	ug/L	U	F	0.52		F	G	STD
11104	WL	10/17/22	RFS01-10.2209052-012	541-73-1	1,3-Dichlorobenzene	N	0.33	ug/L	U	F	0.33		F	G	STD
11104	WL	10/17/22	RFS01-10.2209052-012	106-46-7	1,4-Dichlorobenzene	N	0.39	ug/L	U	F	0.39		F	G	STD
11104	WL	10/17/22	RFS01-10.2209052-012	71-43-2	Benzene	N	0.31	ug/L	U	F	0.31		F	G	STD
11104	WL	10/17/22	RFS01-10.2209052-012	75-25-2	Bromoform	N	1.2	ug/L	U	F	1.2		F	G	STD
11104	WL	10/17/22	RFS01-10.2209052-012	56-23-5	Carbon tetrachloride	N	0.57	ug/L	U	F	0.57		F	G	STD
11104	WL	10/17/22	RFS01-10.2209052-012	108-90-7	Chlorobenzene	N	0.42	ug/L	U	F	0.42		F	G	STD
11104	WL	10/17/22	RFS01-10.2209052-012	67-66-3	Chloroform	N	0.36	ug/L	U	F	0.36		F	G	STD
11104	WL	10/17/22	RFS01-10.2209052-012	74-87-3	Chloromethane	N	0.75	ug/L	U	F	0.75		F	G	STD
11104	WL	10/17/22	RFS01-10.2209052-012	156-59-2	cis-1,2-Dichloroethene	N	0.32	ug/L	U	F	0.32		F	G	STD
11104	WL	10/17/22	RFS01-10.2209052-012	100-41-4	Ethylbenzene	N	0.3	ug/L	U	F	0.3		F	G	STD
11104	WL	10/17/22	RFS01-10.2209052-012	87-68-3	Hexachlorobutadiene	N	1.2	ug/L	U	F	1.2		F	G	STD
11104	WL	10/17/22	RFS01-10.2209052-012	75-09-2	Methylene chloride	N	0.94	ug/L	U	F	0.94		F	G	STD
11104	WL	10/17/22	RFS01-10.2209052-012	91-20-3	Naphthalene	N	0.63	ug/L	U	F	0.63		F	G	STD
11104	WL	10/17/22	RFS01-10.2209052-012	100-42-5	Styrene	N	0.36	ug/L	U	F	0.36		F	G	STD
11104	WL	10/17/22	RFS01-10.2209052-012	127-18-4	Tetrachloroethene	N	0.4	ug/L	U	F	0.4		F	G	STD

