2021 EVALUATION OF WATER QUALITY VARIABILITY FOR URANIUM AND OTHER SELECTED PARAMETERS IN WALNUT CREEK AT THE ROCKY FLATS SITE

PREPARED FOR THE CONTRACTOR TO THE
U.S. DEPARTMENT OF ENERGY OFFICE OF LEGACY MANAGEMENT
AT THE ROCKY FLATS SITE, COLORADO

PREPARED BY:
WRIGHT WATER ENGINEERS, INC.

DECEMBER 2021

PROJECT 071-091.060

2021 EVALUATION OF WATER QUALITY VARIABILITY FOR URANIUM AND OTHER SELECTED PARAMETERS IN WALNUT CREEK AT THE ROCKY FLATS SITE

TABLE OF CONTENTS

Page

TABLES

FIGURES

APPENDICES
(AT END OF REPORT)

EXECUTIVE SUMMARY

This report, prepared by Wright Water Engineers, Inc. (WWE) on behalf of the U.S. Department of Energy (DOE) Office of Legacy Management (LM), summarizes the current findings from an ongoing study to address specific questions regarding uranium in surface water at the Rocky Flats Site (RFS) Central Operable Unit (herein referred to as the Site). The questions addressed were originally raised when the study was initiated in 2012. WWE is working on this project with RSI Entech, the LM technical services contractor responsible for ongoing surveillance and maintenance activities at RFS that collected the data evaluated by WWE and presented in this report.

The primary focus of this study is uranium at RFS within the North and South Walnut Creek drainages. More specifically, the study addresses uranium sources, composition of the uranium (in terms of natural versus anthropogenic uranium fractions) and distribution and transport mechanisms. It also provides an evaluation of other water quality parameters related to the transport of uranium at RFS, such as nitrate[1], and in addition, provides background information on the development of the RFS-specific uranium stream standard. Data evaluated in this report were generally collected from January 1997 through June 2021, though at some locations and for certain parameters, such as isotopic uranium data, data from a different time period are evaluated and discussed. While the main emphasis of the analysis described in this report addresses the science of uranium transport at RFS, regulatory standards are also discussed to provide perspective.

This report follows the same general format as the previous reports for this study and addresses the following questions[2]:

---

[1]Nitrate in this report refers to nitrate plus nitrite as N (NO_3+NO_2 as N). Nitrate concentrations are for units of mg/L as N, not as NO_3.

[2] The listed questions were initially identified when the original study was conducted in 2012 and are addressed in previous reports as part of this ongoing project. Responses to the questions have been updated based on the inclusion of more current data. Text in certain sections remains unchanged from prior reports where new data or information

1) How do concentrations of natural uranium observed globally and throughout Colorado compare with the uranium concentrations observed in the RFS Walnut Creek drainages?
2) Other than predictable and measurable variations in surface flow (such as the diluting effects of storm events and associated runoff and the concentrating effects of low surface water flow and an increased proportion of baseflow/groundwater recharge), what are the primary mechanisms by which concentrations of uranium in surface water may significantly increase and decrease?
3) Are previously unrecognized anthropogenic uranium sources suggested by the data?

In answering these questions, the report focuses on uranium and nitrate concentrations in the Walnut Creek drainage.

Since the last report in 2019, collection of additional data has provided new insights that include the following:

1) Through mid-2021, the improved treatment process at the Solar Ponds Plume Treatment System (SPPTS) continues to have an ongoing measurable benefit in terms of achieving a substantial reduction in nitrate concentrations in North Walnut Creek.
2) The characteristics of how rainfall occurs during wet weather periods makes a difference in terms of the effect on uranium concentrations observed in surface water at RFS. Periods of increased precipitation with higher intensity, such as the large rainfall event that occurred in 2013, appears to produce a more rapid and notable increase in uranium concentrations in North and South Walnut Creek following the storm event compared to periods with longer duration, lower intensity rainfall, such as that which occurred in May 2015 or May 2021.

---

has not been introduced but is repeated as it provides beneficial information for answering the study's original questions.

These topics are discussed further below. In addition, other notable surface water sample results and observations are summarized for both North and South Walnut Creeks.

Continued Effective Nitrate Removal by the SPPTS

Prior to the SPPTS reconfiguration becoming fully effective in October 2016, surface water samples from SPOUT, which is located at the discharge point of the SPPTS, had an average nitrate concentration of approximately 260 mg/L (from January 2010 through April 2016). After the SPPTS was reconfigured, the average concentration of samples collected from November 2016 until June 2021 was less than 2 mg/L. For perspective, the Rocky Flats Legacy Management Agreement (RFLMA) standard for nitrate is 10 mg/L.

Prior to the reconfiguration of the SPPTS, it is estimated that the system contributed approximately 19 percent of the total nitrate load measured at location GS13 in North Walnut Creek.[3] Following the SPPTS reconfiguration in 2016, the nitrate load from the system has been reduced to less than 1 percent of the total nitrate load measured at GS13, confirming the significant ongoing improvement in the removal of nitrate from SPPTS effluent.

In previous reports, the capacity of nitrate to mobilize uranium was described. Reducing nitrate concentrations in North Walnut Creek by improving the efficiency of nitrate treatment by the SPPTS is hypothesized to result in reduced mobilization of uranium from sediment sources in the North Walnut Creek channel. Since the SPPTS was reconfigured to more effectively remove nitrate in 2016, a corresponding reduction in uranium concentrations in North Walnut Creek has been difficult to discern, though uranium concentrations have generally trended lower at GS11 (Pond A-4 outfall) since 2016.

[3] The estimated fraction of nitrate contributed by the SPPTS into North Walnut Creek, as measured at GS13, is likely an underestimate because the nitrate grab samples in North Walnut Creek are typically collected during periods with low flows when nitrate concentrations are typically higher (i.e., less dilution occurring), thereby resulting in an overestimate of the total nitrate load in North Walnut Creek, from all sources, and underestimating the fraction contributed by the SPPTS, as measured at SPOUT.

Major Precipitation Events and Their Effect on Uranium Concentrations in Walnut Creek

Based on precipitation data collected by RFS personnel from 1993 to September 2021, five months had monthly total precipitation depths greater than 4 inches. These are: May 1995 (6.38 inches); April 1999 (4.24 inches); September 2013 (7.52 inches), May 2015 (5.75 inches) and May 2021 (4.18 inches). The effect on uranium concentrations in surface water in North and South Walnut Creeks was evaluated for three of these months, including September 2013, May 2015 and May 2021.

In 2013, the largest precipitation event recorded at the Site occurred from September 9 through September 15, with a rainfall depth of 6.73 inches averaged across the Site for the seven-day period. The first uranium samples after the peak surface water flow rates from the 2013 event had declined, which were collected approximately six weeks after the event, increased and in some cases doubled, at multiple surface water monitoring locations. The uranium concentrations at those surface water locations remained elevated for several months before returning to pre-storm levels, but, for perspective, remained below the 30 µg/L drinking water Maximum Contaminant Level (MCL) during that period, while recognizing that the receiving streams from RFS are not used for domestic water supply.

In contrast to the 2013 event, during the wet weather period in May 2015, 13 days had precipitation totals greater than 0.1 inch, but the peak flows were much lower than the flooding conditions of 2013. After the 2015 wet period, in North Walnut Creek the uranium concentrations increased two months later, in July 2015, and remained elevated for several months thereafter at several monitoring locations (SW093, GS13, GS12). However, the increases in uranium concentrations did not differ substantially from typical seasonal increases. This observation is consistent with an increase in lagged baseflow associated with recharge to groundwater during the period of elevated precipitation. The recharged water is exposed to sub-surface uranium sources and then subsequently discharged to the surface drainages via seeps, thereby elevating surface water uranium concentrations when surface runoff comprises a smaller fraction of surface water flows, though the 2015 uranium surface water concentrations did not vary substantially compared to years with more typical precipitation depths

Following the wet weather in May 2021, with a total precipitation depth of 4.18 inches, no increase in uranium concentrations was observed. It is noted that the wet weather in May 2021 was preceded by very dry weather in 2020. The May 2021 wet period produced roughly one third of the runoff volume of the May 2015 wet period, despite recording approximately 80 percent of the precipitation depth.

Other Notable Water Quality Observations

Uranium Concentrations and Loads

In North Walnut Creek, from 2010 to 2013, the largest annual total uranium loads were measured at station GS13 (inflow to the former Pond A-1). However, since then, from 2014 through 2020, the pattern of uranium loads has shifted, with downstream monitoring location GS12 (discharge from the former Pond A-3) having the largest annual total uranium loads. Explanations for the shift include the following: First, Pond A-3 was breached in 2012, which has resulted in an increase in the relative volume of water discharged at the outfall from the breached Pond A-3 (station GS12) because less water is now lost from infiltration and evaporation which historically occurred at Pond A3; the gain in water volume observed at GS12 translates to a relative gain in uranium load. In addition, settling of suspended sediment provided by Pond A-3 no longer occurs, thereby increasing the mobility of the sediments and their potential to transport uranium. Second, the 2013 storm event mobilized sediments and deposited them where the interior ponds were formerly located upstream of GS12. These sediments are intermittently exposed to the atmosphere and oxidized when North Walnut Creek dries up, which enhances the mobility of uranium ultimately measured at GS12. Downstream from GS12, at GS11 (Pond A-4 outfall), after the pond operations changed from batch-release mode to flow-through mode in late September 2011, uranium concentrations increased and have remained fairly consistent through the present, except for the period with elevated uranium concentrations following the 2013 flood event and the subsequent increased baseflow following that event.

In South Walnut Creek, at GS10, the highest uranium concentrations are typically observed during the early months of each calendar year when a larger fraction of the surface flow is from groundwater sources. Since 2011, when the highest concentration of uranium was measured at GS10 (approximately 89 µg/L), the maximum concentration of uranium measured each annual cycle at GS10 decreased until approximately 2015. From 2015 until late 2017, the maximum uranium concentrations remained relatively constant, after which they increased slightly. In the first six months of 2021, the highest individual composite sample result at GS10 was 33.5 µg/L.

Another notable trend in South Walnut Creek is that from 2010 through 2012, the annual uranium loads were higher at GS10 than at downstream location B5INFLOW, indicating uranium load reduction between those two locations, which was explained at least in part by the losing reach of stream between those two locations during drier conditions. However, from 2013 through 2021, the pattern has been different, with higher loads observed downstream at B5INFLOW compared to GS10 (with exceptions in 2014 and 2018, where the GS10 load was slightly higher). This can be explained, at least in part, by changes in the comparative water volumes observed at GS10 and at B5INFLOW in recent years. Starting in 2016, effluent water that was previously routed to GS10 from the Mound Site Plume Treatment System (MSPTS) has been diverted to bypass GS10 and is now ultimately discharged, after being treated at the East Trenches Plume Treatment System (ETPTS), at a point upstream from B5INFLOW. The change in the flow regime has resulted in a comparative gain in uranium load at B5INFLOW relative to GS10. In addition, the sediments in South Walnut Creek now are routinely dry because of the modifications to routing of MSPTS discharges. The dry sediments enhance oxidation and mobility of uranium, which promotes higher relative uranium loads downstream from GS10 as measured at B5INFLOW.

Since WALPOC became a monitoring location in 2011, measured uranium concentrations in individual flow-paced composite samples have intermittently been above the site-specific 16.8 µg/L standard. However, for perspective, it is noted that none of the WALPOC samples collected from 2011 through June 2021 have exceeded the 30 µg/L drinking water MCL, with the highest result being 23.5 µg/L in January 2018, again recognizing that the receiving streams from RFS are not used for domestic water supply.

The relative contribution of uranium from the SPPTS observed at GS13, calculated by dividing the monthly load measured at SPOUT by the monthly load at GS13, has exhibited some variability since 2010, with the highest SPOUT percentage contributions observed in 2018 and 2020 (approximately 22% and 18%, respectively). The percentage contribution from SPOUT relative to GS13 is higher during drier years when baseflow comprises a larger portion of the total flow in the drainage and the contribution from surface flows measured at station SW093 is less.

Natural Versus Anthropogenic Uranium

As previously reported, in North Walnut Creek at station SW093, the average measured fraction of natural uranium determined using isotopic analyses of samples was approximately 75 percent for six samples from 2007 to November 2015. The older samples in the dataset, collected from 2007 to 2011, had a natural uranium fraction ranging from 91 to 93 percent for three samples. Later, in 2014 and 2015, three samples had an average natural uranium fraction that decreased to 59 percent. However, while the anthropogenic fraction increased in the three samples in 2014 and 2015, the average total uranium concentration from all samples at SW093 in that time period, 7.2 µg/L (collected as part of RFLMA sampling), was less than the 7.9 µg/L average uranium concentration from all the earlier samples from 2007 to 2011 (collected as part of the Rocky Flats Cleanup Agreement [RFCA] and RFLMA sampling). Although the data set size is limited, a potential explanation for the lower natural uranium fractions in the 2014 and 2015 samples is they were collected when strip drains upstream of SW093 were producing a larger portion of the surface water flow compared to the earlier samples. The strip drains may be collecting sub-surface seepage from the Solar Ponds Plume area with elevated anthropogenic uranium in the groundwater.

In South Walnut Creek at station GS10, the average fraction of natural uranium is 66 percent based on 19 samples collected from 2002 to 2015 with the natural fraction ranging from approximately

43 to 78 percent. The natural fraction of uranium at GS10 remained relatively constant from late 2013 through mid-2015, when the last isotopic analysis was conducted for samples from GS10. Downstream from GS10, at GS08 (the Pond B-5 outfall), based on five samples collected from February 2014 to March 2018, the average fraction of natural uranium is 80 percent with a range from 76 to 85 percent.

At WALPOC, the average fraction of natural uranium is 79 percent, based on 39 samples collected from September 2011 through March 2018. The range in the fraction of natural uranium from 2011 through 2014 was approximately 75 to 83 percent, whereas later, from 2015 to 2018, the range was broader, from approximately 69 to 87 percent natural uranium.

Groundwater samples that were historically analyzed for isotopic composition indicate a broad range of anthropogenic uranium fractions, with some samples composed of uranium from entirely anthropogenic sources to other samples composed of nearly entirely natural uranium. However, the isotopic results do not provide information that indicate a previously unknown source of anthropogenic uranium in groundwater.

2021 EVALUATION OF WATER QUALITY VARIABILITY FOR URANIUM AND OTHER SELECTED PARAMETERS IN WALNUT CREEK AT THE ROCKY FLATS SITE

1.0 INTRODUCTION AND BACKGROUND INFORMATION

1.1 Introduction

This report, prepared by Wright Water Engineers, Inc. (WWE) on behalf of the U.S. Department of Energy (DOE) Office of Legacy Management (LM), summarizes the current findings from an ongoing study to address specific questions regarding uranium in surface water at the Rocky Flats Site (RFS) Central Operable Unit (herein referred to as the Site). The questions addressed were originally raised when the study was initiated in 2012. WWE is working on this project with LM technical services contractor RSI Entech, who is responsible for ongoing surveillance and maintenance activities at RFS and who collected the data analyzed by WWE and presented in this report.

The data set evaluated in this report generally includes data collected from January 1997 through June 2021, though at some locations and for certain parameters, data from a different time period are plotted, evaluated and discussed. The time period of data evaluated is generally identified in the discussion of the report. The data referenced are a combination of both flow-weighted composite samples as well as grab samples, as described further for specific types of samples.

1.2 Questions Addressed by Current Study

The questions addressed in this report were initially identified when the original study regarding uranium transport in surface water at the RFS was prepared. The questions were addressed in previous reports for this ongoing study and the responses have been updated based on the inclusion of more current data. Text in certain sections remains unchanged from prior reports where new data or information has not been introduced but its inclusion provides beneficial information for answering the study's original questions. The questions addressed are:

1) How do concentrations of natural uranium observed globally and throughout Colorado compare with the uranium concentrations observed in the RFS Walnut Creek drainages?

2) Other than predictable and measurable variations in surface flow (such as the diluting effects of storm events and associated runoff and the concentrating effects of low surface water flow and an increased proportion of baseflow/groundwater recharge), what are the primary mechanisms by which concentrations of uranium in surface water may significantly increase and decrease?

3) Are previously unrecognized anthropogenic uranium sources suggested by the data?

1.3 Report Format

The questions addressed by this study (i.e., questions 1 through 3 above) have some overlap in terms of their subject matter. To avoid redundancy in the responses to the questions, rather than providing separate responses to each individual question, this report is organized into sections which collectively address the different questions as outlined in Table 1.

Table 1. Summary of Report Sections and Study Questions Addressed

Report Section	Section Title	Study Question(s) Addressed
1.0	Introduction and Background Information	1
2.0	Chemical and Site-specific Factors that Govern Uranium Concentration and Transport in Aqueous Environments. This includes: • General controls (Section 2.1) • RFS-specific conditions (Section 2.2)	2
3.0	RFS Data Analysis This includes: • Spatial and temporal variability of uranium and nitrate (Section 3.3) • Determination of anthropogenic uranium (Section 3.5)	3

Report Section	Section Title	Study Question(s) Addressed
4.0	Effect of Site Operations on Uranium Concentrations This includes: • Solar Ponds Plume Treatment System (Section 4.1) • Ponds A-4 and B-5 (Section 4.2)	2

1.4 Background Information

1.4.1 Site Description and History

The RFS, located approximately 16 miles northwest of Denver, Colorado, was formerly used to produce components for nuclear weapons. The Site was originally developed by the United States Atomic Energy Commission (AEC) in 1952 and served as a weapons component manufacturing facility until 1994. During production operations, radionuclides released to the environment included plutonium-239, americium-241, tritium and uranium.

The work conducted historically at RFS involved uranium that was modified, in either “enriched” or “depleted” forms, which was received from other facilities in the DOE complex (collectively referred to as “anthropogenic” uranium). The work conducted at the facility did not involve uranium from natural sources. (Note: Since the different types of uranium have different isotopic compositions, samples can be analyzed to determine whether the uranium in environmental media at RFS is from anthropogenic sources, natural sources [which are abundant in the region], or a combination of the two; this topic is addressed in Section 3.4). Plutonium, americium, and tritium were also received from other facilities and used in industrial processes at RFS, though these are not evaluated in this report.

In 1994, the mission of the Site was officially transitioned to one of environmental remediation, decommissioning, demolition and removal of production facilities and, ultimately, restoration/revegetation of the Site. The environmental remediation, restoration and “closure” phase was completed in October 2005. Closure of the Site resulted in a different hydrologic regime compared to that which existed during the production and operations phase, because: 1) water that was formerly supplied to the Site for domestic and industrial purposes, and discharged as treated wastewater, was eliminated, and 2) runoff from the Site was reduced substantially because of impervious surfaces (i.e., buildings and pavement) being removed. The reduction in water volume flowing across the Site also had an effect on the movement of uranium (both naturally occurring and anthropogenic) across the Site.

Since Site closure activities were completed in 2005, other major changes and/or relevant events at the Site, in terms of surface water management, have included the following:

- Changes in the configuration of the dams - Removal of all interior dams on Walnut Creek via the construction of engineered breaches, from 2009 through 2012 (this included breaching dams A-1, A-2 and A-3 on North Walnut Creek, dams B-1, B-2, B-3 and B-4 on South Walnut Creek and the East Landfill Pond Dam in No Name Gulch) (see Figure 1).

- Changes in dam operations - The operations of terminal dams A-4 (North Walnut Creek) and B-5 (South Walnut Creek) were changed from batch discharge to flow-through operation in September 2011.[4]

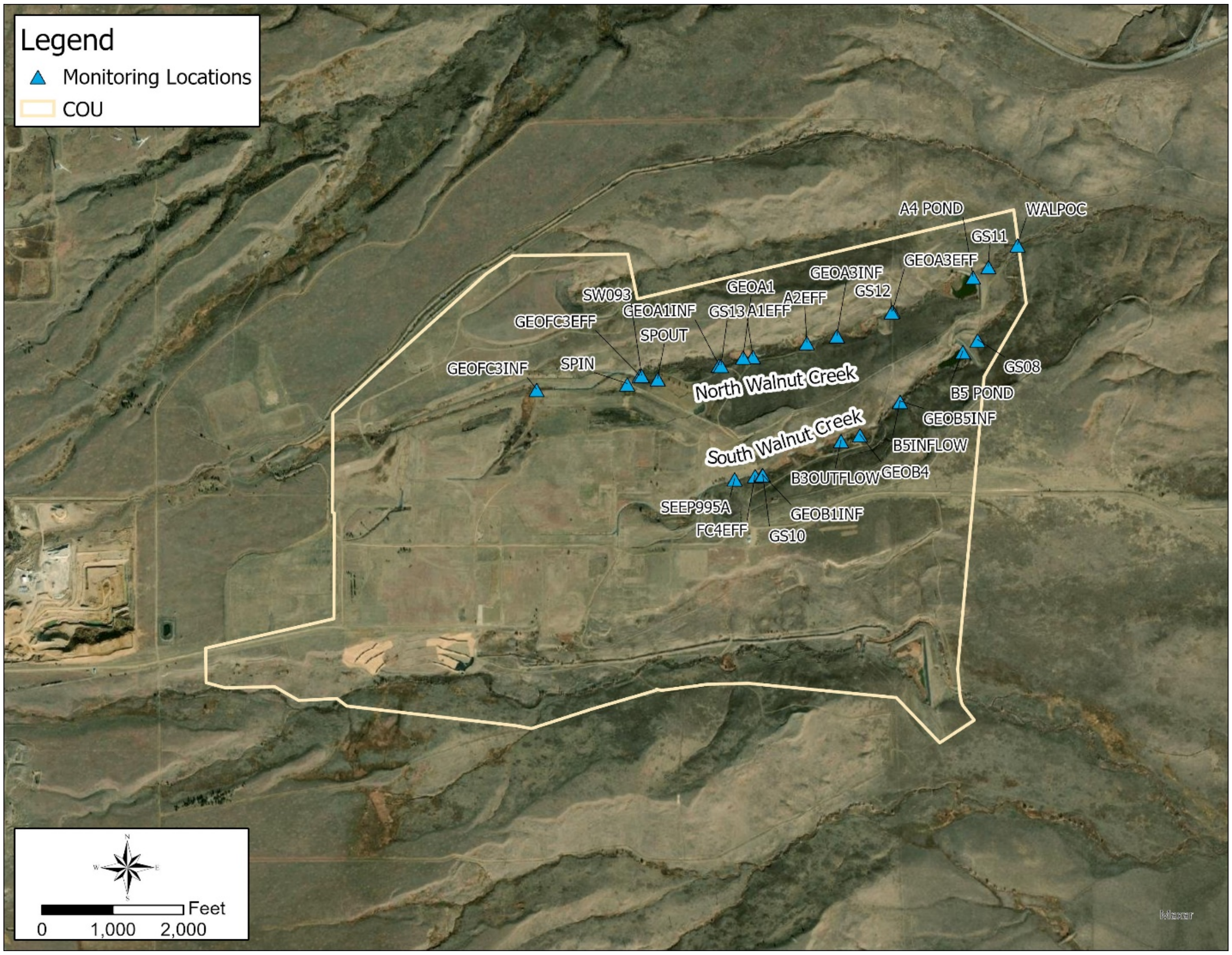
- Wide range of precipitation conditions - 2012 was the driest calendar year that has been recorded by Site rain gages since 1993, with an average total precipitation depth of 7.21 inches measured at gages located across the Site. 2020 was the second driest year recorded, with 7.38 inches and 2016 was the third driest year, with 7.68 inches. The wettest year on record at the Site was 2015 with a total precipitation depth of 18.26 inches. (It is noted that

[4] The Woman Creek drainage, including Dams C-1 and C-2, is not addressed in this report. However, it is noted that Dam C-2, the terminal dam on Woman Creek, was also changed from batch discharge to flow-through operation in September 2011. Dam C-1 was formerly located in the Woman Creek drainage and was breached in 2004.

these precipitation totals are not derived from heated gages and hence do not accurately represent precipitation that occurs as snow.)

- Flood conditions - The largest rainfall event at the Site, since records began in 1993, occurred from September 9 through September 15, 2013, with total rainfall depths ranging from 5.21 to 8.30 inches measured at six rain gages located across the Site, with an average rainfall depth of 6.73 inches across the Site for the 7-day period. This was determined to be approximately a 100-year rainfall event for the Site (for a 7-day period), per the NOAA Atlas 14, Volume 8 (NOAA, 2013a; NOAA, 2013b).

Figure 1. Selected RFS Surface Water Monitoring Locations Used in Study



Note: Figure 1 shows surface water monitoring locations that are most frequently referenced in this report. A map of all monitoring locations referenced in this study is provided in Appendix A (Figure A.1).

1.4.2 Site Regulatory Background

A brief description of the historical evolution of regulations for uranium in surface water at RFS is provided below. A summary of uranium regulations for surface water in Colorado is provided in Section 1.4.5.

RFS Site-Specific Uranium Standard

Through March 2009, the Site-specific standards for uranium (U) that applied at RFS were:

- North and South Walnut Creeks: 10 picocuries per liter (pCi/L) (equivalent to approximately 14.9 µg/L)[5]
- Woman Creek: 11 pCi/L (equivalent to approximately 16.4 µg/L)

These values were based on ambient concentrations of uranium determined during the former operations period at the Site.

An important factor that influenced ambient uranium concentrations during the operations period was the large relative volume of water historically imported to the Site (for industrial purposes, restrooms, irrigation, etc.) and then discharged into South Walnut Creek after being treated at the former on-site wastewater treatment plant (WWTP). Prior to closure of the Site, an average of approximately 195 acre-feet per year was discharged from the WWTP into South Walnut Creek (based on discharge data from 1997 to 2001) (Kaiser-Hill, 2002).

In terms of stormwater runoff during the pre-closure conditions at the Site, the annual volume measured in North and South Walnut Creeks combined (averaged from 1997 through 2005 at stations SW093 and GS10 combined), was approximately 242 acre-feet per year.

For comparison, in the post-closure condition, the average annual stormwater runoff volume measured in North and South Walnut Creeks combined was approximately 137 acre-feet per year (based on flow data from stations SW093 and GS10 in 2010 and 2011, which were typical years in terms of precipitation [see Section 3.1]); during those years, no discharges of treated effluent from the WWTP were added to the stream flows because the WWTP was removed in 2004. In addition, the volume of water imported since site closure is negligible and used only for dust suppression during projects such as regrading of the gravel roads.

The historic discharges of imported, treated water from the WWTP, in conjunction with the higher volume of stormwater runoff from impervious surfaces (i.e., buildings and pavement) that formerly

[5] The conversion from pCi/L to µg/L (0.67 pCi per µg of uranium) is based on the isotopic composition of uranium from a natural source (see 5 CCR 1002-38.71).

existed at RFS, resulted in dilution and lowering of uranium concentrations in surface water flowing at the Site. The historical industrial-era conditions described above and the corresponding ambient concentrations of uranium in surface water at that time are not representative of the current, post-closure conditions.

In 2009, DOE unsuccessfully petitioned the Colorado Water Quality Control Commission (WQCC) to revise the Site-specific uranium standard to the statewide basic standard for uranium, 30 micrograms per liter (µg/L), which is the same as the United States Environmental Protection Agency (EPA) MCL for drinking water. In recognition of the changed conditions following closure of the Site, as described in Section 1.4.1, the WQCC instead revised the Site-specific standard to 16.8 µg/L (equivalent to approximately 11.6 pCi/L of natural U). During the revision proceedings, the WQCC requested that if a higher ambient standard was warranted, the Site should collect additional data justifying this need. In 2011, the 16.8 µg/L standard was defined as the lower end of the Colorado basic statewide standard for uranium for domestic water supply, which has a range from 16.8 µg/L to 30 µg/L.[6]

At RFS, compliance with the 16.8 µg/L stream standard in Walnut Creek is currently monitored in accordance with RFLMA at the Walnut Creek Point of Compliance (WALPOC) monitoring location at the eastern boundary of the Central Operable Unit (COU) (see Figure 1). WALPOC became a Point of Compliance (POC) on September 28, 2011. Prior to WALPOC, three different POCs were located on Walnut Creek: 1) GS11 (outfall of terminal Pond A-4 on North Walnut Creek), 2) GS08 (outfall of terminal Pond B-5 on South Walnut Creek) and 3) GS03 (just west of Indiana Street outside the COU). Per RFLMA, at WALPOC, a 30-day average concentration of uranium that exceeds 16.8 µg/L defines a reportable condition; a 12-month rolling average

[6] The basic statewide standard for uranium uses a concentration measured as a metal mass per unit volume of water (measured as micrograms per liter [µg /L]), versus radioactivity per unit volume of water (measured as picoCuries per liter [pCi/L]).

concentration of uranium that exceeds 16.8 µg/L defines a reportable condition and triggers an evaluation of compliance with remedy performance standards.

The 16.8 µg/L Site-specific standard for uranium at RFS is the lower end of the 16.8 µg/L - 30 µg/L range for Colorado basic statewide standard for uranium in a domestic water supply, and is less than the 30 µg/L MCL for drinking water, though the receiving streams from RFS are not used for domestic water supply.[7]

Further information on uranium standards in surface water in Colorado is provided in Section 1.4.5. Additional information on the RFS Site-specific standard is provided in Section 1.4.5.3.

1.4.3 Basis for Current Study: Water Quality Trends in Walnut Creek

As discussed above, the purpose of this study is to address questions related to water quality and evolving changes in water quality in the Walnut Creek drainage with a focus on uranium and nitrate. Relevant observations regarding water quality in Walnut Creek are summarized below:

<u>North Walnut Creek – Surface Water Uranium Concentrations</u>

Water quality monitoring in the North Walnut Creek drainage following closure of the Site identified trends that raised questions which are addressed by this study. At all surface water monitoring locations in North Walnut Creek upstream of terminal Pond A-4 and at WALPOC (the Walnut Creek Point of Compliance monitoring location), uranium concentrations for individual samples have intermittently been detected at levels that exceed 16.8 µg/L, recognizing that the Site-specific standard is monitored at WALPOC and regulatory responses are based on 30-day average and 12-month rolling average concentrations (see Sections 1.4.5.3 and 3.2.1). Also, with

[7] For types of water use other than domestic water supply, Regulation 38 provides the following equations to calculate the uranium standard:
Aquatic life (acute): $e^{(1.102[\ln(\text{hardness})] + 2.7088)}$
Aquatic life (chronic): $e^{(1.102[\ln(\text{hardness})] + 2.2382)}$

respect to the 30 µg/L MCL for drinking water, it is noted that uranium concentrations at specific monitoring locations in North Walnut Creek upstream of Pond A-4 have intermittently been detected above 30 µg/L.

Discharges from Pond A-4, measured at station GS11, are generally below the 16.8 µg/L site-specific standard. However, four flow-paced composite samples collected starting in October 2013 (approximately one month after the large September 2013 storm event) and into May 2014 collectively had an arithmetic average uranium concentration of approximately 24 µg/L, with individual sample results ranging from approximately 19 to 29 µg/L. Since that time, several other samples intermittently exceeded the 16.8 µg/L Site-specific standard, including: January 2015 (19.6 µg/L), February 2015 (18.5 µg/L), March 2015 (17.1 µg/L), April 2015 (19.4 µg/L), January 2016 (23.1 µg/L), February 2016 (21.9 µg/L), May 2016 (18.8 µg/L), and February 2020 (17.1 µg/L). Most of these sample results were interspersed with other samples that did not exceed the 16.8 µg/L site-specific standard. The majority of these samples, though not all, were collected during winter baseflow conditions.

Expanded monitoring to better understand uranium fate and transport processes in both North and South Walnut Creeks has been conducted for approximately nine years and is ongoing.

South Walnut Creek – Surface Water Uranium Concentrations

Similar to North Walnut Creek, surface water uranium concentrations in South Walnut Creek upstream of terminal Pond B-5 have a variable range that periodically have exceeded 16.8 µg/L and, for reference purposes, also have exceeded the 30 µg/L MCL for drinking water.

Prior to early 2010, no samples had been measured at GS10 with concentrations above 30 µg/L. In early 2011, a composite sample collected at station GS10 had a result of approximately 90 µg/L, or more than twice the highest concentration for previous samples at that location. That sample result was followed by other samples with results also above the prior normal. Although routine cycles of relatively higher uranium concentrations have historically been observed at GS10 in the late fall through the winter, when baseflow comprises a larger portion of the surface flow, the high results in early 2011 were outside the range of normally observed conditions prior to that time. After that time, from mid-2011 through mid-2013, sample results with greater than 30 µg/L of uranium were observed routinely at GS10. Since May 2013, sample results at GS10 that exceed 30 µg/L have been less frequent, though they have occurred, again in the late fall and winter, with sample results from the past three years that include 31.6 µg/L (11/20/2018), 31.3 µg/L (1/2/2020) and 33.5 µg/L (1/4/2021).

Walnut Creek Point of Compliance – Surface Water Uranium Concentrations

Since the WALPOC station was first installed and monitoring initiated in September 2011, all composite sample results for uranium were below the 16.8 µg/L Site-specific uranium standard until October 2013 (approximately one month after the large September 2013 storm event), when consecutive composite sample results at WALPOC were measured above 16.8 µg/L. Similar concentrations continued into May 2014. Starting in mid-May 2014, subsequent composite samples at WALPOC returned to lower concentrations, including three samples from mid-May 2014 that measured below 16 µg/L. Since that timeframe, individual composite samples at WALPOC have periodically had uranium above 16.8 µg/L, primarily during winter low flow conditions in 2016, 2017 and 2018, though no sample results above 16.8 µg/L have been recorded since early March 2018.

1.4.4 General Uranium Background Information

1.4.4.1 Occurrence of Natural Uranium in the Environment

Naturally occurring uranium is ubiquitous in the environment. It is a metal found in all rock types in varying small concentrations and its abundance varies by location as a function of local geologic formations that contain uranium. Uranium is widely dispersed in the earth's crusts, rocks and soils at concentrations of approximately 2 to 4 parts per million (ppm [equivalent to milligrams per kilogram, mg/kg]) (Abdel-Sabour, 2014; TRSL, 2001) and in seawater at approximately 2 to 3.7

parts per billion (ppb [approximately equivalent to micrograms per liter, µg/L]) (Kathren, 1984). For perspective, overall uranium surface concentrations (i.e., in surface crust, seawater, etc.) are more abundant than gold, silver, mercury, antimony, or cadmium, and approximately as abundant as tin, cobalt, lead, molybdenum, and arsenic (Abdel-Sabour, 2014; Todorov, 2006; UNSCEAR, 1993).

Awareness that natural uranium is a common constituent in geologic material, soils, and waters is of particular importance at RFS because the majority of uranium measured in surface water and groundwater at the Site is from natural sources. Natural uranium is composed of three isotopes in the following approximate percentages:

- U-234: 0.006%
- U-235: 0.72%
- U-238: 99.27%

Natural uranium is distinguished from anthropogenic uranium by measuring the isotopic composition, using analytical methods discussed in Section 3.5.

Mineral Sources of Natural Uranium in Colorado

Elevated concentrations of natural uranium are present in granite, metamorphic rocks, lignites, monazite sand and phosphate deposits, as well as in the uranium-rich minerals of uraninite, carnotite, and pitchblende (EPA, 2000). High concentrations of uranium in the South Platte River Basin are directly related to the local geology. The local bedrock, particularly the crystalline rocks (primarily granitic) in the mountains and marine shales and coal deposits in the plains, are naturally high in uranium. Sediments derived from crystalline rocks in the mountains are transported by the streams eastward onto the plains (Dennehy, et al., 1998) and "roll-front" type uranium deposits, similar to those in the Uravan belt in Montrose County, are found primarily in the northeast section of the state (Colorado Division of Reclamation, Mining and Safety [CDRMS], 2014).

Because of the relative natural abundance of uranium in Colorado, uranium has historically been mined throughout the state and Colorado ranks third for uranium reserves, behind Wyoming and New Mexico (CDMRS, 2014). Significant natural deposits of uranium are distributed across Colorado and include: Montrose County, where the Uravan mineral belt contains an estimated 1,200 historic mines; Larimer County, where the EPA lists at least 25 mines or mineable occurrences of uranium (Larimer County Environmental Advisory Board, 2008); and Jefferson County, where the largest vein-type uranium deposit in the United States exists at the Schwartzwalder mine, located approximately 5 miles southwest of RFS in the Ralston Creek drainage (Zielinski et al., 2007).

Natural Uranium in Groundwater and Surface Water

Globally, uranium in natural waters is typically present in concentrations between 0.1 and 10 µg/L. Concentrations greater than 1 µg/L generally occur in water associated with uranium ore deposits and much higher concentrations of natural uranium are possible (Weiner, 2013); a 90-meter deep well in Finland had a natural uranium concentration near 15,000 µg/L (Hem, 1992).

In the United States, the Colorado Plateau and Rocky Mountains are two of the primary areas with relatively higher concentrations of uranium in groundwater. In contrast, in the eastern United States, concentrations of uranium in groundwater are generally relatively lower (EPA, 2004).

A Colorado Geological Survey of 104 water wells studied natural uranium concentrations in groundwater in the Cheyenne Basin of Colorado (in Weld County, north of Greeley) and found water high in uranium in many of the major aquifers (Kirkham, et al., 1980). Review of the study results indicates 90 of the 104 wells sampled do not meet current EPA standards for uranium in drinking water (CGS, 2015).

With respect to surface water and sediments, geochemical sampling of 82 stream waters and 87 stream sediments within mountainous areas immediately west of Denver was conducted by the U.S. Geological Survey in October 1994 (Zielinski et al., 2007). The primary purpose was to evaluate regionally the effects of geology and past mining on the concentration and distribution of uranium. In surface water, concentrations ranged from less than 1 µg/L to 65 µg/L, with most values less than 5µg/L.

Natural Uranium in Colorado Public Drinking Water Systems

As a result of the widespread presence of natural uranium sources in Colorado, 33 public water systems participate in the *Colorado Radionuclides Abatement and Disposal Strategy* (CO-RADS) project. The purpose of CO-RADS is to provide technical assistance with the goal of resolving drinking water radionuclide violations in order to comply with one or more of the Colorado radionuclide drinking water MCLs[8] (CDPHE, 2009). Review of CO-RADS records indicates at least 10 of the systems have uranium measured in one or more source water wells at concentrations that have exceeded the 30 µg/L drinking water MCL, with concentrations ranging as high as 280 µg/L.

1.4.4.2 Occurrence of Anthropogenic Uranium in the Environment

General Description of Anthropogenic Uranium

Natural uranium can be modified to create anthropogenic forms by separating and collecting the three isotopes in natural uranium (U-234, U-235 and U-238) through the use of diffusion and centrifugal processes. Two types of anthropogenic uranium, "enriched" and "depleted," differ from natural uranium chiefly in their relative percentages of U-235, as summarized below:

[8] *Colorado has adopted the USEPA's radionuclide drinking water MCLs of:
Adjusted gross alpha activity: 15 pCi/L
Combined radium 226/228: 5 pCi/l
Uranium: 30 µg/L
Beta and photon particle activity: 4 mrems/yr
Note that uranium is the indirect source of most of the non-uranium radioactivity listed above as a result of daughter products in the decay chains of U-235 and U-238. A small amount of the non-uranium radioactivity is also from daughter products in the Th-232 decay chain.

- Enriched uranium has a higher fraction of U-235 (up to 97% U-235, compared with approximately 0.72% for natural uranium) and is used for nuclear reactor fuel and in weapons.

- Depleted uranium is a remnant of the enrichment process. Most U-235 has been removed from depleted uranium, leaving a higher U-238 fraction than the approximate 99.27% of U-238 in natural uranium. The reduced fraction of U-235 in depleted uranium causes it to be approximately 40 percent less radioactive per unit mass than natural uranium. Because of its high density, depleted uranium is used in applications such as armor plating on military vehicles, munitions, counterweights on aircraft control surfaces and as ballast for ships.

The chemical processes that control the environmental mobility of uranium (speciation, dissolution, precipitation[9], and sorption) are essentially identical for natural or anthropogenic uranium. In any environmental system, the particular forms of uranium present (e.g., dissolved, sorbed, or precipitated) will be the same under the same environmental conditions whether the uranium is composed entirely of natural isotopic composition, entirely anthropogenic composition, or any ratio between. The concentration of uranium present at a given location and time in surface water or groundwater is not related to the isotopic makeup of the uranium source(s).[10]

[9] With respect to chemical processes, "chemical precipitation" means the change of uranium species from soluble and dissolved (most mobile forms) to insoluble and solid (less mobile forms). It does not refer to atmospheric deposition of rain or snowfall.

[10] This is a "rule of thumb" that is applicable to nearly all chemical processes. However, variations have been measured in natural uranium for the mass ratios of U-238/U-235 (ratios of 137.792 to 137.961, respectively) and U-235/U-234 (ratios of 83.63 to 164.17, respectively), that can be attributed to relatively minor geochemical processes (e.g., alpha-recoil damage to the crystalline lattice of uranium-containing minerals that enables isotope-selective leaching) and very small changes in the kinetics of chemical and biological reactions due to mass differences of the isotopes that result in small-but-measurable mass fractionation. None of the natural mass fractionation processes significantly affect the observed mobility of the different uranium isotopes at RFS (Brennecke, 2011; Buerger, 2009).

Anthropogenic Uranium at RFS

The work conducted historically at RFS involved anthropogenic uranium, in either "enriched" or "depleted" forms, which was received from other facilities in the DOE complex. The work conducted at RFS did not involve uranium from natural sources. Because of the high concentration of uranium naturally present at RFS, environmental media at the Site (i.e., soil, surface water, groundwater, etc.), can have uranium from both natural and anthropogenic sources.

Determining whether uranium is from natural or anthropogenic sources, or a combination of both, can be accomplished by analyzing the composition of uranium isotopes in samples using specialized analytical techniques, as discussed in Section 3.5.

1.4.5 Uranium Regulations for Surface Water in Colorado

1.4.5.1 EPA and Colorado - Uranium MCL for Drinking Water

The EPA established drinking water standards for several radioactive contaminants as part of the Radionuclides Rule in order to protect public health. This involved the following major rulemakings:

- 1976 - The original Radionuclides Rule was promulgated to establish the current MCL for combined radium and gross alpha particle activity (uranium was unregulated then).[11]
- 2003 - The Revised Rule took effect in December 2003 and, among other changes, included creation of the 30 μg/L MCL value for uranium. (Note: The basis of the 30 μg/L MCL is discussed below in Section 1.4.5.2).

[11] MCL is defined by the Safe Drinking Water Act as "the maximum permissible level of a contaminant in water which is delivered to any user of a public water system."

The CDPHE Water Quality Control Division (WQCD) adopted the 30 µg/L MCL for uranium as part of the Colorado Primary Drinking Water Regulations (CPDWRs) (CDPHE, 2009).

1.4.5.2 Statewide Uranium Stream Standard

The statewide stream standard with respect to uranium in surface water is as follows:

- CDPHE Water Quality Control Commission, Regulation 31, Basic Standards and Methodologies for Surface Water (5 CCR 1002-31) (Regulation 31) (CDPHE, 2013).
  - Table III of Regulation 31 establishes a statewide Domestic Water Supply standard for uranium of 16.8 µg/L - 30 µg/L (30-day standard). The effective date for this hyphenated standard was January 1, 2011.
    - The 16.8 µg/L lower limit of the statewide stream standard for uranium is based on protection of human health from chemical toxicity. The 16.8 µg/L value is used in the absence of any toxicological data and is calculated using Equation 1-1 for non-carcinogens per WQCC Policy 96-2 (Human Health-Based Water Quality Criteria and Standards)[12]. Equation 1-1 (see footnote) is identical to the equation used by EPA for calculating Maximum Contaminant Level Goals (MCLGs) for chemical toxicity and is based on a daily drinking water consumption rate of 2 liters per day (CDPHE, 2012; EPA, 2011). Because the acceptable risk level for chemical toxicity is not based on an incremental lifetime risk factor, MCLGs are calculated by an equation that is not related to a lifetime dose (40 CFR Part 141).

[12] WQCC Policy 96-2, Equation 1-1: MCLG (µg/L) = (RfD x 70 x 1000 µg/mg x RSC)/(2 x UF), where: RfD (Reference Dose) = 0.0006 mg/kg-day; 70 = weight of avg. adult (kg); RSC(Relative Source Contribution factor) = 0.8; 2 = daily drinking water consumption (L/day); UF (Uncertainty Factor) = 1.0).

- The 30 µg/L upper limit of the statewide stream standard for uranium is the EPA drinking water MCL that was adopted by CDPHE. The MCL value has been determined to be an acceptable concentration in public drinking water supplies, taking treatability and laboratory detection limits into account. The 30 µg/L value is based on an additional lifetime cancer risk of 10^{-4}. This means the estimated lifetime risk of developing cancer, which is approximately 40.14 percent for the U.S. male population (American Cancer Society, 2020), would increase to 40.15 percent [4.014×10^{-1} plus 1×10^{-4}]) for a population consuming drinking water that contains 30 µg/L of uranium. The calculation is based on a consumption rate of two liters of water per day for 70 years (CDPHE, 2008). Similarly, the estimated lifetime risk of developing cancer in a U.S. female population would increase from approximately 38.70 percent to 38.71 percent for the same consumption rate of water containing 30 µg/L of uranium.

o Implementation of the 16.8 µg/L - 30 µg/L hyphenated standard is addressed in Table III of Regulation 31, which has the following note (Note 13) with respect to a standard with a range of values:

> *Whenever a range of standards is listed and referenced to this footnote, the first number in the range is a strictly health-based value, based on the Commission's established methodology for human health-based standards. The second number in the range is a maximum contaminant level, established under the federal Safe Drinking Water Act that has been determined to be an acceptable level of this chemical in public water supplies, taking treatability and laboratory detection limits into account. Control requirements, such as discharge permit effluent limitations, shall be established using the first number in the range as the ambient water quality target, provided that no effluent limitation shall require an "end-of-pipe" discharge level more*

> *restrictive than the second number in the range. Water bodies will be considered in attainment of this standard, and not included on the Section 303(d) List, so long as the existing ambient quality does not exceed the second number in the range*. (Note: emphasis added with underlined text).

- Table III has the following note (Note 17) with respect to uranium:

  > *"When applying the table value standards for uranium to individual segments, the Commission shall consider the need to maintain radioactive materials at the lowest practical level as required by Section 31.11(2) of the Basic Standards regulation."*

1.4.5.3 RFS Site-Specific Uranium Stream Standard

Within the South Platte River Basin, where RFS is located, the following regulations apply:

- CDPHE Water Quality Control Commission, Regulation 38, Classifications and Numeric Standards – South Platte River Basin, Laramie River Basin, Republican River Basin, Smoky Hill River Basin (5 CCR 1002-38) (Regulation 38) (CDPHE, 2013).
  - Regulation 38 establishes a Site-specific uranium standard of 16.8 µg/L for Segments 4a and 5 on Woman Creek and Segments 4a, 4b and 5 on Walnut Creek (see Appendix A, Figure A.2). As discussed under the "Statewide Stream Standard" text above, 16.8 µg/L is the lower end of the 16.8 µg/L – 30 µg/L range for the statewide stream standard for uranium in a drinking water supply.
- Rocky Flats Legacy Management Agreement (RFLMA) (DOE, 2007)
  - At RFS, compliance with the 16.8 µg/L stream standard in Walnut Creek is monitored, in accordance with RFLMA, at the Walnut Creek Point-of Compliance (WALPOC) monitoring location. Per RFLMA, at WALPOC, a 30-day average concentration of uranium that exceeds 16.8 µg/L defines a reportable condition; a

12-month rolling average concentration of uranium that exceeds 16.8 µg/L defines a reportable condition and triggers an evaluation of compliance with remedy performance standards.

Compliance with the 16.8 µg/L Site-specific uranium stream standard is also measured at the WOMPOC monitoring location on Woman Creek at the eastern COU boundary. However, as noted previously, this report is focused on Walnut Creek and, hence, results from WOMPOC are not evaluated.

2.0 CHEMICAL AND SITE-SPECIFIC FACTORS THAT GOVERN URANIUM CONCENTRATION AND TRANSPORT IN AQUEOUS ENVIRONMENTS

This section provides an overview of the primary factors that govern the concentration and transport of uranium in aqueous environments. Uranium concentrations and mobility depend on the relative proportions of uranium that are associated with dissolved and solid species; under a given range of stable geochemical conditions, dissolved species travel with surface and groundwater flow and are the most mobile, while solid species, precipitated and sorbed, are less mobile and move only when surface sediments and subsurface colloids are carried by water flow. In addition to water movement, chemical factors that influence the dissolved/solid equilibria (i.e., chemical speciation) of uranium also have important roles in determining the distribution and transport of uranium at any given site. The aqueous geochemistry is the same whether the uranium is from natural or anthropogenic sources.

The following two sections discuss the aqueous chemistry of uranium: Section 2.1 presents basic chemical principles that are generally applicable to all sites and Section 2.2 addresses chemical and environmental factors specific to RFS.

2.1 General Uranium Chemistry

2.1.1 Chemical Processes

Uranium concentration and mobility in aqueous environments, at RFS and elsewhere, are mainly governed by four chemical processes: precipitation, complexation, sorption, and colloid formation (Silva and Nitsche, 1995):

- <u>Precipitation/dissolution reactions</u> are influenced by uranium concentrations, redox potential, pH, complexation reactions, water chemistry and evapotranspiration. For example, the presence of nitrate can oxidize and mobilize precipitated uranium and the presence or absence of constituents such as phosphate, silica, fluoride or various metals can influence the mineralization of uranium, depending on the general water chemistry.

Evapotranspiration can, in some conditions, cause the precipitation of uranium minerals near the top of the water table which later may be mobilized via dissolution when the water table rises.