Table 12. Analytical Results for Water Samples

LOCATION CODE	LOCATION TYPE	DATE SAMPLED	SAMPLE CODE	CAS	ANALYTE	FILTRATION STATUS	RESULT	UNITS	LAB QUALIFIERS	SAMPLE TYPE	DETECTION LIMIT	UNCER-TAINTY	DATA VALIDATION QUALIFIERS	COLLECTION METHOD	LAB CODE
11104	WL	10/17/22	RFS01-10.2209052-012	108-88-3	Toluene	N	0.32	ug/L	U	F	0.32		F	G	STD
11104	WL	10/17/22	RFS01-10.2209052-012	1330-20-7	Total Xylenes	N	0.33	ug/L	U	F	0.33		F	G	STD
11104	WL	10/17/22	RFS01-10.2209052-012	156-60-5	trans-1,2-Dichloroethene	N	0.37	ug/L	U	F	0.37		F	G	STD
11104	WL	10/17/22	RFS01-10.2209052-012	79-01-6	Trichloroethene	N	0.3	ug/L	U	F	0.3		F	G	STD
11104	WL	10/17/22	RFS01-10.2209052-012	7440-61-1	Uranium	Y	30	ug/L		F	0.05		F	G	STD
11104	WL	10/17/22	RFS01-10.2209052-012	75-01-4	Vinyl chloride	N	0.51	ug/L	U	F	0.51		F	G	STD
42505	WL	10/19/22	RFS01-10.2209051-074	71-55-6	1,1,1-Trichloroethane	N	0.39	ug/L	U	F	0.39		FQ	G	STD
42505	WL	10/19/22	RFS01-10.2209051-074	79-34-5	1,1,2,2-Tetrachloroethane	N	0.21	ug/L	U	F	0.21		FQ	G	STD
42505	WL	10/19/22	RFS01-10.2209051-074	79-00-5	1,1,2-Trichloroethane	N	0.27	ug/L	U	F	0.27		FQ	G	STD
42505	WL	10/19/22	RFS01-10.2209051-074	75-35-4	1,1-Dichloroethene	N	0.23	ug/L	U	F	0.23		FQ	G	STD
42505	WL	10/19/22	RFS01-10.2209051-074	120-82-1	1,2,4-Trichlorobenzene	N	0.58	ug/L	U	F	0.58		FQ	G	STD
42505	WL	10/19/22	RFS01-10.2209051-074	95-50-1	1,2-Dichlorobenzene	N	0.37	ug/L	U	F	0.37		FQ	G	STD
42505	WL	10/19/22	RFS01-10.2209051-074	107-06-2	1,2-Dichloroethane	N	0.54	ug/L	U	F	0.54		FQ	G	STD
42505	WL	10/19/22	RFS01-10.2209051-074	78-87-5	1,2-Dichloropropane	N	0.52	ug/L	U	F	0.52		FQ	G	STD
42505	WL	10/19/22	RFS01-10.2209051-074	541-73-1	1,3-Dichlorobenzene	N	0.33	ug/L	U	F	0.33		FQ	G	STD
42505	WL	10/19/22	RFS01-10.2209051-074	106-46-7	1,4-Dichlorobenzene	N	0.39	ug/L	U	F	0.39		FQ	G	STD
42505	WL	10/19/22	RFS01-10.2209051-074	71-43-2	Benzene	N	0.31	ug/L	U	F	0.31		FQ	G	STD
42505	WL	10/19/22	RFS01-10.2209051-074	75-25-2	Bromoform	N	1.2	ug/L	U	F	1.2		FQ	G	STD
42505	WL	10/19/22	RFS01-10.2209051-074	56-23-5	Carbon tetrachloride	N	0.57	ug/L	U	F	0.57		FQ	G	STD
42505	WL	10/19/22	RFS01-10.2209051-074	108-90-7	Chlorobenzene	N	0.42	ug/L	U	F	0.42		FQ	G	STD
42505	WL	10/19/22	RFS01-10.2209051-074	67-66-3	Chloroform	N	0.36	ug/L	U	F	0.36		FQ	G	STD
42505	WL	10/19/22	RFS01-10.2209051-074	74-87-3	Chloromethane	N	0.75	ug/L	U	F	0.75		FQ	G	STD
42505	WL	10/19/22	RFS01-10.2209051-074	156-59-2	cis-1,2-Dichloroethene	N	0.32	ug/L	U	F	0.32		FQ	G	STD
42505	WL	10/19/22	RFS01-10.2209051-074	100-41-4	Ethylbenzene	N	0.3	ug/L	U	F	0.3		FQ	G	STD
42505	WL	10/19/22	RFS01-10.2209051-074	87-68-3	Hexachlorobutadiene	N	1.2	ug/L	U	F	1.2		FQ	G	STD
42505	WL	10/19/22	RFS01-10.2209051-074	75-09-2	Methylene chloride	N	0.94	ug/L	U	F	0.94		FQ	G	STD
42505	WL	10/19/22	RFS01-10.2209051-074	91-20-3	Naphthalene	N	0.63	ug/L	U	F	0.63		FQ	G	STD
42505	WL	10/19/22	RFS01-10.2209051-074	100-42-5	Styrene	N	0.36	ug/L	U	F	0.36		FQ	G	STD
42505	WL	10/19/22	RFS01-10.2209051-074	127-18-4	Tetrachloroethene	N	0.4	ug/L	U	F	0.4		FQ	G	STD
42505	WL	10/19/22	RFS01-10.2209051-074	108-88-3	Toluene	N	0.32	ug/L	U	F	0.32		FQ	G	STD
42505	WL	10/19/22	RFS01-10.2209051-074	1330-20-7	Total Xylenes	N	0.33	ug/L	U	F	0.33		FQ	G	STD
42505	WL	10/19/22	RFS01-10.2209051-074	156-60-5	trans-1,2-Dichloroethene	N	0.37	ug/L	U	F	0.37		FQ	G	STD
42505	WL	10/19/22	RFS01-10.2209051-074	79-01-6	Trichloroethene	N	0.3	ug/L	U	F	0.3		FQ	G	STD
42505	WL	10/19/22	RFS01-10.2209051-074	75-01-4	Vinyl chloride	N	0.51	ug/L	U	F	0.51		FQ	G	STD
89104	WL	10/18/22	RFS01-10.2209052-046	71-55-6	1,1,1-Trichloroethane	N	0.39	ug/L	U	F	0.39		FQ	G	STD