- Complexation reactions occur in aerobic groundwater and surface water between the highly soluble uranyl cation $U(VI)O_2^{2+}$ and several complexing cations and anions, mainly calcium, magnesium, carbonate, and hydroxide. These complexation reactions influence the amount of uranium that is available for other reactions (sorption and/or precipitation). The calcium/magnesium/carbonate complexes are the most important because they greatly increase the solubility of uranium minerals and decrease the extent of sorption to sediments, thereby acting to increase uranium mobility.
- Sorption/desorption reactions are site- and time-specific, depending on how the water quality is influenced by environmental conditions. Water quality parameters that are important for understanding these influences include pH, dissolved oxygen, redox potential, alkalinity, hardness, nitrate, temperature, uranium concentrations, and total dissolved solids. Sorption/desorption reactions mainly involve sorption of soluble U(VI) species to solid sediments, mainly Fe(III) oxyhydroxides and organic matter (e.g., wetland humus), potentially followed by desorption initiated by changes in redox potential, pH, and/or a decrease in water-phase uranium concentrations.
- Colloid formation – Colloids (very small [sub-micron sized] particles that can have sorbed or precipitated uranium) can both facilitate and impede the transport of highly insoluble compounds, facilitating transport in anoxic aquifers and surface waters and impeding transport when oxic conditions exist and the uranium can be readily soluble (Zaenker, et al., 2007).

Subsequent transport of uranium depends on site-specific environmental and climate conditions that determine surface and groundwater flow characteristics. The three chemical factors of redox potential, pH, and water quality (i.e., concentration and nature of dissolved species), discussed below, act in concert as the major determinants of which aqueous chemical species are formed with uranium and their chemical states (dissolved, solid, or sorbed).

2.1.2 Redox Potential

Although any existing system depends on the chemical factors described above, redox potential is often regarded as the first to consider when evaluating uranium behavior. Redox potential determines whether uranium species occur predominantly in the sparingly soluble reduced U(IV) state or the more highly soluble oxidized U(VI) state, as outlined below:

- At negative redox potentials (reducing conditions):
  - U(VI) is reduced to U(IV)
  - U(IV) forms relatively insoluble and less mobile uranium species such as solid uraninite (UO_2).
  - Sorption of U(VI) species to soil solids is enhanced.
- At positive redox potentials (oxidizing conditions):
  - U(IV) is oxidized to U(VI)
  - U(VI) forms more soluble and mobile uranium species such as uranyl ion, UO_2^{2+}, and its complexes.
  - U(VI) species strongly sorb to Fe(III) oxyhydroxides solids. Because of their common occurrence in soils and sediments, Fe(III) oxyhydroxides are generally the most important sorbents for U(VI). Organic matter such as peat and other humic-sorbing materials are second in importance. Sorption to suspended solids can increase U(VI) mobility, while sorption to soils or bed sediments that are not being transported by water can decrease U(VI) mobility.

- In calcium-carbonate-type waters, such as those which predominate at RFS, the most important complexes are the strong uranyl-carbonate and uranyl-calcium-carbonate complexes [UO_2CO_3, $UO_2(CO_3)_2^{2-}$, $UO_2(CO_3)_3^{4-}$, $CaUO_2(CO_3)_3^{2-}$, and $Ca_2UO_2(CO_3)_3^0$]; these complexes, especially the uranyl-calcium-carbonate complexes, can inhibit sorption of U(VI) to particles of soil and bed sediments, thereby increasing the uranium's mobility.

Effects of Dissolved Oxygen on Redox Potential

In surface water, the redox potential is chiefly determined by the chemical and biological oxygen demands. Oxygen-saturated water tends to have positive redox potentials and oxygen-depleted water tends to have negative redox potentials. Thus, highly oxygenated surface waters such as shallow streams and turbulent waters that rapidly equilibrate with atmospheric oxygen, and which contain only small amounts of oxygen-demand from carbonaceous matter, tend to contain mobile U(VI) species. Oxygen-depleted surface waters that are slow moving or deeper with higher oxygen-demand (e.g., wetlands) tend to contain less-mobile U(IV) species (Owen, 1992).

In the subsurface, where oxygen equilibration with the atmosphere is greatly retarded, the oxygen content of groundwater depends on how rapidly groundwater is recharged by oxygenated surface water, compared to how rapidly bacteria, feeding on subsurface organic matter, can deplete oxygen levels. Hem (1985) notes uranium concentrations greater than 1000 μg/L occurring in natural water associated with uranium ore deposits and describes a 90-meter deep well in Helsinki, Finland where a uranium concentration near 15,000 μg/L (also natural) was measured.

Redox Reversibility

While the expectation that highly oxygenated waters will have positive redox potentials and support mainly soluble and mobile U(VI) species is generally reliable, the converse expectation, that oxygen-depleted waters will contain mostly low solubility U(IV) species, cannot always be assumed. Because redox reactions are reversible, U(VI) species that have been reduced to low solubility U(IV) species can be re-oxidized back again to soluble U(VI) species. In water, sediments, and soils with negative redox potentials, oxidants other than oxygen such as nitrate, can restore and maintain significant levels of soluble U(VI) species.

Several studies have shown that the rate of oxidation of U(IV) to U(VI) by nitrate in oxygen-depleted waters can be enhanced greatly when mediated by the commonly occurring bacterium *Thiobacillus denitrificans* (Beller, 2005; Pokharel, 2013). The microbially-mediated oxidation by nitrate can be so effective at mobilizing uranium that it has been known to hinder efforts to immobilize uranium at sites undergoing remediation, such as in cases where a treatment system or constructed wetland is created in an attempt at reductive immobilization of U(IV) species (Wei-Min Wu, et al., 2010).

The importance of redox reversibility can be illustrated by the following feasible example:

> *Oxygenated stream water carrying dissolved U(VI) species enters a wetland zone where oxygen is depleted and the redox potential is negative, facilitating the reduction of U(VI) to U(IV) and immobilizing much of the uranium in the wetland as precipitated and sorbed U(IV) species. Then, a new oxidant such as nitrate is introduced to the wetland, which re-oxidizes U(IV) back to mobile U(VI), changing the wetland from a uranium sink to a uranium source, a condition that will continue until the nitrate (and any other non-oxygen oxidant) is depleted.*

2.1.3 pH and Water Quality

In addition to the redox potential, the behavior of uranium depends on pH and other water quality properties such as dissolved oxygen, the presence of other oxidizing agents such as nitrate, and complexing agents.

Solubility, sorption, complexation and colloid formation are all sensitive to the water pH. In general, uranium solubility (in pure water where only hydroxyl complexation can occur) decreases rapidly as pH increases from around pH 2 (U_{aq} = ~2.5 g/L) to pH 4 (U_{aq} = ~10^{-6} g/L), remaining fairly constant to pH 8 and then increasing in solubility again to pH 10 (U_{aq} = ~10^{-4} g/L). However, in calcium carbonate waters, where strong and highly soluble U(VI) carbonate complexes species become dominant, higher solubilities (~10^{-4} g/L) occur at a pH value as low as 5 and remain high beyond pH 10 (depending on carbonate concentration) (Langmuir, 1997).

The carbonate complexes are also important because, in addition to facilitating U(IV) oxidation to U(VI) and greatly increasing the solubility of uranium minerals, they limit the extent of uranium sorption to sediments in oxidized waters, further increasing uranium mobility (Langmuir, 1997).

2.1.4 Theoretical Principles: Natural Versus Anthropogenic Uranium

The chemical properties of natural and anthropogenic uranium with respect to speciation, dissolution, precipitation, and sorption are essentially identical (Weiner, 2013). In any environmental system, the particular forms of uranium present (e.g., dissolved, sorbed, or precipitated) will be the same under the same environmental conditions whether the isotopic makeup of the uranium is 100 percent natural, 100 percent anthropogenic, or any ratio between. The concentration of total dissolved uranium that is present at a given location and time in a stream is not correlated to the isotopic makeup of the uranium sources.

However, the proportion of natural versus anthropogenic uranium in a water sample from a stream depends on the proportions of natural and anthropogenic uranium in the different contributing sources and the relative contributions of these sources to the sample collected. This principal applies whether the system is in theoretical equilibrium or, as for any real environment such as RFS, in dynamic disequilibrium.

Determining whether uranium at a particular location is from natural or anthropogenic sources can be accomplished by analyzing the composition of the uranium isotopes in the sample, as discussed in Section 3.5.

2.2 Conditions Specific to RFS

Many factors, in addition to the relative proportions of surface runoff and groundwater to stream channel flow noted in Question 1, influence the concentrations and transport of uranium in surface water at RFS. Numerous site-specific environmental conditions and chemical properties of water and sediments affect uranium chemistry and influence uranium distribution and transport. These environmental conditions and chemical properties must be considered singly and in total when addressing the question of which chemical and physical mechanisms have an observable effect on uranium concentrations in surface water at RFS.

Important site-specific factors at RFS that control uranium concentrations and transport can be generally grouped into three categories,

1. Uranium sources (mass, form, and location of natural and anthropogenic);
2. Environmental conditions (e.g., rainfall events, surface flow, groundwater elevation and flow, residence time in ponds, wetland area effects, streambed sediment composition, and bacterial populations [i.e., sulfate- and nitrate-reducing bacteria]);
3. Chemical properties of surface water, groundwater, soils, and stream-bed sediments. (e.g., measured values of chemical and mineral composition, pH, dissolved oxygen and redox potential, etc.) Most site-specific chemical properties at RFS are discussed in detail in the RFS Data Analysis section (Section 3.0).

These topics are discussed below:

<u>Uranium sources</u>

The uranium sources of interest at RFS are those that contribute uranium, in dissolved or particulate form, from the source area(s) to WALPOC. These sources include:

1. Ambient natural uranium from surface minerals and stream channel sediments which is transported as a dissolved species or suspended sediments (as precipitated and sorbed uranium) and transported in surface waters that ultimately flow through WALPOC.
2. Anthropogenic uranium in stream channel sediments which is transported as dissolved species or suspended sediments by surface waters that ultimately flow through WALPOC.
3. Natural or anthropogenic uranium in subsurface sources which is mobilized by groundwater and transported as a dissolved species before emerging at the surface and flowing to WALPOC in a drainage channel. (Note: as discussed previously, natural uranium is ubiquitous in the environment.)

<u>Environmental Conditions</u>

The availability and influence of the different uranium sources depends strongly on environmental conditions, which can vary seasonally (and with randomly unique events) and be influenced by physical features of a site, both natural and engineered (e.g., channels, wetland zones, dams, groundwater treatment systems, etc.). These varying environmental conditions affect the transport of uranium at any site. Important site-specific environmental conditions at RFS include the following:

- Precipitation rates and volumes (for both rainfall and snowmelt), which influence the flows and volumes of groundwater and surface waters, which in turn affect the movement of contaminants from sources into streams, as well as the chemistry of waters on the surface and in the subsurface.
- The fraction of groundwater flow as a contribution to streamflow in North and South Walnut Creeks is generally seasonally dependent. Groundwater typically provides an increased relative contribution in the autumn and winter (with the exception of snowmelt events), and stormwater runoff provides an increased relative contribution in the spring and summer. Groundwater normally contains higher concentrations of uranium than surface water.

- Changes in groundwater elevation, which may bring groundwater into contact with varying quantities of uranium-containing material in the subsurface. Elevated groundwater levels also increase the rate of seepage to surface water.
- Movement of sediments carrying precipitated and sorbed uranium to downstream stream segments depends on flow rates and stream channel characteristics.
- Environmental conditions which influence the chemical properties of surface water and groundwater, including:
    - The volume of and rate of precipitation, which can influence chemical conditions of waters. For example, the prolonged, heavy rainfall event that occurred at RFS in September 2013, from which the recharge rate appears to have resulted in a prolonged condition of highly oxygenated groundwater over the entire site (the effects of this storm are discussed in the Data Analysis section [Section 3.0]).
    - The flow rates of surface water in the drainage channels have a direct bearing on the amount of soil and sediment disturbance at the Site. For example, the large flow events in 2013 resulted in substantial disturbance to the channel sediments. This caused transport of uranium sorbed to soil particles that were moved by the erosion as well as exposure of sediments to highly oxygenated runoff and/or the atmosphere, which may have resulted in the elevated uranium concentrations observed in surface water at RFS following the 2013 flood.
    - Physical features such as wetlands, mineral and organic soil content, subsurface microbial activity, etc. (Owen, 1992).

<u>Chemical properties of surface water and groundwater at RFS</u>

In waters saturated with oxygen and at positive redox potentials, oxygen is always the strongest and most important oxidant. However, in waters with relatively low concentrations of dissolved oxygen and negative redox potentials, nitrate may become an important oxidizing agent. Under these conditions, nitrate can oxidize slightly soluble U(IV) species to highly soluble U(VI) species, thereby increasing their mobility.

In some areas at RFS, one of the most important chemical characteristics of the surface water and groundwater, in terms of uranium mobility, is the presence of nitrate. While the measured concentrations of nitrate at RFS are relatively low in South Walnut Creek, conditions are different in North Walnut Creek where nitrate concentrations were historically substantially higher, with measurements as high as 140 mg/L at monitoring location GS13 (see Figure 1) as recently as December 2012 and 120 mg/L in October 2015. However, it is noted that after the SPPTS was reconfigured in 2016, the average concentration of samples collected from November 2016 until June 2021 at SPOUT was less than 2 mg/L, compared to an average of approximately 11 mg/L at GS13 for the same time period. For perspective, the RFLMA standard for nitrate is 10 mg/L.

The elevated historical nitrate concentrations in North Walnut Creek are attributed to sources in the area of the former Solar Evaporation Ponds which impact North Walnut Creek water quality upstream from GS13. The presence of high levels of nitrate in oxygen-depleted groundwater and surface waters at RFS can facilitate the microbially-mediated oxidation of immobilized U(IV) species to highly mobile U(VI) dissolved species.

3.0 RFS DATA ANALYSIS

3.1 Meteorological Conditions

Water quality data collected during periods of both routine and extreme meteorological conditions are desirable to account for the variable effects that precipitation can have on water quality in the system being evaluated. There are 9 precipitation gages at the Site.[13] The types of meteorological

[13] The RFS rain gages are not heated, which means the precipitation depth occurring as snowfall is not measured with the same accuracy as precipitation depth occurring as rainfall. Snowfall can provide a substantial fraction of the overall water balance at RFS, in terms of precipitation depth, infiltration and runoff.

conditions represented in the water quality data evaluated for this report include the following:

- "Normal" Conditions – The average annual precipitation depth recorded at RFS from 1993 to 2020 has been 12.04 inches per year (based on calendar year records). The rainfall depths in 2010 (11.64 inches), 2011 (13.12 inches), 2014 (12.27 inches), 2017 (12.67 inches), and 2019 (11.99 inches) are all representative of "normal" precipitation conditions. Data from these years were used in the analyses for this study.

- "Wet" Conditions – Above average precipitation conditions are represented in this study by the September 2013 storm event as well as the extended above average precipitation that occurred over the course of 2015.

  The September 2013 storm event, which delivered approximately 6.7 inches of rainfall over approximately 7 days, had a prolonged "lag" effect on not only the flow rates measured in the stream channels, but also on the environmental chemistry of the Site, which directly affected uranium concentrations in surface water, as described in previous sections of the report. The 7.52 inches of rainfall recorded in September 2013 was the wettest single month on record. It is noted that the September 2013 storm event resulted in large flows of surface water flowing on to RFS from off-Site areas that received significantly heavier precipitation. This influx of runoff resulted in substantial erosion and physical disturbance of the sediments in both North and South Walnut Creeks. To visualize the effect of the September 2013 rainfall on water volumes measured at stream gages across the Site, see Figure F.5.b [in Appendix F, for North Walnut Creek] and Figure G.5.b [in Appendix G, for South Walnut Creek]).

  In terms of annual rainfall, 2015 was the wettest year on record at the Site (18.26 inches) for the period from 1993 to 2020, followed by 1995 (16.49 inches), 2004 (16.91 inches) and 2013 (15.62 inches). Data from both 2013 and 2015 are represented in this study, as are data from the first half of 2021, which measured 9.52 inches through June, the third highest on record for the first six months of the year. 2021 is also an above-average precipitation year, with 13.27 inches measured through September.

Based on these data, it can be reasonably stated that data for an extreme precipitation event and a wet year have been collected and utilized in this analysis.

- “Dry” Conditions – The recorded precipitation depth during 2012 was 7.21 inches, which is the driest year recorded by Site rain gages since 1993. The 7.38 inches of precipitation recorded in 2020 was the second driest year recorded, respectively. (See Appendix F and Appendix G for runoff volumes measured during different years at surface water gages in North Walnut Creek and South Walnut Creek, respectively). It is noted that precipitation depth is not the only factor that determines runoff volume, as antecedent moisture is another important variable. For example, 2016 (with 7.68 inches of precipitation, the third driest year recorded) followed a wet year in 2015, and the resulting runoff volumes measured at gaging stations in 2016 exceeded those measured in 2018 (with 9.87 inches of precipitation).

  The 0.00 inches of monthly precipitation recorded in March 2012 has been equaled only twice, in December 2002 and January 2020, in terms of dry conditions during the period of record from 1993 to 2017 (recognizing that the RFS gages do not record snowfall). While more extreme drought conditions can, and likely will, occur at the Site in the future, the 2012 and 2020 data used in this study are representative of water quality and flow rates at the Site during “dry” conditions.

3.2 Data Collection Methods

Water data presented and discussed in this report were collected by RFS personnel. Different types of sample collection methods are used at different locations and for different analytes. A general summary of the sample locations and respective data collection methods for data presented and discussed in this report is presented in Table 2 and Table 3 (Refer to Appendix A, Figure A.1 for sample locations).

Table 2. Surface water locations and sample collection methods

Drainage	Sample Location Listed upstream to downstream	Uranium Sample Method		NO3 + NO2 (All Grab Samples)	Other Parameters
		Flow-Paced	Grab		
North Walnut Ck.	GEOFC3INF	No	No	No	Yes[1]
	GEOFC3EFF	No	No	No	Yes[1]
	SW093	Yes	Yes	Yes	Yes[1]
	GEOA1INF	No	No	No	Yes[1]
	GS13	Yes	Yes	Yes	Yes[2]
	GEOA1	No	No	No	Yes[1]
	A1EFF	No	Yes	Yes	Yes[2]
	A2EFF	No	Yes	Yes	Yes[2]
	GEOA3INF	No	No	No	Yes[1]
	GS12 or A3EFF	Yes	Yes	Yes	Yes[2]
	GS11 (Pond A4 Outfall)	Yes	Yes	Yes	Yes[2]
South Walnut Ck.	SEEP995A		No		Yes[2]
	FC4EFF		No		Yes[2]
	GS10	Yes	Yes	No	Yes[2]
	GEOB1INF	No	No	No	Yes[1]
	B3OUTFLOW	No	Yes	No	Yes[2]
	GEOB4	No	No	No	Yes[1]
	B5INFLOW	Yes	Yes	No	Yes[2]
	GEOB5INF	No	No	No	Yes[1]
	GS08 (Pond B-5 Outfall)	Yes	Yes	No[3]	Yes[2]
Walnut Creek	WALPOC	Yes	No	Yes	Yes[2]

Notes:
1) Other parameters include: pH, dissolved oxygen, temperature, SO_4, Fe, H_2S, NO_3 and NO_2.
2) Other parameters include isotopic analyses conducted at Los Alamos and Lawrence Berkeley National Laboratories.
3) Nitrate samples not collected currently. Historical samples collected 2007, 2009 – 2011.

Table 3. Solar Ponds Plume Treatment System data locations and data collection methods

Drainage	Sample Location	Uranium Sample Method		NO3 + NO2 (All Grab Samples)	Other Parameters
		Flow-Paced	Grab		
North Walnut Creek	SPIN	No	Yes	Yes	Yes[1]
	SPOUT	No	Yes	Yes	Yes[1]

Notes:
1) Other parameters include isotopic analyses conducted at Los Alamos National Laboratory (up to and including a portion of 2011) and at Lawrence Berkeley National Laboratory (some 2011 samples and thereafter).

3.2.1 Uranium Data

Two types of sample collection methods are used for surface water uranium data discussed in this report:

1. Continuous flow-paced composite samples - Automated sampling units continuously collect individual grab samples at a frequency proportional to the flow rate measured at the monitoring location. The individual samples are combined into a composite sample that is representative of the water quality over the entire sample collection period, which is variable and typically ranges from a few days to several months, varying in large part due to the amount of flow occurring in the drainage. The uranium concentration and stream flow volume data can be combined to calculate the uranium load at a given location for a specific time period.

2. Grab samples – Grab samples for uranium are collected by manually filling a sample bottle at a specific, documented time. In many cases, grab samples are routine biweekly samples and in other cases they may not be collected routinely.

Note: Analyses of the isotopic composition of uranium samples, discussed in Section 3.5, are conducted using splits from selected samples collected by both continuous flow-paced and grab sample methodologies. The routine uranium analysis is for total (not isotopic) uranium.

3.2.2 Nitrate Data

Nitrate sample results, as discussed in this report, refer to results for nitrate + nitrite as nitrogen (NO_3 + NO_2 as N). Due to sample hold-time and preservation requirements, these samples are all collected using a grab sample methodology; none are collected using a flow-paced composite approach. Consequently, nitrate grab samples often do not reflect the dilution effects of periods with high storm runoff, and the potential for nitrate concentration results to be biased high is typically greater than for samples collected using a continuous flow-paced method. Sampling personnel are not always able to be on-site to collect a grab sample when flow rates are high, in contrast to automated sampling equipment that can capture samples during runoff events at any time of the day or night. Calculated average concentrations and loads of nitrate based on grab samples may also be biased high. As a result, any comparisons of the characteristics of uranium data and nitrate data must take sampling methodology into consideration.

3.2.3 Other Parameters

Other water quality parameters, in addition to uranium and nitrate, have also been measured at some locations and are evaluated in this report. These other parameters include: pH, dissolved oxygen, temperature, SO4, Fe, H2S, NO3 and NO2. All are collected via either in-situ measurement or by grab sample.

3.3 Spatial and Temporal Variability

Analysis of the spatial and temporal variability of RFS surface water data in North and South Walnut Creeks are presented for uranium (Section 3.3.1) and nitrate (Section 3.3.2).

3.3.1 Uranium Concentrations and Loads

Surface water uranium data, including calculated mass balance values, were evaluated to assess their spatial variability in order to identify potential sources and/or sinks of uranium in the North and South Walnut Creek drainages. In addition, temporal variability was evaluated to assess whether seasonal or other temporal trends could be identified. Surface water monitoring data were plotted to compare uranium concentrations and uranium loads at monitoring locations in both drainages. Data plots were developed for all monitoring locations to facilitate comparisons between locations for the following types of data:

- Uranium concentrations (monthly volume-weighted average and maximum values [µg/L])
- Water volume flow (liters per month)
- Uranium loads (monthly total values [µg/month])

Data from January 1997 through June 2021 are included on each of the plots (see Appendix B, Figures B.1 through B.7 for North Walnut Creek and Appendix C, Figures C.1 through C.3 for South Walnut Creek), except for locations where data are not available back to 1997 (for example, WALPOC was installed as a monitoring location in 2011). The uranium concentration plots also include the following uranium water quality standards for reference:

- The site-specific uranium standard that applied through March 2009 (10 pCi/L [equivalent to approximately 14.9 µg/L]).
- The site-specific uranium standard that has applied from April 2009 to the present (16.8 µg/L]), which is monitored for regulatory compliance at WALPOC, based on 30-day and 12-month rolling average uranium concentrations.
- The uranium MCL for drinking water (30 µg/L).

3.3.1.1 North Walnut Creek

For North Walnut Creek, data plots of surface water uranium concentration, uranium loads and water volume are presented in Appendices B and F for locations SW093, SPIN (Solar Ponds Plume Treatment System [SPPTS] influent monitoring location), SPOUT (SPPTS effluent monitoring location), GS13, GS12 (or A3EFF), GS11 (Pond A-4 outfall), and WALPOC. A summary of the different data plots developed for this analysis is provided in Table 4.

Table 4. Description of data plots and tables – Uranium in North Walnut Creek (Appendices B and F)

Data plot description	Figure(s) and Table(s) in Appendices B and F
SW093, SPIN, SPOUT, GS13, GS12 (or A3EFF), GS11 and WALPOC – Monthly average and maximum uranium concentrations, water volume, and loads	Figures B.1 – B.7 (Note: All figures use common scales for comparison purposes, with the exception of special plots, as noted, where the scale was expanded to accommodate data outside the common scale)
Annual uranium loads in North Walnut Creek, by location (2010 – 2020)	Figure B.8
Monthly uranium loads in North Walnut Creek, by location (2010 – 2021)	Figures B.9 – B.20
Solar Ponds Plume Treatment System performance, by month (2010 – June 2021)	Figure B.21
Average uranium concentrations, by location, North Walnut Creek (1/27/2010 – 3/1/2021) (period with available data for all locations)	Figure B.22
WALPOC uranium concentrations, September 2011 – June 2021	Figure B.
Uranium loads in North Walnut Creek	Table B.1
Water volumes at North Walnut Creek monitoring locations (annual totals for 2010 - 2017 and monthly totals for 2010 – June 2021), for comparison purposes with uranium load and concentration plots.	Figures F.1 – F.13 and Table F.1

Review of the uranium concentration and loading data plots listed in Table 4 leads to the following observations regarding North Walnut Creek and WALPOC:

Uranium Concentrations in North Walnut Creek and at WALPOC

Average uranium concentrations at monitoring locations along North Walnut Creek (for the period from 1/27/2010 to 3/1/2021) are summarized on Figure B.22. (Note: The average uranium concentrations shown on Figure B.22 provide a general reference for the spatial variability of uranium concentrations along North Walnut Creek, but do not distinguish between different specific site conditions, such as different operating protocols for Pond A-4 or conditions following the September 2013 flood event, which are discussed later in this report.)

Along North Walnut Creek, uranium concentrations measured at individual monitoring locations are highly variable spatially from upstream monitoring station SW093 (Figure B.1) down to station GS11 at the Pond A-4 outfall (Figure B.6), indicating the presence of uranium source(s) and sink(s) as average uranium concentrations increase and then decrease going downstream along this channel reach. (Note: the uranium concentrations on Figures B.1 through B.7 are plotted on common scales to facilitate comparisons between locations.)

In terms of temporal variability, observed uranium concentrations indicate seasonal patterns that are not as distinct in North Walnut Creek (and at WALPOC) as in South Walnut Creek (particularly at GS10; see Figure C.1). Specific observations include the following:

- At SW093, uranium concentrations are generally well below 16.8 µg/L (except for one sample, flow-composited, collected from November 2009 to January 2010) (Figure B.1). In contrast, farther downstream, station GS13 samples were routinely above 16.8 µg/L until January 2018, when the last result above 16.8 µg/L was recorded (Figure B.4).

- At GS13, uranium concentrations are generally higher than at upstream location SW093 and intermittently were above 16.8 µg/L until January 2018 (as noted above), with a limited number of composite sample results over 50 µg/L. In addition, uranium concentrations at GS13 vary significantly over time, though a clear seasonal pattern or a relationship to concentrations measured at SPOUT (Figure B.2.a) are not apparent, recognizing that the uranium load and, therefore, the effect from SPOUT is relatively minor because of the low uranium load associated with SPOUT compared to the uranium load measured at GS13. Regarding discharges from SPOUT, it is noted that work on development of improved long-term uranium treatment methods for the SPPTS is planned by LM for the near future. The focus on the SPPTS has been to identify better treatment approaches that are effective as well as sustainable (see footnote 12 in Section 3.3.2.1).

- At GS11 (Pond A-4 outfall), uranium concentrations in individual flow-paced composite samples from March 1, 2007 through December 18, 2011 had a volume-weighted average of 7.7 µg/L and a maximum individual sample result of 13.5 µg/L (see Figure B.6)[14]. Beginning in 2012, corresponding with the change from batch release to flow-through operations protocol in the ponds that occurred roughly three months prior, uranium concentrations increased from historical values, with an average concentration of 17.6 µg/L from 2012 through May 2014 and a maximum result of 29 µg/L. After May 2014, uranium concentrations at GS11 decreased, with an average concentration of 12.29 µg/L from June 2014 through June 2021; however, the concentrations remained higher than the historical values that occurred during the batch release operational mode that ended in September 2011.
    - During the time period when uranium concentrations were increasing in Pond A-4 discharges (from 2012 to May 2014), the uranium concentrations at locations upstream from Pond A-4, such as SW093 and GS13, were at or below their normal range observed after Site closure in 2005 (see Figure B.1 [SW093] and Figure B.4 [GS13]), further suggesting that the increased uranium concentrations in A-4 discharges starting in 2012 and continuing since then are not attributed to a new upstream uranium source, but instead are related to changing the pond operating protocol from batch mode to flow-through mode. The increased residence time of water during batch mode operations in the terminal pond may have allowed increased chemical precipitation of low solubility uranium species and increased sorption of uranium to pond sediments in deeper pond water containing low dissolved oxygen.

[14] A volume-weighted average concentration of an analyte, based on results from flow-paced composite samples, is the preferred method for determining the concentration of an analyte in surface water samples over a given time period. The volume-weighted average is preferable because an arithmetic average does not account for the volume of water associated with each individual sample.

- At WALPOC, measured uranium concentrations were below the 16.8 µg/L standard until the September 2013 flood event, after which multiple samples were measured above the standard (see Figure B.20). Not until May 2014, approximately eight months after the September 2013 flood event, did sample results return to concentrations below the 16.8 µg/L standard. Subsequent individual sample results at WALPOC have exceeded the 16.8 µg/L standard; these samples were collected primarily during winter low flow conditions in 2016, 2017 and 2018. The standard has not been exceeded at WALPOC since March 2018.

<u>Uranium Loads in North Walnut Creek and at WALPOC</u>

The channel reach between monitoring locations SW093 and GS13 has a measurable gain in uranium load (see Figure 1 and Figure B.8)

- The annual uranium load measured at GS13 is greater than the uranium load measured at upstream monitoring locations SW093 and SPOUT combined, based on total loads measured at those locations from 2010 through June 2020 (Figure B.8). However, there are months where the uranium load solely from SW093 exceeds that at GS13 (Figures B.9 through B.19).
- The increased uranium load observed at GS13 cannot be attributed solely to a gain in water volume between stations SW093 and GS13. Although the stream frequently has a slight gain in water volume in that reach (see Figures B.1 through B.7), the increased water volume at GS13 is proportionately substantially less than the increased uranium load in the same reach, indicating: 1) the inflow of water between SW093 and GS13 has a higher uranium concentration than the water flowing in North Walnut Creek (e.g., subsurface flows that are not collected by the SPPTS) and/or 2) there is a uranium source between SW093 and GS13 that is mobilized and transported to GS13 (for example, channel sediments or wetland area(s), or both, with elevated concentrations of uranium that increase the uranium concentration in surface water), and/or 3) groundwater and/or periodic surface runoff enters North Walnut Creek from the north

side of the channel, presumably with a higher relative uranium concentration. (Note: Extensive historical characterization did not identify anthropogenic sources of uranium on the north side of North Walnut Creek; however, natural uranium from groundwater or surface runoff could potentially cause this increased uranium load).

- The increased load observed at GS13 is temporally consistent:
  - When uranium load data are evaluated on an annual basis, the increased load at GS13, compared to SW093, has occurred every year from 2010 through 2020, with the exception of 2016, a dry year. However, the relative proportion at GS13 has declined since 2017, as have the total uranium loads (see Figure B.8); this corresponds in part with reduced runoff volumes those years (see Figure F.1).
  - When uranium load data are evaluated on a more frequent time step (i.e., monthly total loads) the increased load at GS13 still occurs most months from 2010 through mid-2020, with exceptions (i.e., SW093 uranium loads exceeding those at GS13) occurring during late summer and early fall when stream flows at SW093 continue whereas the flows downstream are substantially reduced, or non-existent, at GS13 and the corresponding uranium loads at GS13 are reduced accordingly (see Figures B.9 to B.17).
- Effluent from the SPPTS monitored at SPOUT (located between SW093 and GS13) (see Figure 1) contributes only a minor fraction of the increased uranium load observed at GS13.
  - The SPOUT effluent, which is located "off-line" from the main North Walnut Creek channel and discharges to the subsurface via the SPPTS Discharge Gallery, comprised approximately 5 percent of the uranium load measured at GS13 before the SPPTS was taken off-line to improve the nitrate removal (based on total loads measured at both locations from January 2010 through April 2016). After the SPPTS modifications to improve nitrate treatment,

SPOUT has had a uranium removal efficiency of approximately 30 percent, and comprised approximately 14 percent of the uranium load measured at GS13 from November 2016 through June 2021. This relatively low uranium load contribution from the SPOUT effluent occurs because of the low relative water volume discharged by SPOUT (SPOUT discharges account for approximately 1 to 2 percent of the volume measured at GS13), resulting in the small relative uranium load from SPOUT (Figure B.2) compared with GS13 (Figure B.4).

- The small relative contribution of uranium load provided by SPOUT compared to GS13 occurs for the entire period analyzed from 2010 through June 2021 (see Figures B.9 through B.20).

The pattern of uranium loads changed along the channel reach between monitoring location GS13 (at the location of the inflow to the former Pond A-1) and GS12 (at the location of the effluent from the former Pond A-3). From 2010 through 2013, GS13 had the highest total annual uranium loads (Figure B.8). However, since 2014, location GS12 has had the highest total annual uranium loads in North Walnut Creek.

Explanations for the shift include the following: First, Pond A-3 was breached in 2012, which has resulted in an increase in the relative volume of water discharged at the outfall from the breached Pond A-3 (station GS12) because less water is now lost from infiltration and evaporation which historically occurred at Pond A3; the gain in water volume observed at GS12 translates to a relative gain in uranium load. In addition, settling of suspended sediment provided by Pond A-3 no longer occurs, thereby increasing the mobility of the sediments and their potential to transport uranium. Second, the 2013 storm event mobilized sediments and deposited them where the interior ponds were formerly located upstream of GS12. These sediments are intermittently exposed to the atmosphere and oxidized when North Walnut Creek dries up, which enhances the mobility of uranium ultimately measured at GS12.

3.3.1.2 South Walnut Creek

Data plots of surface water uranium concentration, water volume and load for South Walnut Creek monitoring locations are compiled in Appendix C (includes plots for locations GS10, B5INFLOW, GS08). A summary of the different data plots developed for the South Walnut Creek data analysis is provided in Table 5.

Table 5. Description of data plots – Uranium in South Walnut Creek (Appendices C and G)

Data plot description	Figure(s) in Appendices C and G
GS10, B5INFLOW, GS08 - Monthly average and maximum uranium concentrations, water volume, and loads, by location	Figures C.1 – C.3
Summary of annual uranium loads in South Walnut Creek, by location (2010 – 2020)	Figure C.4
Monthly uranium loads in South Walnut Creek, by location (2010 – 2020) (includes expanded scale plot for 2013 and 2015 loads)	Figures C.5 – C.15
Average uranium concentrations, by location, South Walnut Creek (1/27/2010 – 9/15/21)	Figure C.17
Uranium loads in South Walnut Creek	Table C.1
Water volumes at South Walnut Creek monitoring locations (annual totals for 2010 - 2017 and monthly totals for 2010 – June 2021), for comparison purposes with uranium load and concentration plots.	Figures G.1 – G.13 and Table G.1

Review of the uranium concentration and loading data plots listed in Table 5 leads to the following observations regarding South Walnut Creek:

<u>Uranium Concentrations in South Walnut Creek</u>

Average uranium concentrations at monitoring locations along South Walnut Creek (for the period 1/27/2010 to 9/15/2021) are summarized on Figure C.17. (Note: The measured uranium concentrations shown on Figure C.17 provide a general reference for the variability of uranium concentrations along South Walnut Creek, but do not distinguish between different specific Site conditions, such as different operating protocols for Pond B-5 or changes in Site geochemical conditions following the September 2013 flood event, which are discussed later in this report.)

Along South Walnut Creek, uranium concentrations measured at individual monitoring locations generally decrease from upstream monitoring station GS10 down to station GS08 at the Pond B-5 outfall, with the exception of B3OUTFLOW concentrations exceeding GS10 (see Figure C.17) and B5INFLOW uranium concentrations slightly exceeding GS10 concentrations during the past five years. These data indicate a net removal of uranium along this channel reach and the formation of uranium “sinks” (Figures C.1 through C.3 and C.17). (Note: the uranium concentrations on Figures C.1 through C.3 are plotted on common scales to facilitate comparisons between locations.)

Observations at specific locations along South Walnut Creek, including temporal variability and seasonal patterns, include the following:

- At GS10, uranium concentrations vary widely temporally, and in a cyclical, seasonal pattern, with the highest concentrations typically observed during the first two to three months each calendar year (see Figure C.1). This supports the understanding that a larger fraction of the flow at GS10 during those months is attributed to groundwater and, as a result, elevated concentrations of uranium will be observed in surface flows. However, other potential sources of uranium (e.g., mobilization of sediments upstream of GS10, or contributions of uranium from specific seeps upstream of GS10) are also possible.

- At GS08 (Pond B-5 outfall), uranium concentrations (monthly flow-weighted averages) increased measurably for the period after 2012 compared to the monitoring results from 2012 dating back to Site closure in 2005 (Figure C3). The change corresponds with the transition in pond operations at B-5 from batch release to flow-through mode.

- During the period after 2012, when uranium concentrations increased in Pond B-5 discharges compared to the period before 2012, the uranium concentrations at monitoring locations upstream from Pond B-5 were variable:

  - At GS10, since 2011, when the highest concentrations of uranium were measured (approximately 89 µg/L), the highest concentration of uranium measured during each annual cycle continually decreased until 2015. From 2015 until late 2017, the maximum uranium concentrations remained relatively constant, after which there has been a minor but quantifiable increase in maximum uranium concentrations observed at GS10. The highest individual sample results for uranium measured at GS10 in recent years are 31.60 µg/L (November 2018 – January 2019), 31.30 µg/L (January 2020) and 33.50 µg/L (January 2021 – February 2021). (Figure C.1).

  - At B5INFLOW (located immediately above Pond B-5), the uranium load historically was lower than at upstream location GS10 in most months evaluated, indicating that uranium removal was occurring between those two locations. However, since 2015, monthly uranium loads at B5INFLOW have often exceeded GS10 (see Figures C.1 and C.2), though this can be attributed, at least in part, to a reduction in the water volumes observed at GS10 that occurred at approximately the same time when groundwater treatment system effluent began being diverted around GS10, as explained further below in the discussion of uranium loads in South Walnut Creek. Multiple samples at B5INFLOW since 2017 have exceeded the 16.8 µg/L uranium standard that is applied at the Point of Compliance located downstream, with a maximum result of 28.50 µg/L in July 2019.

- The increased uranium concentrations measured in Pond B-5 discharges measured at GS08 correspond with the transition from batch-release mode to flow-through mode in Pond B-

5 in September 2011 (Figure C.3). The increased residence time of water in Pond B-5 during batch mode operation allowed increased chemical precipitation of low solubility uranium species and increased sorption of uranium to pond sediments in deeper pond water containing low dissolved oxygen. Changing Pond B-5 to flow-through mode reduced the efficiency of these uranium removal processes.

Uranium Loads in South Walnut Creek

- From 2010 through 2012, the annual and monthly uranium loads were higher at GS10 than at B5INFLOW (the next monitoring locations downstream), indicating uranium load removal occurring between those two locations during most months. However, this can be explained at least in part by the losing reach of stream between those two locations during drier conditions, which explains the pattern of higher uranium relative loads at GS10 being more prevalent during periods with lower flows, such as in 2012. (See the summary of annual loads [Figure C.4] and monthly load data [Figures C.5 through C.16].) However, from 2013 through June 2021 (with the exception of 2014 and 2018), the pattern has been different, with higher loads observed at B5INFLOW compared to GS10 located upstream, as shown on Figure C.4 (annual uranium loads in South Walnut Creek). This shift to higher comparative loads downstream is similar to the change in loading pattern observed in North Walnut Creek. Explanations for the relative gain in load at B5INFLOW, compared to GS10, in recent years, which are summarized below:

    - The comparative water volumes observed at GS10 and at B5INFLOW have changed over time. Effluent water that was previously routed to GS10 from the Mound Site Plume Treatment System (MSPTS) was diverted to bypass GS10 starting in 2016 and is now ultimately discharged, after being treated at the East Trenches Plume Treatment System (ETPTS), at a point upstream from B5INFLOW. The change in the flow regime has shifted some of the uranium load from GS10 to B5INFLOW.

- The sediments where several B-Series ponds were formerly located now routinely dry up for part of the year, as a result of the MSPTS effluent water being diverted further downstream. The dry, exposed sediments are subject to increased oxidation which can increase the availability of the uranium when surface flows return, thereby resulting in higher uranium loads measured in the surface water at B5INFLOW. Large runoff events, such as the flooding in 2013, also disturb and oxidize sediments, making the uranium inventory more available for transport, and translating to a gain in loads as B5INFLOW.

3.3.2 Nitrate Concentrations and Loads

For reasons discussed in Section 2.2, an evaluation of uranium concentrations and loads in RFS surface water must also address nitrate since it is prevalent in North Walnut Creek (as a result of historical activities at RFS), and because nitrate can facilitate uranium mobility via oxidation processes (Wu, et al., 2010).

Similar to the approach used for uranium, the data analysis for nitrate in surface water at RFS involves assessing spatial variability, including mass balance analyses, to identify potential sources and/or sinks of nitrate because of the role that nitrate can play in mobilizing uranium. In addition, temporal variability was evaluated to assess whether seasonal or other temporal trends could be identified. It is noted that care must be taken when comparing nitrate and uranium data because, as discussed in Section 3.1, nitrate samples are collected only as grab samples whereas uranium samples are collected as flow-paced composite samples for compliance purposes and as grab samples for bi-weekly data. As noted previously, the estimated fraction of nitrate contributed by the SPPTS into North Walnut Creek, as measured at GS13, is likely an underestimate because the nitrate grab samples in North Walnut Creek are typically collected during periods with low flows when nitrate concentrations are typically higher (i.e., less dilution occurring), thereby resulting in an overestimate of the total nitrate load in North Walnut Creek, from all sources, and underestimating the fraction contributed by the SPPTS, as measured at SPOUT.

Surface water monitoring data were plotted to compare nitrate concentrations and loads at monitoring locations in both drainages. Data plots were developed for all monitoring locations to facilitate comparisons between locations for the following types of data:

- Nitrate concentrations (monthly average and maximum values [mg/L])
- Water volume discharged (liters per month)
- Nitrate loads (monthly totals [mg/month])

Data from January 1997 through June 2021 are included on each of the plots (where data exist), except for where data are not available back to 1997.

3.3.2.1 North Walnut Creek

For North Walnut Creek, data plots of surface water nitrate concentration, water volume, and nitrate loads are presented in Appendices D and F for locations SW093, SPIN, SPOUT, GS13, GS12 (or A3EFF), GS11 (Pond A-4 outfall) and WALPOC. A summary of the different data plots developed for this analysis is provided in Table 6.

Table 6. Description of data plots and tables – Nitrate in North Walnut Creek (Appendices D and F)

Data plot description	Figure(s) in Appendices D and F
SW093, SPIN, SPOUT, GS13, GS12 (or A3EFF), GS11 and WALPOC – Monthly average and maximum nitrate concentrations, water volume, and loads, by location	Figures D.1 – D.7
Summary of annual nitrate loads in North Walnut Creek, by location (2010 – 2020)	Figure D.8
Monthly nitrate loads in North Walnut Creek, by location (2010 – 2021)	Figures D.9 – D.20
Solar Ponds Plume Treatment System Performance, by month (2010 – June 2021)	Figure D.21

Data plot description	Figure(s) in Appendices D and F
Average nitrate concentrations, by location, in North Walnut Creek, prior to SPPTS nitrate treatment upgrade (9/1/11 – 11/1/16)	Figure D.22
Average nitrate concentrations, by location, in North Walnut Creek, after SPPTS nitrate treatment upgrade (11/1/16 – 9/15/21)	Figure D.23
Pond A-4 Nitrate Grab Sample Data (NO3 + NO2 as N), 2010 – 9/15/21	Figure D.24
A1EFF – uranium vs. nitrate concentrations	Figure D.25
Water volumes at North Walnut Creek monitoring locations (annual totals for 2010 - 2017 and monthly totals for 2010 – June 2021), for comparison purposes with uranium load and concentration plots.	Figures F.1 – F.13 and Table F.1

Review of the nitrate concentration and loading data plots listed in Table 6 leads to the following observations:

Nitrate Concentrations in North Walnut Creek and at WALPOC

Average nitrate concentrations for all North Walnut Creek locations are summarized on Figure D.22 for samples collected prior to the SPPTS nitrate treatment system upgrade (grab sample dates from September 1, 2011, to November 1, 2016), and on Figure D.23 for samples collected after the SPPTS nitrate treatment system upgrade (grab sample dates from November 1, 2016, to September 15, 2021). The general trend of the nitrate concentrations remains the same for the two time periods, increasing from SW093 downstream to GS13, which has the highest average nitrate concentration in both time periods, and then decreasing progressively downstream from GS13. However, the average concentrations of nitrate are lower at all sampling locations in the period after the SPPTS nitrate treatment upgrade. In addition, the average nitrate concentration at SPOUT is reduced substantially from the condition prior to the SPPTS nitrate treatment upgrade (average nitrate concentration of approximately 260 mg/L) to the condition after the SPPTS nitrate treatment upgrade (average nitrate concentration of approximately 1.8 mg/L).

Nitrate concentrations measured at North Walnut Creek monitoring locations are spatially variable from upstream monitoring station SW093 (Figure D.1) down to station GS11 at the Pond A-4 outfall (Figure D.6), indicating the presence of a nitrate source and sink(s) as average nitrate concentrations rise and then fall going downstream along this channel reach, similar to the spatial variation observed for uranium. The presumed nitrate source is groundwater seepage from the solar ponds plume that is not intercepted and routed to the SPPTS. Nitrate sinks would be associated with uptake by wetland vegetation, which can reduce nitrate concentrations in surface water. (Note: the nitrate concentrations on Figures D.1 through D.6 are plotted on common scales to facilitate comparisons between locations.)

Nitrate concentration data and temporal variability are discussed below for individual locations in the North Walnut Creek drainage:

- SW093 - Nitrate concentrations at SW093 have historically been generally below the 10 mg/L RFLMA standard, though multiple exceptions exist with nitrate exceeding 10 mg/L for the period reviewed (from 2010 through June 2021), with these exceptions occurring following periods of elevated rainfall (or snowmelt) and resulting recharge to the area of the former Solar Evaporation Ponds, as described below:
    - From 4/22/10 through 6/2/10, in four consecutive grab samples at SW093, nitrate was measured at concentrations ranging from 25 to 35 mg/L. These elevated nitrate sample results followed a period of high precipitation and resulting recharge to the former Solar Evaporation Ponds area in March and April of 2010, as shown on Figure F.2 (water volume plot for 2010), as well as hillside seepage from the area north of the former Solar Evaporation Ponds with elevated nitrate concentrations reaching SW093 as surface flow (SN3, 2014). The high relative precipitation during this period is evident based on a comparison of Figure F.2 with other months and years (Figures F.3 – F.10).

- From 9/19/13 to 11/26/13, in five consecutive grab samples at SW093, nitrate was measured at concentrations ranging from 15 to 46 mg/L. Again, the elevated nitrate sample results followed a period of high rainfall (the September 2013 storm event), as shown on Figures F.5 and F.6. The September 2013 storm event started on 9/10/13, with the highest runoff rates occurring on 9/12/13. The following week, on 9/19/13, a grab sample was 15 mg/L nitrate; subsequent samples were higher, including: 35 mg/L (10/15/13), 41 mg/L (10/30/13); 39 mg/L (11/13/13), and 46 mg/L (11/26/13), before decreasing, as reflected on Figure D.1. Likely causes of the elevated nitrate concentrations measured at SW093 following the heavy rainfall in September 2013 were: 1) increased infiltration followed by seepage and overland runoff from the hillslope below where the Solar Evaporation Ponds were formerly located, and 2) discharges from the strip drains for the grouted riprap in the channel above SW093, which may provide a conduit for groundwater from the former Solar Evaporation Ponds area when groundwater levels are elevated.

- Similarly, in 2015 and 2016, nitrate at SW093 was measured at concentrations above 10 mg/L following wet periods of weather. Grab samples collected from April 2015 to September 2015 had concentrations above 10 mg/L with a maximum concentration of 61 mg/L collected on 7/22/15. The next year, in May and June 2016, elevated concentrations of nitrate were again recorded at SW093 when four samples were collected from 5/18/16 through 6/29/16 with nitrate concentrations ranging from 11 to 28 mg/L. Since the elevated result in June 2016, there have not been any other sample results at SW093 above 10 mg/L.

- SPOUT – At the SPPTS effluent monitoring location SPOUT, which is located “off-line” from the main North Walnut Creek channel and discharges to the subsurface via the SPPTS Discharge Gallery, prior to the SPPTS reconfiguration being completed in October 2016, the water had a substantially higher average nitrate concentration compared to any other monitoring location in the North Walnut Creek drainage (except for SPIN – the influent monitoring location to the SPPTS).[15] After the system was reconfigured, nitrate treatment was confirmed to be effective on October 3, 2016.

The average nitrate concentration at SPOUT, prior to the SPPTS reconfiguration, was greater than 250 mg/L for samples collected from January 2010 through April 2016. After the system was identified as being fully effective, the average concentration was 1.8 mg/L (based on concentrations from November 2016 through June 2021).

- Prior to the reconfiguration of the SPPTS, the nitrate load historically delivered from SPOUT was estimated to be approximately 18 percent of the total nitrate load measured at GS13 (based on data from January 2010 through April 2016). The large fraction of nitrate from SPOUT occurred because of the high nitrate concentration in SPOUT discharges; the water volume discharged from SPOUT is minor compared to the flows in the main North Walnut Creek channel (SPOUT flows represent approximately one to two percent of the flow volume compared to station GS13).

  (Note: The estimated 18 percent approximate fraction of nitrate contributed by SPOUT at GS13, prior to the reconfiguration of the SPPTS, is uncertain and was likely an underestimate. At in-stream locations such as GS13, there is a greater likelihood of overestimating nitrate loads when using grab sample results [compared with using flow-paced composite sample results] because of the timing of the grab sampling. In contrast, at SPOUT, since the discharge is from an engineered system that does not fluctuate in the same manner as a stream channel, the uncertainty of the nitrate measurements is less. Consequently, if the nitrate loads at GS13 are more likely to be overestimated than at SPOUT, the relative

[15] Contact Record 2009-01 approved testing and development of improved long-term treatment methods for the SPPTS. The Contact Record notes that replacing the original media with fresh media would not result in adequate treatment over the long term, would be costly and difficult, and would need to be repeated every few years. Therefore, the focus on the SPPTS has been to identify better treatment approaches that are effective as well as sustainable, from a cost and maintenance perspective.

contribution of nitrate from SPOUT to GS13 may be underestimated [i.e., the nitrate contribution from SPOUT was likely historically greater than 18 percent]).

- Following the reconfiguration of the SPPTS, the nitrate load delivered from SPOUT has been reduced to approximately 0.6 percent of the total nitrate load measured at GS13, based on samples from November 2016 to June 2021. Unlike uranium, with its abundant natural background, the source of nitrate at RFS (from the Solar Ponds Plume [SPP]) is clearly known.

- Prior to the reconfiguration of the SPPTS in 2016, for the period from September 2011 through April 2016, the average nitrate concentration at GS13 (approximately 28 mg/L) was higher compared to upstream location SW093 (approximately 8.2 mg/L) (see Figure D.22). Some of the elevated nitrate concentration observed at GS13 could be accounted for by the input of nitrate from SPOUT (located between SW093 and GS13). However, following the 2016 SPPTS improvements that reduced the concentration of nitrate in discharges from SPOUT to virtually zero, the average nitrate concentration at GS13 remained nearly ten times that of SW093 (approximately 12 mg/L at GS13 and 1.2 mg/L at SW093 for the period from November 2016 through June 2021) (see Figure D.23). This indicates an input of nitrate along the reach of North Walnut Creek between SW093 and GS13 other than discharges from SPOUT and is likely attributed to seepage from the hillslope below (north or northeast of) where the Solar Evaporation Ponds were formerly located.

- A1EFF - At A1EFF, located downstream from GS13 (see Figure 1), nitrate and uranium data are plotted against each other (using grab sample data for each) to assess the relationship between the two (see Figure D.25). The plot indicates two separate clusters of data, both with positive correlations between uranium and nitrate concentrations. The "steeper" data cluster on the left side of the plot has less nitrate relative to uranium. The red data points, which are part of lower nitrate data cluster on the left, are for samples collected after the reconfigured SPPTS went on-line, beginning in November 2016, which shows the effectiveness of nitrate removal by the SPPTS. A cluster of data points with the highest uranium concentrations (indicated with dark crosses) occurred between December 2010 and February 2011), before the SPPTS reconfiguration; prior to that period, the former Pond A-1 area was dry and the exposed, oxidized sediments may have contributed additional uranium without the nitrate.

- GS11 – The operating protocol for Pond A-4 was changed from batch mode to flow-through mode operations in autumn 2011. Then, in 2013, the large storm event increased the volume of recharge into groundwater with elevated nitrate concentrations in the former Solar Evaporation Ponds area, which discharges via seeps into North Walnut Creek. Prior to the September 2013 storm event, nitrate concentrations measured at GS11 (Pond A-4 discharge) were consistently below the RFLMA 10 mg/L standard. However, following the September 2013 storm, grab samples from Pond A-4 had nitrate concentrations that were as high as 18 mg/L from February through April 2014 (see Figure D.24). The increased nitrate concentrations in Pond A-4 coincided with a spike in nitrate loads at SW093 in March 2014 (see Figure D.13). Accordingly, the elevated nitrate concentrations observed in the Pond A-4 discharges were likely the result of the flow-through operations in Pond A-4 in combination with increased groundwater influence resulting from the 2013 storm event (i.e., elevated baseflow as well as seepage of groundwater to the surface).

  Later, following periods of wet weather in 2015 and 2016, GS11 again had measurements of nitrate greater than 10 mg/L, including samples from 5/4/15 and 5/8/15 with results of 10.40 mg/L and 10.80 mg/L, respectively. Nitrate concentrations greater than 10 mg/L were also recorded during the wet spring in 2016, with samples collected from 2/24/16 to 4/19/16 ranging from 10.80 to 11.80 mg/L, respectively. No other nitrate results above 10 mg/L have been observed since 2018.

- WALPOC - At WALPOC, prior to the SPPTS reconfiguration, the average nitrate concentration was approximately 2.9 mg/L, based on 70 grab samples collected from

9/12/11 to 4/28/16. Results during that time period ranged in concentration from less than 0.01 mg/L to approximately 8.7 mg/L. One result of 7.69 mg/L was measured on 2/23/12. Two subsequent periods had nitrate concentrations greater than 5 mg/L, which occurred following the large storm in September 2013 and between February 2016 and April 2016.

The increase in nitrate concentration at WALPOC following the 2013 storm event reflected the increased concentrations of nitrate at all the upstream monitoring locations in North Walnut Creek that were influenced, as discussed above, by increased contributions of groundwater with elevated nitrate following the storm, as well as minimal biological reduction of nitrate occurring during the cold winter months (see Figures D.1 through D.6). Similarly, increases in nitrate at WALPOC in early 2016 followed the elevated precipitation that occurred in 2015.

Since the reconfiguration of the SPPTS, the average nitrate concentration measured at WALPOC was approximately 0.56 mg/L, based on 53 grab samples collected from 1/3/2017 to 6/4/2021, compared to approximately 2.9 mg/L before the SPPTS was reconfigured in 2016.

Nitrate Loads in North Walnut Creek and at WALPOC

Review of North Walnut Creek nitrate load data indicates a measurable portion of the nitrate load entering GS13 is from a source other than SW093 or SPOUT (see annual load analysis Figure D.8). Review of monthly nitrate load analyses for 2010 to June 2021 (the time frame selected based on available data for multiple locations in the drainage) shows an additional nitrate load to GS13, from a source other than SW093 or SPOUT, for most months from 2010 through June 2021, accounting for the flow that was not present at GS13 for several months (see Figures D.9 to D.20). It is noteworthy that since the SPPTS nitrate treatment upgrade was completed in October 2016, the concentrations and loads of nitrate have decreased at all sampling locations in North Walnut Creek, including at GS13, the location with the highest nitrate concentrations, except for elevated sample results observed at GS13 in March 2021 and SW093 in May 2021. Consequently, the nitrate concentration at GS13 is frequently below the 10 mg/L standard and the gain in load historically observed at that location is of much less significance than it was prior to the SPPTS upgrades.

The gain in nitrate load at GS13, while less now with the SPPTS upgrades, cannot be explained merely by a gain in water volume (see the annual average water balance [Figure F.1] and monthly water balance plots [Figures F.2 through F.13]). The gain in water volume from the combined SW093+SPOUT downstream to GS13 is not the same proportion as the increase in nitrate load, indicating that the water entering North Walnut Creek upstream from GS13 has nitrate at a higher concentration than the water flowing in North Walnut Creek. Based on the presence of the Solar Ponds Plume (SPP), the only known groundwater source of nitrate in this area, it appears that a portion of the SPP is not collected by the SPPTS and enters the North Walnut Creek channel between SW093 and GS13, increasing nitrate loads and concentrations at GS13 and at locations further downstream in North Walnut Creek. Overall, month after month, nitrate loads are frequently higher at GS13 than at any other location sampled in the North Walnut Creek drainage (see North Walnut Creek monthly load plots, Figures D.9 to D.20), and since the SPPTS upgrades were completed, the portion of the SPP that is not collected by the SPPTS is a more significant portion of the nitrate load at GS13.

3.3.2.2 South Walnut Creek

Nitrate data from South Walnut Creek are very limited and were collected historically only at location GS08 (Pond B-5 outfall) because of the low nitrate concentrations observed in that drainage. The data plots of surface water nitrate concentrations, water volume, and nitrate loads at GS08 are presented in Appendix E.[16] A summary of the different data plots developed for this analysis is provided in Table 7.

[16] Nitrate data are available in South Walnut Creek only at GS08 (Pond B-5 outfall) because the majority of nitrate sampling at RFS is conducted in the North Walnut Creek drainage as a result of the groundwater plume associated with the former Solar Evaporation Ponds.

Table 7. Description of data plots and tables – Nitrate in South Walnut Creek (Appendices E and G)

Data plot description	Figure(s) in Appendices E and G
GS08 – Monthly average and maximum nitrate concentrations, water volume, and loads	Figure E.1
Water volumes at South Walnut Creek monitoring locations (annual totals for 2010 - 2020 and monthly totals for 2010 through June 2021), for comparison purposes with uranium load and concentration plots.	Figures G.1 – G.13 and Table G.1

3.3.3 Other Parameters

Evaluation of data for multiple chemical parameters, other than uranium and nitrate (such as pH, dissolved oxygen, sulfate and sulfide), are plotted and tabulated in Appendix H (for North Walnut Creek monitoring locations), Appendix I (for South Walnut Creek monitoring locations) and Appendix J (for other parameters in both North and South Walnut Creeks). Summaries of the findings are provided in Section 3.3.3.1 (for North Walnut Creek) and in Section 3.3.3.2 (for South Walnut Creek). Note that the sample locations for these other parameters, while still in North and South Walnut Creeks, differ from those discussed in prior sections for uranium and nitrate (see Appendix A, Figure A.1). This sampling was discontinued after June 2019 as it was determined that the additional data were not contributing substantially to improved understanding of uranium transport processes in the Walnut Creek drainage.

3.3.3.1 North Walnut Creek

pH: pH shows no significant temporal (or spatial) trends. The average value from all monitoring locations was 7.63, with a range of to 6.53 to 8.9.

Dissolved Oxygen – Dissolved oxygen had an important temporal change during the period between December 2012 and July 2013.

- Between December 5, 2012 and July 10, 2013, dissolved oxygen saturation was consistently low (average range at all stations: 35.3% to 56.8%), with minimal diurnal variation. For surface waters, these values represent reducing conditions (indicative of negative redox conditions), with little plant photosynthesis occurring, and are consistent with a groundwater-dominated stream flow (low groundwater dissolved oxygen resulting from subsurface bio-consumption of dissolved oxygen, not relieved by sufficient oxygenated recharge water). Under these conditions and absent any influx of oxygenated water, uranium is expected to mostly be present as low solubility U(IV) species, but is potentially susceptible to mobilization by nitrate.

- <u>Change in Dissolved Oxygen</u> - Sometime between 7/10/2013 and 11/07/2013, stream conditions changed to relatively higher dissolved oxygen saturation (average range: 78% to 87%), with the shift occurring during the period with heavy rainfall in September 2013, (see Figures H.1 through H.6 and Tables H.1 through H.6).

- <u>Persistence of Aerobic Conditions up to mid-July 2014</u> - The aerobic conditions persisted following the September 2013 storm event, with a slow decline in dissolved oxygen concentrations as measured in July and August 2014. (Note: The July and August 2014 dissolved oxygen samples were at only three locations [GEOFC3INF, GEOFC3EFF and GEOA1INF] due to limited water flow at sample locations in mid-summer.) These data are consistent with a flood-triggered mechanism in which the heavy rainstorms of September 2013 recharged the groundwater with oxygenated water more rapidly than subsurface bio-consumption could deplete it. Where the oxygen-rich groundwater entered North Walnut Creek, it provided: 1) increased mobilization of uranium in subsurface deposits, thereby causing elevated concentrations of uranium in groundwater to be issued to surface drainages, and 2) an increase in dissolved oxygen concentrations in the stream channels, thereby enhancing uranium transport to WALPOC via mobilization of uranium in channel sediments.

- Long-term Persistence of Aerobic Conditions up to June 2019 – Between mid-July 2014 and June 2019, dissolved oxygen stream concentrations underwent several fluctuations, sometimes decreasing to the levels that existed prior to the September 2013 heavy rains, and sometimes increasing as high as the concentrations that occurred immediately following the September 2013 heavy rains, but overall indicating no significant long-term trends.

Sulfate and hydrogen sulfide - Sulfate and hydrogen sulfide were included in the chemical parameters analyzed because the reduction of sulfate to hydrogen sulfide would indicate very strong reducing conditions. While substantial changes in hydrogen sulfide concentrations have not been observed, relatively small increases have been observed in 2019 relative to the samples collected from 2014 to 2017 (see Figure H.4).

Uranium in sediment – Uranium concentrations in sediment in North Walnut Creek fluctuate by location (six locations sampled) but generally are lower upstream compared to downstream, based on one sample event on 11/8/12 (Appendix J, Figure J.3). The concentrations of uranium in sediment in the North Walnut Creek drainage range from slightly more than 1 mg/kg at the uppermost sampling location GEOFC3INF to approximately 7 mg/kg at the most downstream location GEOA3EFF (see Figure A.1 for sample locations). It is noted that pond sediments were not removed from North Walnut Creek during Site closure activities.

Hardness and alkalinity – Hardness and alkalinity data for six North Walnut Creek monitoring locations, collected from 12/24/13 to 4/30/14, are presented in Appendix J (Figures J.5 and J.7, respectively). Both hardness and alkalinity generally declined over the sampling period at most monitoring locations (with hardness ranging from approximately 500 to 700 mg/L in December 2013 down to 370 to 510 mg/L in April 2014). It is noted that this sample period reflects the prolonged period of increased groundwater seepage to the surface that followed the 2013 flood event. The data also reflect the proportionately larger contribution from groundwater during the winter months. Pond A-4 was an exception, with lower hardness values than the other locations until mid-February, after which hardness was comparable for all locations. Similarly, alkalinity in Pond A-4 was also lower than the upstream stations until mid-February, at which time the alkalinity increased to a level comparable with the other upstream monitoring locations.

Total Suspended Solids (TSS) and Uranium – Data are presented for TSS versus uranium at monitoring locations SW093 and GS11 (Pond A-4 outfall) in the North Walnut Creek drainage, as well as for locations in South Walnut Creek and at WALPOC (Appendix J, Figure J.9). The date ranges for the available data sets vary by location and while no relationship between uranium and TSS is apparent, the data indicate comparable TSS concentrations at the terminal pond outfalls in both North and South Walnut Creeks, as observed at GS11 (Pond A-4 outfall) and GS08 (Pond B-5 outfall), with average TSS concentrations of 16.7 mg/L 18.6 mg/L, respectively.

3.3.3.2 South Walnut Creek

pH: pH values in South Walnut Creek are similar to those in North Walnut Creek, with an average of 7.8, with a range of 6.8 to 8.7 and showing no significant spatial or temporal trends (see Appendix I).

Dissolved Oxygen – Dissolved oxygen shows the same temporal change in South Walnut Creek (see Appendix I) that was observed in North Walnut Creek.

- Before 7/10/2013, dissolved oxygen saturation was consistently relatively low (average range at all stations: 42.4% to 55.0%), with minimal diurnal variation. For surface waters, these values represent reducing conditions in stream water and sediments (indicative of negative redox conditions), with little plant photosynthesis occurring, and are consistent with a groundwater-dominated stream flow (low groundwater dissolved oxygen resulting from subsurface bio-consumption of dissolved oxygen, not relieved by sufficient oxygenated recharge water). Under these conditions, uranium is expected to mostly be present as low solubility U(IV) species, but is potentially susceptible to mobilization by nitrate.

- Changes in Dissolved Oxygen - Between 7/10/2013 and 11/07/2013, stream conditions changed to relatively higher dissolved oxygen saturation (average range: 77.5% to 87.1%), with the shift occurring during the period with heavy rainfall in September 2013, (see Figures I.1 through I.3 and Tables I.1 through I.3). Later, in mid-June 2017, the dissolved oxygen dropped to approximately 38%, before returning to levels more typical for that location.

- Long-term Persistence of Aerobic Conditions up to June 2019 – Similar to North Walnut Creek, between mid-July 2014 and June 2019, dissolved oxygen stream concentrations underwent many fluctuations, sometimes decreasing to the levels that existed prior to the September 2013 heavy rains, and sometimes as high as the concentrations that occurred immediately following the September 2013 heavy rains, but overall indicating no significant long-term trends.

Sulfate and hydrogen sulfide – The concentration was elevated in 2019 compared to samples from prior years, though substantial changes in hydrogen sulfide were not observed.

Uranium in sediment – Uranium concentrations in sediment in South Walnut Creek fluctuate by location (three locations sampled), with the highest concentration, approximately 14 mg/kg, measured upstream at location GEOB1INF (sampled on 11/8/12). Concentrations near 2 mg/kg were measured at downstream locations GEOB4 and GEOB5INF (Appendix J, Figure J.4). For historical reference, pond sediments were removed from Ponds B-1, B-2 and B-3 as part of Site closure activities to remediate plutonium concentrations in the sediments and were replaced with clean fill. The concentration of natural uranium in the added fill material, if known, was not evaluated for this study.

Hardness and alkalinity – Hardness and alkalinity data for six South Walnut Creek monitoring locations, collected from 12/24/13 to 4/30/14, are presented in Appendix J (Figures J.6 and J.8, respectively). Both hardness and alkalinity generally declined over the sampling period at most monitoring locations (ranging from approximately 650 to 700 mg/L in December 2013 down to

470 to 530 mg/L in April 2014). This reflects the proportionately larger contribution from groundwater during the winter months. Pond B-5 was an exception, with lower hardness values than the other locations until mid-February, after which hardness was comparable for all locations. Similarly, alkalinity in Pond B-5 was also lower than the upstream stations until mid-February, at which time the alkalinity increased, though it remained lower than at all but one other location for all sample dates.

Total Suspended Solids (TSS) and Uranium – Data are presented for TSS versus uranium at monitoring locations GS10 and GS08 (Pond B-5 outfall) in the South Walnut Creek drainage, as well as for SW093 and GS11 in the North Walnut Creek drainage and at WALPOC (Appendix J, Figure J.9). The date ranges for the available data sets vary by location and while no relationship between uranium and TSS is apparent, the data indicate the average TSS concentrations are substantially higher at upstream monitoring locations SW093 on North Walnut Creek and GS10 on South Walnut Creek compared to the downstream locations including GS11 (Pond A-4 outfall) and GS08 (Pond B-5 outfall); the lower TSS sample results are expected at the pond outfalls because of the particle settling that occurs in the ponds, even when operating in flow-through mode.

3.4 Meteorological Conditions Effects

The relationship of uranium to the findings for other water quality parameters discussed in Section 3.3.3 is shown on Figure J.1, where uranium concentrations in North and South Walnut Creeks and at WALPOC are plotted over a time span that includes the heavy rainfall in September 2013 (the 7.67 inches of rainfall recorded for the entire month in September 2013 was the wettest month on record since Site precipitation records were kept beginning in 1993) as well as spring 2015 with above average precipitation depths.

At each monitoring location illustrated on Figure J.1, uranium concentrations (from flow-paced composite samples) were relatively lower just prior to and during the September 2013 rain event and began to increase following the storm, after runoff declined and baseflow from groundwater seepage to the surface drainages increased. The atypical increased uranium concentrations at WALPOC persisted until mid-May 2014, at which time a decline in concentrations was observed, with three consecutive samples all below the 16.8 µg/L standard (sample dates 5/12/14 through 5/21/14). At some locations, particularly GS10 (Figure J.1), uranium concentrations in samples collected after the September 2013 flood remained within the pre-flood range but were more uniform and generally higher than in samples collected immediately prior to the September 2013 event. The extended duration of elevated uranium in the Walnut Creek surface water drainages is believed to have resulted from, among other factors:

- Physical disturbance of channel bed sediments from the high flows during the 2013 flood event may have facilitated oxidizing the sediments, causing precipitated U(IV) to be mobilized as uranium U(VI) (see Figure J.1 and Figures H.1 through H.6 and Figures I.1 through I.3).

- An increased proportion of groundwater being discharged to the surface, with elevated uranium concentrations relative to surface water (see Figure B.34).

- Increased oxygen concentration in groundwater, which facilitates mobilization of uranium.

- Higher groundwater elevations which can cause groundwater to remain in contact with subsurface sources with higher uranium content (e.g., Solar Ponds Plume, subsurface sediments, "evaporite-type" deposits at the water table interface, etc.).

A comparison between 2013 and 2015 is valuable because both years had elevated precipitation. However, an important characteristic of the September 2013 storm that differentiates it from other periods of wet weather is the disturbance of soil and sediments in the drainage channels that resulted from the high flow rates during the 2013 event. In addition, a period of dry conditions prior to the 2013 event exposed and promoted oxidation of sediments, potentially enhancing the mobility of the uranium. The characteristics of the 2013 event caused a longer-term increase in uranium concentrations compared to the 2015 event. Data suggest that as long as the Solar Ponds

Plume and sediment sources of uranium remain, it can be expected that a future storm of a magnitude comparable to the September 2013 event will have a similar effect of initiating prolonged periods of relatively higher uranium concentrations at surface water monitoring locations along North and South Walnut Creeks.

Following the wet weather in May 2021, with a total precipitation depth of 4.18 inches, no increase in uranium concentrations was observed. The May 2021 wet weather produced roughly one third of the runoff volume of the May 2015 event, despite recording approximately 80 percent of the precipitation depth. (Note: The wet weather in May 2021 was preceded by dry conditions in 2020 which resulted in reduced runoff in 2021. In both May 2015 and May 2021, the majority of the precipitation [i.e., over 90 percent] occurred as rainfall, rather than snow, based on a review of National Weather Service data from the Boulder monitoring location. Accordingly, the form of the precipitation did not play a role in the comparison between the 2015 and 2021 wet weather periods. The form of precipitation is important because snowfall typically infiltrates more and produces less runoff for a given depth of moisture compared to rainfall).

3.5 Determination of Uranium from Anthropogenic Sources

The work conducted historically at RFS involved forms of anthropogenic uranium, both enriched and depleted, that was received from other facilities in the DOE complex, but did not involve uranium from natural sources. As a result of the historic activities, residual quantities of anthropogenic uranium remain in the environment at RFS. Primary sources of anthropogenic uranium at the Site from which uranium is transported in the North and South Walnut Creek drainages and which have been previously documented and characterized include: 1) the former Solar Evaporation Ponds area with elevated concentrations of uranium in groundwater (Kaiser-Hill, 2005 and in more recently published annual reports by DOE), and 2) sediments with anthropogenic uranium in both North Walnut Creek and South Walnut Creek, which were previously characterized for isotopic ratios by a Los Alamos National Laboratory (LANL) study for the purpose of determining the anthropogenic fractions (Efurd et al., 1993), though the Site has been altered substantially since those samples were collected. In addition, other uranium source locations were previously documented in the Historical Release Report (EG&G, 1994; Kaiser-Hill, 2006), though many of those sources were removed during Site remediation activities.

To evaluate more current conditions with respect to distinguishing between anthropogenic versus natural uranium, results of uranium isotopic composition analyses (i.e., analyses of the content of individual isotopes as well as ratios of U-234/U-238, U235/U-238 and U236/U-238) were reviewed for analyses conducted from 2002 through March 2019 from locations throughout the Site, for both surface water and groundwater, with sample dates varying by location. The analyses were conducted at LANL and the Lawrence Berkeley National Laboratory (LBNL) and involved the use of Thermal Ionization Mass Spectrometry (TIMS) and Multi-Collector-Inductively Coupled Plasma/Mass Spectrometry (MC-ICP/MS) analytical techniques (LANL, 2011; LBNL, 2013a; LBNL, 2013b). Results were used to address the question of whether previously unrecognized anthropogenic sources of uranium have been identified at the Site (Question 3). (Note: For reference, for the post-closure era, results of the isotopic analyses are contained within appendices to the RFLMA annual reports issued for Rocky Flats since closure).

3.5.1 Surface Water Isotopic Uranium Analyses

Results of the isotopic uranium composition analyses for surface water samples are summarized in Table 8. Data plots of isotopic uranium analyses for individual surface water locations are shown on figures in Appendix K as listed in Table 8. A map of isotopic uranium results from surface water stations is shown on Figure K.33.

Table 8. Summary of isotopic composition of uranium at selected surface water monitoring locations

Drainage/ Water Source	Location	Numbers of Samples Analyzed at LANL and/or LBNL	Sample Date Range	Average U Concen. Of Samples Analyzed at LANL and/or LBNL (µg/L)	Percent Natural Uranium			Data Plot (Appen. K)
					Min. %	Max. %	Avg. %	
Walnut Creek	WALPOC	39	9/22/11 - 3/28/18	13.93	68.64%	87.08%	78.86%	K.1 and K.2
	GS33	2	3/9/15 - 5/18/15	4.83	99.04%	99.12%	99.08%	K.16
North Walnut Creek	SPIN	5	6/6/08 - 4/25/17	65.44	47.80%	62.00%	55.35%	K.17
	SW093	6	12/6/07 - 11/16/15	6.88	47.28%	92.70%	75.48%	K.3
	SPOUT	2	3/17/10 - 4/20/11	31.40	57.70%	65.10%	61.40%	K.4
	SPPDG	5	6/18/2002 - 3/17/10	51.40	41.40%	67.20%	51.62%	
	GS13	8	5/1/02 - 1/3/17	25.21	53.07%	74.80%	69.40%	K.5
	A1EFF	2	3/17/10 - 4/20/11	31.75	69.60%	73.10%	71.35%	
	A2EFF	2	3/17/10 - 4/20/11	43.15	70.70%	70.90%	70.80%	
	GS12/A3EFF	3	3/7/10 – 4/2/14	32.87	72.50%	73.68%	72.96%	K.6
	A4 POND	3	9/16/08 – 2/13/14	10.93	71.80%	77.00%	74.56%	K.7
	GS11	5	2/13/14 – 1/3/18	21.52	67.60%	74.27%	72.56%	K.8
South Walnut Creek	FC4750	1	9/28/11	17.60	--	--	70.90%	
	FC4991	1	9/28/11	5.00	--	--	78.30%	
	SEEP995A	2	9/30/13 – 11/25/13	23.45	59.67%	68.14%	63.91%	K.10
	FC4EFF	2	9/30/13 – 11/25/13	20.20	71.17%	73.86%	72.52%	K.9

Drainage/ Water Source	Location	Numbers of Samples Analyzed at LANL and/or LBNL	Sample Date Range	Average U Concen. Of Samples Analyzed at LANL and/or LBNL (µg/L)	Percent Natural Uranium			Data Plot (Appen. K)
					Min. %	Max. %	Avg. %	
	GS10	19	5/1/02 – 5/19/15	17.81	43.29%	77.84%	66.47%	K.11 and K.12
	B3OUTFLOW	2	3/1710 – 9/27/11	15.30	74.30%	76.60%	75.45%	
	POM2	2	8/28/08 – 3/17/10	24.65	69.20%	75.40%	72.30%	
	B5INFLOW	3	3/17/10 – 4/2/14	14.47	75.85%	78.50%	77.12%	K.13
	B5 POND	2	9/16/08 – 2/13/14	3.80	78.80%	80.32%	79.56%	K.14
	GS08	5	2/13/14 – 3/28/18	16.02	75.79%	84.68%	80.53%	K.15

Notes:
1) Uranium concentrations of samples analyzed at LANL or LBNL are provided for reference with results of isotopic analyses. Uranium concentrations provided by LANL and LBNL are not used for compliance purposes.

Summaries of the isotopic uranium data for different surface water sample locations are provided below, beginning with results at WALPOC followed by isotopic results from monitoring locations upstream.

WALPOC

The average natural uranium composition at WALPOC, as shown in Table 8, is approximately 79%, based on isotopic uranium analyses conducted on 39 samples collected from 9/22/11 to 3/28/18. The proportion of natural uranium measured in those samples has remained relatively consistent over that time period, with reported values ranging from approximately 69% to 87% (see Figures K.1 and K.2).

There is no apparent temporal relationship at WALPOC between the uranium concentration in samples and the measured percentage of natural uranium, based on eight years of available data (see Figure K.1). A fluctuation in isotopic composition of uranium at WALPOC was associated with the September 2013 flood event, when the percentage of natural uranium dropped from approximately 80% to 75% for samples collected from runoff between 9/13/13 and 9/16/13 (see Figure K.1). Since mid-2014, the percentage of natural uranium measured in samples from WALPOC has fluctuated more than previously, though results generally fall in a range from approximately 74 to 87 percent natural uranium, though two samples from May and June 2015 were approximately 69 percent natural. Since those results, 11 subsequent samples have been in the range of 74 to 87 percent natural uranium.

The isotopic analyses conducted at WALPOC through 3/28/2018 include samples from a broad range of precipitation and runoff conditions, including a prolonged dry period in 2012 and the extreme runoff conditions associated with the September 2013 storm event as well as the heavy prolonged precipitation in 2015 (see Figures F.1 through F.7) with a range of approximately 69% to 87%) of the uranium from natural sources.

<u>Locations Upstream from WALPOC</u>

At locations upstream from WALPOC, the following observations can be made regarding the percentage of natural uranium:

- North Walnut Creek (discussed in order from upstream to downstream locations):
    - SW093 – From 2007 to 2011, three samples analyzed for uranium isotopes during that time (samples from 12/6/2007 to 4/20/2011) had greater than 90 percent natural uranium (Figure K.3). Since then, three subsequent samples had results of approximately 72 percent, 47 percent and 58 percent natural uranium (from samples collected on 10/2/14, 5/18/15 and 11/16/15, respectively, which are the most recent isotopic data for this location). The reason for the increased fraction of anthropogenic uranium at SW093 is uncertain. However, it is hypothesized that: 1) the samples with increased anthropogenic uranium were collected when the strip drains upstream of SW093 were producing a greater fraction of the surface water flow than with the earlier samples. The strip drains may collect subsurface flow

from the SPP (with elevated anthropogenic uranium) that historically has not extended that far, and 2) overland flow to SW093 from the SPP hillside has been observed by RFS personnel. It is noteworthy that during the same time period in mid-2015 that SW093 had an elevated fraction of anthropogenic uranium compared to previous samples, WALPOC also had an increased concentration of anthropogenic uranium before returning to a range typically observed at that location.

- SPOUT – the percentage of natural uranium in samples varies from approximately 65 percent to less than 60 percent, based on two samples collected in 2010 and 2011 (Figure K.4), reflecting the anthropogenic composition of the groundwater being treated from the Solar Ponds Plume (Figure K.4).

- GS13 – The percentage of natural uranium, ranging from 53 to 75 percent, reflects the effects from SW093 flows as well as discharges from SPOUT and other sources with anthropogenic uranium (e.g., subsurface flows that are not collected by the SPPTS, sediment in the channel with anthropogenic uranium, etc.). The results from GS13 were consistently in the 72 to 75 percent range of natural uranium from 2002 to 2011, until results from 5/18/2015 and 1/13/2016 decreased to 53 and 67 percent natural uranium, respectively. A more recent result, collected on 1/3/2017, was approximately 72 percent, which is more typical of the values previously observed at that location.

- GS12, A4POND, GS11 (Pond A-4 outfall) – The average natural uranium percentage is in the same range (from 73 to 75 percent) at all these locations, based on a limited sample set (Figures K.6 – K.8).

- South Walnut Creek (discussed in order from upstream to downstream locations):

- GS10 – 19 samples with isotopic uranium results at GS10 indicate substantial fluctuation in the percentage of natural uranium compared to other locations at the Site, ranging from approximately 43 percent to nearly 78 percent in samples analyzed from 2002 to 2015 (Figure K.11). An inverse relationship between natural percentage and uranium concentration is indicated for several samples (Figure K.11). Plotting natural uranium percentage versus uranium concentration (Figure K.12), shows that all results greater than 30 µg/L are composed of less than 60% natural uranium, indicating that an anthropogenic source (or sources) upgradient from GS10 may be contributing a larger share of the uranium at GS10 when concentrations are elevated.

- B5INFLOW – The natural percentage of uranium ranges from approximately 76 to 79 percent and indicates an inverse relationship between natural uranium percentage versus uranium concentration, though the data set limited to only three sample results (Figure K.13).

- B5POND and GS08 (Pond B-5 outfall) – The natural percentage of uranium was approximately 80 percent at B5POND (2 samples) and ranges between 76 and 85 percent at GS08 (5 samples). An inverse relationship between natural uranium percentage versus uranium concentration at GS08 may be indicated (Figure K.15)

3.5.1 Groundwater Isotopic Uranium Analyses

Table 9 provides a summary of results for isotopic uranium analyses for selected groundwater wells that had at least one sample analyzed for isotopic composition from 2011 through 2019.

Table 9. Summary of isotopic composition of uranium at selected groundwater wells

Drainage/ Water Source	Well #	Number of Samples Analyzed	Sample Date Range	Average U Concen. of Samples Analyzed[1] (µg/L)	Percent Natural Uranium (%)			Data Plot (Appen. K)
					Min. %	Max. %	Avg. %	
Ground-water	79102	3	6/22/04 - 6/2/15	613.7	0.00%	0.00%	0.00%	K.18
	79202	1	6/2/15	40.0	-	-	15.53%	K.29
	79302	2	10/29/13 – 6/2/15	243.0	87.14%	89.95%	88.55%	K.19
	79402	1	5/28/15	290.0	-	-	49.07%	K.24
	79502	2	10/29/13 – 6/2/15	14.2	96.81%	97.24%	97.03%	K.20
	79605	1	5/27/15	550.0	-	-	99.97%	K.25
	91305	3	8/9/05 - 6/14/17	49.7	90.80%	95.79%	93.65%	K.21
	99405	3	8/8/05 - 4/20/11	415.3	99.90%	100.00%	99.95%	K.22
	00203	1	5/27/15	130.0	--	--	99.93%	K.23
	22205	1	6/2/15	43.0	--	--	95.68%	K.27
	P208989	1	5/28/15	130.0	--	--	71.64%	K.26
	P210089	3	11/9/04 - 5/28/15	29.6	81.50%	100.00%	90.92%	K.28
	P210189	2	3/26/2002 - 5/28/15	23.32	60.13%	92.33%	76.23%	K.30
	73617	1	3/20/2019	196.0	--	--	99.98%	K.31

Note: 1) Uranium sample results presented in Table 9 are based solely on the uranium concentrations measured in samples used for isotopic analyses conducted at LANL or LBNL. Uranium concentrations from the LANL and LBNL analyses are for reference, but are not for compliance purposes. It is noted that many other samples have been analyzed for uranium at these locations, separate from the isotopic analyses presented in Table 9, and the overall average uranium concentrations at these wells from the other analyses may vary substantially from the uranium concentrations associated with the isotopic analyses presented in Table 9.

Noteworthy results presented in Table 9 are discussed below:

Wells with the highest fraction of uranium from anthropogenic source(s)

- Well 79102 (located in the northwest section of the former Solar Evaporation Ponds area [see Figures K.31h and K.32]) – The percentage of natural uranium is 0% (3 samples), with a corresponding average uranium concentration of approximately 614 µg/L (Figure K.18). One of the isotopic analyses was conducted at LANL in 2004 (801 µg/L) and two were conducted at LBNL in 2012 and 2015 (510 µg/L and 530 µg/L, respectively). Isotopic analysis results from this well indicate a source of relatively high concentration, anthropogenic uranium in groundwater in the North Walnut Creek drainage.

- Well 79202 (located in the northwest section of the former Solar Evaporation Ponds area, east of well 79102 [see Figure K.32]) – The percentage of natural uranium is 15.5% (1 sample), with a corresponding uranium concentration of 40 µg/L (Figure K.29). Well 79202 has the second highest fraction of anthropogenic uranium of any of the wells analyzed for uranium isotopes.

- Well 79402 (located in the northeast section of the former Solar Evaporation Ponds area [see Figure K.32]) – The percentage of natural uranium is 49.1% (1 sample), with a corresponding uranium concentration of 290 µg/L (Figure K.24). Well 79202 has the third highest fraction of anthropogenic uranium of any of the wells analyzed for uranium isotopes.

- Well P210189 (located in the northwest section of the former Solar Evaporation Ponds area, south of well 79102 [see Figures K.31h and K.32]) – The percentage of natural uranium is 60.1 % (1 sample), with a corresponding average uranium concentration of approximately 43 µg/L (Figure K. 30).

Wells with highest concentration of uranium primarily from natural source(s)

- Well 79605 (located in the east section of the former Solar Evaporation Ponds area [see Figure K.32]) – The percentage of natural uranium is 99.97% (1 sample), with a corresponding uranium concentration of 550 µg/L (Figure K. 25). Well 79605 has the second highest concentration of uranium of the wells analyzed for uranium isotopes, but is virtually all from natural uranium sources.

- Well 99405 (located in the upper reach of South Walnut Creek [see Figures K.31h and K.32]) – The percentage of natural uranium is greater than 99% (3 samples), with a corresponding average uranium concentration of approximately 415 µg/L (Figure K.22).

- Well 79302 (located in the northern section of the former Solar Evaporation Ponds area [see Figure K.32]) – The average percentage of natural uranium is approximately 89% (2 samples), with a corresponding average uranium concentration of approximately 243 µg/L (Figure K.19).

- Well 00203 (located in the southern section of the former Solar Evaporation Ponds area [see Figure K.32]) – The percentage of natural uranium is 99.93 % (1 sample), with a corresponding uranium concentration of approximately 130 µg/L (Figure K. 23).
- Well 73617 (located northeast of the former Solar Evaporation Ponds area [see Figure K.32]) – The percentage of natural uranium is 99.98 % (1 sample), with a corresponding uranium concentration of approximately 196 µg/L (Figure K.31).

In addition to the limited sample set of isotopic analyses for wells presented in Table 9, K.31a – K.31i (sample results from 1998 to 2005) and K.32 (sample results from 2007 to 2019) display results for isotopic and uranium concentration analyses for a larger group of groundwater wells that had samples analyzed for isotopic composition. These other isotopic results are provided for reference to give a general indication of which areas of the Site have: 1) high relative concentrations of uranium in groundwater, and 2) high relative fractions of anthropogenic uranium.

4.0 EFFECT OF SITE OPERATIONS ON URANIUM CONCENTRATIONS

4.1 Solar Ponds Plume Treatment System Operations

The SPPTS influent uranium and nitrate concentrations (measured at the SPIN monitoring location) and effluent uranium and nitrate concentrations (measured at the SPOUT monitoring location) were evaluated to assess the performance of the SPPTS and its effect on uranium and nitrate concentrations in North Walnut Creek.

The relative effectiveness of the treatment system, in terms of percent removal, is plotted on Figure B.21 for uranium (see Appendix B) and Figure D.21 for nitrate (see Appendix D) (Note: Nitrate load data computations for SPIN and SPOUT begin in January 2010 which corresponds with the date when reliable flow measurement was established at those locations). As noted previously (see footnote 12 in Section 3.3.2.1), design and installation of a modified treatment process for improved uranium removal is currently planned, with a focus to identify better treatment approaches that are effective as well as sustainable, from a cost and maintenance perspective. For both plots, the monthly water volumes measured at SPOUT are provided for reference regarding whether it was a relatively wet period or dry period and the effect the conditions had on the performance of the SPPTS.

4.1.1 SPPTS and Uranium in North Walnut Creek

Overall, the reduction in uranium load discharged monthly from SPOUT, compared to SPIN, varies widely, with the most effective uranium treatment (nearly 80 percent removal of uranium) occurring in early 2011 and the least effective uranium treatment (less than 20 percent removal of uranium) generally occurring since mid-2015, based on monthly measurements. There does not appear to be a clear relationship between flow rate and treatment system effectiveness, though on several occasions where high flow rates have passed through the system (such as June 2010, Spring 2014 and Spring 2015), a period has followed with decreased effectiveness by the SPPTS, suggesting the system's treatment capacity for uranium may have been reduced during those high flow periods. Also noteworthy is the upward trend in uranium concentrations entering the SPPTS (as measured at SPIN) that peaked in 2012 and 2013 (Figure B.3b). Overall, the system's effectiveness for uranium removal appears to have generally trended downward from 2010 to the present, though it has remained relatively constant since mid-2015, except for a period of increased variability in 2019 (Figure B.21). The uranium concentrations of water discharged from the SPPTS at SPOUT generally increased from 2009 (when it was installed) to about 2014, and since then has generally remained relatively constant since 2014 (Figure B.2a).

During periods where the SPPTS was less effective at removing uranium (for example, February 2014) (see Figures B.2 and B.21), there is not a clear corresponding increase in uranium observed at GS13 (see Figure B.4), suggesting the relationship between SPPTS uranium removal performance and downstream water quality in North Walnut Creek may not be strong, which is expected since the SPOUT uranium load was approximately 7 percent of the uranium load measured at GS13 based on data from January 2010 through June 2021. More recently, during the period from November 2016 through June 2021, the uranium load at SPOUT represented approximately 14 percent of the uranium load measured at GS13. The increased percentage of uranium load attributed to SPOUT during that period was not associated with an increasing trend in uranium concentration at GS13, though periods of elevated uranium concentrations were observed at GS13 in 2011, 2016 and in early 2017.

Looking to the future, LM is moving forward in late 2021 with a procurement process to contract the services of a consulting engineering firm to evaluate and design the SPPTS uranium treatment process. This process is in its initial stages at the time this report was completed.

4.1.2 SPPTS and Nitrate in North Walnut Creek

Nitrate removal effectiveness in the SPPTS fluctuated from 2010 to April 2016 and then improved significantly in October 2016 following reconfiguration of the treatment system. Removal efficiencies were calculated based on monthly nitrate loads measured in SPIN versus SPOUT (see Figures D.2a, D.2b, D.3a, D.3b, and D.21).

Prior to when the most recent SPPTS improvements were completed in October 2016, two periods existed after 2010 when the nitrate removal efficiency decreased substantially. Both periods of diminished treatment performance followed periods of elevated precipitation, including in 2013 (following the heavy rainfall in September) and in 2015 (following heavy spring rainfall).

Since the reconfiguration of the SPPTS in autumn 2016, the nitrate removal efficiency as measured at SPOUT increased to nearly 100 percent during most months, with the exception during two periods of reduced denitrifying bacteria activity during unusually cold weather in early 2019 and early 2020, when nitrate concentrations at SPOUT for individual samples were measured up to approximately 41 mg/L and 52 mg/L, respectively (Figure D.21).

From November 2016 through June 2021, the nitrate load contributed by SPOUT has represented approximately 0.6 percent of the total nitrate load measured downstream in North Walnut Creek at monitoring location GS13. Prior to the improvements made to the SPPTS, the nitrate load discharged from SPOUT was typically approximately 18 percent of the nitrate load measured at GS13 from January 2010 until April 2016.

4.2 Pond A-4 and B-5

Box-plots and scattergrams were developed to provide a statistical summary for evaluating uranium data at surface water monitoring locations GS11 (Pond A-4 outfall), GS08 (Pond B-5 outfall) and WALPOC. The range of uranium concentrations observed was evaluated for four distinct pond operating protocols:

- Condition 1 - (samples from 3/1/07 – 9/26/11): Batch mode operations at terminal dams A-4 and B-5.
- Condition 2 – (samples from 9/27/11 – 9/12/13): Flow-through operations at terminal dams A-4 and B-5, prior to the flood event in September 2013.
- Condition 3 – (samples from 9/13/13 – 12/31/14): Flow-through operations at terminal dams A-4 and B-5, during and near term after the flood event in September 2013.
- Condition 4 – (samples from 1/1/2015 – 6/16/21): Flow-through operations at terminal dams A-4 and B-5, after the effects of the 2013 flood are diminished. The latest sample results included in the analysis are: 6/4/21 (WALPOC) and 6/16/21 (GS08 and GS11).

Box plots and scattergrams for GS11, GS08 and WALPOC are provided in Appendix J, Figure J.2. Summary statistics for the evaluation are provided in Table 10, followed by an assessment of the results.

Table 10. Summary Statistics – Uranium Concentrations for Varying Site Conditions at GS08, GS11 and WALPOC

Statistic	GS11 (A-4 Discharges)				GS08 (B-5 Discharges)				WALPOC		
	Batch Release Mode	Flow-Through Mode, Pre-2013 Storm	Flow-Through Mode, Post-2013 Storm - 2014	Flow-Through Mode, 2015 - 2021	Batch Release Mode	Flow-Through Mode, Pre-2013 Storm	Flow-Through Mode, Post-2013 Storm - 2014	Flow-Through Mode, 2015 - 2021	Flow-Through Mode, Pre-2013 Storm	Flow-Through Mode, Post-2013 Storm - 2014	Flow-Through Mode, 2015 - 2021
Nbr. of observations	34	11	8	55	33	9	16	61	17	19	91
Minimum	3.7	4.8	1.3	4.6	5.4	7.1	4.3	5.4	3.2	2.0	5.6
Maximum	11.8	17.5	29.0	23.1	15.1	17.2	20.4	22.1	15.1	22.9	23.5
1st Quartile	5.9	11.0	10.8	8.5	6.5	8.8	6.4	8.3	7.6	12.4	9.4
Median	6.6	13.5	16.0	10.7	7.9	10.2	12.5	11.3	11.4	16.8	11.9
3rd Quartile	8.4	15.3	24.7	13.9	10.1	16.1	15.3	12.6	12.6	20.3	14.7
Mean	7.2	12.7	16.7	11.7	8.9	11.8	11.6	10.8	10.5	15.4	12.3
Standard deviation (n-1)	1.9	3.8	9.4	4.3	2.9	3.8	5.0	3.5	3.3	6.5	4.1
Geometric mean	7.0	12.0	12.7	10.9	8.4	11.3	10.5	10.3	9.9	13.1	11.6

The statistical summary results presented in Table 10 provide a reference to evaluate the uranium concentrations historically observed at WALPOC, GS11 and GS08, under varying conditions at the Site.

- GS11 (Pond A-4 outfall) – Differences between the uranium concentrations are distinct for each of the four conditions evaluated. Approximately 68 to 74 percent of the uranium passing through Pond A-4 is from natural sources.
    - During batch-release mode, uranium concentrations at GS11 (mean: 7.2 µg/L; median: 6.6 µg/L) are substantially lower compared to the flow-through mode, pre-2013 storm conditions (mean: 12.7 µg/L; median: 13.5 µg/L). This indicates that a reduction of uranium concentration occurs in Pond A-4 during batch-release mode operations.

  - During flow-through mode, pre-2013 storm conditions, uranium concentrations at GS11 (mean: 12.7 µg/L; median: 13.5 µg/L) are slightly lower compared to the flow-through mode, post-2013 storm conditions based on post-storm samples collected through 2014 (mean: 16.7 µg/L; median: 16.0 µg/L).
  - During 2015 to June 2021 flow-through mode conditions, uranium concentrations at GS11 (mean: 11.7 µg/L; median: 10.7 µg/L), indicate a minor reduction in uranium concentrations compared to all other periods of flow-through conditions.
- GS08 (Pond B-5 outfall) – Differences between the uranium concentrations at GS08 for each of the four conditions evaluated are not as distinct as the differences observed at GS11 (Pond A-4 outfall). Approximately 76 to 85 percent of the uranium passing through Pond B-5 is from natural sources.
  - During batch-release mode, uranium concentrations at GS08 (mean: 8.9 µg/L; median: 7.9 µg/L), are slightly lower compared to the flow-through mode, pre-2013 storm conditions (mean: 11.8 µg/L; median: 10.2 µg/L). This indicates that batch-release mode operations in Pond B-5 caused some reduction in uranium concentrations compared to flow-through mode operations, prior to the September 2013 storm.
  - During flow-through mode, pre-2013 storm conditions, uranium concentrations at GS08 (mean: 11.8 µg/L; median: 10.2 µg/L) µg/L) are comparable to the flow-through mode, post-storm conditions (mean: 11.6 µg/L; median: 12.5 µg/L) measured from September 2013 through 2014. This indicates that the conditions of the Site following the September 2013 storm did not result in a substantial change in concentration of uranium in Pond B-5 discharges, when averaged for more than one year after the storm, compared to the pre-storm condition.
  - During 2015 to June 2021 flow-through mode conditions, uranium concentrations at GS08 (mean: 10.8 µg/L; median: 11.3 µg/L), are comparable to those measured during the pre-2013 storm flow-through mode.

- WALPOC – Differences between the uranium concentrations are distinct for the three conditions evaluated for WALPOC[17]:
  - During flow-through mode, pre-2013 storm conditions, uranium concentrations at WALPOC (mean: 10.5 µg/L; median: 11.4 µg/L) are lower compared to the flow-through mode, post-storm conditions from September 13, 2013 through 2014 (mean: 15.4 µg/L; median: 16.8 µg/L). This indicates that the ongoing changed conditions of the Site following the September 2013 storm resulted in a higher concentration of uranium at WALPOC compared to the conditions before the storm, to the extent that the median concentration at WALPOC during the post-storm period approached the Site-specific 16.8 µg/L standard. It also indicates that the uranium concentrations at WALPOC are more closely tied to Pond A-4 discharge concentrations than to Pond B-5 discharges; this is logical since the uranium load from A-4 discharges is substantially higher than the load from Pond B-5 discharges.
  - During flow-through mode from 2015 to June 2021, uranium concentrations at WALPOC (mean: 12.3 µg/L; median: 11.9 µg/L) had reduced uranium concentrations compared to the conditions in the time period following the 2013 storm (from September 13, 2013 through 2014), (mean: 15.4 µg/L; median: 16.8 µg/L) and are slightly higher than the concentrations observed in flow-through conditions prior to the 2013 storm (mean: 10.5 µg/L; median: 11.4 µg/L).

[17] Data from batch mode operations at WALPOC were not evaluated since monitoring at WALPOC began in September 2011 at the same time when Ponds A-4 and B-5 were switched to flow-through mode.

5.0 REFERENCES

Abdel-Sabour, M.F., 2014. Uranium fixation and Removal from Different Soil Types: Review. Journal of Nuclear Energy Science and Power Generation Technology. 3:3. 1000126.