89104	WL	10/18/22	RFS01-10.2209052-046	79-34-5	1,1,2,2-Tetrachloroethane	N	0.21	ug/L	U	F	0.21		FQ	G	STD
89104	WL	10/18/22	RFS01-10.2209052-046	79-00-5	1,1,2-Trichloroethane	N	0.27	ug/L	U	F	0.27		FQ	G	STD
89104	WL	10/18/22	RFS01-10.2209052-046	75-35-4	1,1-Dichloroethene	N	0.23	ug/L	U	F	0.23		FQ	G	STD
89104	WL	10/18/22	RFS01-10.2209052-046	120-82-1	1,2,4-Trichlorobenzene	N	0.58	ug/L	U	F	0.58		FQ	G	STD
89104	WL	10/18/22	RFS01-10.2209052-046	95-50-1	1,2-Dichlorobenzene	N	0.37	ug/L	U	F	0.37		FQ	G	STD
89104	WL	10/18/22	RFS01-10.2209052-046	107-06-2	1,2-Dichloroethane	N	0.54	ug/L	U	F	0.54		FQ	G	STD
89104	WL	10/18/22	RFS01-10.2209052-046	78-87-5	1,2-Dichloropropane	N	0.52	ug/L	U	F	0.52		FQ	G	STD
89104	WL	10/18/22	RFS01-10.2209052-046	541-73-1	1,3-Dichlorobenzene	N	0.33	ug/L	U	F	0.33		FQ	G	STD
89104	WL	10/18/22	RFS01-10.2209052-046	106-46-7	1,4-Dichlorobenzene	N	0.39	ug/L	U	F	0.39		FQ	G	STD
89104	WL	10/18/22	RFS01-10.2209052-046	71-43-2	Benzene	N	0.31	ug/L	U	F	0.31		FQ	G	STD
89104	WL	10/18/22	RFS01-10.2209052-046	75-25-2	Bromoform	N	1.2	ug/L	U	F	1.2		FQ	G	STD
89104	WL	10/18/22	RFS01-10.2209052-046	56-23-5	Carbon tetrachloride	N	0.57	ug/L	U	F	0.57		FQ	G	STD
89104	WL	10/18/22	RFS01-10.2209052-046	108-90-7	Chlorobenzene	N	0.42	ug/L	U	F	0.42		FQ	G	STD
89104	WL	10/18/22	RFS01-10.2209052-046	67-66-3	Chloroform	N	0.36	ug/L	U	F	0.36		FQ	G	STD
89104	WL	10/18/22	RFS01-10.2209052-046	74-87-3	Chloromethane	N	0.75	ug/L	U	F	0.75		FQ	G	STD
89104	WL	10/18/22	RFS01-10.2209052-046	156-59-2	cis-1,2-Dichloroethene	N	0.32	ug/L	U	F	0.32		FQ	G	STD
89104	WL	10/18/22	RFS01-10.2209052-046	100-41-4	Ethylbenzene	N	0.3	ug/L	U	F	0.3		FQ	G	STD
89104	WL	10/18/22	RFS01-10.2209052-046	87-68-3	Hexachlorobutadiene	N	1.2	ug/L	U	F	1.2		FQ	G	STD
89104	WL	10/18/22	RFS01-10.2209052-046	75-09-2	Methylene chloride	N	0.94	ug/L	U	F	0.94		FQ	G	STD
89104	WL	10/18/22	RFS01-10.2209052-046	91-20-3	Naphthalene	N	0.63	ug/L	U	F	0.63		FQ	G	STD
89104	WL	10/18/22	RFS01-10.2209052-046	100-42-5	Styrene	N	0.36	ug/L	U	F	0.36		FQ	G	STD
89104	WL	10/18/22	RFS01-10.2209052-046	127-18-4	Tetrachloroethene	N	0.4	ug/L	U	F	0.4		FQ	G	STD
89104	WL	10/18/22	RFS01-10.2209052-046	108-88-3	Toluene	N	0.32	ug/L	U	F	0.32		FQ	G	STD
89104	WL	10/18/22	RFS01-10.2209052-046	1330-20-7	Total Xylenes	N	0.33	ug/L	U	F	0.33		FQ	G	STD
89104	WL	10/18/22	RFS01-10.2209052-046	156-60-5	trans-1,2-Dichloroethene	N	0.37	ug/L	U	F	0.37		FQ	G	STD
89104	WL	10/18/22	RFS01-10.2209052-046	79-01-6	Trichloroethene	N	0.3	ug/L	U	F	0.3		FQ	G	STD
89104	WL	10/18/22	RFS01-10.2209052-046	75-01-4	Vinyl chloride	N	0.51	ug/L	U	F	0.51		FQ	G	STD
B206989	WL	10/17/22	RFS01-10.2209052-019	71-55-6	1,1,1-Trichloroethane	N	0.39	ug/L	U	D	0.39		FQ	G	STD
B206989	WL	10/17/22	RFS01-10.2209052-059	71-55-6	1,1,1-Trichloroethane	N	0.39	ug/L	U	F	0.39		FQ	G	STD
B206989	WL	10/17/22	RFS01-10.2209052-019	79-34-5	1,1,2,2-Tetrachloroethane	N	0.21	ug/L	U	D	0.21		FQ	G	STD
B206989	WL	10/17/22	RFS01-10.2209052-059	79-34-5	1,1,2,2-Tetrachloroethane	N	0.21	ug/L	U	F	0.21		FQ	G	STD
B206989	WL	10/17/22	RFS01-10.2209052-019	79-00-5	1,1,2-Trichloroethane	N	0.27	ug/L	U	D	0.27		FQ	G	STD
B206989	WL	10/17/22	RFS01-10.2209052-059	79-00-5	1,1,2-Trichloroethane	N	0.27	ug/L	U	F	0.27		FQ	G	STD
B206989	WL	10/17/22	RFS01-10.2209052-019	75-35-4	1,1-Dichloroethene	N	0.23	ug/L	U	D	0.23		FQ	G	STD
B206989	WL	10/17/22	RFS01-10.2209052-059	75-35-4	1,1-Dichloroethene	N	0.23	ug/L	U	F	0.23		FQ	G	STD
B206989	WL	10/17/22	RFS01-10.2209052-019	120-82-1	1,2,4-Trichlorobenzene	N	0.58	ug/L	U	D	0.58		FQ	G	STD