American Cancer Society, 2020. Lifetime Risk of Developing or Dying from Cancer. https://www.cancer.org/cancer/cancer-basics/lifetime-probability-of-developing-or-dying-from-cancer.html. October 2020.

Beller, Henry R., 2005. "Aerobic, Nitrate-Dependent Oxidation of U(IV) Oxide Minerals by the Chemolithoautotrophic Bacterium *Thiobacillus denitrificans*." *Applied and Environmental Microbiology* 71.4 (2005): 2170-2174.

Brennecke, G. A., 2011, Uranium Isotope Variations in Nature: Mechanisms, Applications, and Implications, PhD. Thesis, Arizona State University.

Buerger, S., S.F. Boulyga, J.A. Cunningham, A. Koepf, J. Poths, 2009, "The range of variation of uranium isotope ratios in natural uranium samples and potential application to nuclear safeguards." International Atomic Energy Agency, Safeguards Analytical Services, Austria, IAECA-CN-184/256.

CDRMS (Colorado Division of Reclamation, Mining and Safety). 2014. Uranium Mining in Colorado.

CDPHE (Colorado Department of Public Health and Environment). 2008. Colorado Radionuclide Abatement and Disposal Strategy (CO-RADS). Final Report Radionuclide Risk Assessment Analysis Report, Appendix B. Prepared by Malcom Pirnie, Inc. for CDPHE. March 2008.

CDPHE (Colorado Department of Public Health and Environment). 2009. Colorado Radionuclide Abatement and Disposal Strategy (CO-RADS) Phase 2 and 3 Summary Report. Prepared by Malcom Pirnie, Inc. for CDPHE. March.

CDPHE (Colorado Department of Public Health and Environment). 2012. Water Quality Control Commission. Policy 96-2. Amended October 9, 2012.

CDPHE (Colorado Department of Public Health and Environment). 2013. Water Quality Control Commission Regulation No. 31. The Basic Standards and Methodologies for Surface Water (5 CCR 1002-31). Effective January 31, 2013.

CDPHE (Colorado Department of Public Health and Environment). 2014. Water Quality Control Commission Regulation. Regulation 38, Classifications and Numeric Standards – South Platte River Basin, Laramie River Basin, Republican River Basin, Smoky Hill River Basin (5 CCR 1002-38). Effective June 30, 2014.

CGS (Colorado Geological Survey). 2015. CGS website: http://coloradogeologicalsurvey.org/water/water-quality/.

Dennehy, K.F., D. W. Litke, C. M. Tate, S. L. Qi, P. B. McMahon, B. W. Bruce, R. A. Kimbrough, and J. S. Heiny, 1998. Water Quality in the South Platte River Basin, Colorado, Nebraska, and Wyoming, 1992-95. USGS Circular 1167.

DOE (U.S. Department of Energy), 2007. Rocky Flats Legacy Management Agreement, Rocky Flats Environmental Technology Site, Golden, Colorado, February.

Efurd, D.W., D.J. Rokop and R.E. Perrin, 1993. Characterization of the Radioactivity in Surface Waters and Sediment Collected at the Rocky Flats Facility, Final Report, Los Alamos National Laboratory, LA-UR-93-4373.

EPA (U. S. Environmental Protection Agency), 2000. Radionuclides Notice of Data Availability Technical Support Document. Targeting and Analysis Branch Standards and Risk Management Division Office of Ground Water and Drinking Water United States Environmental Protection Agency.

EPA (U. S. Environmental Protection Agency), 2000. Cancer Risk Coefficients for Environmental Exposure to Radionuclides. Federal Guidance Report No. 13. EPA 402-R-99-001. September 1999.

EPA (U. S. Environmental Protection Agency), State of Colorado and DOE, 2007. Rocky Flats Legacy Management Agreement. Federal Facility Agreement and Consent Order. February 2007.

EPA (U. S. Environmental Protection Agency), 2011. Letter dated August 4, 2011 from Carol Campbell to Peter Butler, CDPHE, regarding 2010 Revisions to the Basic Standards and Methodologies for Surface Waters.

Hem, J.D., 1985. Study and Interpretation of the Chemical Characteristics of Natural Water. United States Geological Survey Water-Supply Paper 2254.

Kaiser-Hill, 2002. Site-Wide Water Balance Model Report of the Rocky Flats Environmental Technology Site. May.

Kaiser-Hill, 2005. Final Interim Measure/Interim Remedial Action for Groundwater at the Rocky Flats Environmental Technology Site. June 21.

Kaiser-Hill, 2006. Historical Release Report. Rocky Flats Environmental Technology Site.

Kathren, R.L., 1984. Radioactivity in the Environment. Distribution and Surveillance. New York, NY: Harwood Academic Publishers, 93-115.

Kirkham, R. M., W. J. O'Leary, J. W. Warner, 1980. Information Series 12. Hydrogeologic and Stratigraphic Data Pertinent to Uranium Mining, Cheyenne Basin, CO. Colorado Geological Survey.

Langmuir, D. 1997, *Aqueous Environmental Geochemistry*, Upper Saddle River, Prentice Hall, Inc.

Larimer County Environmental Advisory Board, 2008. Report on In Situ Leach and Open-Pit Mining. February.

LANL, 2011. Thermal Ionization Mass Spectrometry Uranium Results for 2011 RFETS Waters.

LBNL, 2013a. U Isotopic Compositions and Concentrations of Rocky Flats Water Samples Collected During 9/13/13 to 11/25/13 and Submitted to LBNL. John N. Christensen. Report date 3/20/13.

LBNL, 2013b. U Isotopic Compositions and Concentrations of the First Batch of Rocky Flats Water Samples Submitted to LBNL. John N. Christensen. Report date 9/16/13.

NOAA, 2013a. NOAA Atlas 14, Hydrometeorological Design Studies Center, Precipitation Frequency Data Studies Center, http://hdsc.nws.noaa.gov/hdsc/pfds/.

NOAA, 2013b. Exceedance Probability Analysis for the Colorado Flood Event, 9 - 16 September 2013, Hydrometeorological Design Studies Center, National Weather Service National Oceanic and Atmospheric Administration. September 24, 2013.

Owen, Douglass E., James K. Otton. 1992. "Mountain Wetlands: Efficient Uranium Filters - Potential Impacts." U.S. Geological Survey, MS-939, Denver, CO (1992).

Pokharel, Rasesh, 2013. Oxidative dissolution of Bio-U(IV)O2(s) in presence of nitrate and iron under anaerobic conditions using flow-through columns. M.S. thesis, University of California, Merced, 60 p.

Silva, RJ and Nitsche, H, 1995. Actinide Environmental Chemistry. *Radiochimica Acta*, **70/71**, 377-396.

SN3, 2014. Verbal communication with SN3 personnel (G. Squibb).

Todorov, P.T; E.N. Illieva, 2006. Contamination with Uranium from Natural and Anthropological Sources, Rom. Journal of Physics, 51: 27-34.

TRSL (The Royal Society London), 2001. The Health Hazards of Depleted Uranium Munitions, Part I. The Royal Society London.

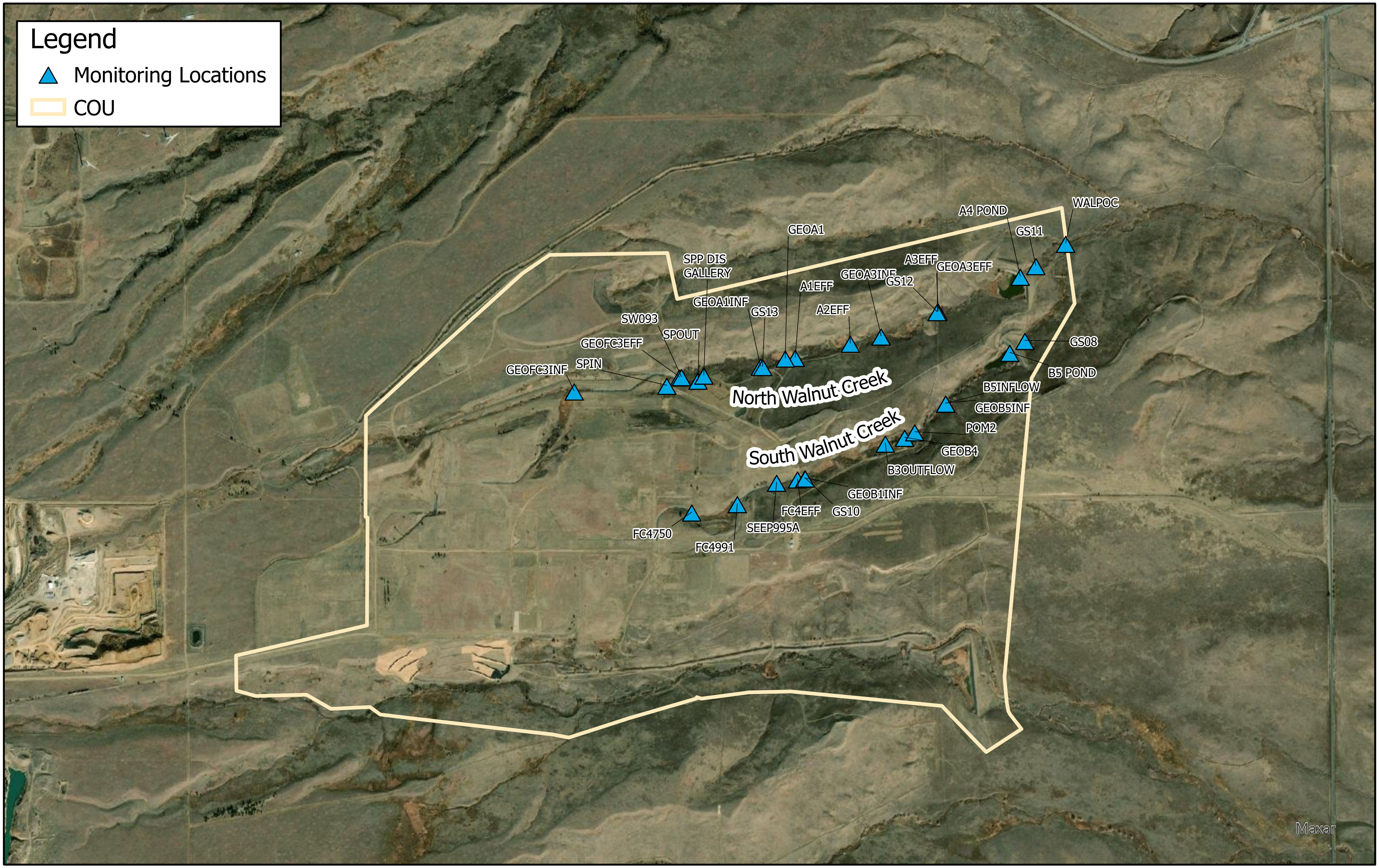
UNSCEAR (United Nations Scientific Committee on the Effects of Atomic Radiation), 1993. Report to the General Assembly, with scientific annexes, New York.

Wu, Wei-Min, Jack Carley, Stefan J. Green, Jian Luo, Shelly D. Kelly, Joy Van Nostrand, Kenneth Lowe, Tonia Mehlhorn, Sue Carroll, Benjaporn Boonchayanant, Frank E. Löfller, David Watson, Kenneth M. Kemner, Jizhong Zhou, Peter K. Kitanidis, Joel E. Kostka, Philip M. Jardine and Craig S. Criddle, 2010. Effects of Nitrate on the Stability of Uranium in a Bioreduced Region of the Subsurface. *Environmental Science Technology* 44.13 (2010): 5104-5111. doi: 10.1021/es1000837).

Weiner, E. R. 2013. Applications of Environmental Aquatic Chemistry. A Practical Guide. Third Edition. CRC Press. Boca Raton, FL.

Zaenker, Harald, Kai-Uwe Ulrich, Kai-Uwe Ulrich, Karsten Opel and Vinzenz Brendler, 2007. The Role of Colloids in Uranium Transport: a Comparison of Nuclear Waste Repositories and Abandoned Uranium Mines. IMWA Symposium 2007: Water in Mining Environments, R. Cidu & F. Frau (Eds), 27th - 31st May 2007, Cagliari, Italy.

Zielinski, R. A., J.K. Otton, R.R. Schumann, and L. Wirt. 2007. Uranium in Surface Waters and Sediments Affected by Historical Mining in the Denver West 1:100,000 Quadrangle, Colorado. Scientific Investigations Report 2007-5246. United States Geological Survey.



Path: Z:\Project Files\07\071-091\071-091.060\CAD-GIS\GIS\01_projects\RockyFlats_GW_2021\RockyFlats_GW_2021.aprx

WRIGHT WATER ENGINEERS, INC.

JEFFERSON COUNTY, COLORADO

SURFACE WATER AND SEDIMENT MONITORING LOCATIONS

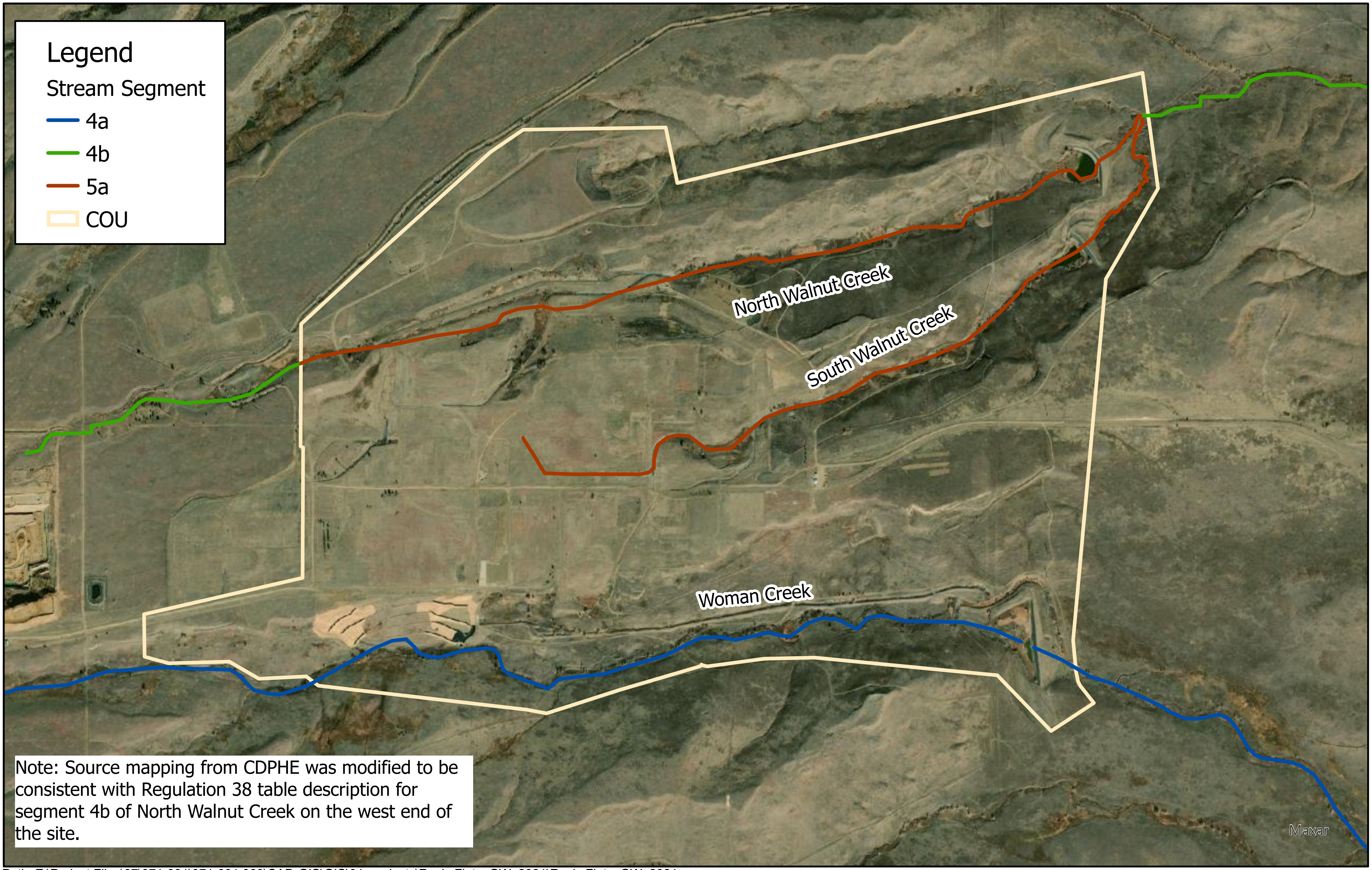
ROCKY FLATS SITE

N W E S

Feet
0 500 1,000 2,000

PROJECT NO. 071-091.060

FIGURE A.1



Path: Z:\Project Files\07\071-091\071-091.060\CAD-GIS\GIS\01_projects\RockyFlats_GW_2021\RockyFlats_GW_2021.aprx

WRIGHT WATER ENGINEERS, INC.

JEFFERSON COUNTY, COLORADO

REGULATION 38 - BIG DRY CREEK BASIN STREAM SEGMENTS

ROCKY FLATS SITE

N E S W

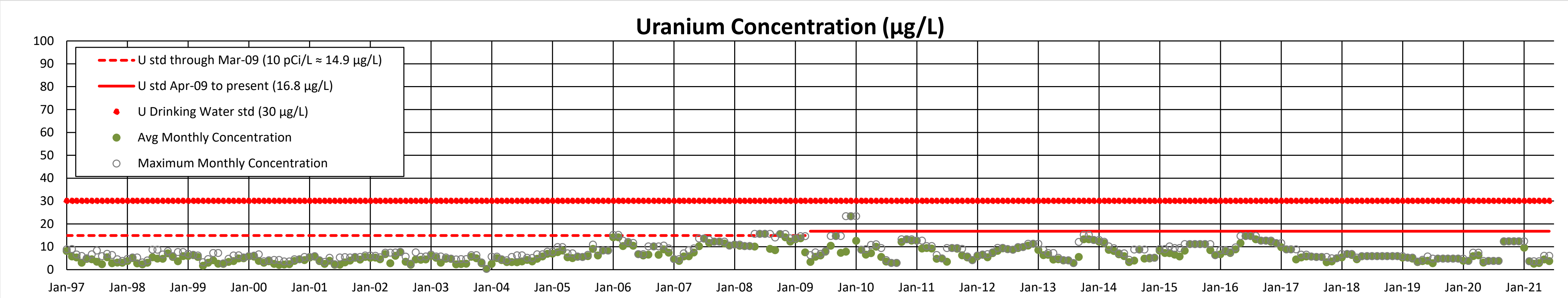
Feet 0 500 1,000

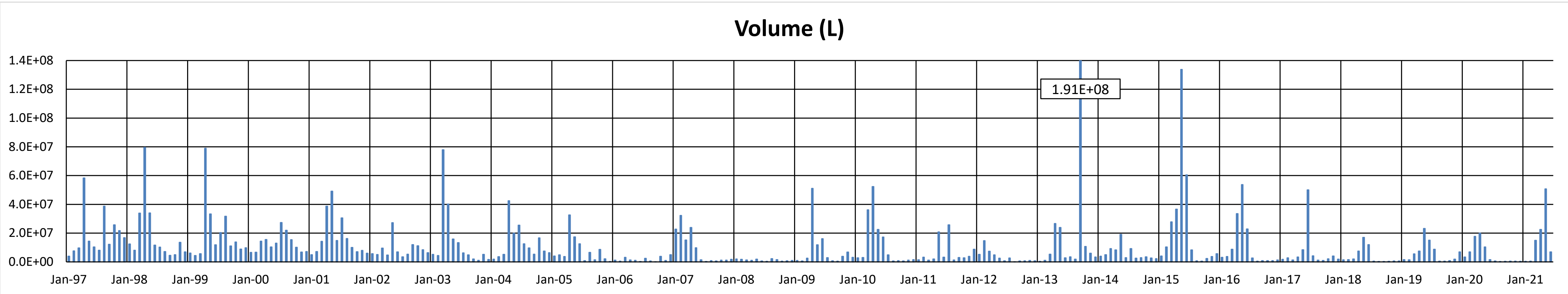
PROJECT NO. 071-091.060

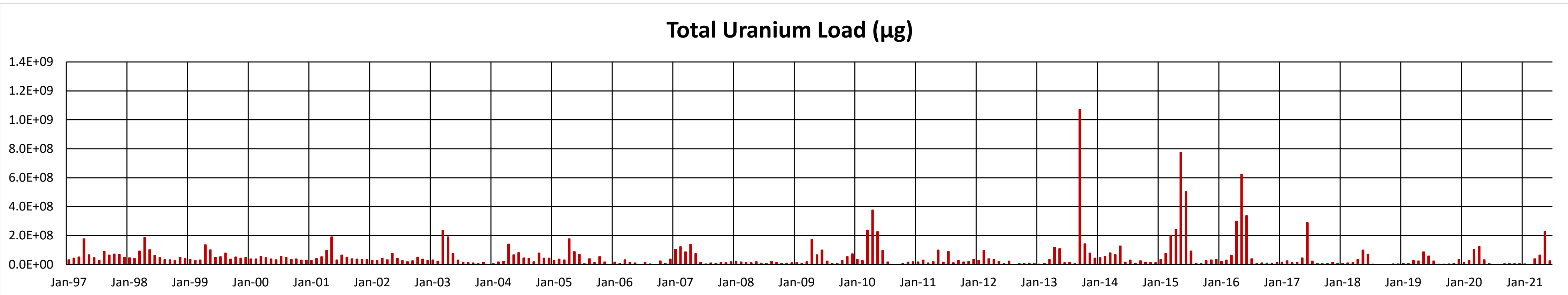
FIGURE A.2

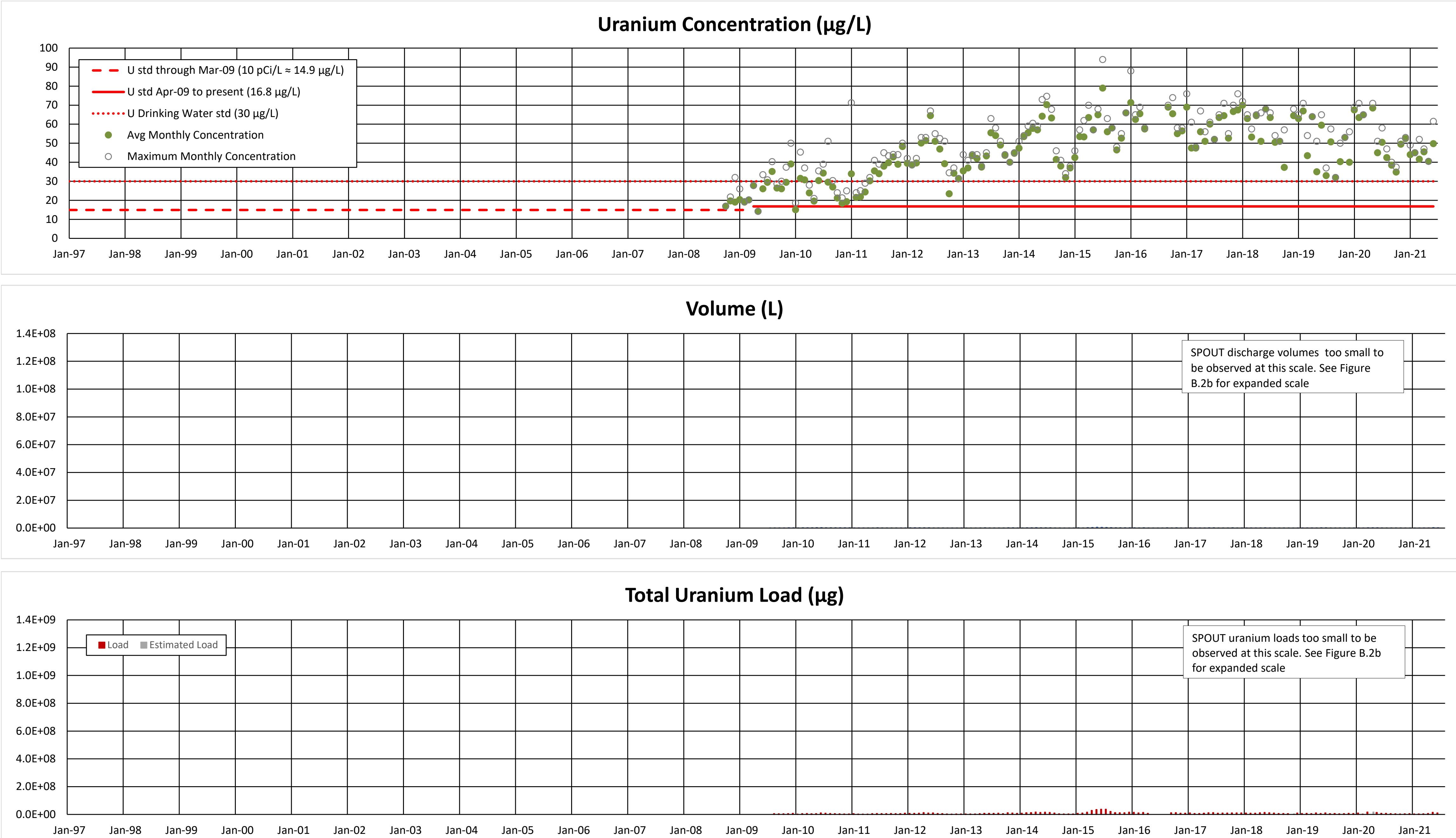
Figure B.1
Location: SW093, Jan 1997 - June 2021

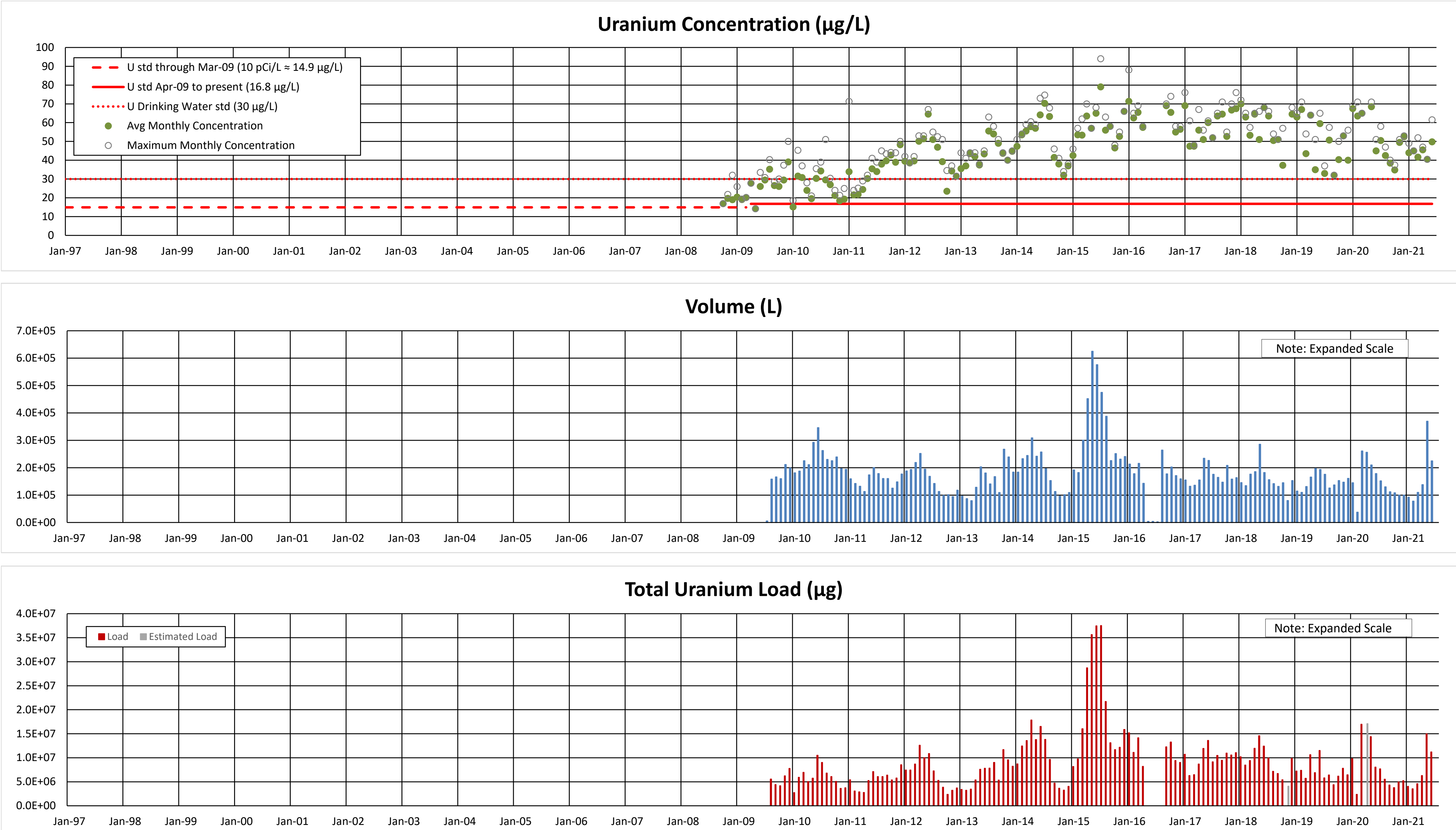
North Walnut Creek-1
(IA Perimeter)

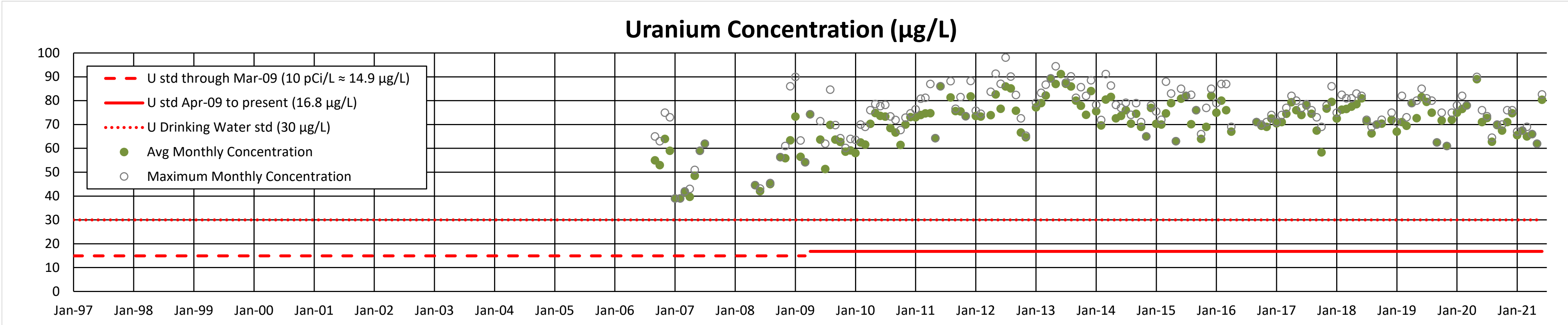


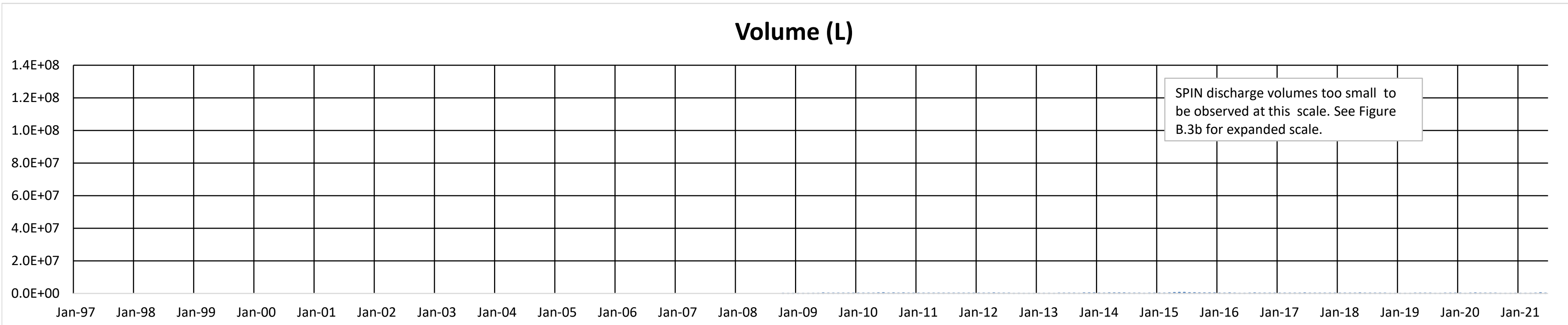





Uranium Concentration (µg/L)
U std through Mar-09 (10 pCi/L ≈ 14.9 µg/L)
U std Apr-09 to present (16.8 µg/L)
U Drinking Water std (30 µg/L)
Avg Monthly Concentration
Maximum Monthly Concentration
100
90
80
70
60
50
40
30
20
10
0
Jan-97 Jan-98 Jan-99 Jan-00 Jan-01 Jan-02 Jan-03 Jan-04 Jan-05 Jan-06 Jan-07 Jan-08 Jan-09 Jan-10 Jan-11 Jan-12 Jan-13 Jan-14 Jan-15 Jan-16 Jan-17 Jan-18 Jan-19 Jan-20 Jan-21
Volume (L)
1.4E+08
1.2E+08
1.0E+08
8.0E+07
6.0E+07
4.0E+07
2.0E+07
0.0E+00
SPOUT discharge volumes too small to be observed at this scale. See Figure B.2b for expanded scale
Jan-97 Jan-98 Jan-99 Jan-00 Jan-01 Jan-02 Jan-03 Jan-04 Jan-05 Jan-06 Jan-07 Jan-08 Jan-09 Jan-10 Jan-11 Jan-12 Jan-13 Jan-14 Jan-15 Jan-16 Jan-17 Jan-18 Jan-19 Jan-20 Jan-21
Total Uranium Load (µg)
Load
Estimated Load
1.4E+09
1.2E+09
1.0E+09
8.0E+08
6.0E+08
4.0E+08
2.0E+08
0.0E+00
SPOUT uranium loads too small to be observed at this scale. See Figure B.2b for expanded scale
Jan-97 Jan-98 Jan-99 Jan-00 Jan-01 Jan-02 Jan-03 Jan-04 Jan-05 Jan-06 Jan-07 Jan-08 Jan-09 Jan-10 Jan-11 Jan-12 Jan-13 Jan-14 Jan-15 Jan-16 Jan-17 Jan-18 Jan-19 Jan-20 Jan-21


Uranium Concentration (µg/L)
U std through Mar-09 (10 pCi/L ≈ 14.9 µg/L)
U std Apr-09 to present (16.8 µg/L)
U Drinking Water std (30 µg/L)
Avg Monthly Concentration
Maximum Monthly Concentration
100
90
80
70
60
50
40
30
20
10
0
Jan-97 Jan-98 Jan-99 Jan-00 Jan-01 Jan-02 Jan-03 Jan-04 Jan-05 Jan-06 Jan-07 Jan-08 Jan-09 Jan-10 Jan-11 Jan-12 Jan-13 Jan-14 Jan-15 Jan-16 Jan-17 Jan-18 Jan-19 Jan-20 Jan-21
Volume (L)
Note: Expanded Scale
7.0E+05
6.0E+05
5.0E+05
4.0E+05
3.0E+05
2.0E+05
1.0E+05
0.0E+00
Jan-97 Jan-98 Jan-99 Jan-00 Jan-01 Jan-02 Jan-03 Jan-04 Jan-05 Jan-06 Jan-07 Jan-08 Jan-09 Jan-10 Jan-11 Jan-12 Jan-13 Jan-14 Jan-15 Jan-16 Jan-17 Jan-18 Jan-19 Jan-20 Jan-21
Total Uranium Load (µg)
Load
Estimated Load
Note: Expanded Scale
4.0E+07
3.5E+07
3.0E+07
2.5E+07
2.0E+07
1.5E+07
1.0E+07
5.0E+06
0.0E+00
Jan-97 Jan-98 Jan-99 Jan-00 Jan-01 Jan-02 Jan-03 Jan-04 Jan-05 Jan-06 Jan-07 Jan-08 Jan-09 Jan-10 Jan-11 Jan-12 Jan-13 Jan-14 Jan-15 Jan-16 Jan-17 Jan-18 Jan-19 Jan-20 Jan-21


Uranium Concentration (µg/L)
U std through Mar-09 (10 pCi/L ≈ 14.9 µg/L)
U std Apr-09 to present (16.8 µg/L)
U Drinking Water std (30 µg/L)
Avg Monthly Concentration
Maximum Monthly Concentration
100
90
80
70
60
50
40
30
20
10
0
Jan-97 Jan-98 Jan-99 Jan-00 Jan-01 Jan-02 Jan-03 Jan-04 Jan-05 Jan-06 Jan-07 Jan-08 Jan-09 Jan-10 Jan-11 Jan-12 Jan-13 Jan-14 Jan-15 Jan-16 Jan-17 Jan-18 Jan-19 Jan-20 Jan-21


Volume (L)
SPIN discharge volumes too small to be observed at this scale. See Figure B.3b for expanded scale.
1.4E+08
1.2E+08
1.0E+08
8.0E+07
6.0E+07
4.0E+07
2.0E+07
0.0E+00
Jan-97 Jan-98 Jan-99 Jan-00 Jan-01 Jan-02 Jan-03 Jan-04 Jan-05 Jan-06 Jan-07 Jan-08 Jan-09 Jan-10 Jan-11 Jan-12 Jan-13 Jan-14 Jan-15 Jan-16 Jan-17 Jan-18 Jan-19 Jan-20 Jan-21

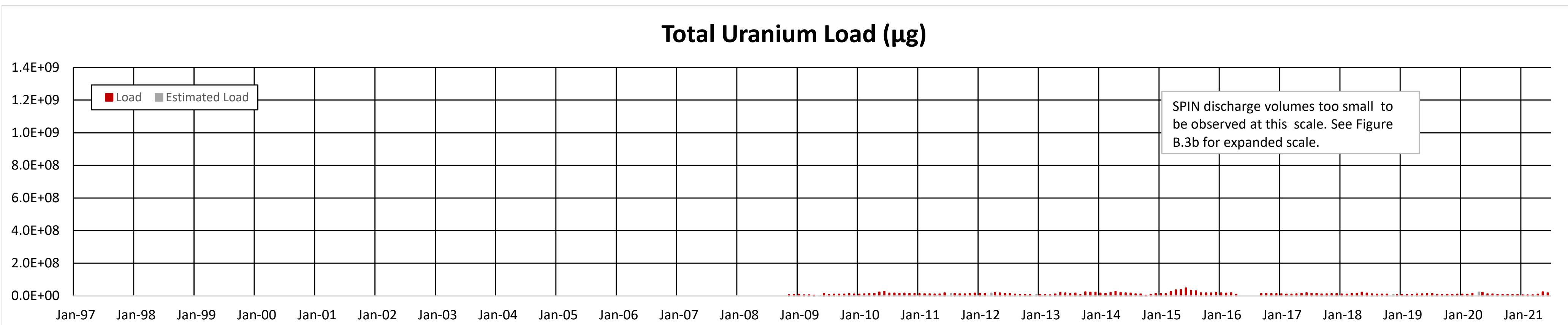
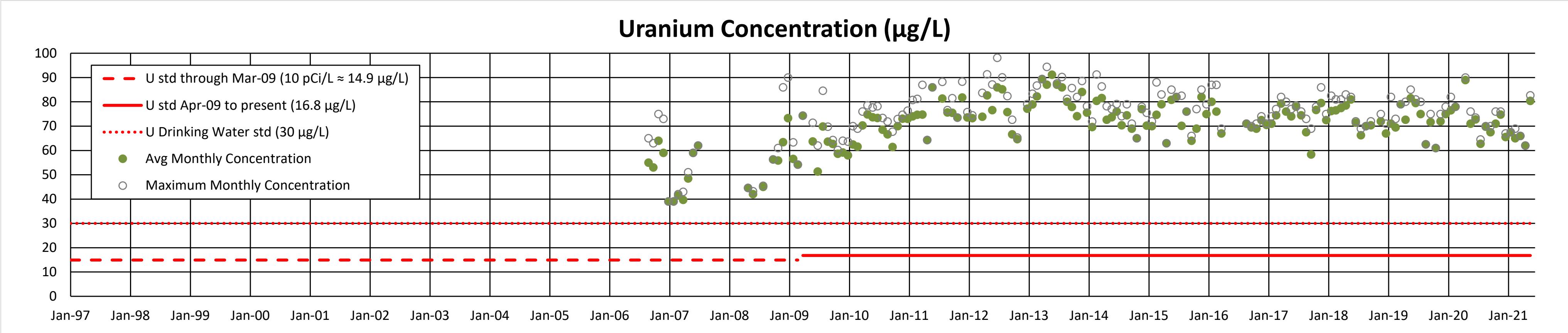
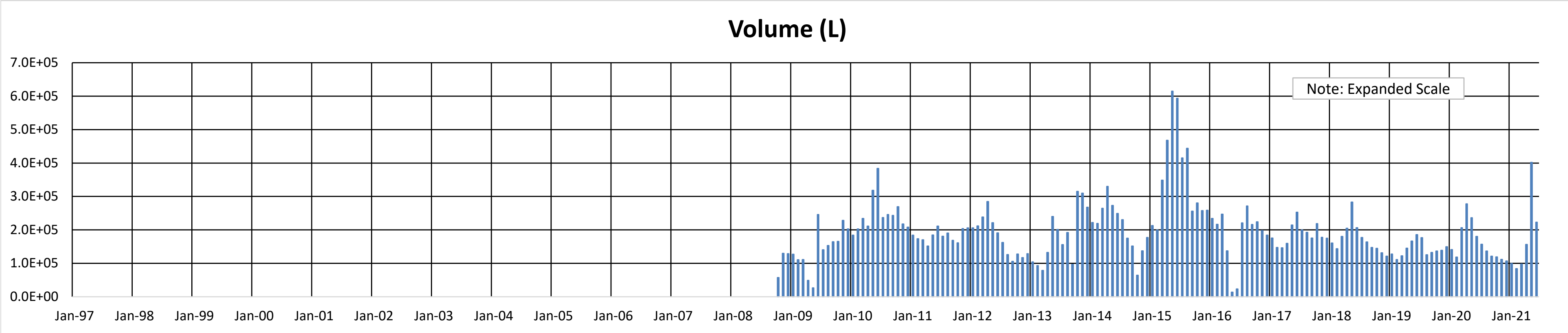
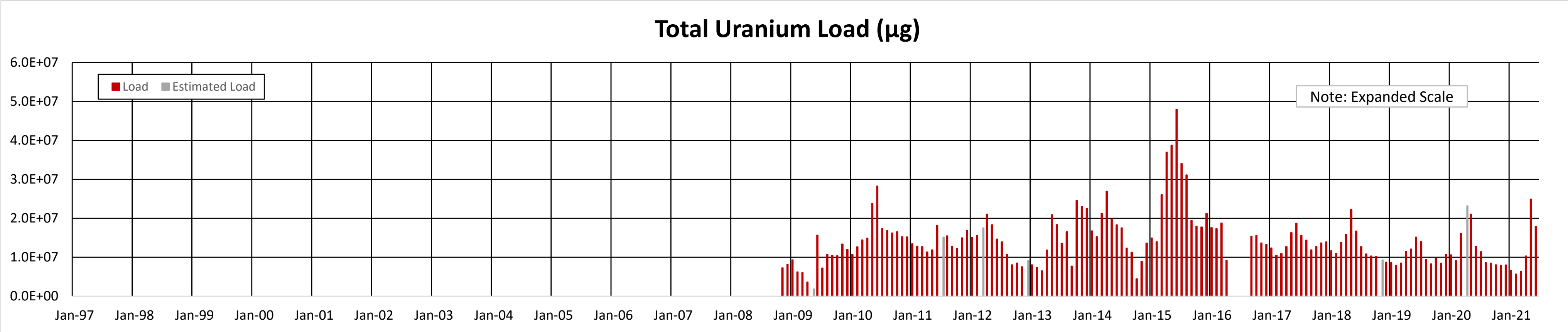

Total Uranium Load (µg)
Load
Estimated Load
SPIN discharge volumes too small to be observed at this scale. See Figure B.3b for expanded scale.
1.4E+09
1.2E+09
1.0E+09
8.0E+08
6.0E+08
4.0E+08
2.0E+08
0.0E+00
Jan-97 Jan-98 Jan-99 Jan-00 Jan-01 Jan-02 Jan-03 Jan-04 Jan-05 Jan-06 Jan-07 Jan-08 Jan-09 Jan-10 Jan-11 Jan-12 Jan-13 Jan-14 Jan-15 Jan-16 Jan-17 Jan-18 Jan-19 Jan-20 Jan-21

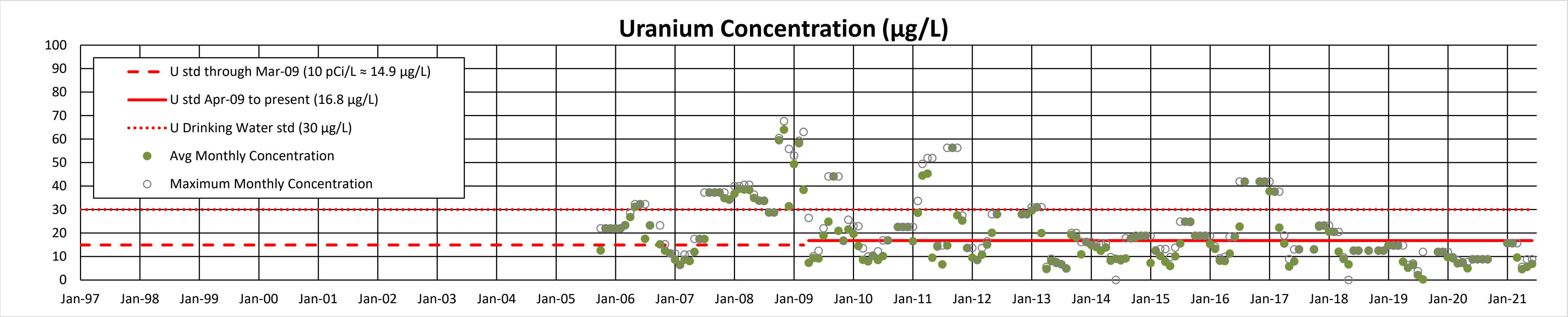
Figure B.3b
Location: SPIN, Jan 1997 - June 2021

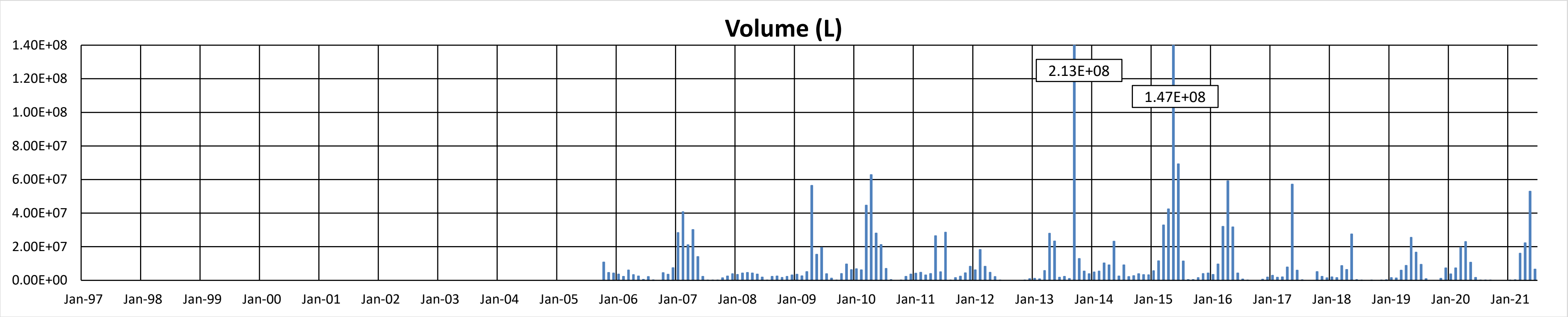
North Walnut Creek-2B
(SPPTS Inflow)








Uranium Concentration (µg/L)
U std through Mar-09 (10 pCi/L ≈ 14.9 µg/L)
U std Apr-09 to present (16.8 µg/L)
U Drinking Water std (30 µg/L)
Avg Monthly Concentration
Maximum Monthly Concentration


Volume (L)
2.13E+08
1.47E+08

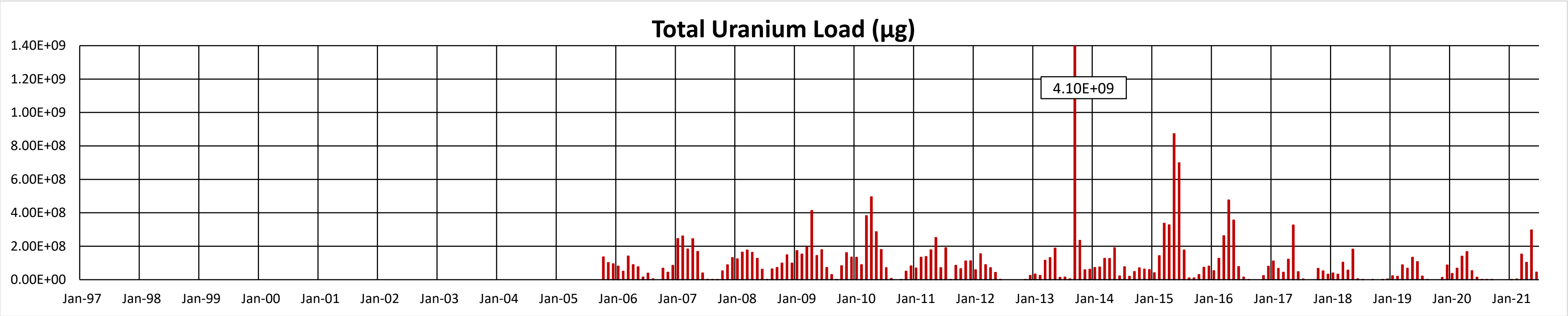
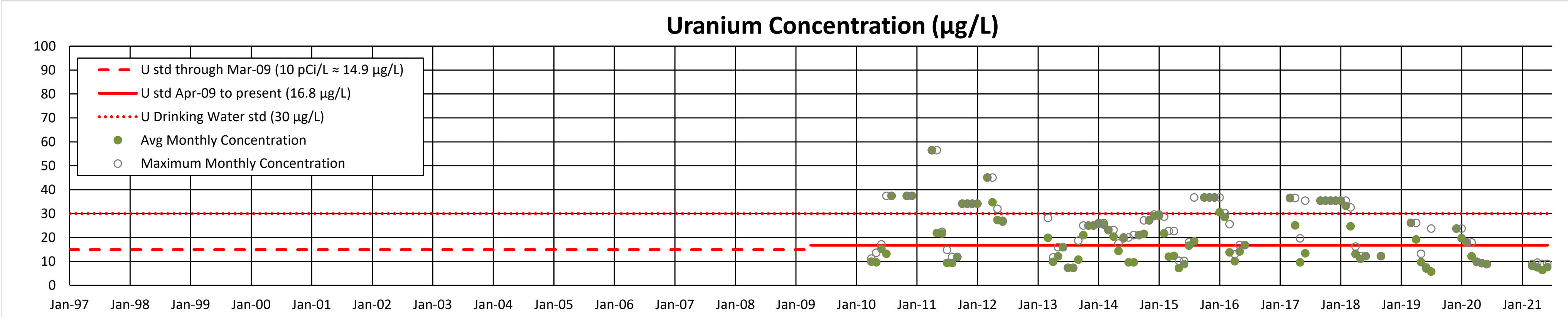
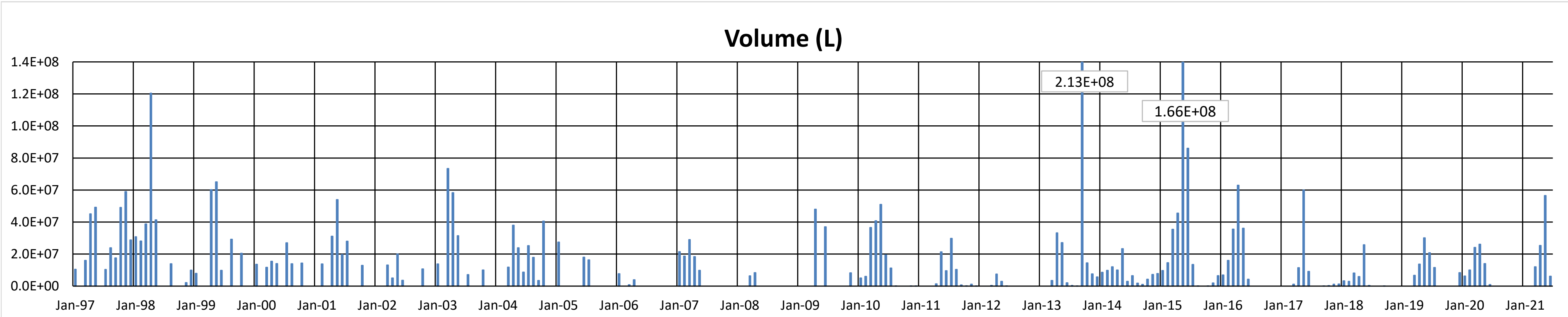
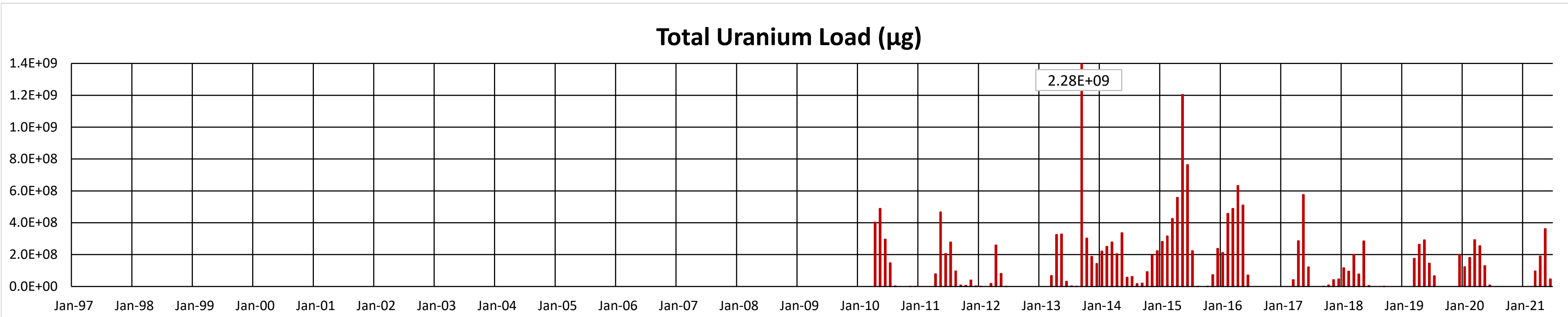

Total Uranium Load (µg)
4.10E+09

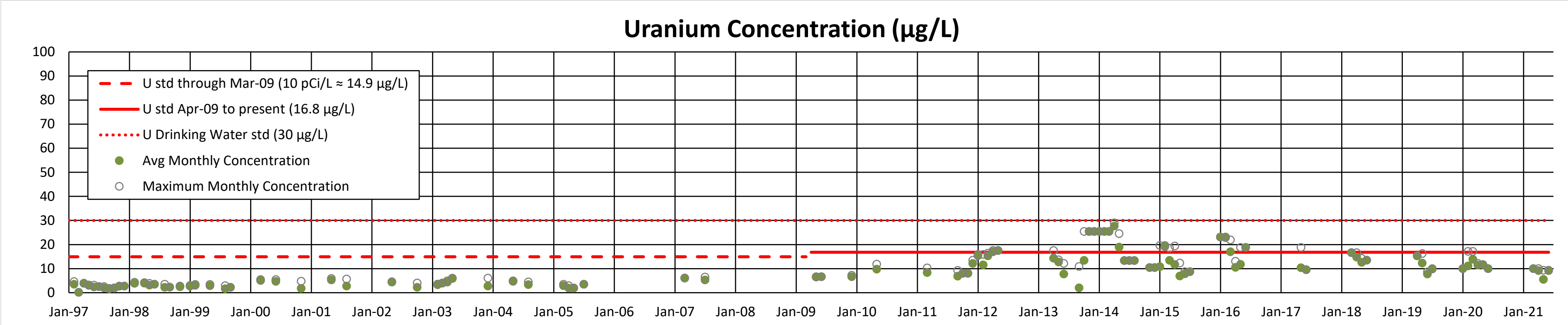
Figure B.5
Location: GS12, Jan 1997 - June 2021

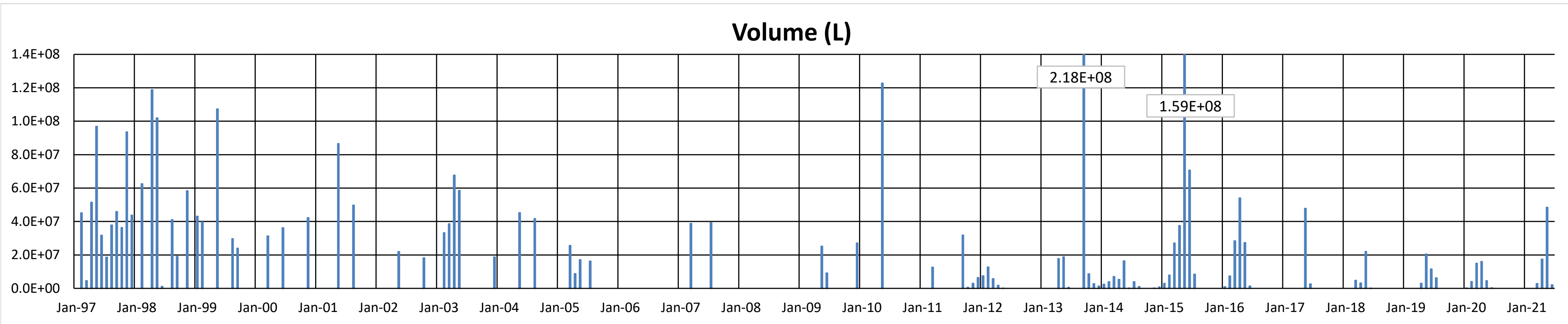
North Walnut Creek-4
(A3 Out)








Uranium Concentration (µg/L)
100
90
80
70
60
50
40
30
20
10
0
U std through Mar-09 (10 pCi/L ≈ 14.9 µg/L)
U std Apr-09 to present (16.8 µg/L)
U Drinking Water std (30 µg/L)
Avg Monthly Concentration
Maximum Monthly Concentration
Jan-97
Jan-98
Jan-99
Jan-00
Jan-01
Jan-02
Jan-03
Jan-04
Jan-05
Jan-06
Jan-07
Jan-08
Jan-09
Jan-10
Jan-11
Jan-12
Jan-13
Jan-14
Jan-15
Jan-16
Jan-17
Jan-18
Jan-19
Jan-20
Jan-21


Volume (L)
1.4E+08
1.2E+08
1.0E+08
8.0E+07
6.0E+07
4.0E+07
2.0E+07
0.0E+00
2.18E+08
1.59E+08
Jan-97
Jan-98
Jan-99
Jan-00
Jan-01
Jan-02
Jan-03
Jan-04
Jan-05
Jan-06
Jan-07
Jan-08
Jan-09
Jan-10
Jan-11
Jan-12
Jan-13
Jan-14
Jan-15
Jan-16
Jan-17
Jan-18
Jan-19
Jan-20
Jan-21

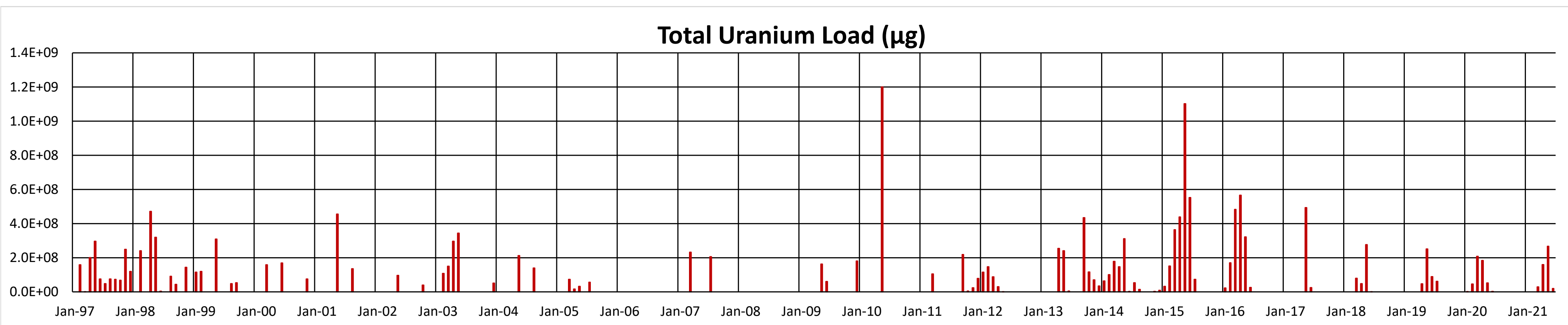
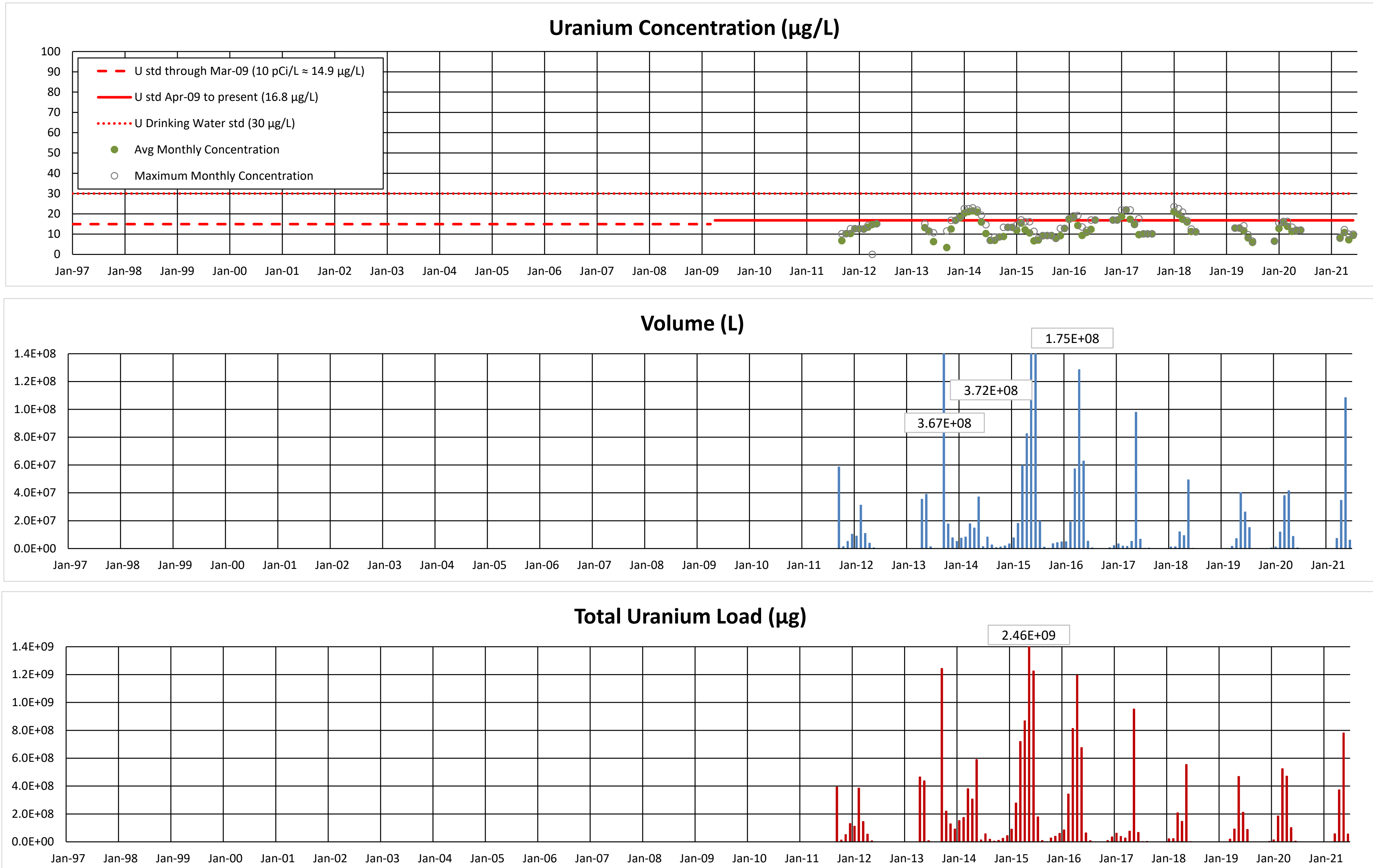
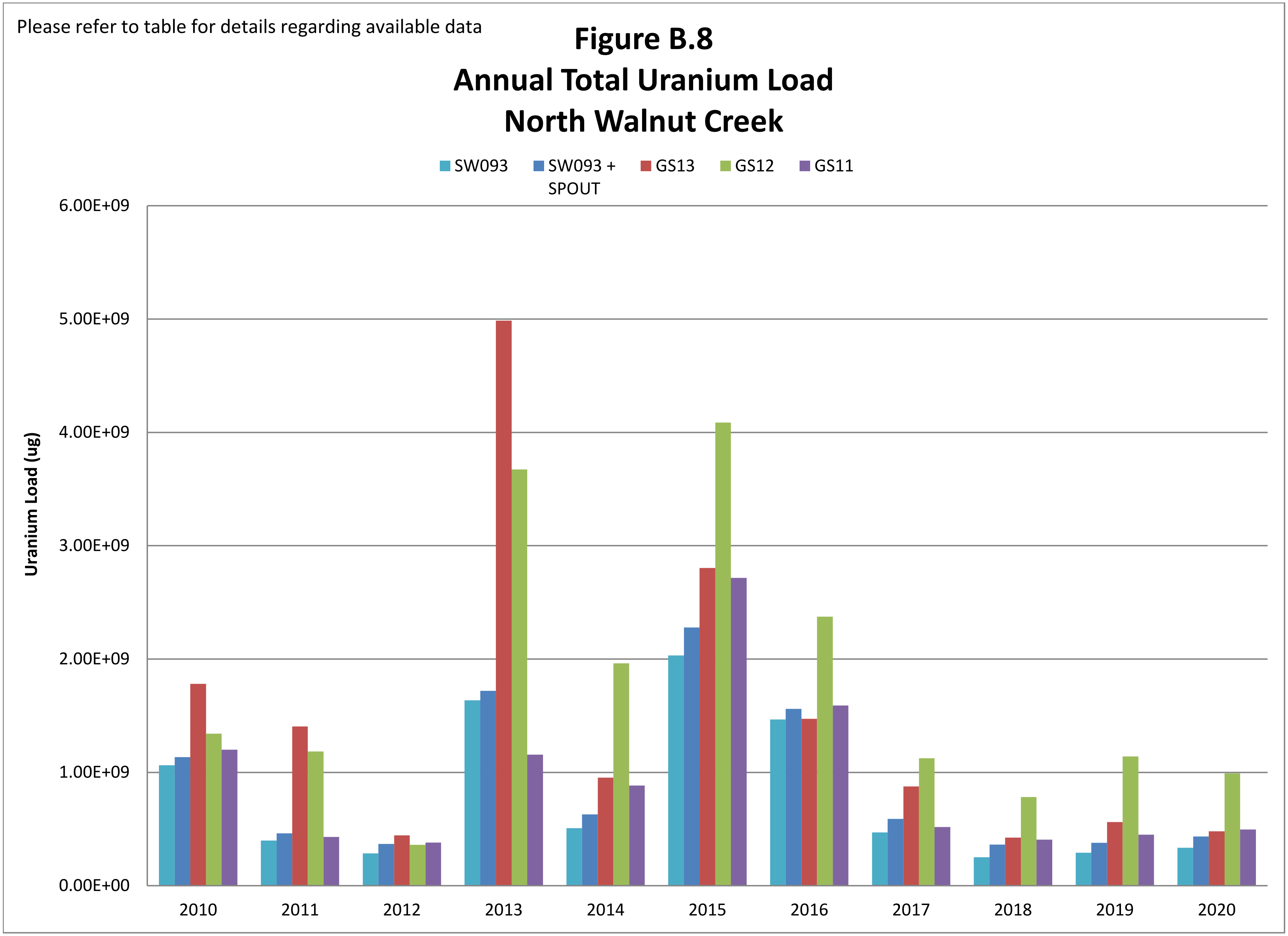

Total Uranium Load (µg)
1.4E+09
1.2E+09
1.0E+09
8.0E+08
6.0E+08
4.0E+08
2.0E+08
0.0E+00
Jan-97
Jan-98
Jan-99
Jan-00
Jan-01
Jan-02
Jan-03
Jan-04
Jan-05
Jan-06
Jan-07
Jan-08
Jan-09
Jan-10
Jan-11
Jan-12
Jan-13
Jan-14
Jan-15
Jan-16
Jan-17
Jan-18
Jan-19
Jan-20
Jan-21

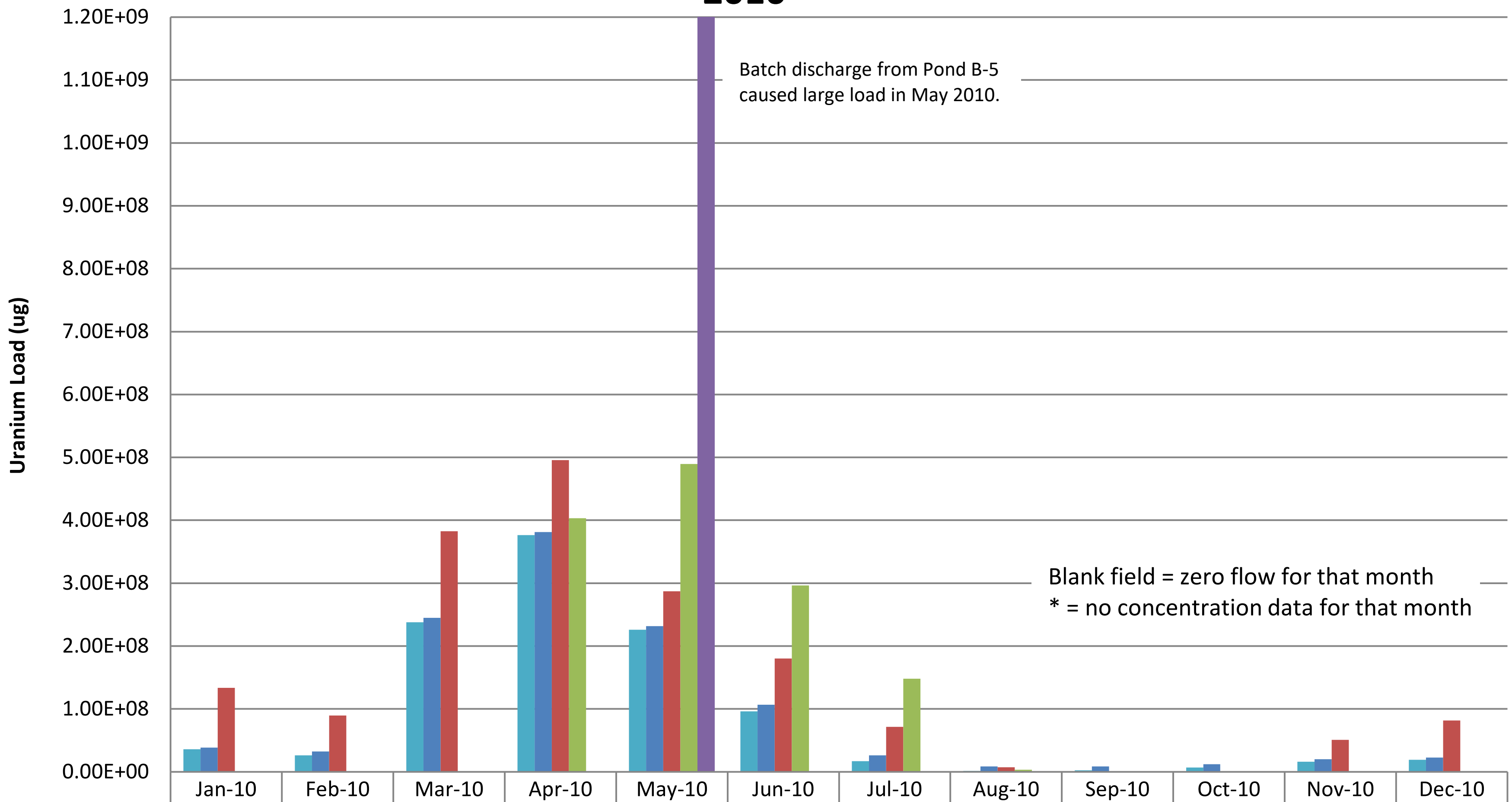
Figure B.7
Location: WALPOC, Jan 1997 - June 2021




Please refer to table for details regarding available data
Figure B.8
Annual Total Uranium Load
North Walnut Creek
SW093
SW093 + SPOUT
GS13
GS12
GS11
Uranium Load (ug)
6.00E+09
5.00E+09
4.00E+09
3.00E+09
2.00E+09
1.00E+09
0.00E+00
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020

Please refer to table for details regarding available data

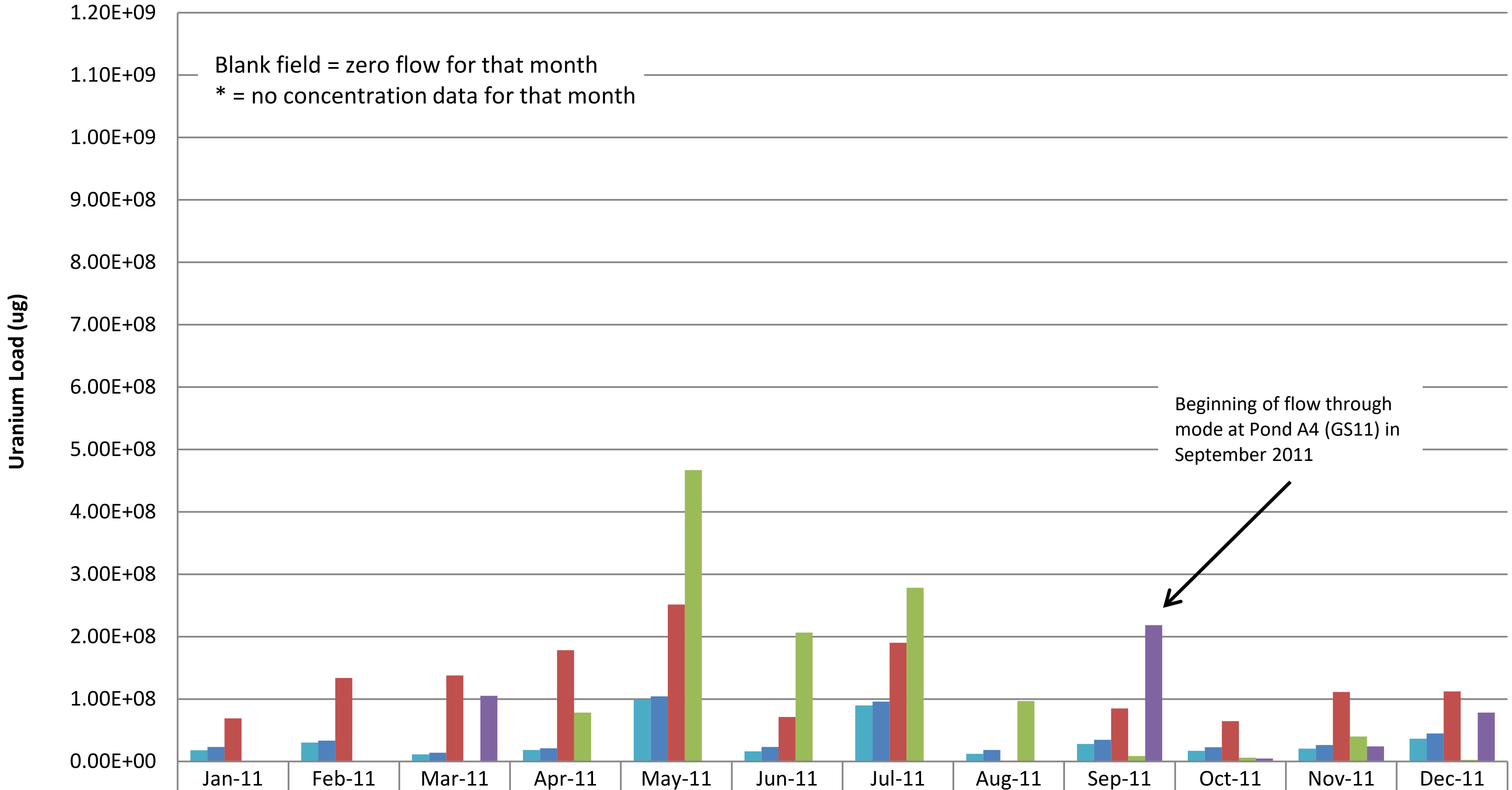
Figure B.9
Monthly Uranium Load in North Walnut Creek
2010



	Jan-10	Feb-10	Mar-10	Apr-10	May-10	Jun-10	Jul-10	Aug-10	Sep-10	Oct-10	Nov-10	Dec-10
SW093	3.60E+07	2.64E+07	2.38E+08	3.76E+08	2.26E+08	9.63E+07	1.72E+07	1.69E+06	2.39E+06	7.05E+06	1.63E+07	1.91E+07
SW093 + SPOUT	3.87E+07	3.23E+07	2.45E+08	3.81E+08	2.32E+08	1.07E+08	2.62E+07	8.49E+06	8.48E+06	1.21E+07	1.99E+07	2.28E+07
GS13	1.33E+08	8.98E+07	3.83E+08	4.96E+08	2.87E+08	1.80E+08	7.17E+07	7.17E+06		8.64E+03	5.08E+07	8.16E+07
GS12	*	*	*	4.03E+08	4.89E+08	2.96E+08	1.48E+08	3.26E+06			7.29E+05	8.74E+05
GS11					1.20E+09							

Please refer to table for details regarding available data

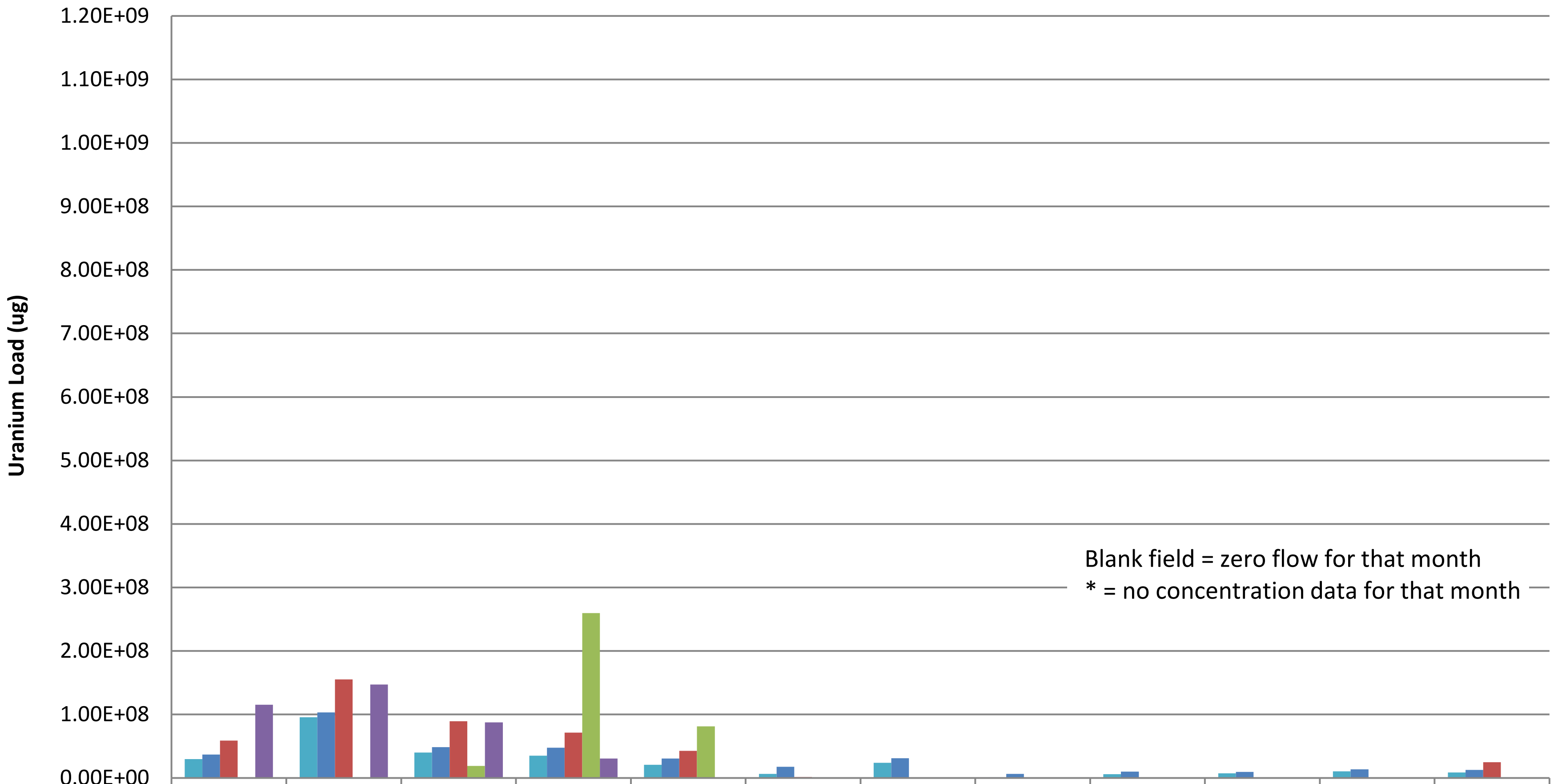
Figure B.10
Monthly Uranium Load in North Walnut Creek
2011



	Jan-11	Feb-11	Mar-11	Apr-11	May-11	Jun-11	Jul-11	Aug-11	Sep-11	Oct-11	Nov-11	Dec-11
SW093	1.80E+07	3.02E+07	1.12E+07	1.84E+07	9.92E+07	1.62E+07	8.99E+07	1.23E+07	2.81E+07	1.73E+07	2.07E+07	3.63E+07
SW093 + SPOUT	2.34E+07	3.32E+07	1.41E+07	2.12E+07	1.05E+08	2.33E+07	9.60E+07	1.84E+07	3.45E+07	2.27E+07	2.64E+07	4.48E+07
GS13	6.90E+07	1.34E+08	1.38E+08	1.78E+08	2.51E+08	7.13E+07	1.90E+08	1.02E+06	8.48E+07	6.46E+07	1.12E+08	1.12E+08
GS12				7.84E+07	4.67E+08	2.07E+08	2.79E+08	9.68E+07	8.92E+06	6.15E+06	3.98E+07	2.55E+06
GS11			1.05E+08						2.18E+08	4.79E+06	2.41E+07	7.85E+07

Please refer to table for details regarding available data

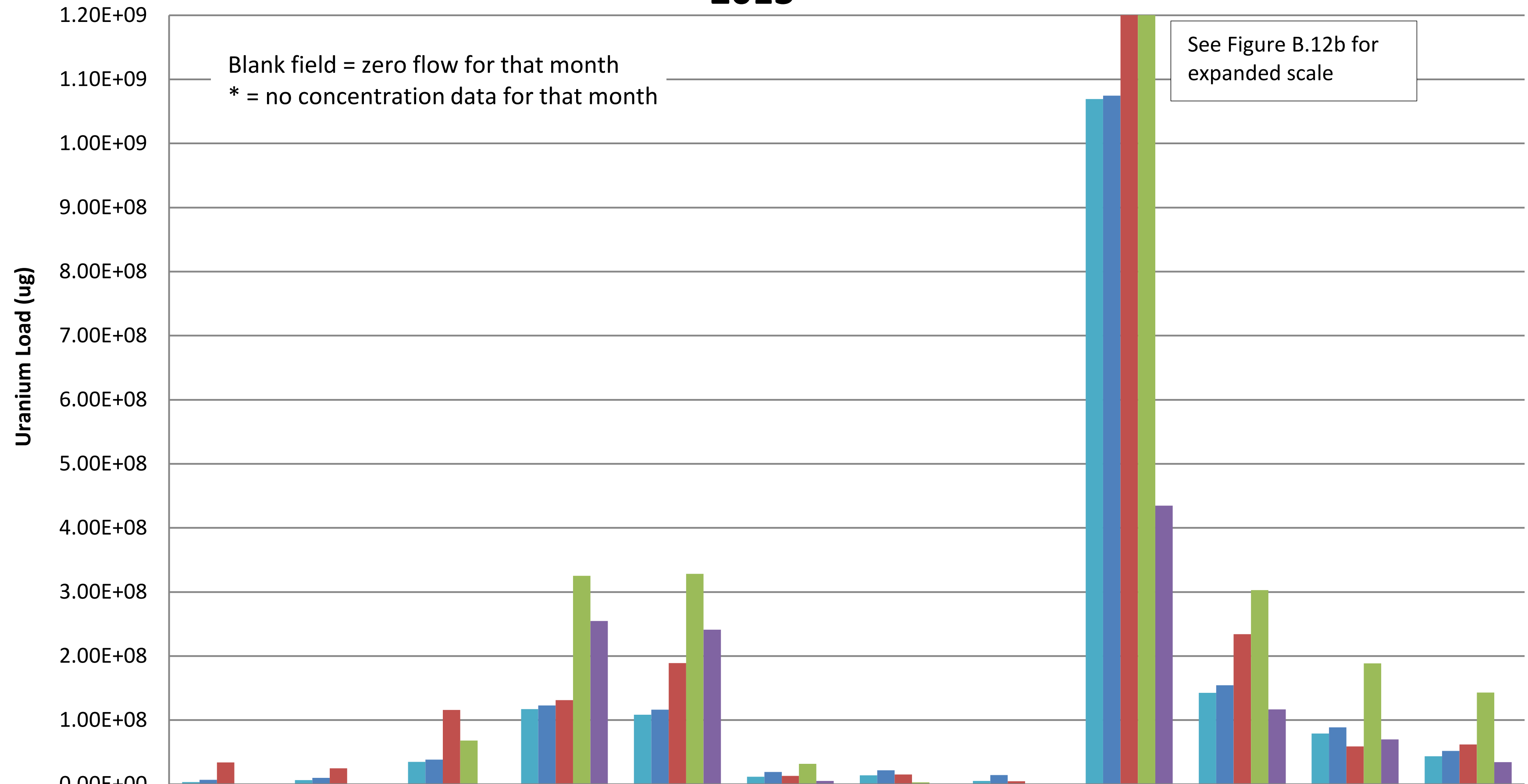
Figure B.11
Monthly Uranium Load in North Walnut Creek
2012



	Jan-12	Feb-12	Mar-12	Apr-12	May-12	Jun-12	Jul-12	Aug-12	Sep-12	Oct-12	Nov-12	Dec-12
SW093	2.97E+07	9.58E+07	3.99E+07	3.53E+07	2.08E+07	6.55E+06	2.38E+07	9.65E+05	6.17E+06	7.40E+06	1.04E+07	8.80E+06
SW093 + SPOUT	3.71E+07	1.03E+08	4.86E+07	4.79E+07	3.09E+07	1.74E+07	3.10E+07	6.27E+06	1.00E+07	9.78E+06	1.36E+07	1.25E+07
GS13	5.88E+07	1.55E+08	8.95E+07	7.14E+07	4.26E+07	1.31E+06					7.12E+05	2.47E+07
GS12	5.14E+02		1.91E+07	2.60E+08	8.15E+07	4.20E+05						
GS11	1.15E+08	1.47E+08	8.76E+07	3.04E+07	6.40E+05							

Please refer to table for details regarding available data

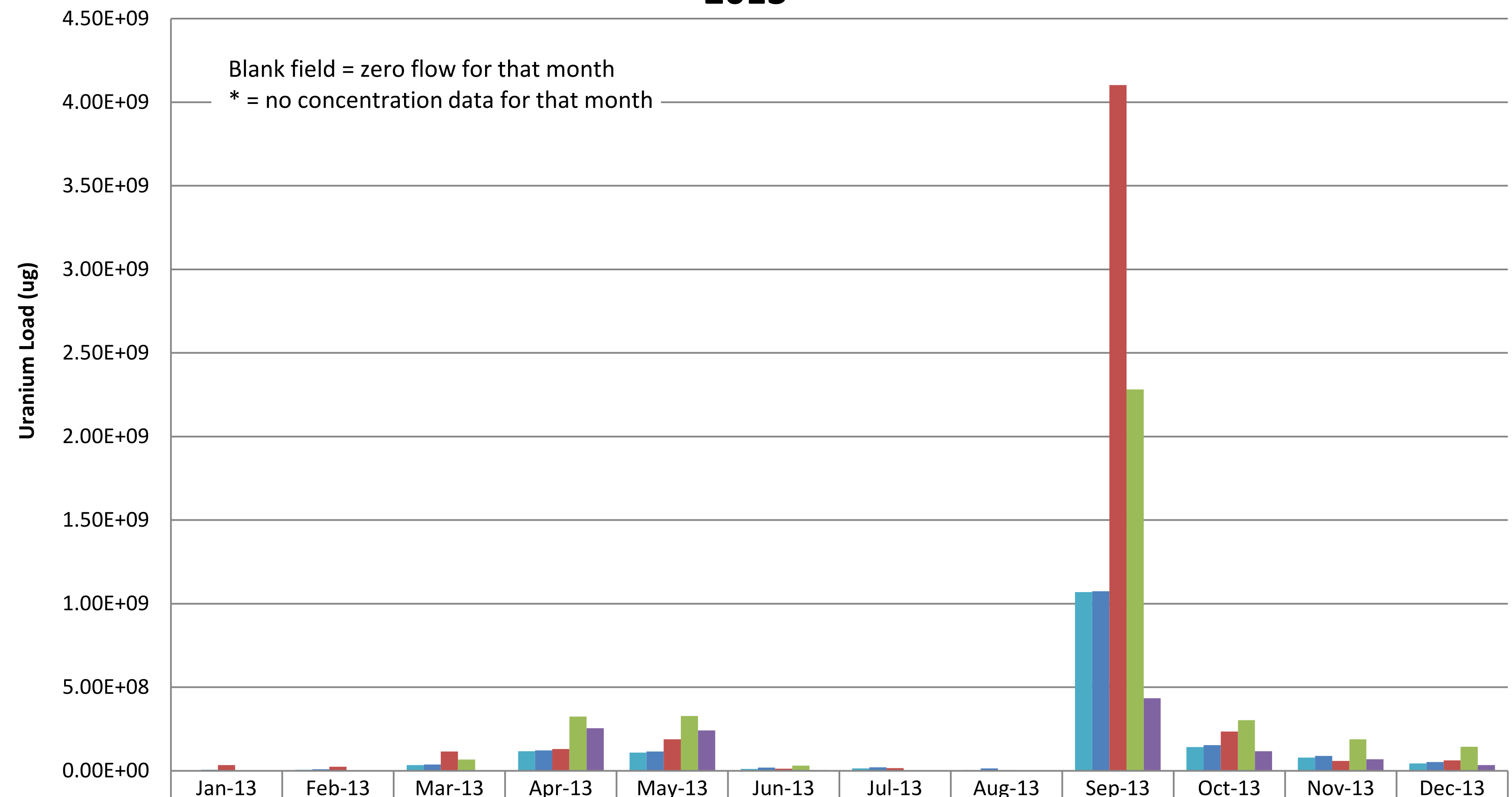
Figure B.12a
Monthly Uranium Load in North Walnut Creek
2013



	Jan-13	Feb-13	Mar-13	Apr-13	May-13	Jun-13	Jul-13	Aug-13	Sep-13	Oct-13	Nov-13	Dec-13
SW093	3.28E+06	6.68E+06	3.48E+07	1.17E+08	1.09E+08	1.15E+07	1.41E+07	5.34E+06	1.07E+09	1.43E+08	7.94E+07	4.37E+07
SW093 + SPOUT	6.70E+06	9.90E+06	3.83E+07	1.23E+08	1.16E+08	1.94E+07	2.19E+07	1.44E+07	1.07E+09	1.54E+08	8.89E+07	5.19E+07
GS13	3.39E+07	2.47E+07	1.16E+08	1.31E+08	1.89E+08	1.30E+07	1.54E+07	4.81E+06	4.10E+09	2.34E+08	5.89E+07	6.22E+07
GS12			6.83E+07	3.25E+08	3.28E+08	3.19E+07	3.01E+06	4.83E+02	2.28E+09	3.03E+08	1.89E+08	1.43E+08
GS11				2.55E+08	2.41E+08	5.21E+06			4.35E+08	1.17E+08	6.98E+07	3.46E+07

Please refer to table for details regarding available data

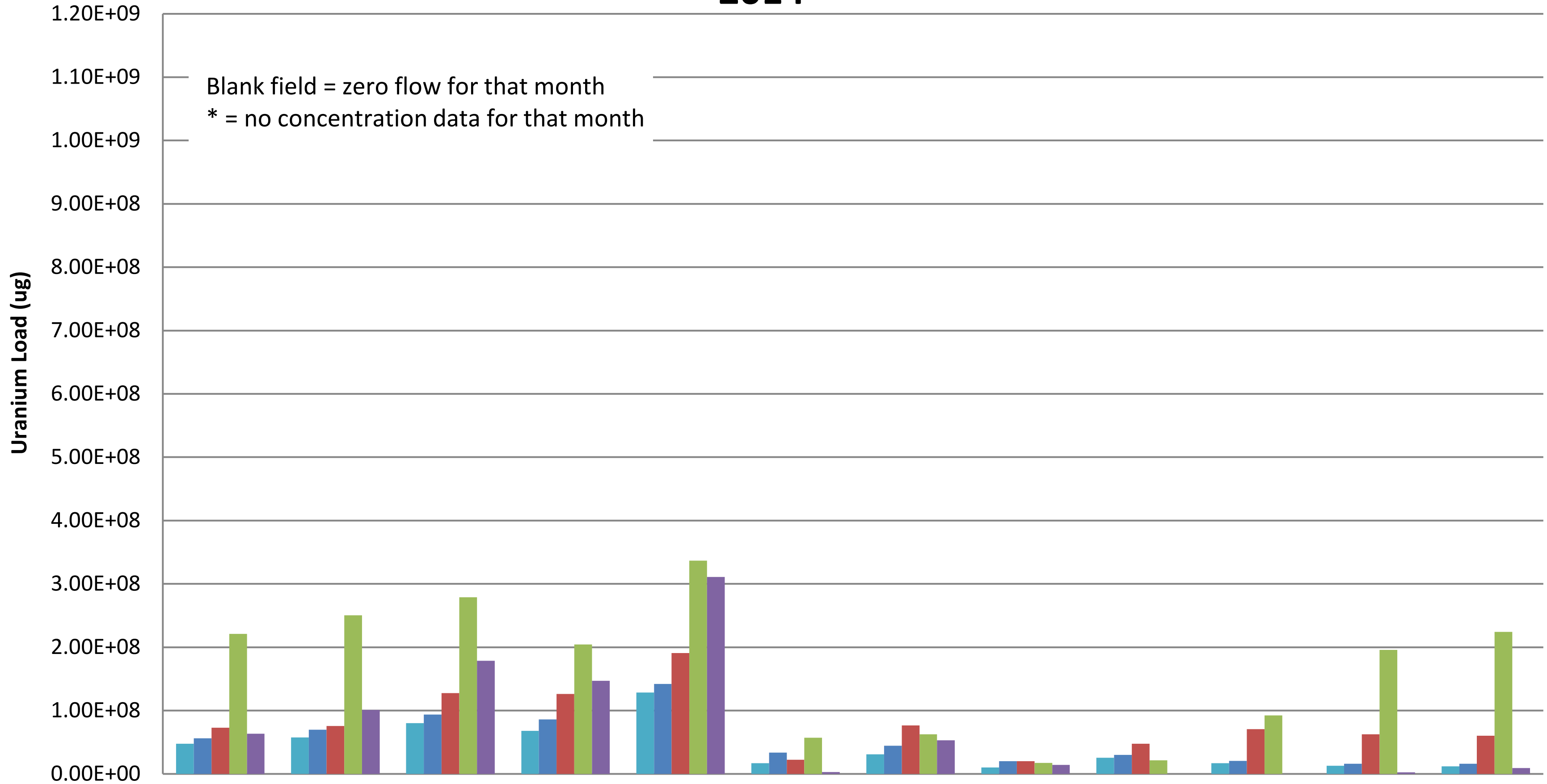
Figure B.12b
Monthly Uranium Load in North Walnut Creek
2013



	Jan-13	Feb-13	Mar-13	Apr-13	May-13	Jun-13	Jul-13	Aug-13	Sep-13	Oct-13	Nov-13	Dec-13
SW093	3.28E+06	6.68E+06	3.48E+07	1.17E+08	1.09E+08	1.15E+07	1.41E+07	5.34E+06	1.07E+09	1.43E+08	7.94E+07	4.37E+07
SW093 + SPOUT	6.70E+06	9.90E+06	3.83E+07	1.23E+08	1.16E+08	1.94E+07	2.19E+07	1.44E+07	1.07E+09	1.54E+08	8.89E+07	5.19E+07
GS13	3.39E+07	2.47E+07	1.16E+08	1.31E+08	1.89E+08	1.30E+07	1.54E+07	4.81E+06	4.10E+09	2.34E+08	5.89E+07	6.22E+07
GS12			6.83E+07	3.25E+08	3.28E+08	3.19E+07	3.01E+06	4.83E+02	2.28E+09	3.03E+08	1.89E+08	1.43E+08
GS11				2.55E+08	2.41E+08	5.21E+06			4.35E+08	1.17E+08	6.98E+07	3.46E+07