Table 12. Analytical Results for Water Samples

LOCATION CODE	LOCATION TYPE	DATE SAMPLED	SAMPLE CODE	CAS	ANALYTE	FILTRATION STATUS	RESULT	UNITS	LAB QUALIFIERS	SAMPLE TYPE	DETECTION LIMIT	UNCER-TAINTY	DATA VALIDATION QUALIFIERS	COLLECTION METHOD	LAB CODE
B206989	WL	10/17/22	RFS01-10.2209052-059	120-82-1	1,2,4-Trichlorobenzene	N	0.58	ug/L	U	F	0.58		FQ	G	STD
B206989	WL	10/17/22	RFS01-10.2209052-019	95-50-1	1,2-Dichlorobenzene	N	0.37	ug/L	U	D	0.37		FQ	G	STD
B206989	WL	10/17/22	RFS01-10.2209052-059	95-50-1	1,2-Dichlorobenzene	N	0.37	ug/L	U	F	0.37		FQ	G	STD
B206989	WL	10/17/22	RFS01-10.2209052-019	107-06-2	1,2-Dichloroethane	N	0.54	ug/L	U	D	0.54		FQ	G	STD
B206989	WL	10/17/22	RFS01-10.2209052-059	107-06-2	1,2-Dichloroethane	N	0.54	ug/L	U	F	0.54		FQ	G	STD
B206989	WL	10/17/22	RFS01-10.2209052-019	78-87-5	1,2-Dichloropropane	N	0.52	ug/L	U	D	0.52		FQ	G	STD
B206989	WL	10/17/22	RFS01-10.2209052-059	78-87-5	1,2-Dichloropropane	N	0.52	ug/L	U	F	0.52		FQ	G	STD
B206989	WL	10/17/22	RFS01-10.2209052-019	541-73-1	1,3-Dichlorobenzene	N	0.33	ug/L	U	D	0.33		FQ	G	STD
B206989	WL	10/17/22	RFS01-10.2209052-059	541-73-1	1,3-Dichlorobenzene	N	0.33	ug/L	U	F	0.33		FQ	G	STD
B206989	WL	10/17/22	RFS01-10.2209052-019	106-46-7	1,4-Dichlorobenzene	N	0.39	ug/L	U	D	0.39		FQ	G	STD
B206989	WL	10/17/22	RFS01-10.2209052-059	106-46-7	1,4-Dichlorobenzene	N	0.39	ug/L	U	F	0.39		FQ	G	STD
B206989	WL	10/17/22	RFS01-10.2209052-019	71-43-2	Benzene	N	0.31	ug/L	U	D	0.31		FQ	G	STD
B206989	WL	10/17/22	RFS01-10.2209052-059	71-43-2	Benzene	N	0.31	ug/L	U	F	0.31		FQ	G	STD
B206989	WL	10/17/22	RFS01-10.2209052-019	75-25-2	Bromoform	N	1.2	ug/L	U	D	1.2		FQ	G	STD
B206989	WL	10/17/22	RFS01-10.2209052-059	75-25-2	Bromoform	N	1.2	ug/L	U	F	1.2		FQ	G	STD
B206989	WL	10/17/22	RFS01-10.2209052-019	56-23-5	Carbon tetrachloride	N	0.57	ug/L	U	D	0.57		FQ	G	STD
B206989	WL	10/17/22	RFS01-10.2209052-059	56-23-5	Carbon tetrachloride	N	0.57	ug/L	U	F	0.57		FQ	G	STD
B206989	WL	10/17/22	RFS01-10.2209052-019	108-90-7	Chlorobenzene	N	0.42	ug/L	U	D	0.42		FQ	G	STD
B206989	WL	10/17/22	RFS01-10.2209052-059	108-90-7	Chlorobenzene	N	0.42	ug/L	U	F	0.42		FQ	G	STD
B206989	WL	10/17/22	RFS01-10.2209052-019	67-66-3	Chloroform	N	0.36	ug/L	U	D	0.36		FQ	G	STD
B206989	WL	10/17/22	RFS01-10.2209052-059	67-66-3	Chloroform	N	0.36	ug/L	U	F	0.36		FQ	G	STD
B206989	WL	10/17/22	RFS01-10.2209052-019	74-87-3	Chloromethane	N	0.75	ug/L	U	D	0.75		FQ	G	STD
B206989	WL	10/17/22	RFS01-10.2209052-059	74-87-3	Chloromethane	N	0.75	ug/L	U	F	0.75		FQ	G	STD
B206989	WL	10/17/22	RFS01-10.2209052-019	156-59-2	cis-1,2-Dichloroethene	N	0.32	ug/L	U	D	0.32		FQ	G	STD
B206989	WL	10/17/22	RFS01-10.2209052-059	156-59-2	cis-1,2-Dichloroethene	N	0.32	ug/L	U	F	0.32		FQ	G	STD
B206989	WL	10/17/22	RFS01-10.2209052-019	100-41-4	Ethylbenzene	N	0.3	ug/L	U	D	0.3		FQ	G	STD
B206989	WL	10/17/22	RFS01-10.2209052-059	100-41-4	Ethylbenzene	N	0.3	ug/L	U	F	0.3		FQ	G	STD
B206989	WL	10/17/22	RFS01-10.2209052-019	87-68-3	Hexachlorobutadiene	N	1.2	ug/L	U	D	1.2		FQ	G	STD
B206989	WL	10/17/22	RFS01-10.2209052-059	87-68-3	Hexachlorobutadiene	N	1.2	ug/L	U	F	1.2		FQ	G	STD
B206989	WL	10/17/22	RFS01-10.2209052-019	75-09-2	Methylene chloride	N	0.94	ug/L	U	D	0.94		FQ	G	STD
B206989	WL	10/17/22	RFS01-10.2209052-059	75-09-2	Methylene chloride	N	0.94	ug/L	U	F	0.94		FQ	G	STD
B206989	WL	10/17/22	RFS01-10.2209052-019	91-20-3	Naphthalene	N	0.63	ug/L	U	D	0.63		FQ	G	STD
B206989	WL	10/17/22	RFS01-10.2209052-059	91-20-3	Naphthalene	N	0.63	ug/L	U	F	0.63		FQ	G	STD
B206989	WL	10/17/22	RFS01-10.2209052-019	NO3+NO2 AS N	Nitrate + Nitrite as Nitrogen	N	6	mg/L		D	0.044		FQ	G	STD
B206989	WL	10/17/22	RFS01-10.2209052-059	NO3+NO2 AS N	Nitrate + Nitrite as Nitrogen	N	6	mg/L		F	0.044		FQ	G	STD
B206989	WL	10/17/22	RFS01-10.2209052-019	100-42-5	Styrene	N	0.36	ug/L	U	D	0.36		FQ	G	STD
B206989	WL	10/17/22	RFS01-10.2209052-059	100-42-5	Styrene	N	0.36	ug/L	U	F	0.36		FQ	G	STD
B206989	WL	10/17/22	RFS01-10.2209052-019	127-18-4	Tetrachloroethene	N	0.4	ug/L	U	D	0.4		FQ	G	STD
B206989	WL	10/17/22	RFS01-10.2209052-059	127-18-4	Tetrachloroethene	N	0.4	ug/L	U	F	0.4		FQ	G	STD
B206989	WL	10/17/22	RFS01-10.2209052-019	108-88-3	Toluene	N	0.32	ug/L	U	D	0.32		FQ	G	STD
B206989	WL	10/17/22	RFS01-10.2209052-059	108-88-3	Toluene	N	0.32	ug/L	U	F	0.32		FQ	G	STD
B206989	WL	10/17/22	RFS01-10.2209052-019	1330-20-7	Total Xylenes	N	0.33	ug/L	U	D	0.33		FQ	G	STD
B206989	WL	10/17/22	RFS01-10.2209052-059	1330-20-7	Total Xylenes	N	0.33	ug/L	U	F	0.33		FQ	G	STD
B206989	WL	10/17/22	RFS01-10.2209052-019	156-60-5	trans-1,2-Dichloroethene	N	0.37	ug/L	U	D	0.37		FQ	G	STD
B206989	WL	10/17/22	RFS01-10.2209052-059	156-60-5	trans-1,2-Dichloroethene	N	0.37	ug/L	U	F	0.37		FQ	G	STD
B206989	WL	10/17/22	RFS01-10.2209052-019	79-01-6	Trichloroethene	N	0.3	ug/L	U	D	0.3		FQ	G	STD