Please refer to table for details regarding available data

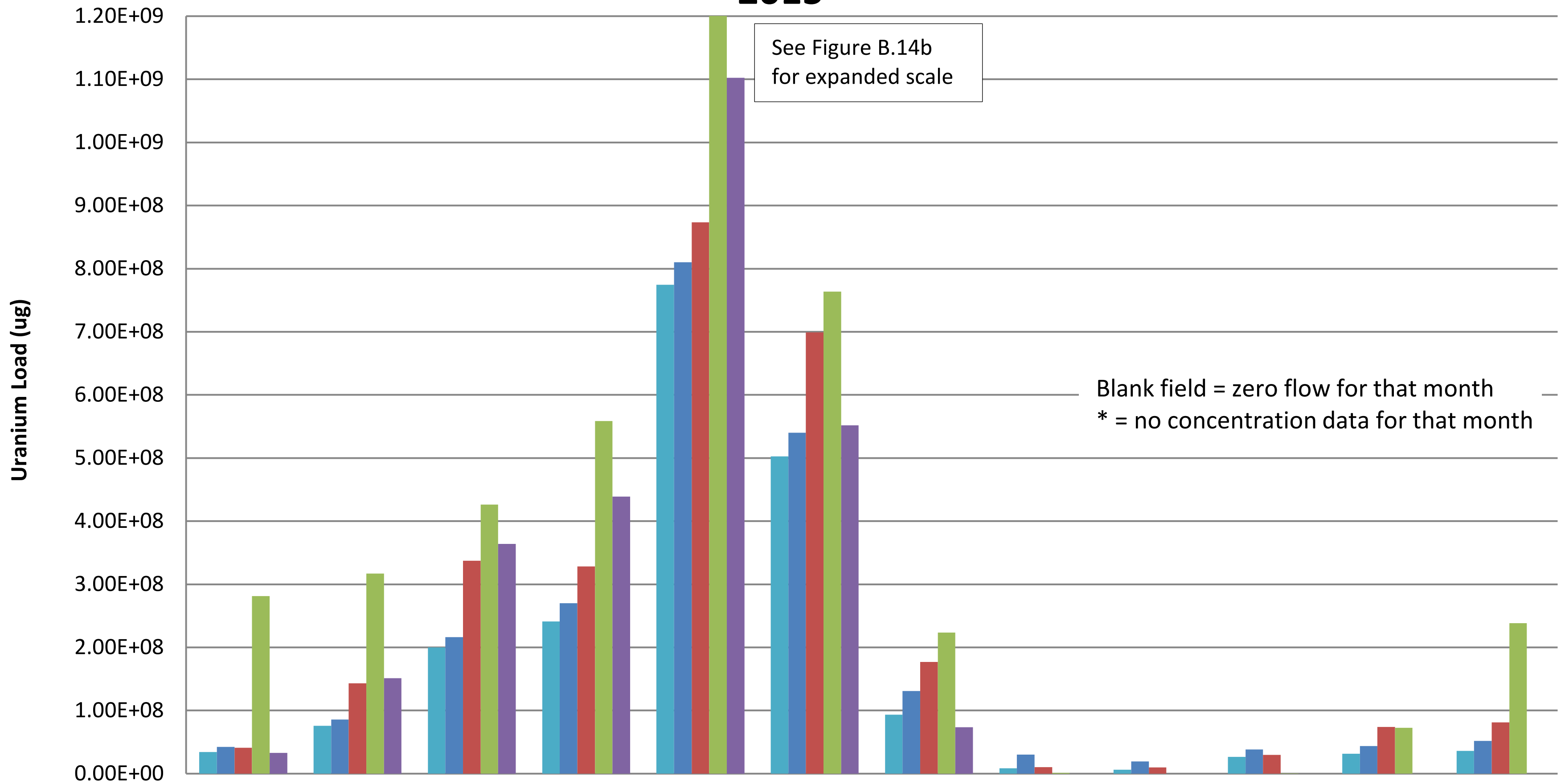
Figure B.13
Monthly Uranium Load in North Walnut Creek
2014



	Jan-14	Feb-14	Mar-14	Apr-14	May-14	Jun-14	Jul-14	Aug-14	Sep-14	Oct-14	Nov-14	Dec-14
SW093	4.77E+07	5.75E+07	8.02E+07	6.80E+07	1.28E+08	1.71E+07	3.08E+07	1.03E+07	2.55E+07	1.69E+07	1.30E+07	1.19E+07
SW093 + SPOUT	5.64E+07	6.99E+07	9.37E+07	8.59E+07	1.42E+08	3.36E+07	4.46E+07	1.99E+07	3.02E+07	2.05E+07	1.62E+07	1.59E+07
GS13	7.28E+07	7.55E+07	1.28E+08	1.26E+08	1.91E+08	2.22E+07	7.67E+07	1.99E+07	4.78E+07	7.07E+07	6.25E+07	6.03E+07
GS12	2.21E+08	2.51E+08	2.79E+08	2.04E+08	3.36E+08	5.73E+07	6.24E+07	1.74E+07	2.14E+07	9.24E+07	1.96E+08	2.24E+08
GS11	6.34E+07	1.01E+08	1.79E+08	1.47E+08	3.11E+08	2.85E+06	5.30E+07	1.44E+07			2.60E+06	9.24E+06

Please refer to table for details regarding available data

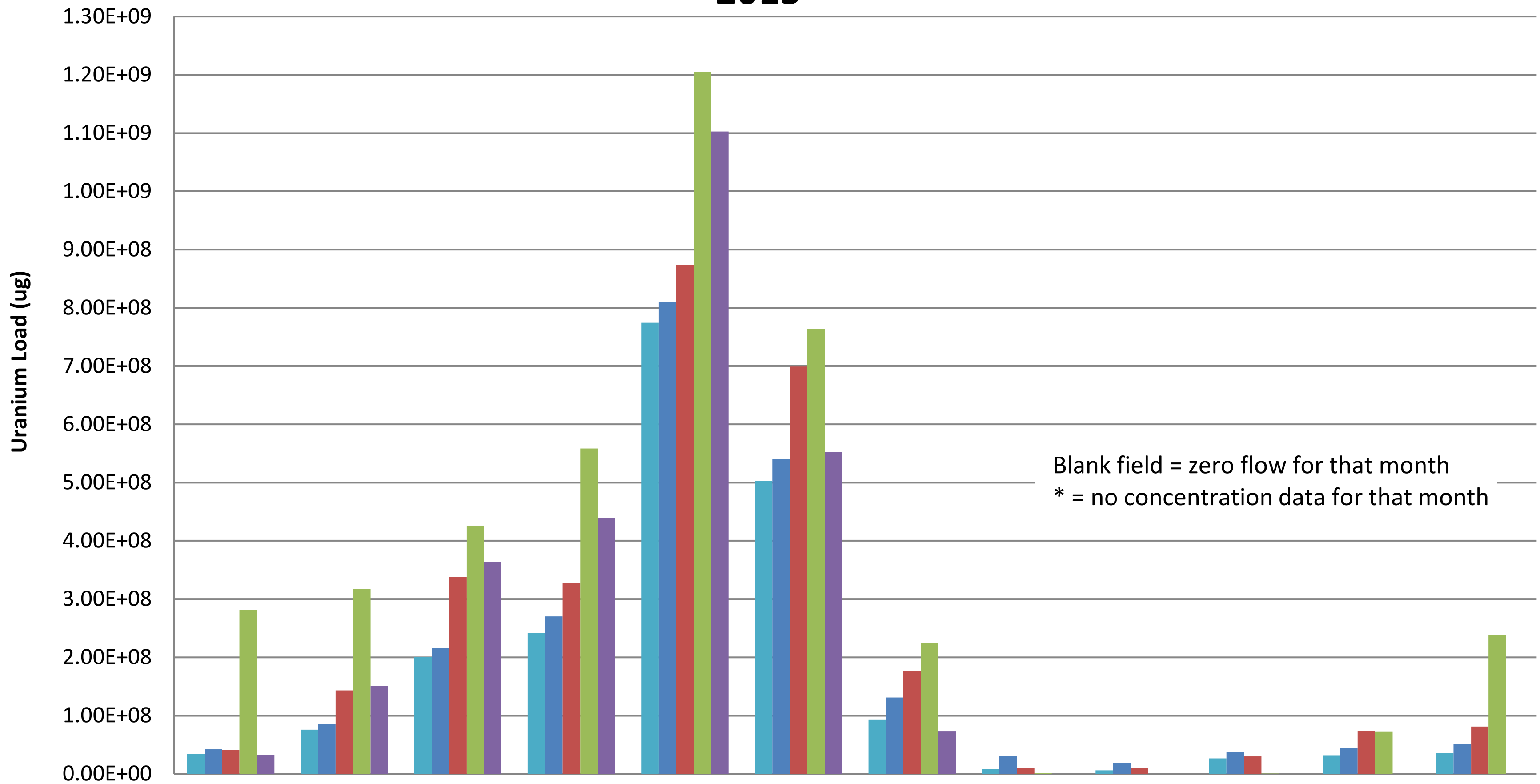
Figure B.14a
Monthly Uranium Load in North Walnut Creek
2015



	Jan-15	Feb-15	Mar-15	Apr-15	May-15	Jun-15	Jul-15	Aug-15	Sep-15	Oct-15	Nov-15	Dec-15
SW093	3.41E+07	7.58E+07	2.00E+08	2.41E+08	7.75E+08	5.03E+08	9.35E+07	8.63E+06	6.11E+06	2.65E+07	3.17E+07	3.59E+07
SW093 + SPOUT	4.23E+07	8.56E+07	2.16E+08	2.70E+08	8.10E+08	5.40E+08	1.31E+08	3.03E+07	1.92E+07	3.82E+07	4.39E+07	5.18E+07
GS13	4.10E+07	1.43E+08	3.38E+08	3.28E+08	8.73E+08	6.99E+08	1.77E+08	1.02E+07	9.87E+06	2.99E+07	7.40E+07	8.12E+07
GS12	2.81E+08	3.17E+08	4.26E+08	5.58E+08	1.20E+09	7.64E+08	2.24E+08	1.29E+06		3.80E+05	7.28E+07	2.38E+08
GS11	3.28E+07	1.51E+08	3.64E+08	4.39E+08	1.10E+09	5.52E+08	7.36E+07					

Please refer to table for details regarding available data

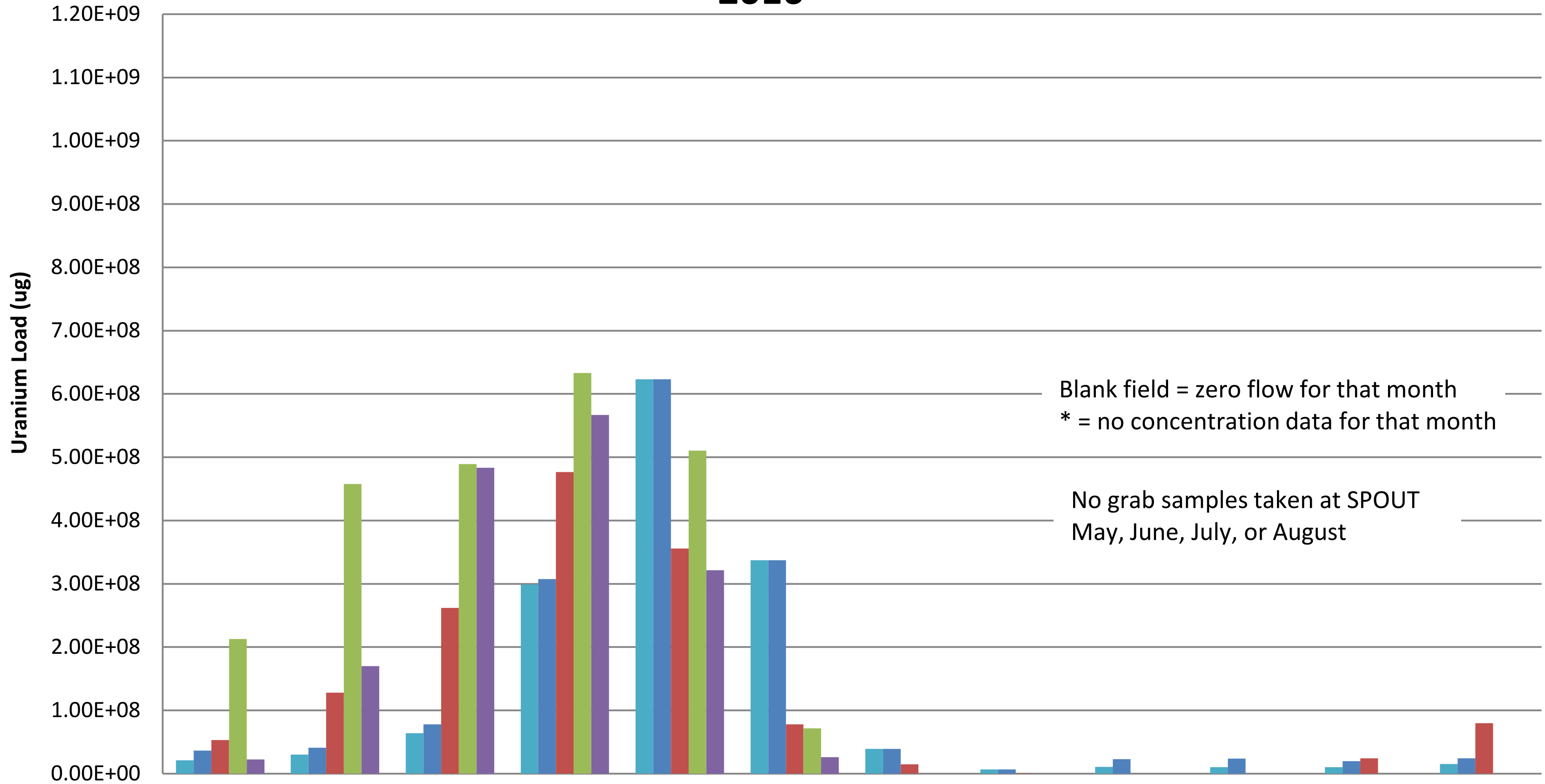
Figure B.14b
Monthly Uranium Load in North Walnut Creek
2015



	Jan-15	Feb-15	Mar-15	Apr-15	May-15	Jun-15	Jul-15	Aug-15	Sep-15	Oct-15	Nov-15	Dec-15
SW093	3.41E+07	7.58E+07	2.00E+08	2.41E+08	7.75E+08	5.03E+08	9.35E+07	8.63E+06	6.11E+06	2.65E+07	3.17E+07	3.59E+07
SW093 + SPOUT	4.23E+07	8.56E+07	2.16E+08	2.70E+08	8.10E+08	5.40E+08	1.31E+08	3.03E+07	1.92E+07	3.82E+07	4.39E+07	5.18E+07
GS13	4.10E+07	1.43E+08	3.38E+08	3.28E+08	8.73E+08	6.99E+08	1.77E+08	1.02E+07	9.87E+06	2.99E+07	7.40E+07	8.12E+07
GS12	2.81E+08	3.17E+08	4.26E+08	5.58E+08	1.20E+09	7.64E+08	2.24E+08	1.29E+06		3.80E+05	7.28E+07	2.38E+08
GS11	3.28E+07	1.51E+08	3.64E+08	4.39E+08	1.10E+09	5.52E+08	7.36E+07					

Please refer to table for details regarding available data

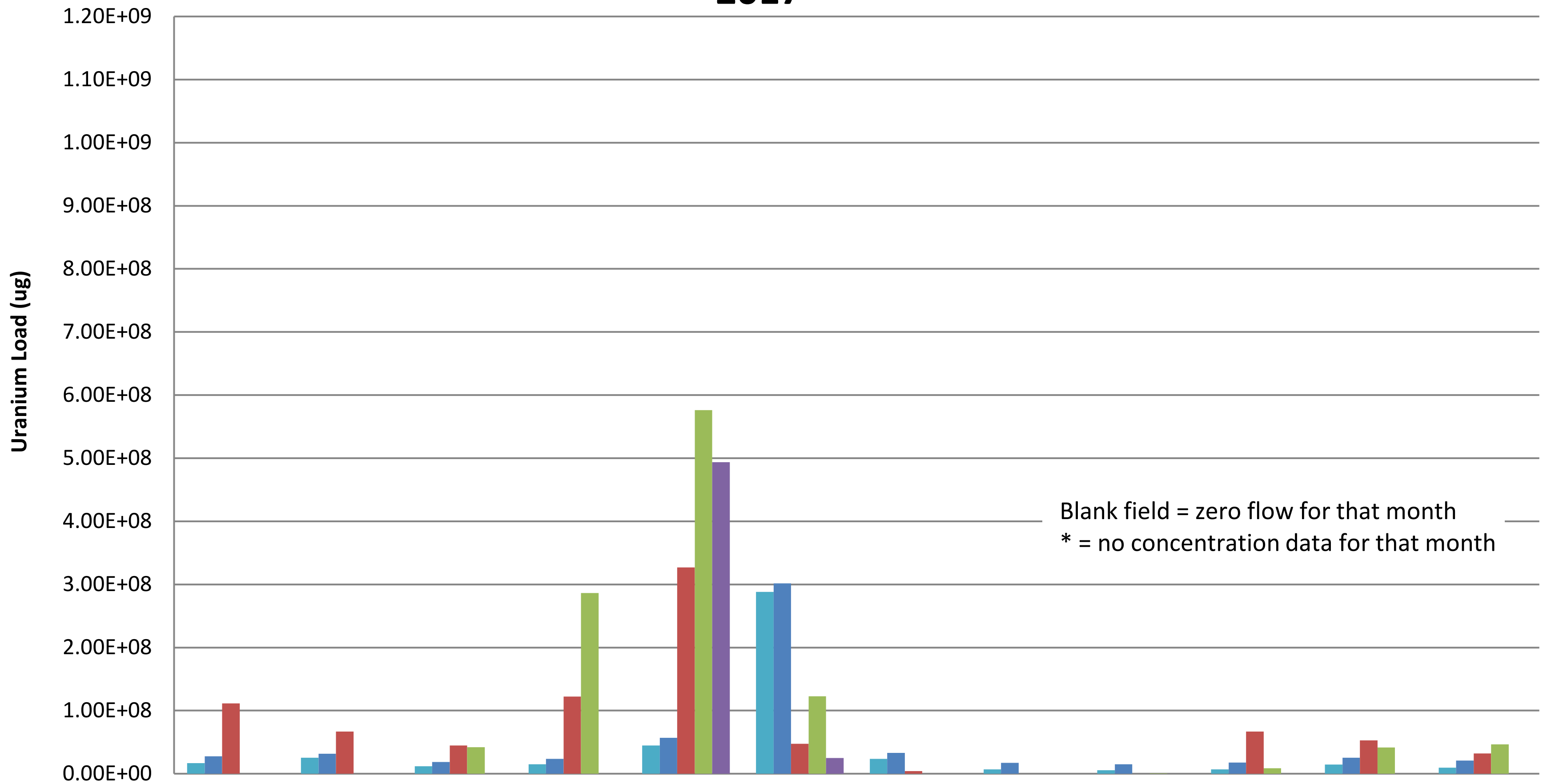
Figure B.15
Monthly Uranium Load in North Walnut Creek
2016



	Jan-16	Feb-16	Mar-16	Apr-16	May-16	Jun-16	Jul-16	Aug-16	Sep-16	Oct-16	Nov-16	Dec-16
SW093	2.12E+07	3.00E+07	6.39E+07	2.99E+08	6.23E+08	3.37E+08	3.92E+07	6.56E+06	1.07E+07	1.04E+07	1.02E+07	1.53E+07
SW093 + SPOUT	3.64E+07	4.12E+07	7.81E+07	3.07E+08	6.23E+08	3.37E+08	3.92E+07	6.56E+06	2.30E+07	2.36E+07	1.96E+07	2.44E+07
GS13	5.30E+07	1.28E+08	2.62E+08	4.76E+08	3.56E+08	7.79E+07	1.50E+07	7.94E+04			2.44E+07	7.98E+07
GS12	2.13E+08	4.58E+08	4.89E+08	6.33E+08	5.11E+08	7.15E+07						
GS11	2.27E+07	1.70E+08	4.83E+08	5.67E+08	3.21E+08	2.62E+07						

Please refer to table for details regarding available data

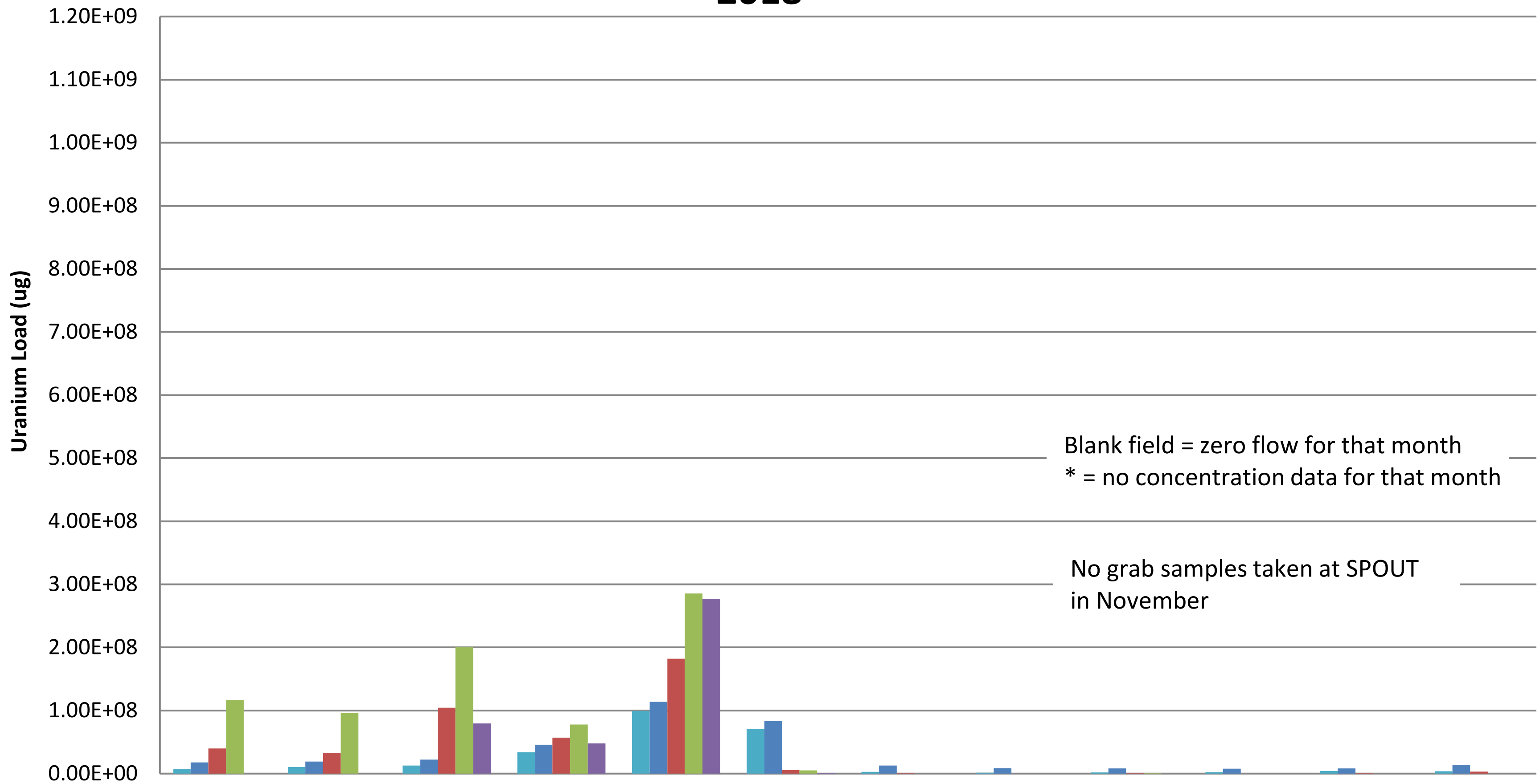
Figure B.16
Monthly Uranium Load in North Walnut Creek
2017



	Jan-17	Feb-17	Mar-17	Apr-17	May-17	Jun-17	Jul-17	Aug-17	Sep-17	Oct-17	Nov-17	Dec-17
SW093	1.70E+07	2.52E+07	1.19E+07	1.48E+07	4.49E+07	2.88E+08	2.37E+07	6.81E+06	5.55E+06	6.79E+06	1.46E+07	9.72E+06
SW093 + SPOUT	2.77E+07	3.15E+07	1.84E+07	2.35E+07	5.68E+07	3.02E+08	3.28E+07	1.73E+07	1.50E+07	1.78E+07	2.52E+07	2.08E+07
GS13	1.12E+08	6.70E+07	4.45E+07	1.22E+08	3.27E+08	4.75E+07	4.28E+06			6.69E+07	5.29E+07	3.21E+07
GS12			4.22E+07	2.86E+08	5.76E+08	1.23E+08			5.36E+05	8.67E+06	4.16E+07	4.67E+07
GS11					4.94E+08	2.51E+07						

Please refer to table for details regarding available data

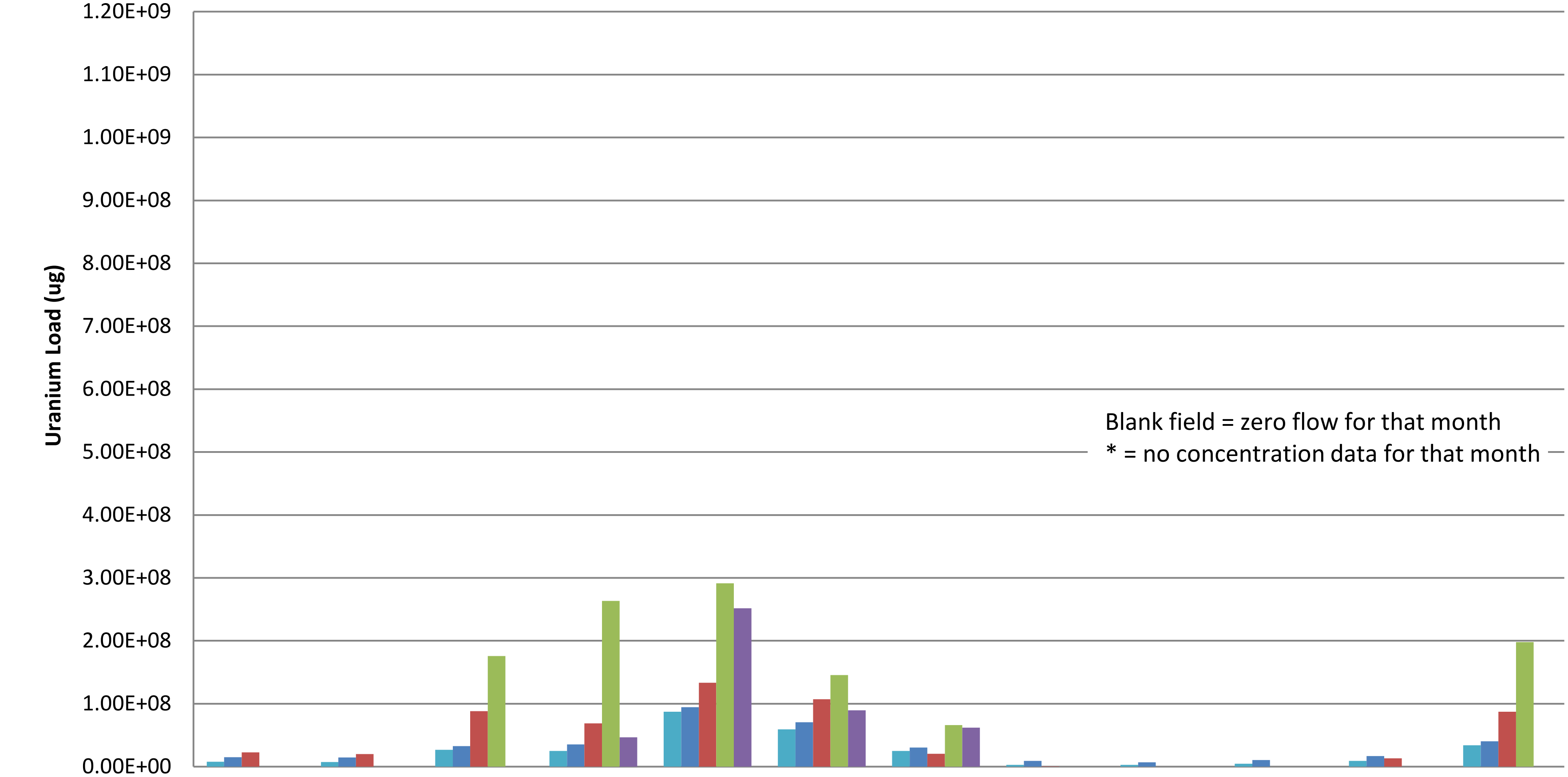
Figure B.17
Monthly Uranium Load in North Walnut Creek
2018



	Jan-18	Feb-18	Mar-18	Apr-18	May-18	Jun-18	Jul-18	Aug-18	Sep-18	Oct-18	Nov-18	Dec-18
SW093	7.54E+06	1.07E+07	1.27E+07	3.40E+07	9.93E+07	7.08E+07	2.94E+06	1.62E+06	1.73E+06	2.34E+06	4.07E+06	3.80E+06
SW093 + SPOUT	1.77E+07	1.92E+07	2.21E+07	4.59E+07	1.14E+08	8.32E+07	1.29E+07	8.78E+06	8.47E+06	7.75E+06	8.15E+06	1.37E+07
GS13	3.97E+07	3.25E+07	1.04E+08	5.69E+07	1.82E+08	5.40E+06	2.54E+04		4.16E+03		1.70E+05	3.45E+06
GS12	1.17E+08	9.57E+07	2.00E+08	7.78E+07	2.86E+08	4.93E+06			1.16E+05			
GS11			7.95E+07	4.80E+07	2.77E+08	7.75E+05						

Please refer to table for details regarding available data

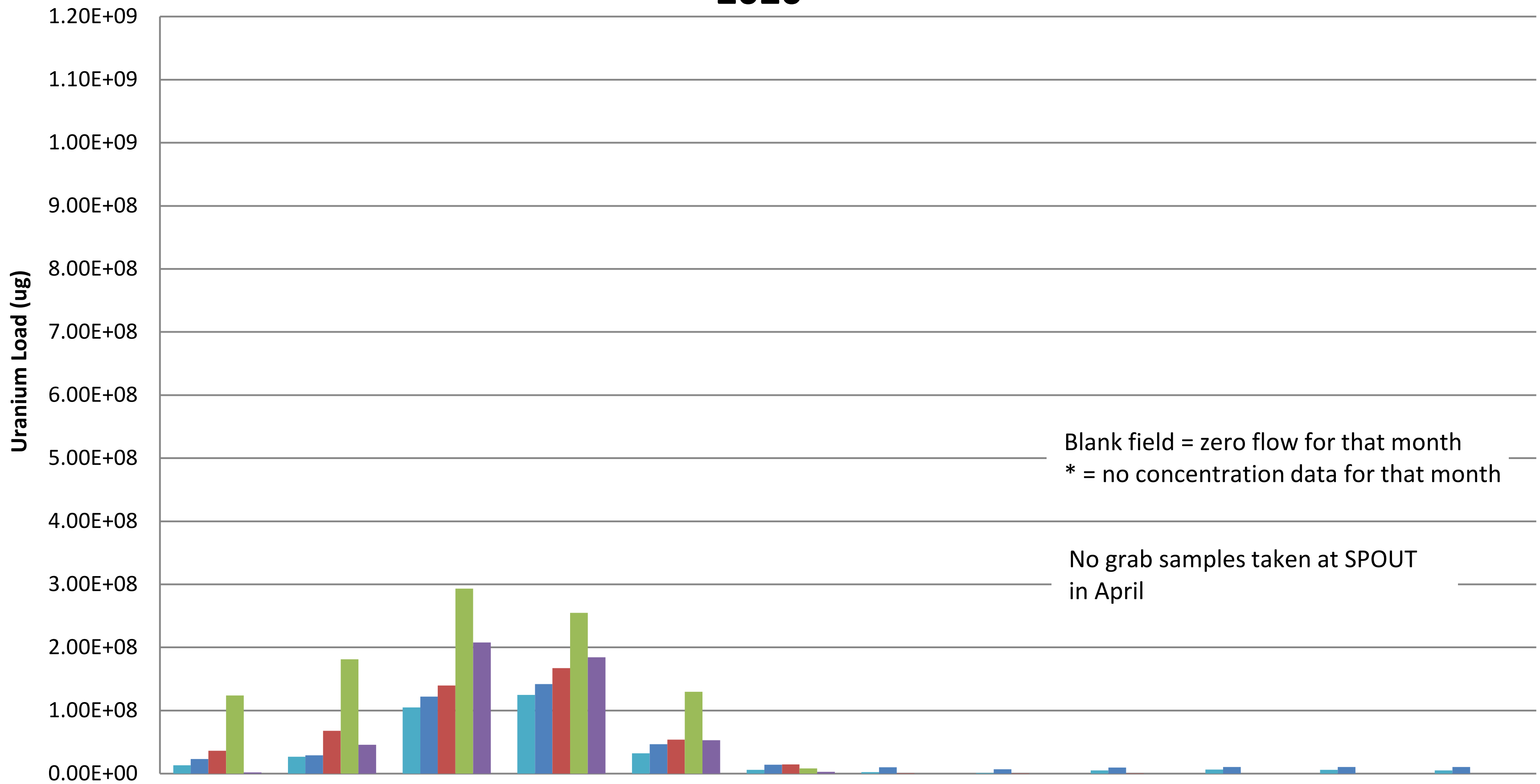
Figure B.18
Monthly Uranium Load in North Walnut Creek
2019



	Jan-19	Feb-19	Mar-19	Apr-19	May-19	Jun-19	Jul-19	Aug-19	Sep-19	Oct-19	Nov-19	Dec-19
SW093	7.99E+06	7.39E+06	2.69E+07	2.49E+07	8.75E+07	5.92E+07	2.47E+07	2.69E+06	2.67E+06	4.45E+06	9.14E+06	3.40E+07
SW093 + SPOUT	1.52E+07	1.48E+07	3.26E+07	3.55E+07	9.44E+07	7.07E+07	3.05E+07	9.09E+06	7.07E+06	1.06E+07	1.69E+07	4.04E+07
GS13	2.25E+07	2.01E+07	8.81E+07	6.87E+07	1.34E+08	1.07E+08	2.04E+07	2.02E+05			1.30E+07	8.73E+07
GS12			1.76E+08	2.64E+08	2.92E+08	1.46E+08	6.61E+07					1.98E+08
GS11				4.66E+07	2.51E+08	8.94E+07	6.19E+07					

Please refer to table for details regarding available data

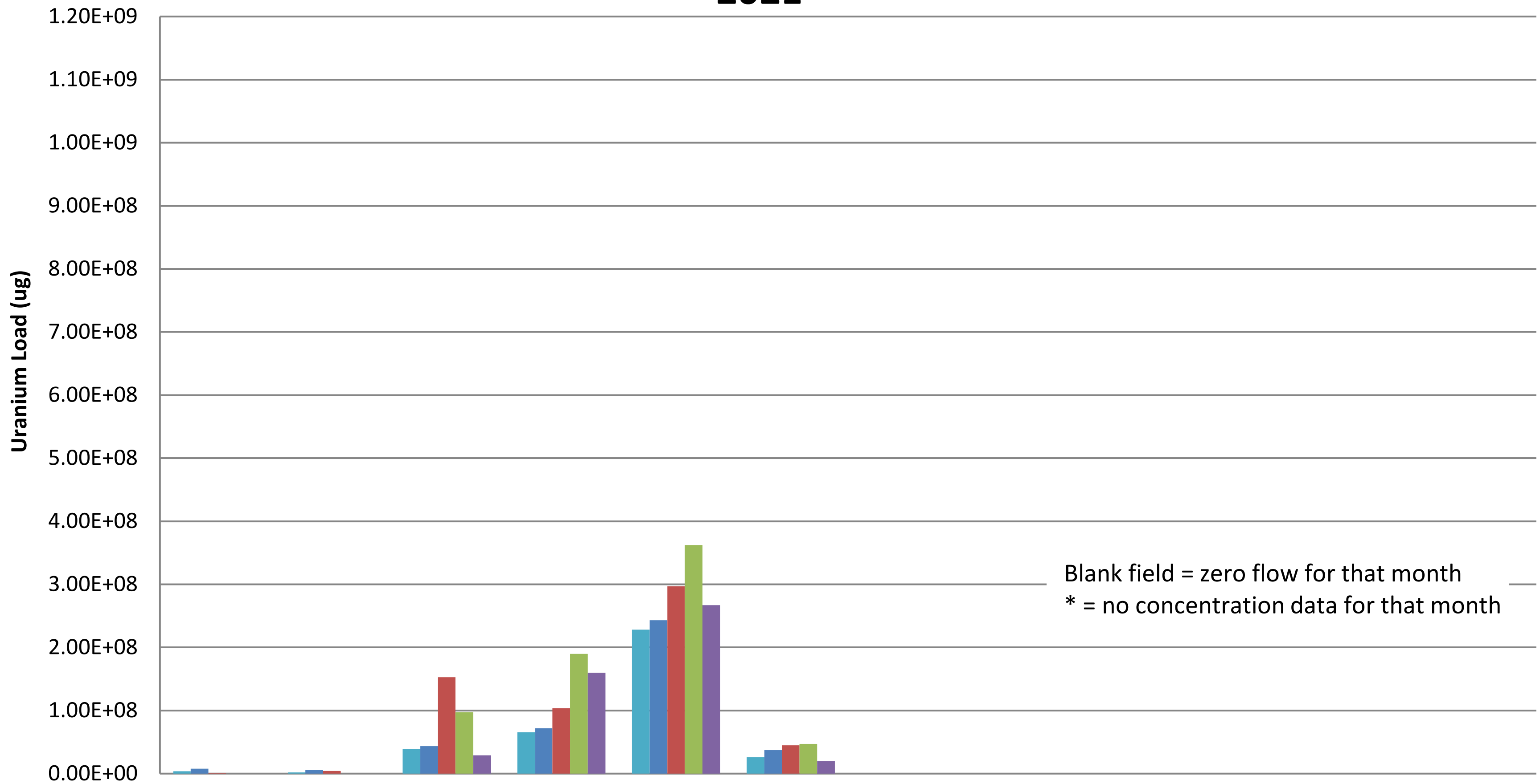
Figure B.19
Monthly Uranium Load in North Walnut Creek
2020



	Jan-20	Feb-20	Mar-20	Apr-20	May-20	Jun-20	Jul-20	Aug-20	Sep-20	Oct-20	Nov-20	Dec-20
SW093	1.32E+07	2.66E+07	1.05E+08	1.25E+08	3.24E+07	6.06E+06	2.22E+06	1.14E+06	5.13E+06	6.57E+06	5.78E+06	5.27E+06
SW093 + SPOUT	2.30E+07	2.90E+07	1.22E+08	1.42E+08	4.68E+07	1.41E+07	9.90E+06	6.69E+06	9.45E+06	1.04E+07	1.07E+07	1.05E+07
GS13	3.62E+07	6.79E+07	1.40E+08	1.67E+08	5.38E+07	1.44E+07	6.81E+05	5.17E+02	1.68E+03			
GS12	1.24E+08	1.81E+08	2.93E+08	2.55E+08	1.30E+08	8.39E+06						
GS11	1.78E+06	4.56E+07	2.08E+08	1.84E+08	5.28E+07	2.97E+06						

Please refer to table for details regarding available data

Figure B.20
Monthly Uranium Load in North Walnut Creek
2021



	Jan-21	Feb-21	Mar-21	Apr-21	May-21	Jun-21	Jul-21	Aug-21	Sep-21	Oct-21	Nov-21	Dec-21
SW093	3.72E+06	1.90E+06	3.89E+07	6.55E+07	2.28E+08	2.59E+07						
SW093 + SPOUT	7.78E+06	5.42E+06	4.34E+07	7.17E+07	2.43E+08	3.71E+07						
GS13	5.66E+05	4.19E+06	1.53E+08	1.03E+08	2.97E+08	4.50E+07						
GS12			9.72E+07	1.90E+08	3.62E+08	4.71E+07						
GS11			2.92E+07	1.60E+08	2.67E+08	1.98E+07						

Figure B.21
Solar Ponds Plume Treatment System Performance

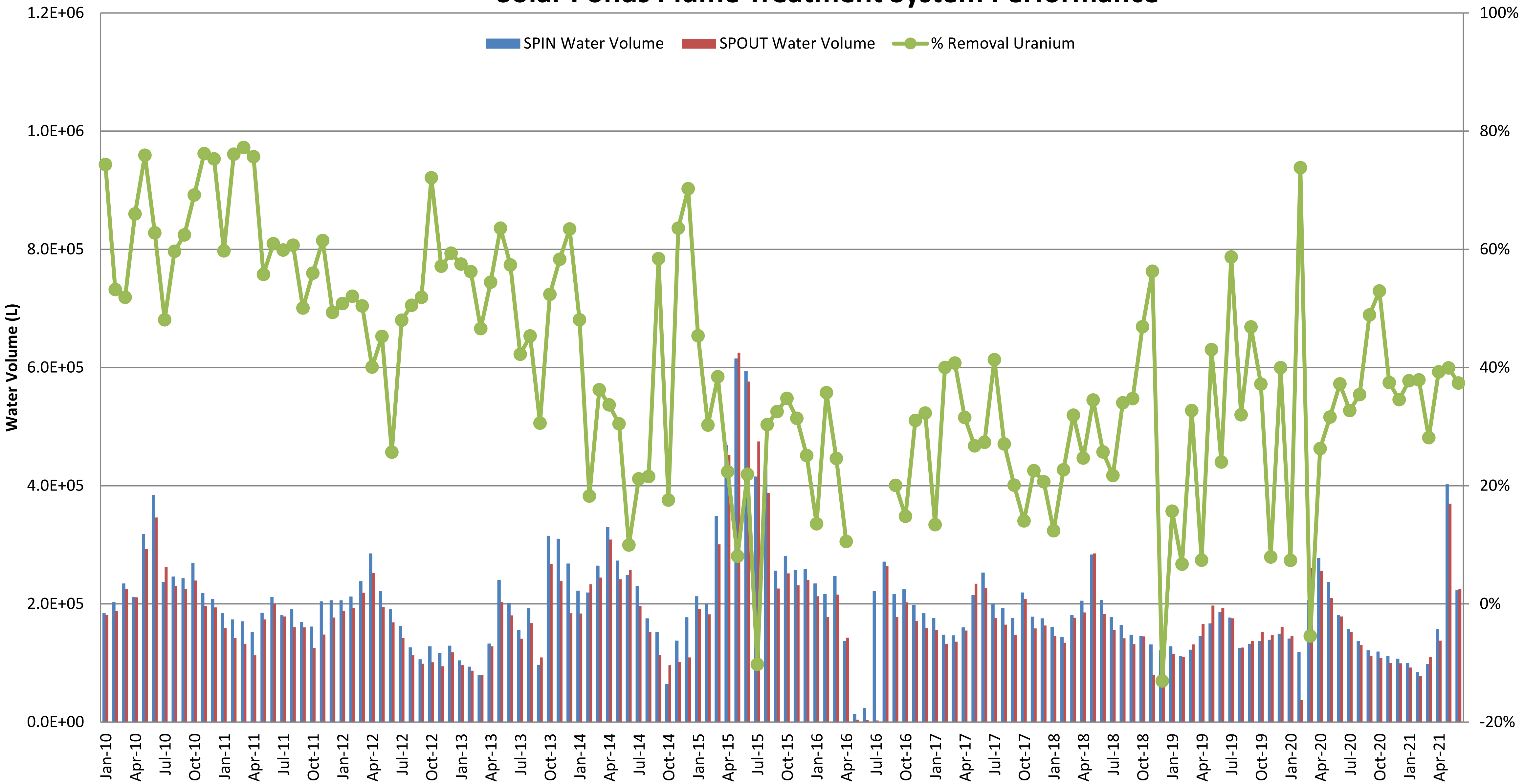
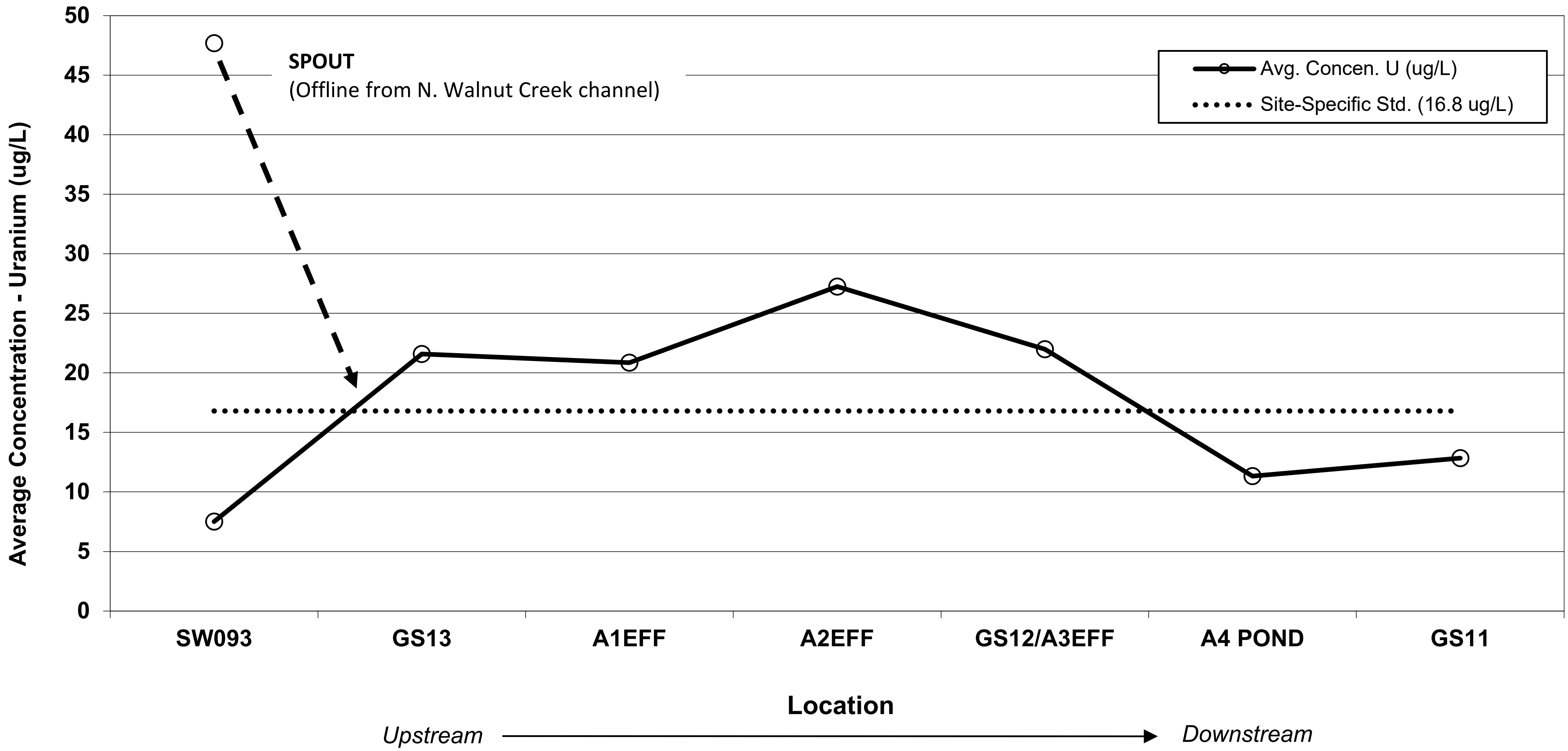


Figure B.22
North Walnut Creek Monitoring Locations
Average Concentrations of Uranium (1/27/10 - 9/15/2021)



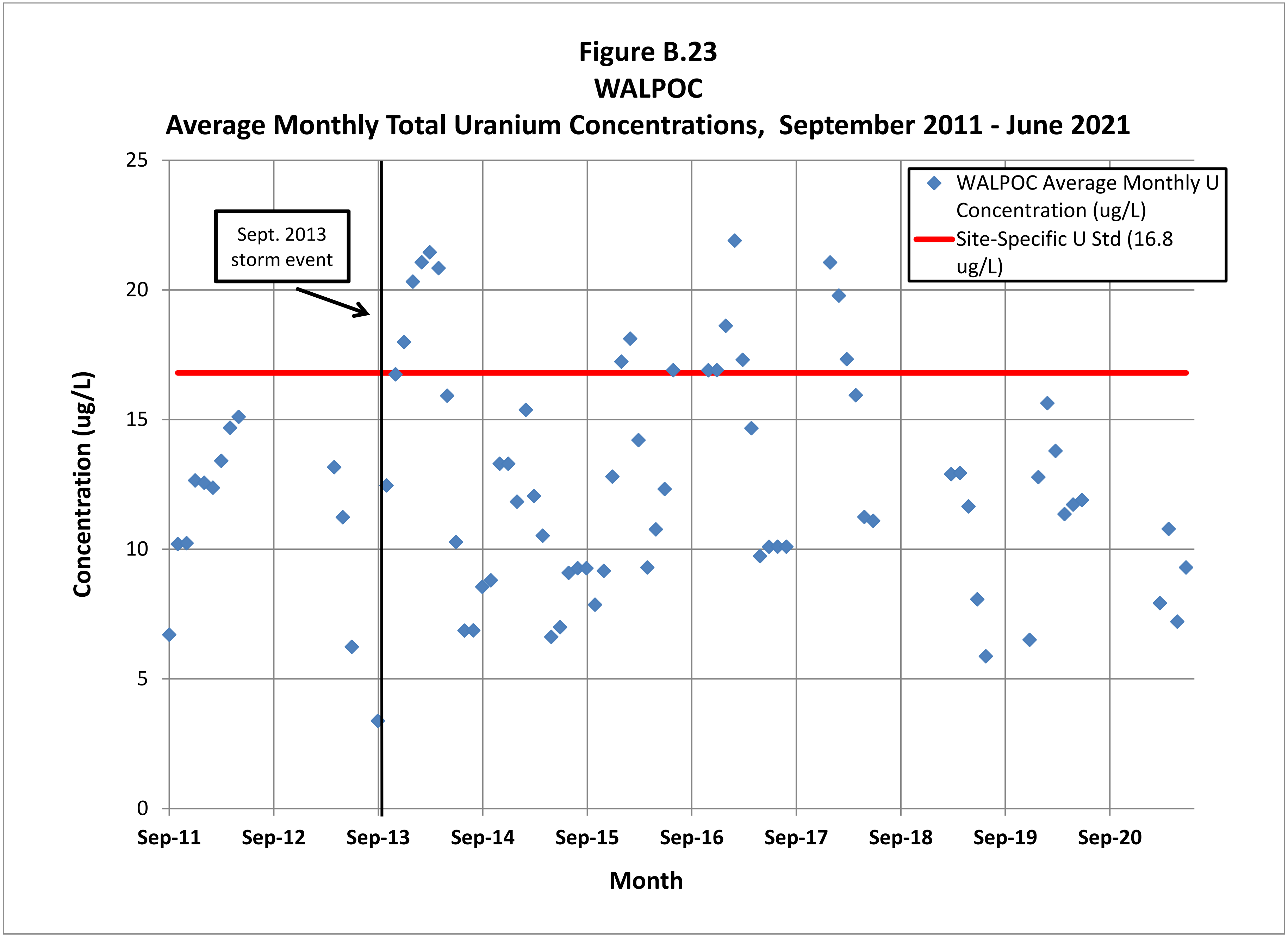


Figure B.23
WALPOC
Average Monthly Total Uranium Concentrations, September 2011 - June 2021
Concentration (ug/L)
25
20
15
10
5
0
Sept. 2013 storm event
WALPOC Average Monthly U Concentration (ug/L)
Site-Specific U Std (16.8 ug/L)
Sep-11
Sep-12
Sep-13
Sep-14
Sep-15
Sep-16
Sep-17
Sep-18
Sep-19
Sep-20
Month