B206989	WL	10/17/22	RFS01-10.2209052-059	79-01-6	Trichloroethene	N	0.3	ug/L	U	F	0.3		FQ	G	STD
B206989	WL	10/17/22	RFS01-10.2209052-019	7440-61-1	Uranium	Y	100	ug/L		D	0.05		FQ	G	STD
B206989	WL	10/17/22	RFS01-10.2209052-059	7440-61-1	Uranium	Y	99	ug/L		F	0.05		FQ	G	STD
B206989	WL	10/17/22	RFS01-10.2209052-019	75-01-4	Vinyl chloride	N	0.51	ug/L	U	D	0.51		FQ	G	STD
B206989	WL	10/17/22	RFS01-10.2209052-059	75-01-4	Vinyl chloride	N	0.51	ug/L	U	F	0.51		FQ	G	STD
SPOUT	TS	7/15/22	RFS01-06.2207027-013	NO3+NO2 AS N	Nitrate + Nitrite as Nitrogen	N	0.094	mg/L		F	0.044			G	STD
SPOUT	TS	8/1/22	RFS01-04.2208094-014	NO3+NO2 AS N	Nitrate + Nitrite as Nitrogen	N	0.044	mg/L	U	F	0.044			G	STD
SPOUT	TS	8/1/22	RFS01-04.2208094-014	7440-61-1	Uranium	N	34	ug/L		F	0.05			G	STD
SPOUT	TS	8/15/22	RFS01-04.2208095-014	NO3+NO2 AS N	Nitrate + Nitrite as Nitrogen	N	0.044	mg/L	U	F	0.044			G	STD
SPOUT	TS	8/31/22	RFS01-04.2208096-014	NO3+NO2 AS N	Nitrate + Nitrite as Nitrogen	N	0.044	mg/L	U	F	0.044			G	STD
SPOUT	TS	8/31/22	RFS01-04.2208096-014	7440-61-1	Uranium	N	39	ug/L		F	0.05			G	STD
SPOUT	TS	9/15/22	RFS01-04.2209097-014	NO3+NO2 AS N	Nitrate + Nitrite as Nitrogen	N	0.044	mg/L	U	F	0.044			G	STD
SPOUT	TS	9/29/22	RFS01-04.2209098-014	NO3+NO2 AS N	Nitrate + Nitrite as Nitrogen	N	0.11	mg/L		F	0.044			G	STD
SPOUT	TS	9/29/22	RFS01-04.2209098-014	7440-61-1	Uranium	N	54	ug/L		F	0.05			G	STD
SPOUT	TS	10/17/22	RFS01-04.2210099-014	NO3+NO2 AS N	Nitrate + Nitrite as Nitrogen	N	0.044	mg/L	U	F	0.044		J	G	STD
SPOUT	TS	10/18/22	RFS01-10.2209052-071	NO3+NO2 AS N	Nitrate + Nitrite as Nitrogen	N	0.06	mg/L		F	0.044			G	STD
SPOUT	TS	10/18/22	RFS01-10.2209052-084	NO3+NO2 AS N	Nitrate + Nitrite as Nitrogen	N	0.054	mg/L		D	0.044			G	STD
SPOUT	TS	10/18/22	RFS01-10.2209052-071	7440-61-1	Uranium	N	39	ug/L		F	0.05			G	STD
SPOUT	TS	10/18/22	RFS01-10.2209052-084	7440-61-1	Uranium	N	39	ug/L		D	0.05			G	STD
SPOUT	TS	11/2/22	RFS01-04.2211100-014	NO3+NO2 AS N	Nitrate + Nitrite as Nitrogen	N	0.06	mg/L		F	0.044			G	STD
SPOUT	TS	11/2/22	RFS01-04.2211100-014	7440-61-1	Uranium	N	52	ug/L		F	0.05			G	STD
SPOUT	TS	11/16/22	RFS01-01.2211030-011	NO3+NO2 AS N	Nitrate + Nitrite as Nitrogen	N	0.076	mg/L		F	0.044		U	G	STD
SPOUT	TS	11/30/22	RFS01-04.2211101-014	NO3+NO2 AS N	Nitrate + Nitrite as Nitrogen	N	0.044	mg/L	U	F	0.044			G	STD
SPOUT	TS	11/30/22	RFS01-04.2211101-014	7440-61-1	Uranium	N	56	ug/L		F	0.05			G	STD

Table 12. Analytical Results for Water Samples

LOCATION CODE	LOCATION TYPE	DATE SAMPLED	SAMPLE CODE	CAS	ANALYTE	FILTRATION STATUS	RESULT	UNITS	LAB QUALIFIERS	SAMPLE TYPE	DETECTION LIMIT	UNCER-TAINTY	DATA VALIDATION QUALIFIERS	COLLECTION METHOD	LAB CODE
SW093	SL	10/17/22	RFS01-04.2210099-015	NO3+NO2 AS N	Nitrate + Nitrite as Nitrogen	N	0.044	mg/L	U	F	0.044		J	G	STD
SW093	SL	11/2/22	RFS01-04.2211100-015	NO3+NO2 AS N	Nitrate + Nitrite as Nitrogen	N	0.82	mg/L		F	0.044			G	STD
SW093	SL	11/2/22	RFS01-04.2211100-015	7440-61-1	Uranium	N	13	ug/L		F	0.05			G	STD
SW093	SL	11/16/22	RFS01-01.2211030-009	NO3+NO2 AS N	Nitrate + Nitrite as Nitrogen	N	1.2	mg/L		F	0.044		J	G	STD
SW093	SL	11/30/22	RFS01-04.2211101-015	NO3+NO2 AS N	Nitrate + Nitrite as Nitrogen	N	1.4	mg/L		F	0.044			G	STD
SW093	SL	11/30/22	RFS01-04.2211101-015	7440-61-1	Uranium	N	17	ug/L		F	0.05			G	STD
WOMPOC	SL	6/7/22	RFS01-13.2209083-015	14596-10-2	Americium-241	N	-0.00134	pCi/L	U	F		0.00585		C	GEN
WOMPOC	SL	6/7/22	RFS01-13.2209083-015	PU-239,240	Plutonium-239, 240	N	0.00852	pCi/L	U	F		0.00926		C	GEN
WOMPOC	SL	6/7/22	RFS01-13.2209083-015	7440-61-1	Uranium	N	2.2	ug/L		F	0.067			C	GEN
WOMPOC	SL	9/29/22	RFS01-13.2210084-001	14596-10-2	Americium-241	N	0.00779	pCi/L	U	D		0.00919		C	GEN
WOMPOC	SL	9/29/22	RFS01-13.2210084-015	14596-10-2	Americium-241	N	-0.00939	pCi/L	U	F		0.0184		C	GEN
WOMPOC	SL	9/29/22	RFS01-13.2210084-001	PU-239,240	Plutonium-239, 240	N	0.00566	pCi/L	U	D		0.0157		C	GEN
WOMPOC	SL	9/29/22	RFS01-13.2210084-015	PU-239,240	Plutonium-239, 240	N	-0.00148	pCi/L	U	F		0.0112		C	GEN
WOMPOC	SL	9/29/22	RFS01-13.2210084-001	7440-61-1	Uranium	N	0.931	ug/L		D	0.067		J	C	GEN
WOMPOC	SL	9/29/22	RFS01-13.2210084-015	7440-61-1	Uranium	N	0.95	ug/L		F	0.067		J	C	GEN

EXPLANATION

FILTRATION STATUS
N = Sample was not filtered.
Y = Sample was filtered.

UNITS
mg/L; ppm = milligrams per liter
pCi/L = picocuries per liter
ug/L = micrograms per liter
C = degrees celsius
mS/cm = milliSiemens per centimeter
NTU = normal turbidity units
s.u. = standard pH units
uS/cm = microSiemens per centimeter
umhos/cm = microSiemens per centimeter

SAMPLE_TYPE
F = Field Sample
D = Duplicate

DATA_VALIDATION_QUALIFIERS
<blank> No qualifiers needed for result.
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.
999 Validation not complete

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 compund (TIC).
P > 25% difference in detected pesticide or Arochlor 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 (USEPA CLP organic) qualifier, see case narrative.
Y Laboratory defined (USEPA CLP organic) qualifier, see case narrative.
Z Laboratory defined (USEPA CLP organic) qualifier, see case narrative.