Figure B.24

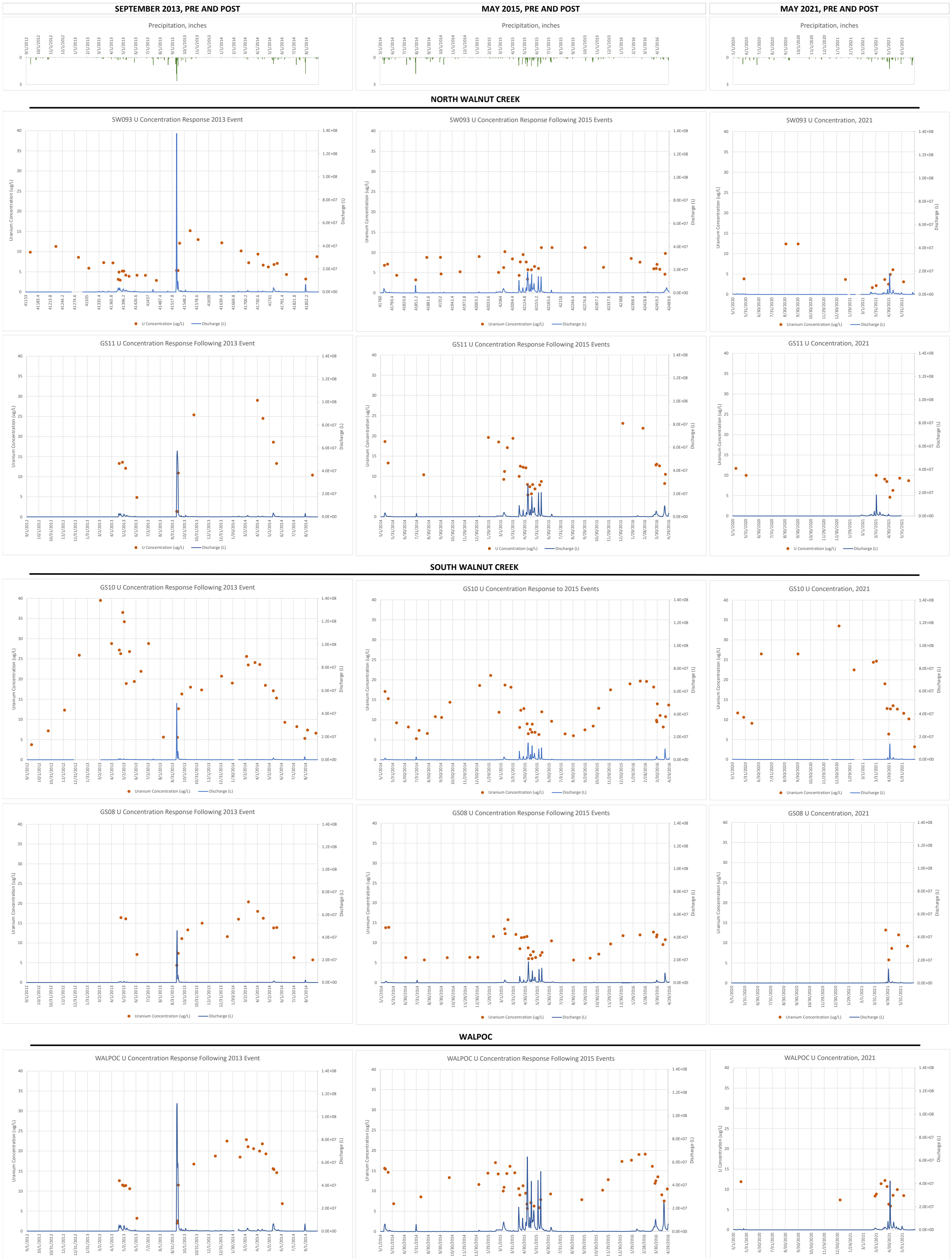

SEPTEMBER 2013, PRE AND POST
MAY 2015, PRE AND POST
MAY 2021, PRE AND POST
Precipitation, inches
NORTH WALNUT CREEK
SW093 U Concentration Response 2013 Event
SW093 U Concentration Response Following 2015 Events
SW093 U Concentration, 2021
GS11 U Concentration Response Following 2013 Event
GS11 U Concentration Response Following 2015 Events
GS11 U Concentration, 2021
SOUTH WALNUT CREEK
GS10 U Concentration Response Following 2013 Event
GS10 U Concentration Response to 2015 Events
GS10 U Concentration, 2021
GS08 U Concentration Response Following 2013 Event
GS08 U Concentration Response Following 2015 Events
GS08 U Concentration, 2021
WALPOC
WALPOC U Concentration Response Following 2013 Event
WALPOC U Concentration Response Following 2015 Events
WALPOC U Concentration, 2021
Uranium Concentration (ug/L)
Discharge (L)

Table B.1

	Uranium Load (µg)								
Date	SW093	SPOUT	SW093 + SPOUT	+/-	GS13	+/-	GS12	+/-	GS11
Jan-09	1.23E+07		1.23E+07	*1.61E+08*	1.73E+08	--	0	--	0
Feb-09	8.27E+06		8.27E+06	*1.44E+08*	1.53E+08	--	0	--	0
Mar-09	1.95E+07		1.95E+07	*1.75E+08*	1.95E+08	--	0	--	0
Apr-09	1.73E+08		1.73E+08	*2.40E+08*	4.13E+08	--		--	0
May-09	6.65E+07		6.65E+07	*7.78E+07*	1.44E+08	--	0	--	1.63E+08
Jun-09	1.00E+08		1.00E+08	*7.86E+07*	1.79E+08	--		--	6.06E+07
Jul-09	2.31E+07		2.31E+07	*4.92E+07*	7.23E+07	--	0	--	0
Aug-09	7.35E+06	5.57E+06	1.29E+07	*1.75E+07*	3.04E+07	--	0	--	0
Sep-09	7.50E+06	4.41E+06	1.19E+07	*-1.19E+07*	3.47E+04	--	0	--	0
Oct-09	2.82E+07	4.18E+06	3.24E+07	*5.05E+07*	8.29E+07	--	0	--	0
Nov-09	5.37E+07	6.24E+06	6.00E+07	*1.01E+08*	1.61E+08	--		--	0
Dec-09	7.36E+07	7.77E+06	8.14E+07	*5.29E+07*	1.34E+08	--	0	--	1.80E+08
2009	**5.73E+08**	**2.82E+07**	**6.01E+08**	***1.14E+09***	**1.74E+09**	**--**	**--**	**--**	**4.04E+08**
Jan-10	3.60E+07	2.74E+06	3.87E+07	*9.47E+07*	1.33E+08	--		--	
Feb-10	2.64E+07	5.93E+06	3.23E+07	*5.75E+07*	8.98E+07	--		--	
Mar-10	2.38E+08	6.94E+06	2.45E+08	*1.38E+08*	3.83E+08	--		--	
Apr-10	3.76E+08	5.06E+06	3.81E+08	*1.14E+08*	4.96E+08	*-9.23E+07*	4.03E+08	*-4.03E+08*	
May-10	2.26E+08	5.73E+06	2.32E+08	*5.53E+07*	2.87E+08	*2.02E+08*	4.89E+08	*7.11E+08*	1.20E+09
Jun-10	9.63E+07	1.05E+07	1.07E+08	*7.33E+07*	1.80E+08	*1.16E+08*	2.96E+08	*-2.96E+08*	
Jul-10	1.72E+07	9.01E+06	2.62E+07	*4.55E+07*	7.17E+07	*7.65E+07*	1.48E+08	*-1.48E+08*	
Aug-10	1.69E+06	6.80E+06	8.49E+06	*-1.32E+06*	7.17E+06	*-3.91E+06*	3.26E+06	*-3.26E+06*	
Sep-10	2.39E+06	6.09E+06	8.48E+06	*-8.48E+06*		*0.00E+00*		*0.00E+00*	
Oct-10	7.05E+06	5.09E+06	1.21E+07	*-1.21E+07*	8.64E+03	*-8.64E+03*		*0.00E+00*	
Nov-10	1.63E+07	3.63E+06	1.99E+07	*3.08E+07*	5.08E+07	*-5.00E+07*	7.29E+05	*-7.29E+05*	
Dec-10	1.91E+07	3.75E+06	2.28E+07	*5.87E+07*	8.16E+07	*-8.07E+07*	8.74E+05	*-8.74E+05*	
2010	**1.06E+09**	**7.13E+07**	**1.13E+09**	***6.46E+08***	**1.78E+09**	***-4.38E+08***	**1.34E+09**	***-1.42E+08***	**1.20E+09**
Jan-11	1.80E+07	5.41E+06	2.34E+07	*4.56E+07*	6.90E+07	*-6.90E+07*		*0.00E+00*	
Feb-11	3.02E+07	3.06E+06	3.32E+07	*1.01E+08*	1.34E+08	*-1.34E+08*		*0.00E+00*	
Mar-11	1.12E+07	2.89E+06	1.41E+07	*1.24E+08*	1.38E+08	*-1.38E+08*		*1.05E+08*	1.05E+08
Apr-11	1.84E+07	2.76E+06	2.12E+07	*1.57E+08*	1.78E+08	*-9.97E+07*	7.84E+07	*-7.84E+07*	
May-11	9.92E+07	5.26E+06	1.05E+08	*1.47E+08*	2.51E+08	*2.16E+08*	4.67E+08	*-4.67E+08*	
Jun-11	1.62E+07	7.10E+06	2.33E+07	*4.80E+07*	7.13E+07	*1.35E+08*	2.07E+08	*-2.07E+08*	
Jul-11	8.99E+07	6.08E+06	9.60E+07	*9.43E+07*	1.90E+08	*8.82E+07*	2.79E+08	*-2.79E+08*	
Aug-11	1.23E+07	6.09E+06	1.84E+07	*-1.74E+07*	1.02E+06	*9.58E+07*	9.68E+07	*-9.68E+07*	
Sep-11	2.81E+07	6.38E+06	3.45E+07	*5.03E+07*	8.48E+07	*-7.59E+07*	8.92E+06	*2.09E+08*	2.18E+08
Oct-11	1.73E+07	5.37E+06	2.27E+07	*4.20E+07*	6.46E+07	*-5.85E+07*	6.15E+06	*-1.35E+06*	4.79E+06
Nov-11	2.07E+07	5.77E+06	2.64E+07	*8.51E+07*	1.12E+08	*-7.17E+07*	3.98E+07	*-1.57E+07*	2.41E+07
Dec-11	3.63E+07	8.53E+06	4.48E+07	*6.74E+07*	1.12E+08	*-1.10E+08*	2.55E+06	*7.60E+07*	7.85E+07
2011	**3.98E+08**	**6.47E+07**	**4.63E+08**	***9.43E+08***	**1.41E+09**	***-2.21E+08***	**1.18E+09**	***-7.53E+08***	**4.31E+08**
Jan-12	2.97E+07	7.44E+06	3.71E+07	*2.17E+07*	5.88E+07	*-5.88E+07*	5.14E+02	*1.15E+08*	1.15E+08
Feb-12	9.58E+07	7.45E+06	1.03E+08	*5.20E+07*	1.55E+08	*-1.55E+08*		*1.47E+08*	1.47E+08
Mar-12	3.99E+07	8.69E+06	4.86E+07	*4.09E+07*	8.95E+07	*-7.04E+07*	1.91E+07	*6.85E+07*	8.76E+07
Apr-12	3.53E+07	1.26E+07	4.79E+07	*2.35E+07*	7.14E+07	*1.88E+08*	2.60E+08	*-2.29E+08*	3.04E+07
May-12	2.08E+07	1.00E+07	3.09E+07	*1.17E+07*	4.26E+07	*3.89E+07*	8.15E+07	--	6.40E+05
Jun-12	6.55E+06	1.09E+07	1.74E+07	*-1.61E+07*	1.31E+06	*-8.91E+05*	4.20E+05	*-4.20E+05*	
Jul-12	2.38E+07	7.26E+06	3.10E+07	*-3.10E+07*		*0.00E+00*		*0.00E+00*	
Aug-12	9.65E+05	5.30E+06	6.27E+06	*-6.27E+06*		*0.00E+00*		*0.00E+00*	
Sep-12	6.17E+06	3.87E+06	1.00E+07	*-1.00E+07*		*0.00E+00*		*0.00E+00*	
Oct-12	7.40E+06	2.38E+06	9.78E+06	*-9.78E+06*		*0.00E+00*		*0.00E+00*	
Nov-12	1.04E+07	3.24E+06	1.36E+07	*-1.29E+07*	7.12E+05	*-7.12E+05*		*0.00E+00*	
Dec-12	8.80E+06	3.72E+06	1.25E+07	*1.22E+07*	2.47E+07	*-2.47E+07*		*0.00E+00*	
2012	**2.86E+08**	**8.29E+07**	**3.68E+08**	***7.58E+07***	**4.44E+08**	***-8.34E+07***	**3.61E+08**	***2.02E+07***	**3.81E+08**
Jan-13	3.28E+06	3.41E+06	6.70E+06	*2.73E+07*	3.39E+07	*-3.39E+07*		*0.00E+00*	
Feb-13	6.68E+06	3.22E+06	9.90E+06	*1.48E+07*	2.47E+07	*-2.47E+07*		*0.00E+00*	
Mar-13	3.48E+07	3.46E+06	3.83E+07	*7.75E+07*	1.16E+08	*-4.75E+07*	6.83E+07	*-6.83E+07*	
Apr-13	1.17E+08	5.39E+06	1.23E+08	*8.56E+06*	1.31E+08	*1.94E+08*	3.25E+08	*-7.06E+07*	2.55E+08
May-13	1.09E+08	7.61E+06	1.16E+08	*7.28E+07*	1.89E+08	*1.39E+08*	3.28E+08	*-8.73E+07*	2.41E+08
Jun-13	1.15E+07	7.82E+06	1.94E+07	*-6.35E+06*	1.30E+07	*1.89E+07*	3.19E+07	*-2.67E+07*	5.21E+06
Jul-13	1.41E+07	7.83E+06	2.19E+07	*-6.57E+06*	1.54E+07	*-1.23E+07*	3.01E+06	*-3.01E+06*	
Aug-13	5.34E+06	9.04E+06	1.44E+07	*-9.57E+06*	4.81E+06	*-4.81E+06*	4.83E+02	*-4.83E+02*	
Sep-13	1.07E+09	5.36E+06	1.07E+09	*3.03E+09*	4.10E+09	*-1.82E+09*	2.28E+09	*-1.85E+09*	4.35E+08
Oct-13	1.43E+08	1.17E+07	1.54E+08	*8.00E+07*	2.34E+08	*6.87E+07*	3.03E+08	*-1.86E+08*	1.17E+08
Nov-13	7.94E+07	9.57E+06	8.89E+07	*-3.00E+07*	5.89E+07	*1.30E+08*	1.89E+08	*-1.19E+08*	6.98E+07
Dec-13	4.37E+07	8.23E+06	5.19E+07	*1.03E+07*	6.22E+07	*8.10E+07*	1.43E+08	*-1.09E+08*	3.46E+07
2013	**1.64E+09**	**8.26E+07**	**1.72E+09**	***3.27E+09***	**4.99E+09**	***-1.31E+09***	**3.67E+09**	***-2.52E+09***	**1.16E+09**
Jan-14	4.77E+07	8.71E+06	5.64E+07	*1.63E+07*	7.28E+07	*1.48E+08*	2.21E+08	*-1.58E+08*	6.34E+07
Feb-14	5.75E+07	1.25E+07	6.99E+07	*5.61E+06*	7.55E+07	*1.75E+08*	2.51E+08	*-1.49E+08*	1.01E+08
Mar-14	8.02E+07	1.36E+07	9.37E+07	*3.39E+07*	1.28E+08	*1.51E+08*	2.79E+08	*-1.00E+08*	1.79E+08
Apr-14	6.80E+07	1.79E+07	8.59E+07	*4.04E+07*	1.26E+08	*7.82E+07*	2.04E+08	*-5.73E+07*	1.47E+08
May-14	1.28E+08	1.38E+07	1.42E+08	*4.88E+07*	1.91E+08	*1.46E+08*	3.36E+08	*-2.55E+07*	3.11E+08
Jun-14	1.71E+07	1.65E+07	3.36E+07	*-1.14E+07*	2.22E+07	*3.51E+07*	5.73E+07	*-5.45E+07*	2.85E+06
Jul-14	3.08E+07	1.38E+07	4.46E+07	*3.21E+07*	7.67E+07	*-1.43E+07*	6.24E+07	*-9.41E+06*	5.30E+07
Aug-14	1.03E+07	9.67E+06	1.99E+07	*-1.86E+04*	1.99E+07	*-2.50E+06*	1.74E+07	*-3.00E+06*	1.44E+07
Sep-14	2.55E+07	4.70E+06	3.02E+07	*1.76E+07*	4.78E+07	*-2.64E+07*	2.14E+07	*-2.14E+07*	
Oct-14	1.69E+07	3.66E+06	2.05E+07	*5.01E+07*	7.07E+07	*2.17E+07*	9.24E+07	*-9.24E+07*	
Nov-14	1.30E+07	3.25E+06	1.62E+07	*4.63E+07*	6.25E+07	*1.33E+08*	1.96E+08	*-1.93E+08*	2.60E+06
Dec-14	1.19E+07	4.05E+06	1.59E+07	*4.44E+07*	6.03E+07	*1.64E+08*	2.24E+08	*-2.15E+08*	9.24E+06
2014	**5.07E+08**	**1.22E+08**	**6.29E+08**	***3.24E+08***	**9.53E+08**	***1.01E+09***	**1.96E+09**	***-1.08E+09***	**8.84E+08**
Jan-15	3.41E+07	8.16E+06	4.23E+07	*-1.25E+06*	4.10E+07	*2.40E+08*	2.81E+08	*-2.49E+08*	3.28E+07
Feb-15	7.58E+07	9.75E+06	8.56E+07	*5.78E+07*	1.43E+08	*1.74E+08*	3.17E+08	*-1.66E+08*	1.51E+08
Mar-15	2.00E+08	1.60E+07	2.16E+08	*1.21E+08*	3.38E+08	*8.87E+07*	4.26E+08	*-6.24E+07*	3.64E+08
Apr-15	2.41E+08	2.87E+07	2.70E+08	*5.80E+07*	3.28E+08	*2.30E+08*	5.58E+08	*-1.19E+08*	4.39E+08
May-15	7.75E+08	3.56E+07	8.10E+08	*6.32E+07*	8.73E+08	*3.31E+08*	1.20E+09	*-1.02E+08*	1.10E+09
Jun-15	5.03E+08	3.74E+07	5.40E+08	*1.59E+08*	6.99E+08	*6.45E+07*	7.64E+08	*-2.12E+08*	5.52E+08
Jul-15	9.35E+07	3.75E+07	1.31E+08	*4.58E+07*	1.77E+08	*4.69E+07*	2.24E+08	*-1.50E+08*	7.36E+07
Aug-15	8.63E+06	2.17E+07	3.03E+07	*-2.02E+07*	1.02E+07	*-8.86E+06*	1.29E+06	*-1.29E+06*	
Sep-15	6.11E+06	1.31E+07	1.92E+07	*-9.36E+06*	9.87E+06	*-9.87E+06*		*0.00E+00*	
Oct-15	2.65E+07	1.17E+07	3.82E+07	*-8.37E+06*	2.99E+07	*-2.95E+07*	3.80E+05	*-3.80E+05*	
Nov-15	3.17E+07	1.22E+07	4.39E+07	*3.02E+07*	7.40E+07	*-1.22E+06*	7.28E+07	*-7.28E+07*	
Dec-15	3.59E+07	1.59E+07	5.18E+07	*2.94E+07*	8.12E+07	*1.57E+08*	2.38E+08	*-2.38E+08*	
2015	**2.03E+09**	**2.48E+08**	**2.28E+09**	***5.25E+08***	**2.80E+09**	**1.28E+09**	**4.09E+09**	**-1.37E+09**	**2.72E+09**
Jan-16	2.12E+07	1.52E+07	3.64E+07	*1.65E+07*	5.30E+07	*1.60E+08*	2.13E+08	*-1.90E+08*	2.27E+07
Feb-16	3.00E+07	1.11E+07	4.12E+07	*8.66E+07*	1.28E+08	*3.30E+08*	4.58E+08	*-2.88E+08*	1.70E+08
Mar-16	6.39E+07	1.41E+07	7.81E+07	*1.84E+08*	2.62E+08	*2.27E+08*	4.89E+08	*-5.82E+06*	4.83E+08
Apr-16	2.99E+08	8.22E+06	3.07E+08	*1.69E+08*	4.76E+08	*1.57E+08*	6.33E+08	*-6.66E+07*	5.67E+08
May-16	6.23E+08		6.23E+08	*-2.67E+08*	3.56E+08	*1.55E+08*	5.11E+08	*-1.89E+08*	3.21E+08
Jun-16	3.37E+08		3.37E+08	*-2.59E+08*	7.79E+07	*-6.45E+06*	7.15E+07	*-4.53E+07*	2.62E+07
Jul-16	3.92E+07		3.92E+07	*-2.42E+07*	1.50E+07	*-1.50E+07*		*0.00E+00*	
Aug-16	6.56E+06		6.56E+06	*-6.48E+06*	7.94E+04	*-7.94E+04*		*0.00E+00*	
Sep-16	1.07E+07	1.23E+07	2.30E+07	*-2.30E+07*		*0.00E+00*		*0.00E+00*	
Oct-16	1.04E+07	1.33E+07	2.36E+07	*-2.36E+07*		*0.00E+00*		*0.00E+00*	
Nov-16	1.02E+07	9.41E+06	1.96E+07	*4.77E+06*	2.44E+07	*-2.44E+07*		*0.00E+00*	
Dec-16	1.53E+07	9.02E+06	2.44E+07	*5.54E+07*	7.98E+07	*-7.98E+07*		*0.00E+00*	
2016	**1.47E+09**	**9.26E+07**	**1.56E+09**	**-8.73E+07**	**1.47E+09**	**9.02E+08**	**2.37E+09**	**-7.84E+08**	**1.59E+09**
Jan-17	1.70E+07	1.07E+07	2.77E+07	*8.39E+07*	1.12E+08	*-1.12E+08*		*0.00E+00*	
Feb-17	2.52E+07	6.29E+06	3.15E+07	*3.55E+07*	6.70E+07	*-6.70E+07*		*0.00E+00*	
Mar-17	1.19E+07	6.46E+06	1.84E+07	*2.61E+07*	4.45E+07	*-2.33E+06*	4.22E+07	*-4.22E+07*	
Apr-17	1.48E+07	8.68E+06	2.35E+07	*9.89E+07*	1.22E+08	*1.64E+08*	2.86E+08	*-2.86E+08*	
May-17	4.49E+07	1.20E+07	5.68E+07	*2.70E+08*	3.27E+08	*2.49E+08*	5.76E+08	*-8.24E+07*	4.94E+08
Jun-17	2.88E+08	1.36E+07	3.02E+08	*-2.54E+08*	4.75E+07	*7.52E+07*	1.23E+08	*-9.77E+07*	2.51E+07
Jul-17	2.37E+07	9.14E+06	3.28E+07	*-2.85E+07*	4.28E+06	*-4.28E+06*		*0.00E+00*	
Aug-17	6.81E+06	1.05E+07	1.73E+07	*-1.73E+07*		*0.00E+00*		*0.00E+00*	
Sep-17	5.55E+06	9.48E+06	1.50E+07	*-1.50E+07*		*5.36E+05*	5.36E+05	*-5.36E+05*	
Oct-17	6.79E+06	1.10E+07	1.78E+07	*4.91E+07*	6.69E+07	*-5.82E+07*	8.67E+06	*-8.67E+06*	
Nov-17	1.46E+07	1.06E+07	2.52E+07	*2.77E+07*	5.29E+07	*-1.13E+07*	4.16E+07	*-4.16E+07*	
Dec-17	9.72E+06	1.10E+07	2.08E+07	*1.14E+07*	3.21E+07	*1.45E+07*	4.67E+07	*-4.67E+07*	
2017	**4.69E+08**	**1.19E+08**	**5.89E+08**	**2.87E+08**	**8.76E+08**	**2.49E+08**	**1.12E+09**	**-6.06E+08**	**5.19E+08**
Jan-18	7.54E+06	1.02E+07	1.77E+07	*2.20E+07*	3.97E+07	*7.69E+07*	1.17E+08	*-1.17E+08*	
Feb-18	1.07E+07	8.46E+06	1.92E+07	*1.34E+07*	3.25E+07	*6.32E+07*	9.57E+07	*-9.57E+07*	
Mar-18	1.27E+07	9.40E+06	2.21E+07	*8.23E+07*	1.04E+08	*9.61E+07*	2.00E+08	*-1.21E+08*	7.95E+07
Apr-18	3.40E+07	1.20E+07	4.59E+07	*1.10E+07*	5.69E+07	*2.09E+07*	7.78E+07	*-2.98E+07*	4.80E+07
May-18	9.93E+07	1.46E+07	1.14E+08	*6.83E+07*	1.82E+08	*1.04E+08*	2.86E+08	*-8.70E+06*	2.77E+08
Jun-18	7.08E+07	1.24E+07	8.32E+07	*-7.78E+07*	5.40E+06	*-4.72E+05*	4.93E+06	*-4.15E+06*	7.75E+05
Jul-18	2.94E+06	9.93E+06	1.29E+07	*-1.28E+07*	2.54E+04	*-2.54E+04*		*0.00E+00*	
Aug-18	1.62E+06	7.16E+06	8.78E+06	*-8.78E+06*		*0.00E+00*		*0.00E+00*	
Sep-18	1.73E+06	6.73E+06	8.47E+06	*-8.46E+06*	4.16E+03	*1.11E+05*	1.16E+05	*-1.16E+05*	
Oct-18	2.34E+06	5.41E+06	7.75E+06	*-7.75E+06*		*0.00E+00*		*0.00E+00*	
Nov-18	4.07E+06	4.08E+06	8.15E+06	*-7.98E+06*	1.70E+05	*-1.70E+05*		*0.00E+00*	
Dec-18	3.80E+06	9.88E+06	1.37E+07	*-1.02E+07*	3.45E+06	*-3.45E+06*		*0.00E+00*	
2018	**2.51E+08**	**1.10E+08**	**3.62E+08**	**6.30E+07**	**4.25E+08**	**3.57E+08**	**7.81E+08**	**-3.76E+08**	**4.05E+08**
Jan-19	7.99E+06	7.23E+06	1.52E+07	*7.28E+06*	2.25E+07	*-2.25E+07*		*0.00E+00*	
Feb-19	7.39E+06	7.37E+06	1.48E+07	*5.30E+06*	2.01E+07	*-2.01E+07*		*0.00E+00*	
Mar-19	2.69E+07	5.72E+06	3.26E+07	*5.55E+07*	8.81E+07	*8.74E+07*	1.76E+08	*-1.76E+08*	
Apr-19	2.49E+07	1.06E+07	3.55E+07	*3.33E+07*	6.87E+07	*1.95E+08*	2.64E+08	*-2.17E+08*	4.66E+07
May-19	8.75E+07	6.90E+06	9.44E+07	*3.91E+07*	1.34E+08	*1.58E+08*	2.92E+08	*-4.02E+07*	2.51E+08
Jun-19	5.92E+07	1.15E+07	7.07E+07	*3.63E+07*	1.07E+08	*3.86E+07*	1.46E+08	*-5.62E+07*	8.94E+07
Jul-19	2.47E+07	5.80E+06	3.05E+07	*-1.01E+07*	2.04E+07	*4.57E+07*	6.61E+07	*-4.17E+06*	6.19E+07
Aug-19	2.69E+06	6.40E+06	9.09E+06	*-8.89E+06*	2.02E+05	*-2.02E+05*		*0.00E+00*	
Sep-19	2.67E+06	4.39E+06	7.07E+06	*-7.07E+06*		*0.00E+00*		*0.00E+00*	
Oct-19	4.45E+06	6.16E+06	1.06E+07	*-1.06E+07*		*0.00E+00*		*0.00E+00*	
Nov-19	9.14E+06	7.80E+06	1.69E+07	*-3.93E+06*	1.30E+07	*-1.30E+07*		*0.00E+00*	
Dec-19	3.40E+07	6.45E+06	4.04E+07	*4.69E+07*	8.73E+07	*1.10E+08*	1.98E+08	*-1.98E+08*	
2019	**2.91E+08**	**8.64E+07**	**3.78E+08**	**1.83E+08**	**5.61E+08**	**5.79E+08**	**1.14E+09**	**-6.91E+08**	**4.49E+08**
Jan-20	1.32E+07	9.81E+06	2.30E+07	*1.33E+07*	3.62E+07	*8.77E+07*	1.24E+08	*-1.22E+08*	1.78E+06
Feb-20	2.66E+07	2.37E+06	2.90E+07	*3.89E+07*	6.79E+07	*1.13E+08*	1.81E+08	*-1.35E+08*	4.56E+07
Mar-20	1.05E+08	1.70E+07	1.22E+08	*1.77E+07*	1.40E+08	*1.54E+08*	2.93E+08	*-8.57E+07*	2.08E+08
Apr-20	1.25E+08	1.71E+07	1.42E+08	*2.55E+07*	1.67E+08	*8.76E+07*	2.55E+08	*-7.06E+07*	1.84E+08
May-20	3.24E+07	1.44E+07	4.68E+07	*6.98E+06*	5.38E+07	*7.60E+07*	1.30E+08	*-7.70E+07*	5.28E+07
Jun-20	6.06E+06	8.04E+06	1.41E+07	*3.03E+05*	1.44E+07	*-6.02E+06*	8.39E+06	*-5.42E+06*	2.97E+06
Jul-20	2.22E+06	7.68E+06	9.90E+06	*-9.22E+06*	6.81E+05	*-6.81E+05*		*0.00E+00*	
Aug-20	1.14E+06	5.54E+06	6.69E+06	*-6.68E+06*	5.17E+02	*-5.17E+02*		*0.00E+00*	
Sep-20	5.13E+06	4.32E+06	9.45E+06	*-9.45E+06*	1.68E+03	*-1.68E+03*		*0.00E+00*	
Oct-20	6.57E+06	3.78E+06	1.04E+07	*-1.04E+07*		*0.00E+00*		*0.00E+00*	
Nov-20	5.78E+06	4.96E+06	1.07E+07	*-1.07E+07*		*0.00E+00*		*0.00E+00*	
Dec-20	5.27E+06	5.23E+06	1.05E+07	*-1.05E+07*		*0.00E+00*		*0.00E+00*	
2020	**3.34E+08**	**1.00E+08**	**4.34E+08**	**4.58E+07**	**4.80E+08**	**5.12E+08**	**9.91E+08**	**-4.96E+08**	**4.95E+08**
Jan-21	3.72E+06	4.06E+06	7.78E+06	*-7.22E+06*	5.66E+05	*-5.66E+05*		*0.00E+00*	
Feb-21	1.90E+06	3.52E+06	5.42E+06	*-1.23E+06*	4.19E+06	*-4.19E+06*		*0.00E+00*	
Mar-21	3.89E+07	4.58E+06	4.34E+07	*1.10E+08*	1.53E+08	*-5.58E+07*	9.72E+07	*-6.80E+07*	2.92E+07
Apr-21	6.55E+07	6.28E+06	7.17E+07	*3.17E+07*	1.03E+08	*8.65E+07*	1.90E+08	*-3.00E+07*	1.60E+08
May-21	2.28E+08	1.50E+07	2.43E+08	*5.34E+07*	2.97E+08	*6.57E+07*	3.62E+08	*-9.52E+07*	2.67E+08
Jun-21	2.59E+07	1.12E+07	3.71E+07	*7.94E+06*	4.50E+07	*2.05E+06*	4.71E+07	*-2.73E+07*	1.98E+07
Jul-21				*0.00E+00*		*0.00E+00*		*0.00E+00*	
Aug-21				*0.00E+00*		*0.00E+00*		*0.00E+00*	
Sep-21				*0.00E+00*		*0.00E+00*		*0.00E+00*	
Oct-21				*0.00E+00*		*0.00E+00*		*0.00E+00*	
Nov-21				*0.00E+00*		*0.00E+00*		*0.00E+00*	
Dec-21				*0.00E+00*		*0.00E+00*		*0.00E+00*	
2021	**3.64E+08**	**4.46E+07**	**4.09E+08**	**1.94E+08**	**6.03E+08**	**9.37E+07**	**6.97E+08**	**-2.20E+08**	**4.76E+08**

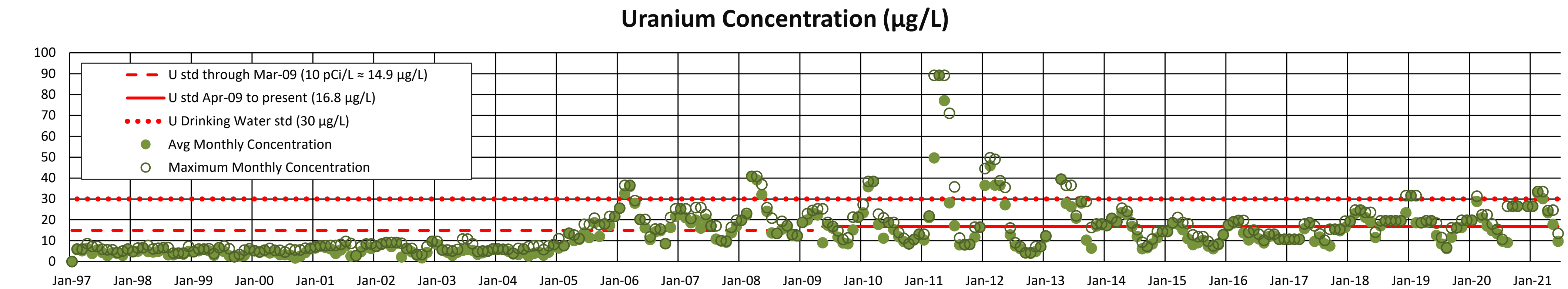
Notes: First full month of concentration data at GS12 4/2010
Flow data missing for all or partial month
No grab sample taken this month
Zero discharge this month
Estimated Load with Linear Interpolation of Concentration

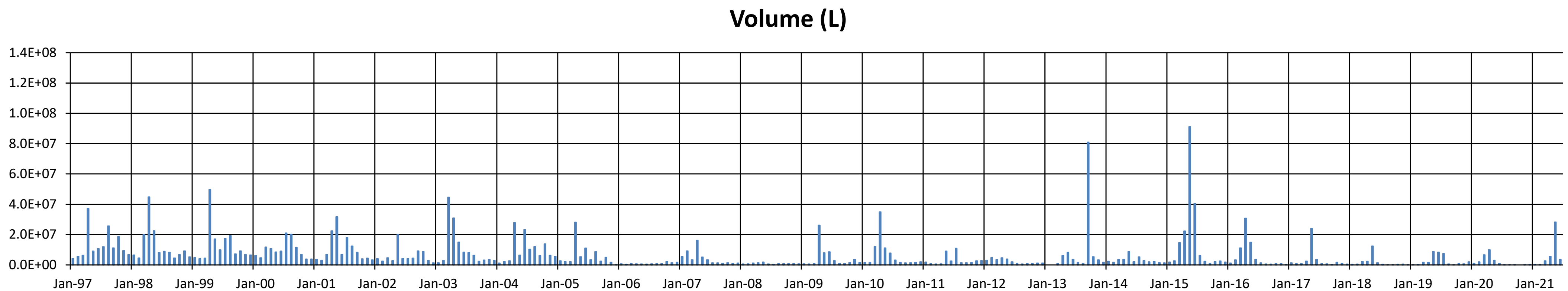
Table B.2

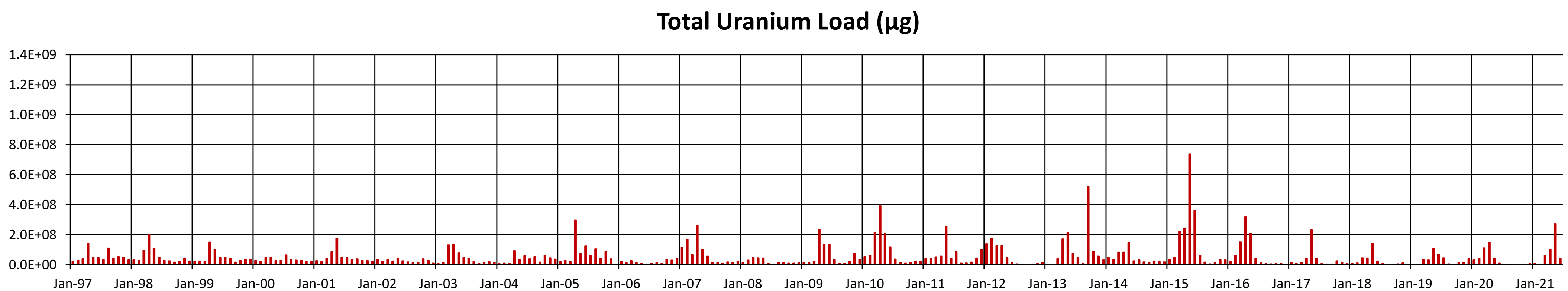
SW093		GS11		GS10		GS08		WALPOC	
Date	U Concentration (ug/L)	Date	U Concentration (ug/L)	Date	U Concentration (ug/L)	Date	U Concentration (ug/L)	Date	U Concentration (ug/L)
September 2013, pre and post									
9/12/2012	9.9	4/21/2013	13.3	9/12/2012	3.8	4/25/2013	16.4	4/21/2013	12.6
11/15/2012	11.3	4/29/2013	13.6	10/24/2012	7.2	5/7/2013	16.1	4/29/2013	11.5
1/10/2013	8.6	5/7/2013	12.1	12/4/2012	12.3	6/4/2013	7.1	5/3/2013	11.3
2/5/2013	5.9	6/4/2013	4.8	1/10/2013	25.9	9/12/2013	4.3	5/7/2013	11.4
3/14/2013	7.3	9/12/2013	1.3	3/4/2013	39.5	9/15/2013	7.4	5/17/2013	10.6
4/6/2013	7.2	9/14/2013	1.3	4/1/2013	28.8	9/24/2013	11.1	6/4/2013	3.2
4/19/2013	3.1	9/16/2013	10.9	4/20/2013	27.2	10/9/2013	13.3	9/13/2013	2.0
4/21/2013	4.9	10/25/2013	25.4	4/24/2013	26.3	11/14/2013	15.0	9/14/2013	2.6
4/24/2013	2.9	4/2/2014	29.0	4/29/2013	36.5	1/16/2014	11.6	9/16/2013	11.5
4/29/2013	5.2	4/16/2014	24.5	5/3/2013	34.2	2/13/2014	16.0	10/25/2013	16.8
5/3/2013	5.2	5/12/2014	18.6	5/8/2013	18.9	3/10/2014	20.4	12/18/2013	18.8
5/8/2013	4.2	5/20/2014	13.3	5/16/2013	26.8	4/2/2014	18.0	1/16/2014	22.5
5/16/2013	3.9	8/18/2014	10.4	5/28/2013	19.4	4/16/2014	16.3	2/18/2014	18.5
6/5/2013	4.2			6/14/2013	21.9	5/12/2014	13.8	3/6/2014	22.9
6/26/2013	4.1			7/3/2013	28.8	5/20/2014	13.9	3/10/2014	21.1
7/23/2013	2.9			8/9/2013	5.6	7/2/2014	6.3	3/24/2014	20.6
9/11/2013	5.3			9/13/2013	5.6	8/18/2014	5.7	4/8/2014	20.0
9/15/2013	5.3			9/16/2013	12.7			4/15/2014	21.8
9/19/2013	12.1			9/24/2013	16.3			4/24/2014	19.3
10/15/2013	15.2			10/16/2013	18.0			5/12/2014	15.6
11/4/2013	13.0			11/13/2013	17.3			5/14/2014	15.4
1/2/2014	12.2			1/2/2014	20.7			5/21/2014	14.6
2/19/2014	10.2			1/29/2014	19.0			6/4/2014	6.9
3/10/2014	7.3			3/6/2014	25.6				
4/2/2014	9.4			3/10/2014	23.5				
4/15/2014	6.7			3/27/2014	24.1				
4/28/2014	6.2			4/8/2014	23.6				
5/12/2014	6.8			4/22/2014	18.5				
5/20/2014	7.1			5/12/2014	17.1				
6/12/2014	4.4			5/20/2014	15.3				
7/30/2014	3.2			6/10/2014	9.3				
8/27/2014	8.8			7/10/2014	8.2				
				7/30/2014	5.3				
				8/6/2014	7.4				
				8/27/2014	6.6				
May 2015, pre and post									
5/12/2014	6.8	5/12/2014	18.6	5/12/2014	17.1	5/12/2014	13.8	5/12/2014	15.6
5/20/2014	7.1	5/20/2014	13.3	5/20/2014	15.3	5/20/2014	13.9	5/14/2014	15.4
6/12/2014	4.4	8/18/2014	10.4	6/10/2014	9.3	7/2/2014	6.3	5/21/2014	14.6
7/30/2014	3.2	1/29/2015	19.6	7/10/2014	8.2	8/18/2014	5.7	6/4/2014	6.9
8/27/2014	8.8	2/24/2015	18.5	7/30/2014	5.3	10/15/2014	6.3	8/12/2014	8.6
10/1/2014	8.8	3/9/2015	9.3	8/6/2014	7.4	12/11/2014	6.4	10/23/2014	13.3
10/2/2014	4.7	3/11/2015	11.2	8/27/2014	6.6	1/1/2015	6.4	1/6/2015	11.6
11/19/2014	5.2	3/18/2015	17.1	9/16/2014	10.8	2/9/2015	11.6	1/29/2015	14.4
1/6/2015	9.0	4/1/2015	19.4	10/2/2014	10.6	3/9/2015	13.5	2/17/2015	17.0
2/24/2015	5.1	4/17/2015	10.0	10/23/2014	14.4	3/11/2015	12.3	2/24/2015	14.2
3/9/2015	6.3	4/20/2015	12.5	1/6/2015	18.6	3/18/2015	15.8	3/9/2015	10.0
3/12/2015	10.2	4/27/2015	12.3	2/3/2015	21.1	4/7/2015	12.1	3/11/2015	10.9
3/31/2015	8.4	5/4/2015	12.1	2/24/2015	11.9	4/17/2015	8.5	3/18/2015	14.3
4/17/2015	4.3	5/8/2015	8.0	3/11/2015	18.7	4/21/2015	11.3	3/26/2015	16.1
4/20/2015	7.7	5/9/2015	5.4	3/26/2015	18.2	4/28/2015	11.4	4/7/2015	14.5
4/27/2015	9.5	5/14/2015	7.4	4/17/2015	8.1	5/5/2015	11.6	4/17/2015	10.6
5/5/2015	7.6	5/18/2015	5.7	4/20/2015	12.4	5/8/2015	8.8	4/20/2015	9.0
5/8/2015	3.4	5/21/2015	8.0	4/28/2015	12.8	5/9/2015	6.0	4/28/2015	11.3
5/9/2015	5.7	5/27/2015	6.9	5/6/2015	9.0	5/14/2015	6.9	5/5/2015	9.5
5/18/2015	5.7	6/8/2015	7.9	5/9/2015	6.5	5/18/2015	6.1	5/8/2015	6.8
5/26/2015	6.5	6/12/2015	8.7	5/14/2015	7.6	5/21/2015	7.8	5/9/2015	5.7
6/5/2015	6.0	1/4/2016	23.1	5/18/2015	6.9	5/27/2015	6.3	5/18/2015	7.1
6/12/2015	11.2	2/24/2016	21.9	5/19/2015	8.9	6/8/2015	6.9	5/26/2015	6.3
7/9/2015	11.2	3/28/2016	12.8	5/26/2015	6.9	6/12/2015	7.6	6/8/2015	5.9
10/1/2015	11.2	3/30/2016	13.0	6/5/2015	6.3	7/6/2015	10.5	6/12/2015	7.9
11/16/2015	6.3	4/6/2016	12.6	6/12/2015	12.0	8/31/2015	5.7	7/7/2015	9.3
1/25/2016	8.5	4/19/2016	8.2	7/7/2015	9.7	10/12/2015	6.2	9/24/2015	7.9
2/16/2016	7.6	4/21/2016	10.5	8/10/2015	6.5	11/3/2015	7.2	11/16/2015	10.2
3/22/2016	6.0			8/31/2015	6.0	12/3/2015	9.7	11/30/2015	12.8
3/28/2016	6.0			9/29/2015	7.5	1/4/2016	11.8	1/4/2016	17.3
3/30/2016	7.0			10/20/2015	8.4	2/16/2016	12.0	1/28/2016	17.6
4/6/2016	5.8			11/3/2015	12.9	3/21/2016	12.7	2/16/2016	19.0
4/19/2016	4.6			12/3/2015	17.5	3/29/2016	11.5	3/3/2016	19.1
4/20/2016	9.7			1/21/2016	19.0	3/30/2016	12.0	3/21/2016	16.1
				2/16/2016	19.7	4/14/2016	9.6	3/28/2016	11.9
				3/3/2016	19.6	4/20/2016	10.8	3/30/2016	12.5
				3/21/2016	18.2			4/4/2016	13.5
				3/28/2016	9.9			4/14/2016	9.1
				3/29/2016	9.5			4/20/2016	7.5
				3/30/2016	14.0			4/28/2016	10.5
				4/6/2016	11.1				
				4/14/2016	8.2				
				4/20/2016	10.8				
				4/28/2016	13.7				
May 2021, pre and post									
5/27/2020	3.8	5/8/2020	11.7	5/13/2020	11.7	4/26/2021	13.2	5/19/2020	11.9
9/2/2020	12.4	6/1/2020	10.0	5/27/2020	10.6	5/3/2021	5.8	1/6/2021	7.4
10/1/2020	12.4	4/1/2021	10.0	6/15/2020	9.1	5/10/2021	8.6	3/29/2021	8.4
1/19/2021	3.7	4/21/2021	9.1	7/7/2020	26.5	5/26/2021	12.0	4/1/2021	8.8
3/23/2021	1.7	4/26/2021	8.5	10/1/2020	26.5	6/16/2021	9.2	4/12/2021	11.4
4/1/2021	2.2	5/3/2021	4.6	1/4/2021	33.5			4/21/2021	12.2
4/21/2021	3.7	5/10/2021	6.3	2/8/2021	22.5			4/26/2021	10.7
4/30/2021	2.5	5/26/2021	9.3	3/25/2021	24.4			4/30/2021	6.3
5/4/2021	4.9	6/16/2021	8.7	4/1/2021	24.7			5/4/2021	5.9
5/10/2021	6.1			4/21/2021	19.0			5/10/2021	8.5
6/4/2021	3.1			4/26/2021	12.8			5/20/2021	9.9
				4/30/2021	6.4			6/4/2021	8.5
				5/4/2021	12.7				
				5/10/2021	13.5				
				5/20/2021	12.7				
				6/4/2021	11.6				
				6/16/2021	10.2				
				6/29/2021	3.2				

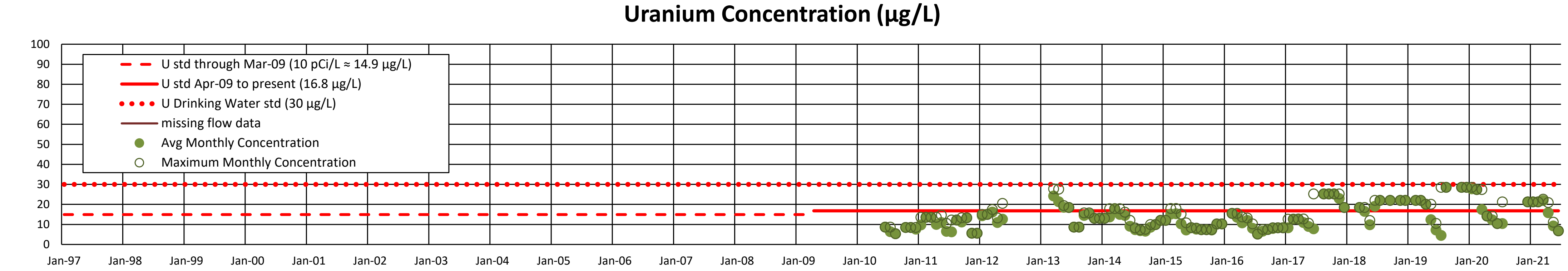
Figure C.1
Location: GS10, Jan 1997 - June 2021

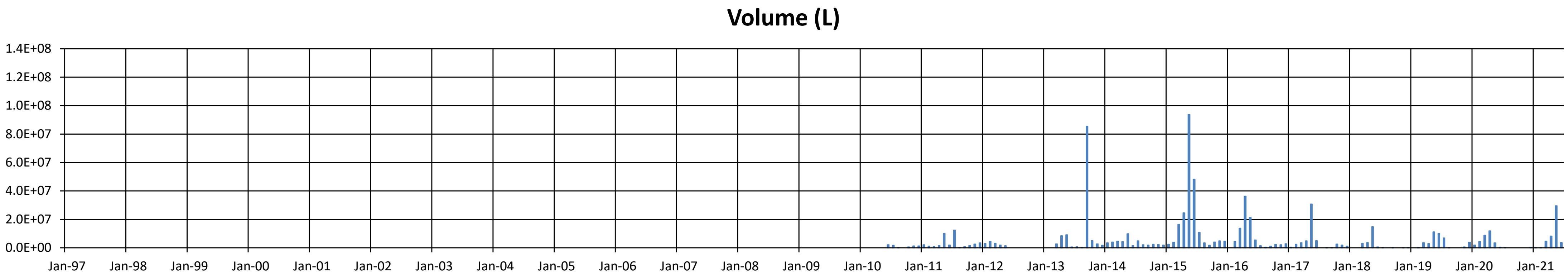
South Walnut Creek-1
(IA Perimeter)