LOCATION_TYPE
SL SURFACE LOCATION
TS TREATMENT SYSTEM
WL WELL

LAB_CODE
GEN Gel Laboratories
STD Test America

COLLECTION_METHOD
G Grab
C Composite

Table 13. Water Sampling Events: Fourth Quarter CY 2022

	Sampling Dates		Sample Info			Analytes					Sample Tracking Info
Location Code	**Start**	**End**	**Collection Method**	**Type**	**Filtered**	**VOC**	**U**	**Nitrate**	**Pu/Am**	**TSS**	**Sample ID**
SPOUT	7/15/2022 11:20	7/15/2022 12:30	grab	F	No			X			RFS01-06.2207027-013
SPOUT	8/1/2022 11:18	8/1/2022 11:18	grab	F	No		X	X			RFS01-04.2208094-014
SPOUT	8/15/2022 12:26	8/15/2022 12:26	grab	F	No			X			RFS01-04.2208095-014
SPOUT	8/31/2022 11:13	8/31/2022 11:13	grab	F	No		X	X			RFS01-04.2208096-014
SPOUT	9/15/2022 11:05	9/15/2022 11:05	grab	F	No			X			RFS01-04.2209097-014
SPOUT	9/29/2022 9:35	9/29/2022 9:35	grab	F	No		X	X			RFS01-04.2209098-014
WOMPOC	6/7/2022 12:36	9/29/2022 11:23	composite	F	No		X		X		RFS01-13.2209083-015
SW093	10/17/2022 12:53	10/17/2022 12:53	grab	F	No			X			RFS01-04.2210099-015
SPOUT	10/17/2022 13:02	10/17/2022 13:02	grab	F	No			X			RFS01-04.2210099-014
11104	10/17/2022 13:55	10/17/2022 13:55	grab	F	Yes		X				RFS01-10.2209052-012
11104	10/17/2022 13:55	10/17/2022 13:55	grab	F	No	X					RFS01-10.2209052-012
4087	10/17/2022 15:05	10/17/2022 15:05	grab	F	Yes		X				RFS01-10.2209052-027
4087	10/17/2022 15:05	10/17/2022 15:05	grab	F	No	X		X			RFS01-10.2209052-027
B206989	10/17/2022 15:25	10/17/2022 15:25	grab	D	Yes		X				RFS01-10.2209052-019
B206989	10/17/2022 15:25	10/17/2022 15:25	grab	D	No	X		X			RFS01-10.2209052-019
B206989	10/17/2022 15:25	10/17/2022 15:25	grab	F	Yes		X				RFS01-10.2209052-059
B206989	10/17/2022 15:25	10/17/2022 15:25	grab	F	No	X		X			RFS01-10.2209052-059
00193	10/18/2022 9:25	10/18/2022 9:25	grab	F	Yes		X				RFS01-10.2209052-001
00193	10/18/2022 9:25	10/18/2022 9:25	grab	F	No	X					RFS01-10.2209052-001
10304	10/18/2022 10:38	10/18/2022 10:38	grab	F	Yes		X				RFS01-10.2209052-010
10304	10/18/2022 10:38	10/18/2022 10:38	grab	F	No	X		X			RFS01-10.2209052-010
10304	10/18/2022 10:38	10/18/2022 10:38	grab	D	Yes		X				RFS01-10.2209052-076
10304	10/18/2022 10:38	10/18/2022 10:38	grab	D	No	X		X			RFS01-10.2209052-076
89104	10/18/2022 11:27	10/18/2022 11:27	grab	F	No	X					RFS01-10.2209052-046
42505	10/19/2022 10:55	10/19/2022 10:55	grab	F	No	X					RFS01-10.2209051-074
WOMPOC	9/29/2022 11:14	10/25/2022 10:38	composite	D	No		X		X		RFS01-13.2210084-001
WOMPOC	9/29/2022 11:14	10/25/2022 10:38	composite	F	No		X		X		RFS01-13.2210084-015
SPOUT	11/2/2022 9:36	11/2/2022 9:36	grab	F	No		X	X			RFS01-04.2211100-014
SW093	11/2/2022 10:13	11/2/2022 10:13	grab	F	No		X	X			RFS01-04.2211100-015
SPOUT	11/16/2022 12:03	11/16/2022 12:03	grab	F	No			X			RFS01-01.2211030-011
SW093	11/16/2022 12:08	11/16/2022 12:08	grab	F	No			X			RFS01-01.2211030-009
SW093	11/30/2022 9:06	11/30/2022 9:06	grab	F	No		X	X			RFS01-04.2211101-015
SPOUT	11/30/2022 9:19	11/30/2022 9:19	grab	F	No		X	X			RFS01-04.2211101-014

EXPLANATION

FILTRATION STATUS
No = Sample was not filtered.
Yes = Sample was filtered.

SAMPLE_TYPE
F = Field Sample
D = Duplicate

ANALYTES
VOC = volatile organic compound
U = uranium
Pu/Am = plutonium and americium
TSS = total suspended solids