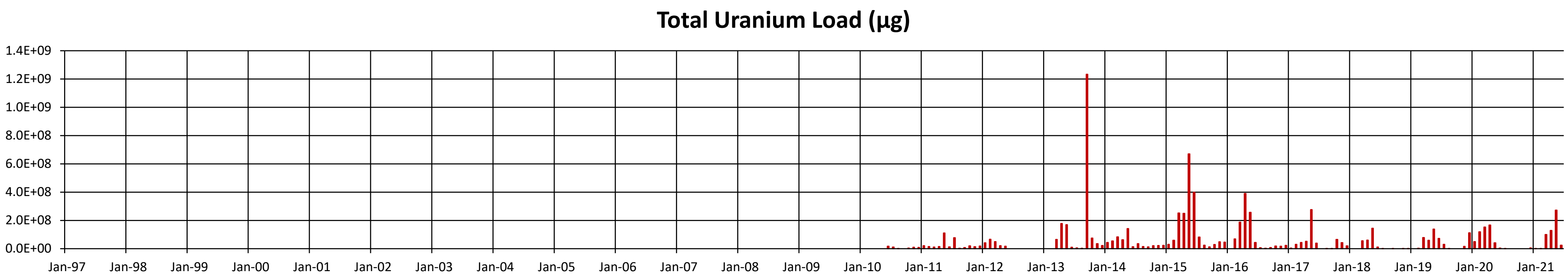


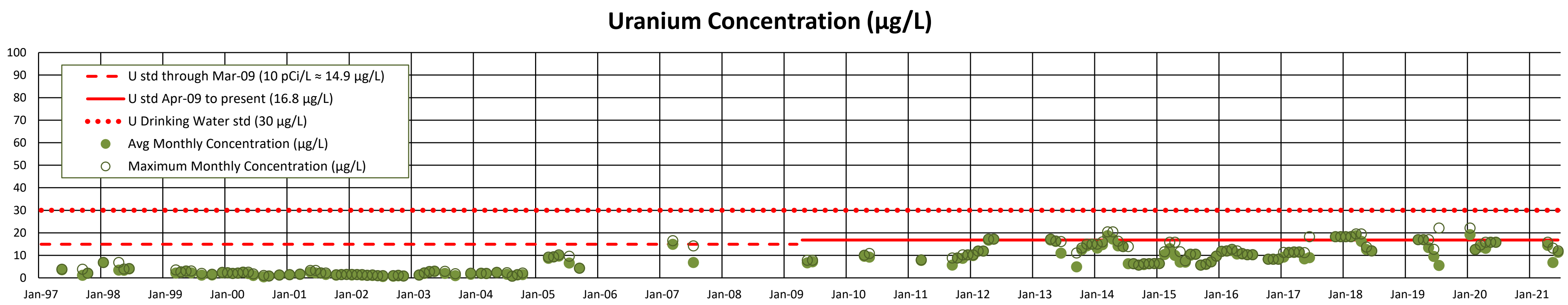


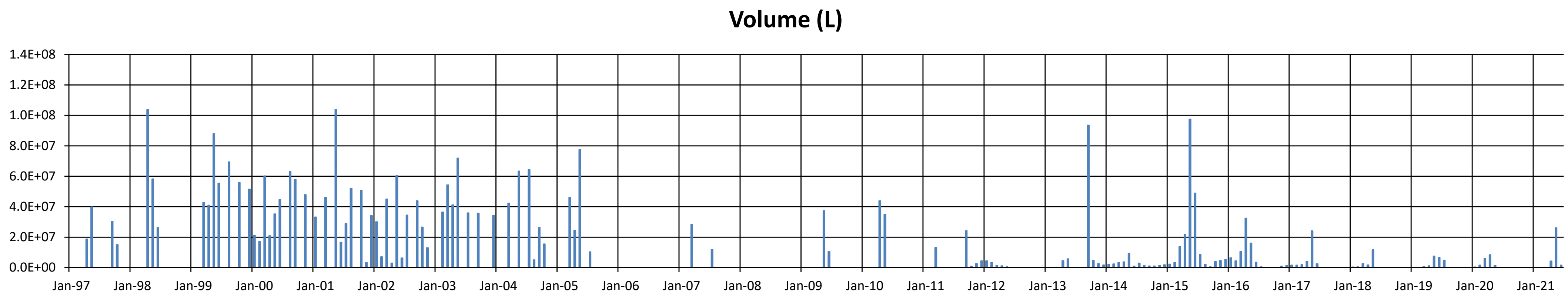


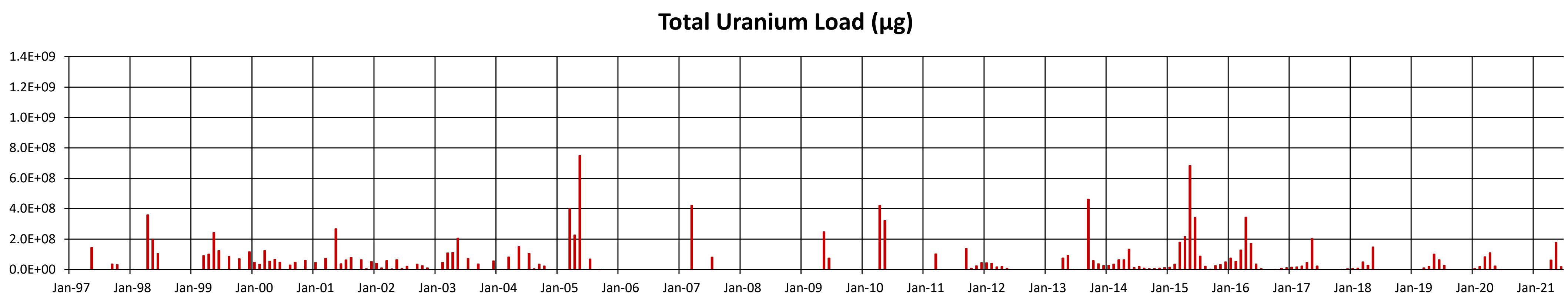

Uranium Concentration (µg/L)
U std through Mar-09 (10 pCi/L ≈ 14.9 µg/L)
U std Apr-09 to present (16.8 µg/L)
U Drinking Water std (30 µg/L)
missing flow data
Avg Monthly Concentration
Maximum Monthly Concentration
100
90
80
70
60
50
40
30
20
10
0
Jan-97
Jan-98
Jan-99
Jan-00
Jan-01
Jan-02
Jan-03
Jan-04
Jan-05
Jan-06
Jan-07
Jan-08
Jan-09
Jan-10
Jan-11
Jan-12
Jan-13
Jan-14
Jan-15
Jan-16
Jan-17
Jan-18
Jan-19
Jan-20
Jan-21

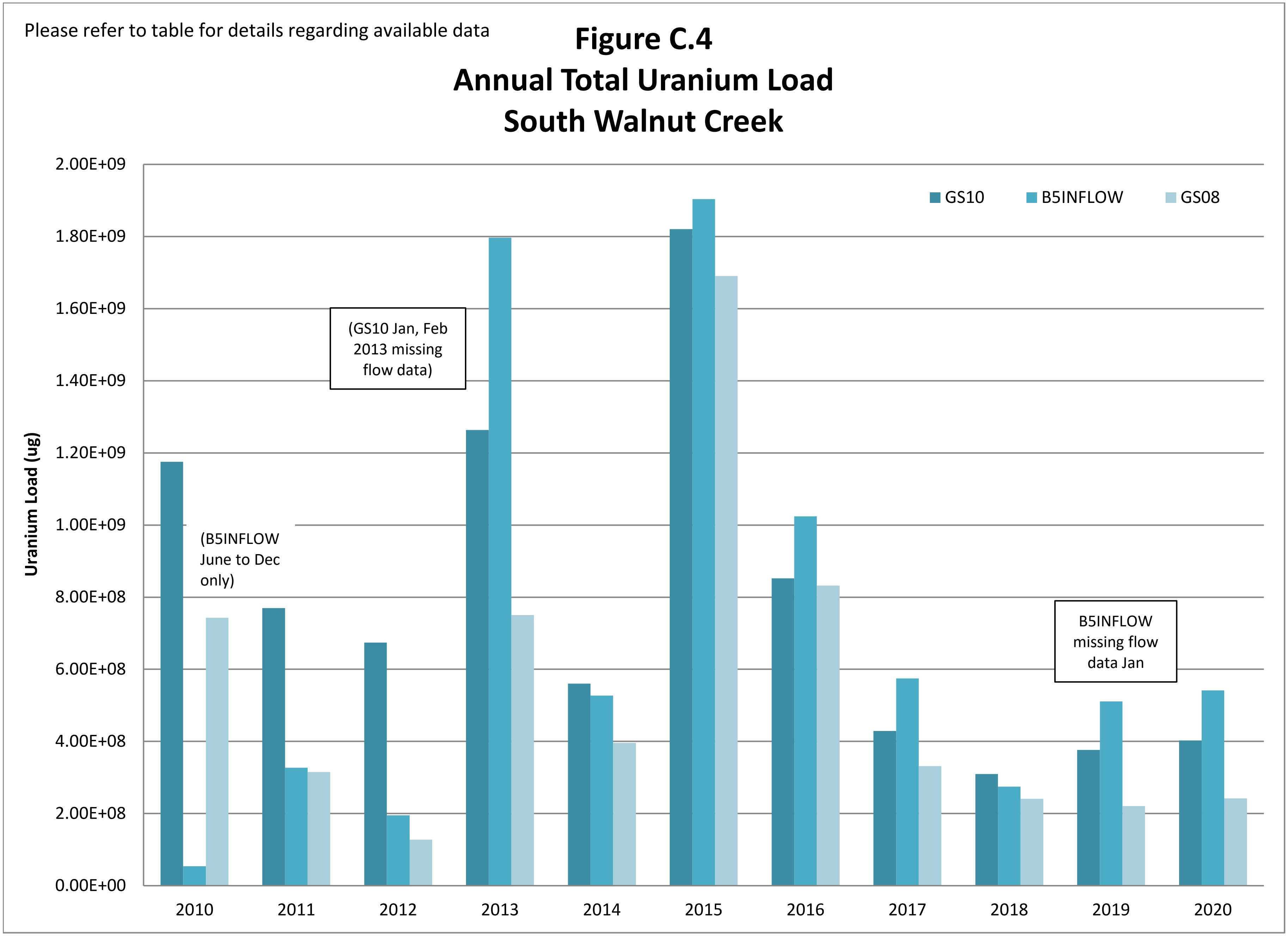

Volume (L)
1.4E+08
1.2E+08
1.0E+08
8.0E+07
6.0E+07
4.0E+07
2.0E+07
0.0E+00
Jan-97
Jan-98
Jan-99
Jan-00
Jan-01
Jan-02
Jan-03
Jan-04
Jan-05
Jan-06
Jan-07
Jan-08
Jan-09
Jan-10
Jan-11
Jan-12
Jan-13
Jan-14
Jan-15
Jan-16
Jan-17
Jan-18
Jan-19
Jan-20
Jan-21


Total Uranium Load (µg)
1.4E+09
1.2E+09
1.0E+09
8.0E+08
6.0E+08
4.0E+08
2.0E+08
0.0E+00
Jan-97
Jan-98
Jan-99
Jan-00
Jan-01
Jan-02
Jan-03
Jan-04
Jan-05
Jan-06
Jan-07
Jan-08
Jan-09
Jan-10
Jan-11
Jan-12
Jan-13
Jan-14
Jan-15
Jan-16
Jan-17
Jan-18
Jan-19
Jan-20
Jan-21


Uranium Concentration (µg/L)
U std through Mar-09 (10 pCi/L ≈ 14.9 µg/L)
U std Apr-09 to present (16.8 µg/L)
U Drinking Water std (30 µg/L)
Avg Monthly Concentration (µg/L)
Maximum Monthly Concentration (µg/L)
0
10
20
30
40
50
60
70
80
90
100
Jan-97
Jan-98
Jan-99
Jan-00
Jan-01
Jan-02
Jan-03
Jan-04
Jan-05
Jan-06
Jan-07
Jan-08
Jan-09
Jan-10
Jan-11
Jan-12
Jan-13
Jan-14
Jan-15
Jan-16
Jan-17
Jan-18
Jan-19
Jan-20
Jan-21

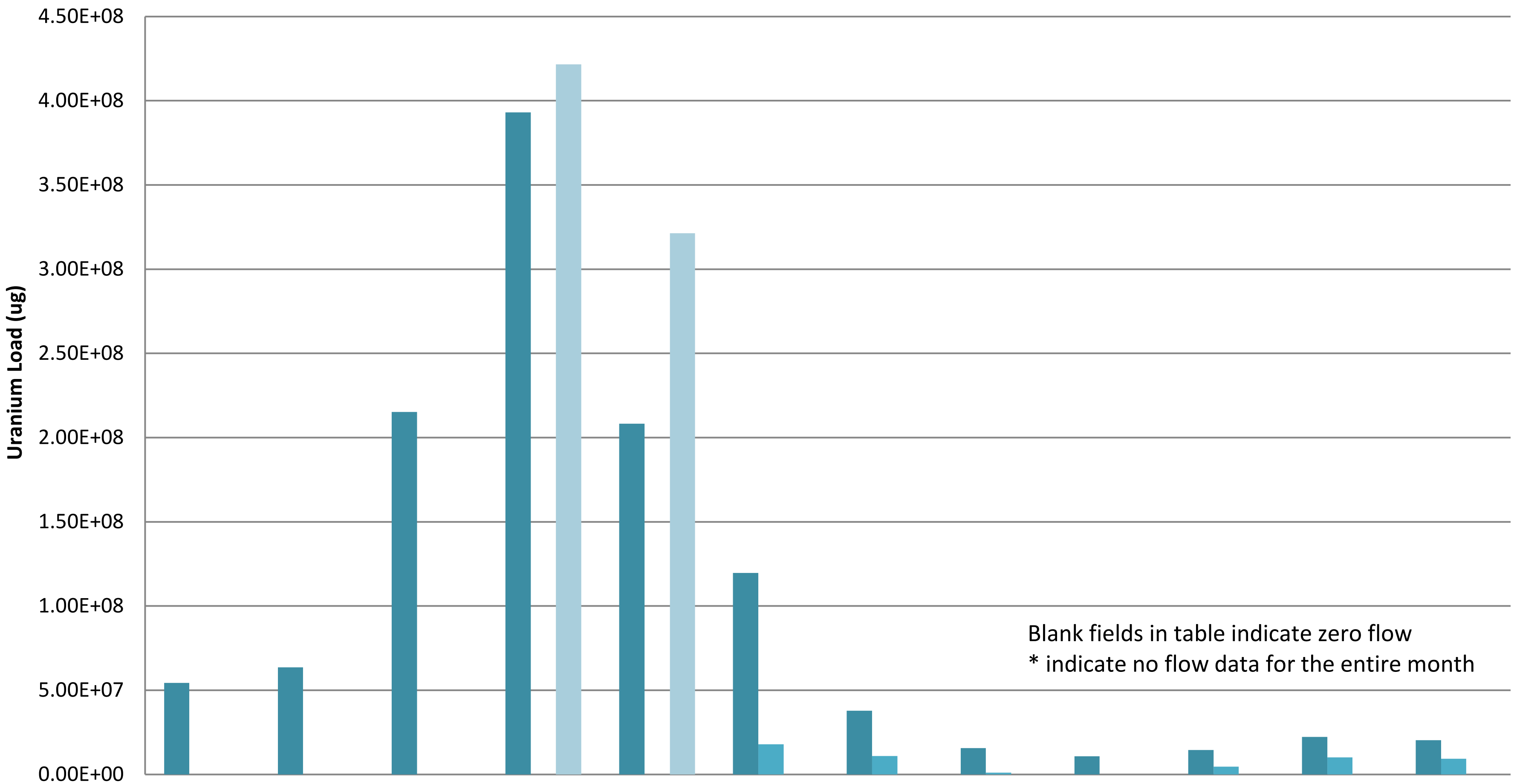

Volume (L)
0.0E+00
2.0E+07
4.0E+07
6.0E+07
8.0E+07
1.0E+08
1.2E+08
1.4E+08
Jan-97
Jan-98
Jan-99
Jan-00
Jan-01
Jan-02
Jan-03
Jan-04
Jan-05
Jan-06
Jan-07
Jan-08
Jan-09
Jan-10
Jan-11
Jan-12
Jan-13
Jan-14
Jan-15
Jan-16
Jan-17
Jan-18
Jan-19
Jan-20
Jan-21


Total Uranium Load (µg)
0.0E+00
2.0E+08
4.0E+08
6.0E+08
8.0E+08
1.0E+09
1.2E+09
1.4E+09
Jan-97
Jan-98
Jan-99
Jan-00
Jan-01
Jan-02
Jan-03
Jan-04
Jan-05
Jan-06
Jan-07
Jan-08
Jan-09
Jan-10
Jan-11
Jan-12
Jan-13
Jan-14
Jan-15
Jan-16
Jan-17
Jan-18
Jan-19
Jan-20
Jan-21


Please refer to table for details regarding available data
Figure C.4
Annual Total Uranium Load
South Walnut Creek
Uranium Load (ug)
2.00E+09
1.80E+09
1.60E+09
1.40E+09
1.20E+09
1.00E+09
8.00E+08
6.00E+08
4.00E+08
2.00E+08
0.00E+00
GS10
B5INFLOW
GS08
(GS10 Jan, Feb 2013 missing flow data)
(B5INFLOW June to Dec only)
B5INFLOW missing flow data Jan
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020

Please refer to table for details regarding available data

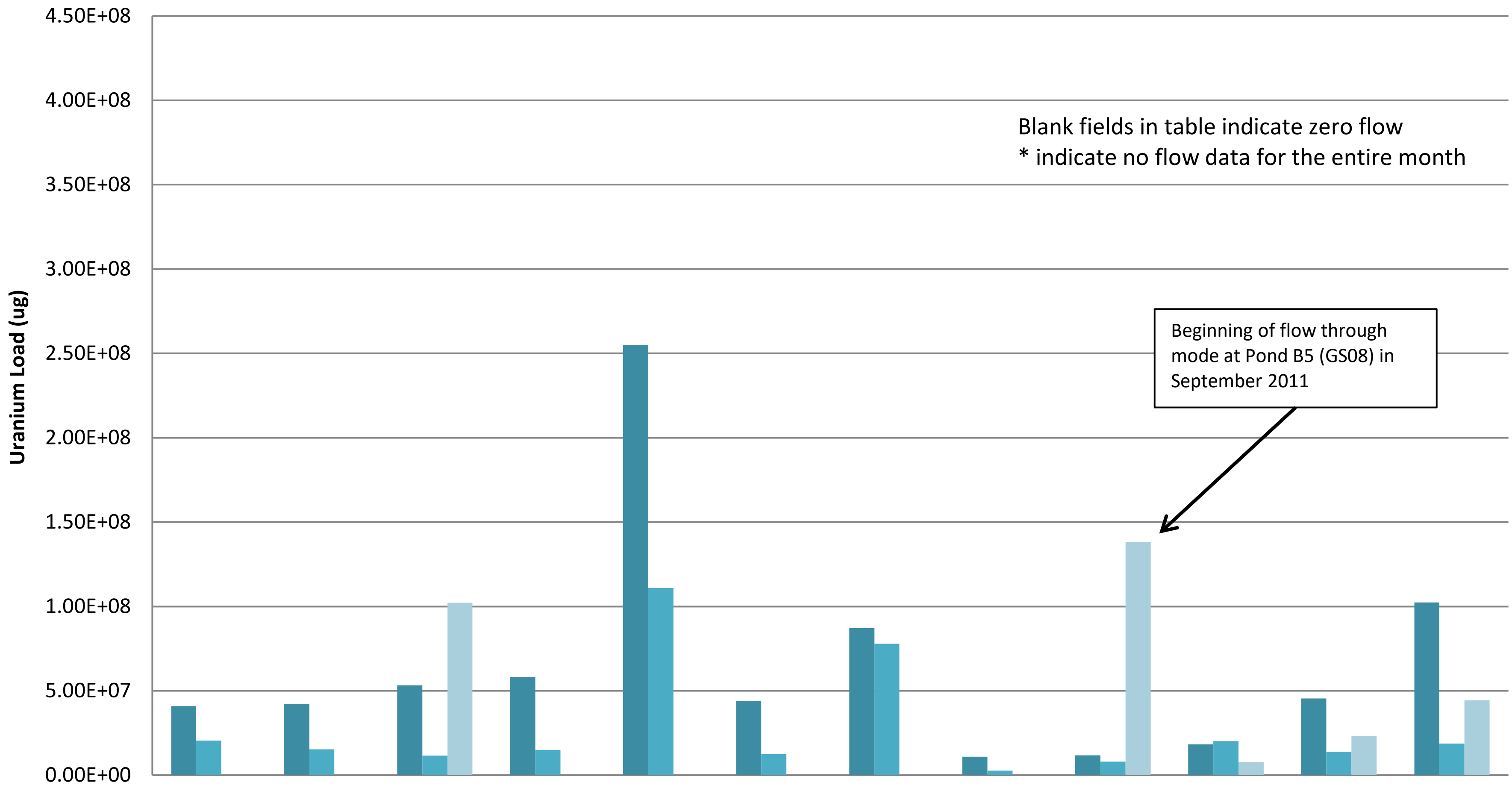
Figure C.5
Monthly Uranium Load in South Walnut Creek
2010



	Jan-10	Feb-10	Mar-10	Apr-10	May-10	Jun-10	Jul-10	Aug-10	Sep-10	Oct-10	Nov-10	Dec-10
GS10	5.44E+07	6.36E+07	2.15E+08	3.93E+08	2.08E+08	1.20E+08	3.78E+07	1.56E+07	1.08E+07	1.46E+07	2.23E+07	2.03E+07
B5INFLOW	*	*	*	*	*	1.79E+07	1.10E+07	1.04E+06		4.66E+06	1.02E+07	9.28E+06
GS08				4.22E+08	3.21E+08							

Please refer to table for details regarding available data

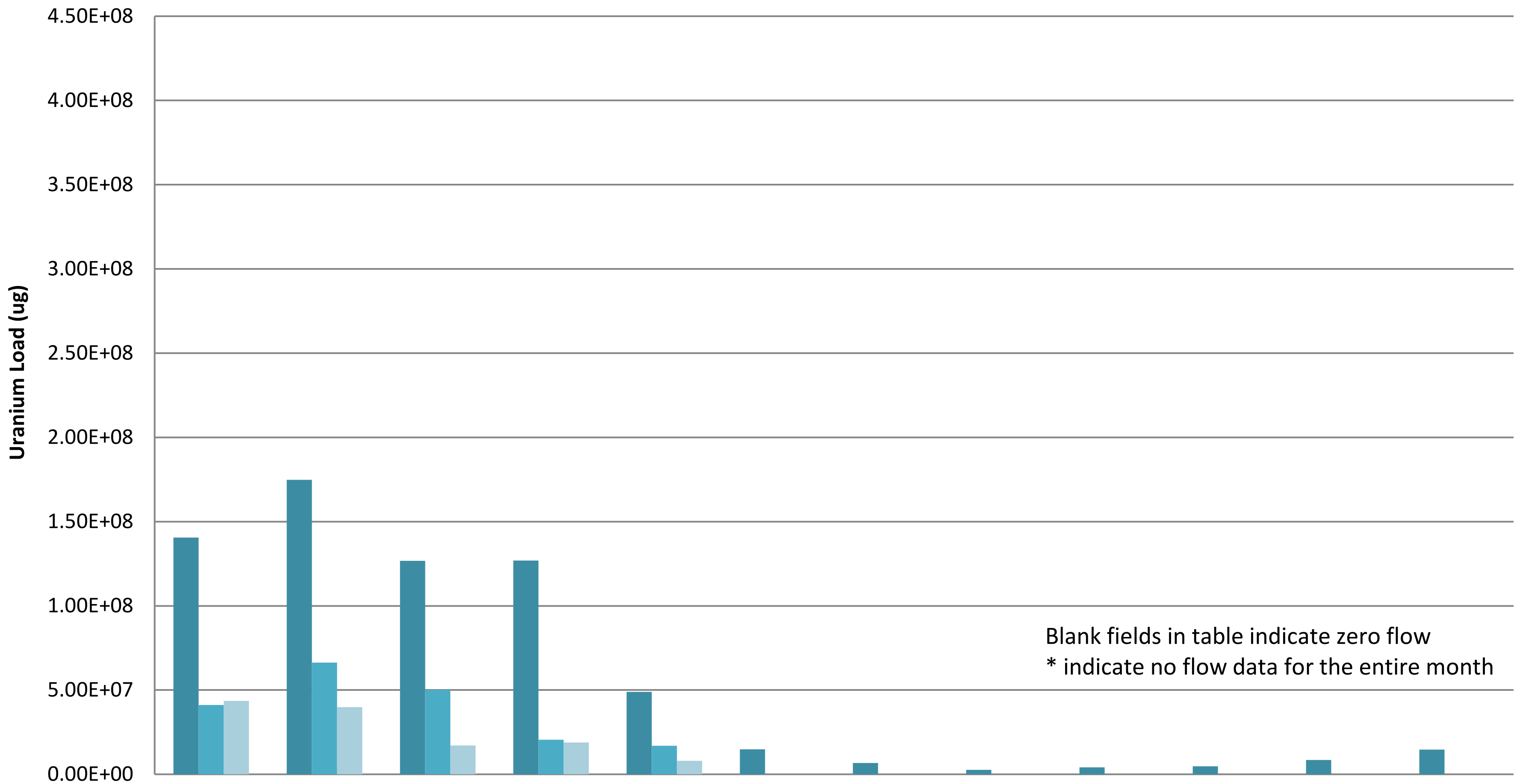
Figure C.6
Monthly Uranium Load in South Walnut Creek
2011



	Jan-11	Feb-11	Mar-11	Apr-11	May-11	Jun-11	Jul-11	Aug-11	Sep-11	Oct-11	Nov-11	Dec-11
GS10	4.09E+07	4.22E+07	5.33E+07	5.83E+07	2.55E+08	4.41E+07	8.71E+07	1.09E+07	1.17E+07	1.82E+07	4.55E+07	1.02E+08
B5INFLOW	2.05E+07	1.54E+07	1.17E+07	1.50E+07	1.11E+08	1.24E+07	7.78E+07	2.69E+06	8.06E+06	2.02E+07	1.39E+07	1.87E+07
GS08			1.02E+08						1.38E+08	7.68E+06	2.30E+07	4.44E+07

Please refer to table for details regarding available data

Figure C.7
Monthly Uranium Load in South Walnut Creek
2012

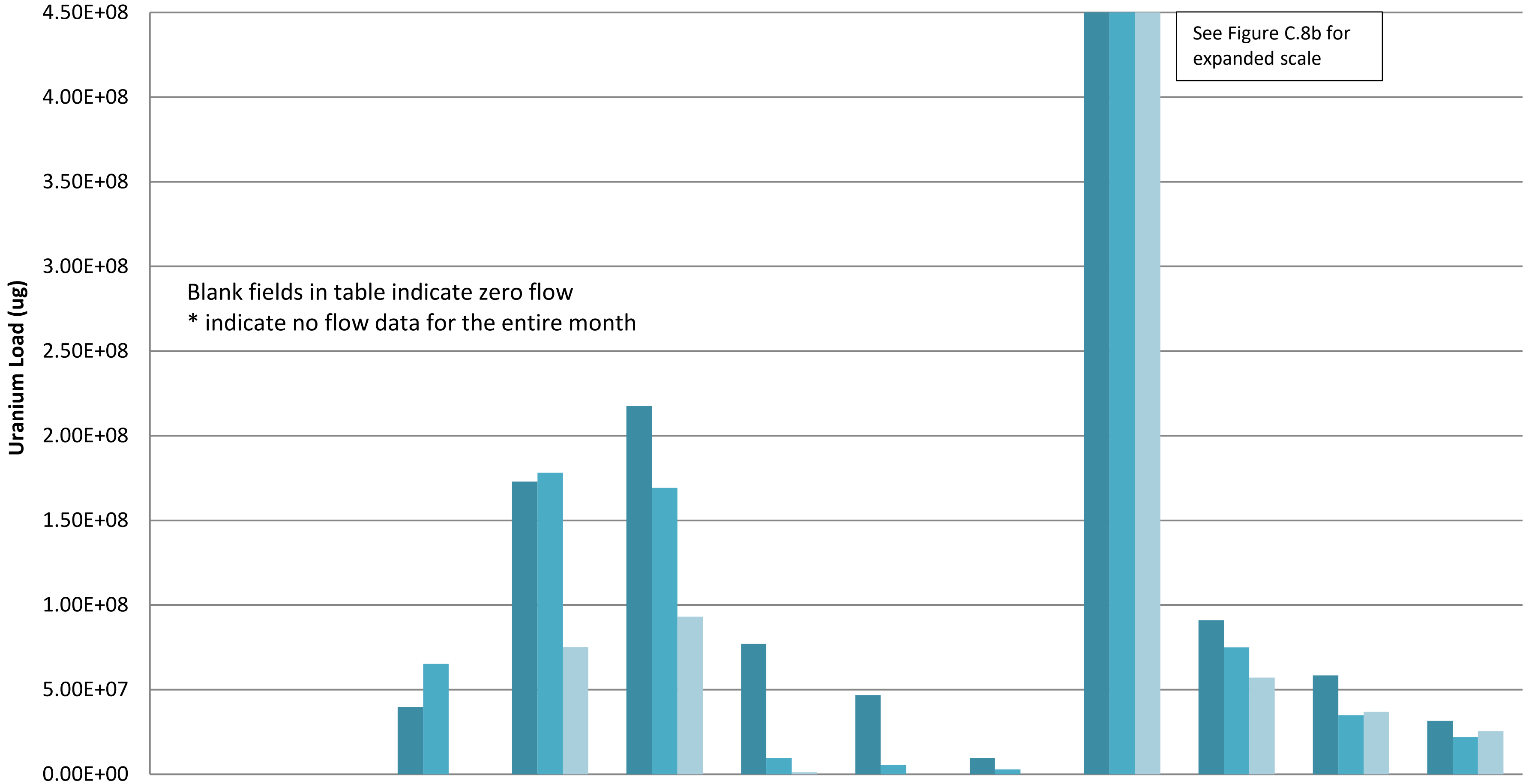


Blank fields in table indicate zero flow
* indicate no flow data for the entire month

	Jan-12	Feb-12	Mar-12	Apr-12	May-12	Jun-12	Jul-12	Aug-12	Sep-12	Oct-12	Nov-12	Dec-12
GS10	1.41E+08	1.75E+08	1.27E+08	1.27E+08	4.89E+07	1.48E+07	6.76E+06	2.71E+06	4.04E+06	4.76E+06	8.58E+06	1.47E+07
B5INFLOW	4.12E+07	6.63E+07	5.02E+07	2.04E+07	1.69E+07							
GS08	4.36E+07	3.99E+07	1.70E+07	1.88E+07	8.03E+06							

Please refer to table for details regarding available data

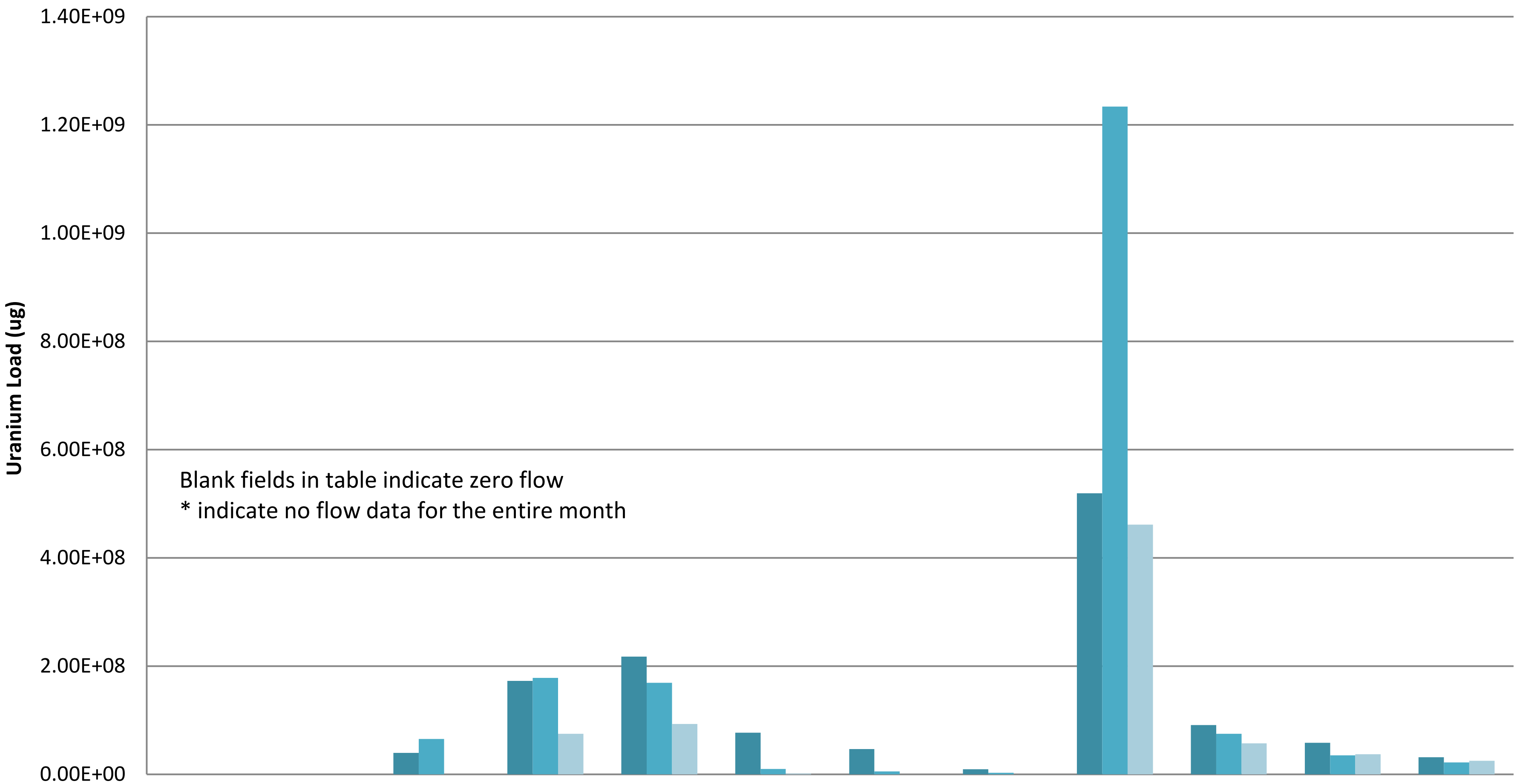
Figure C.8a
Monthly Uranium Load in South Walnut Creek
2013



	Jan-13	Feb-13	Mar-13	Apr-13	May-13	Jun-13	Jul-13	Aug-13	Sep-13	Oct-13	Nov-13	Dec-13
GS10	*	*	3.98E+07	1.73E+08	2.17E+08	7.70E+07	4.68E+07	9.53E+06	5.19E+08	9.10E+07	5.84E+07	3.15E+07
B5INFLOW			6.53E+07	1.78E+08	1.69E+08	9.72E+06	5.58E+06	2.94E+06	1.23E+09	7.50E+07	3.49E+07	2.21E+07
GS08				7.51E+07	9.31E+07	1.19E+06			4.62E+08	5.71E+07	3.69E+07	2.53E+07

Please refer to table for details regarding available data

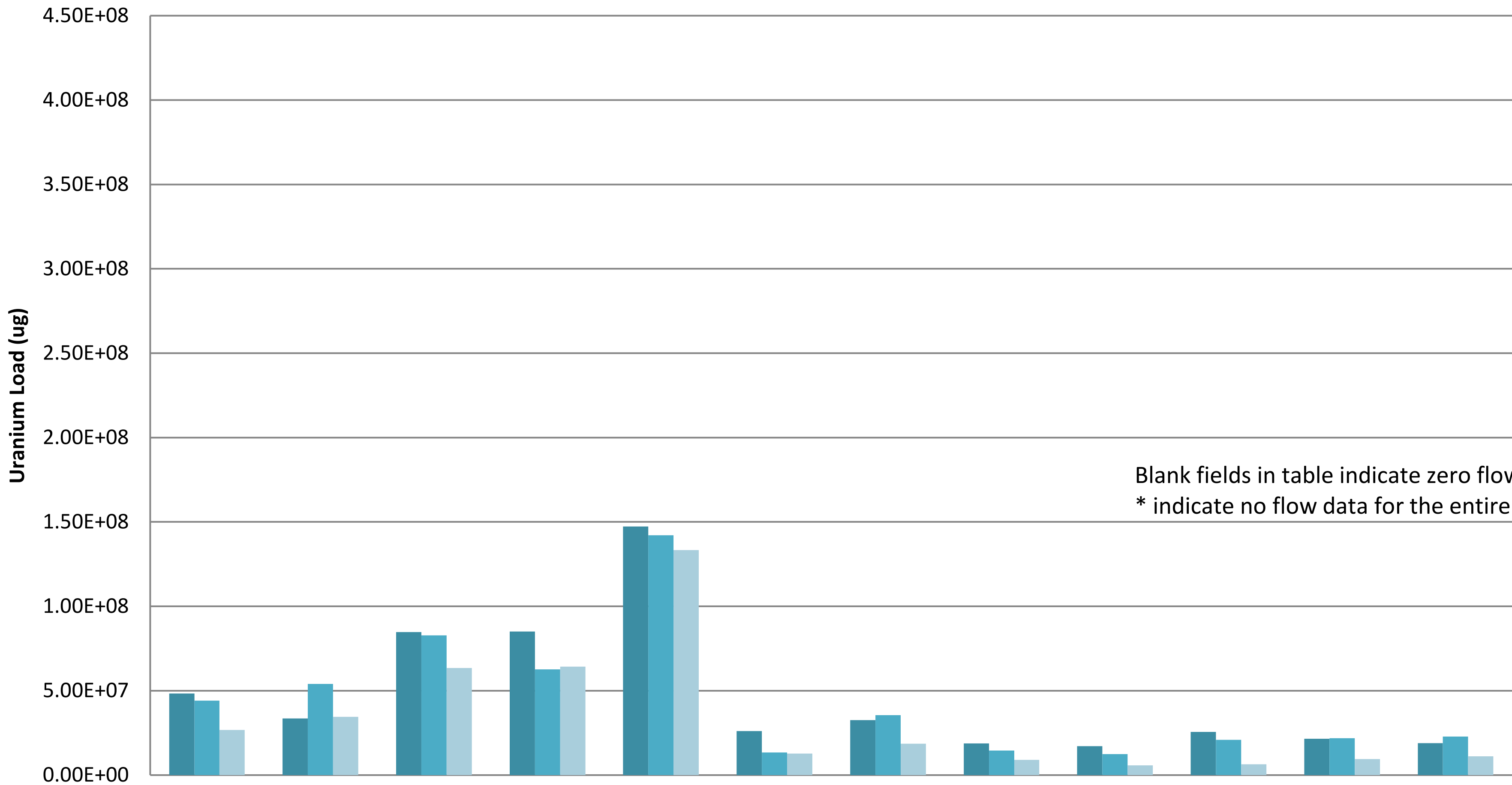
Figure C.8b
Monthly Uranium Load in South Walnut Creek
2013



	Jan-13	Feb-13	Mar-13	Apr-13	May-13	Jun-13	Jul-13	Aug-13	Sep-13	Oct-13	Nov-13	Dec-13
GS10	*	*	3.98E+07	1.73E+08	2.17E+08	7.70E+07	4.68E+07	9.53E+06	5.19E+08	9.10E+07	5.84E+07	3.15E+07
B5INFLOW			6.53E+07	1.78E+08	1.69E+08	9.72E+06	5.58E+06	2.94E+06	1.23E+09	7.50E+07	3.49E+07	2.21E+07
GS08				7.51E+07	9.31E+07	1.19E+06			4.62E+08	5.71E+07	3.69E+07	2.53E+07

Please refer to table for details regarding available data

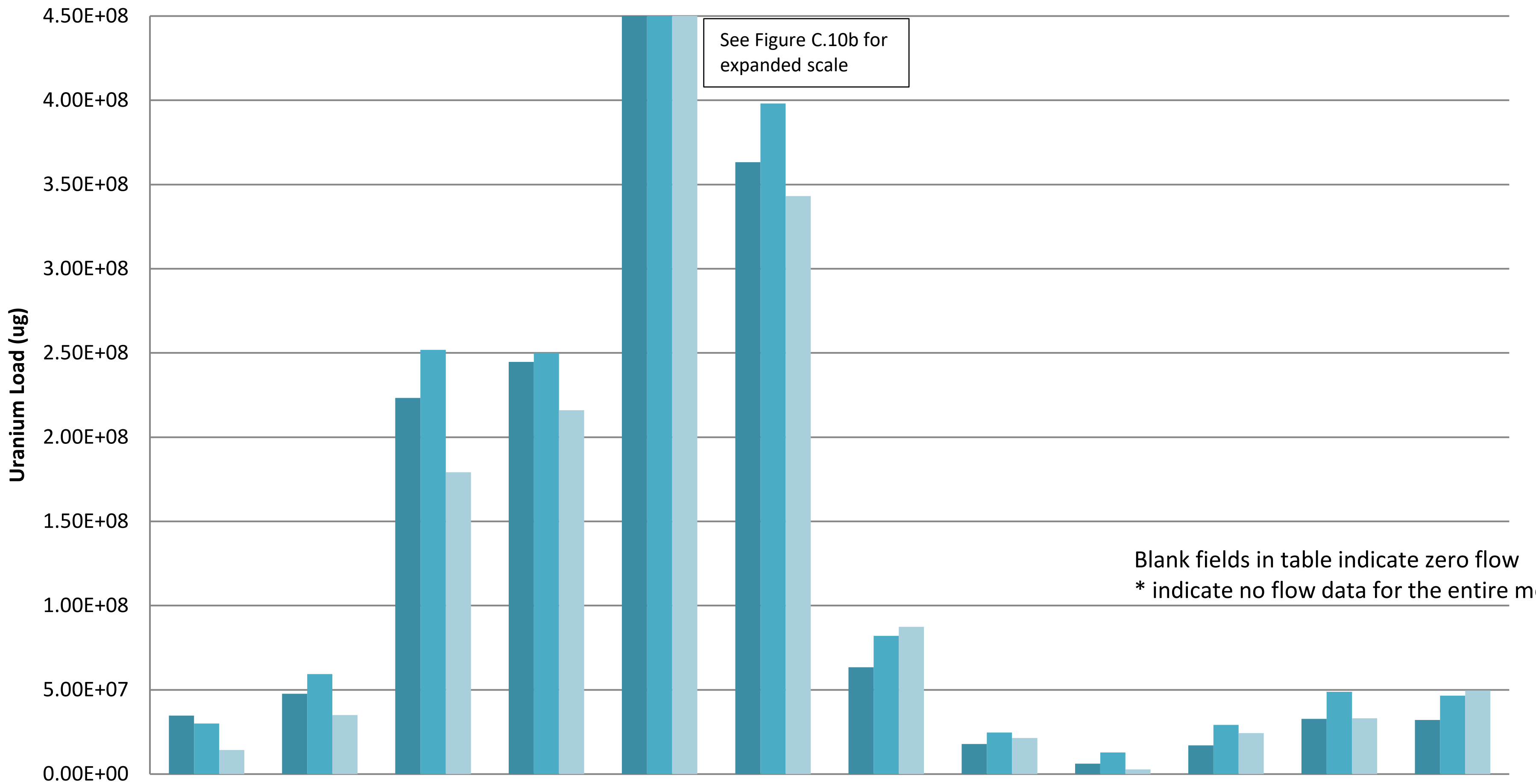
Figure C.9
Monthly Uranium Load in South Walnut Creek
2014



	Jan-14	Feb-14	Mar-14	Apr-14	May-14	Jun-14	Jul-14	Aug-14	Sep-14	Oct-14	Nov-14	Dec-14
GS10	4.83E+07	3.35E+07	8.48E+07	8.51E+07	1.47E+08	2.62E+07	3.26E+07	1.87E+07	1.71E+07	2.57E+07	2.16E+07	1.90E+07
B5INFLOW	4.42E+07	5.41E+07	8.27E+07	6.26E+07	1.42E+08	1.34E+07	3.54E+07	1.45E+07	1.24E+07	2.08E+07	2.18E+07	2.28E+07
GS08	2.67E+07	3.45E+07	6.35E+07	6.42E+07	1.33E+08	1.28E+07	1.86E+07	9.04E+06	5.70E+06	6.35E+06	9.56E+06	1.12E+07

Please refer to table for details regarding available data

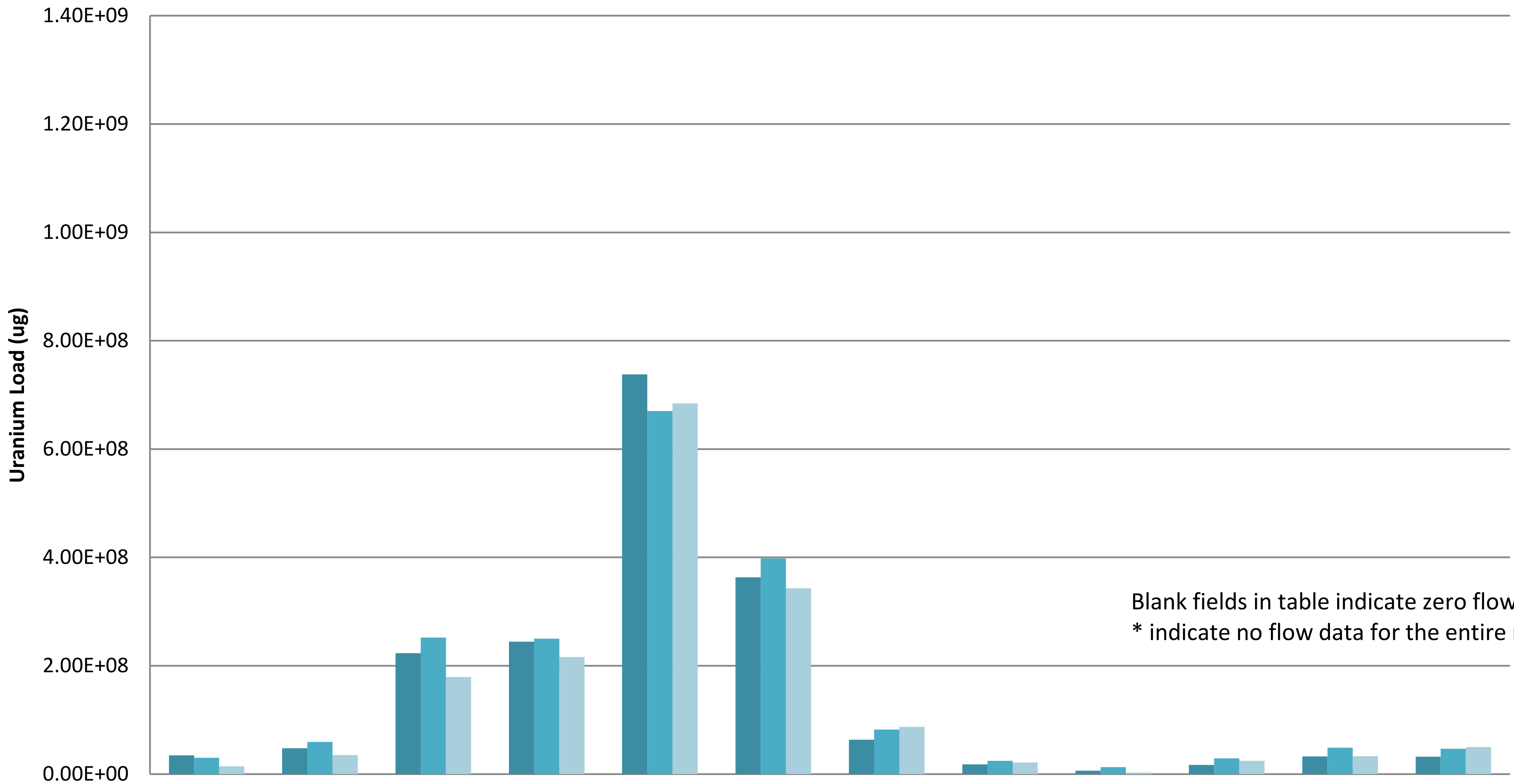
Figure C.10a
Monthly Uranium Load in South Walnut Creek
2015



	Jan-15	Feb-15	Mar-15	Apr-15	May-15	Jun-15	Jul-15	Aug-15	Sep-15	Oct-15	Nov-15	Dec-15
GS10	3.47E+07	4.77E+07	2.23E+08	2.45E+08	7.38E+08	3.63E+08	6.33E+07	1.79E+07	6.24E+06	1.71E+07	3.27E+07	3.21E+07
B5INFLOW	3.00E+07	5.94E+07	2.52E+08	2.50E+08	6.70E+08	3.98E+08	8.20E+07	2.47E+07	1.28E+07	2.91E+07	4.88E+07	4.66E+07
GS08	1.42E+07	3.51E+07	1.79E+08	2.16E+08	6.84E+08	3.43E+08	8.74E+07	2.15E+07	2.82E+06	2.44E+07	3.30E+07	4.96E+07

Please refer to table for details regarding available data

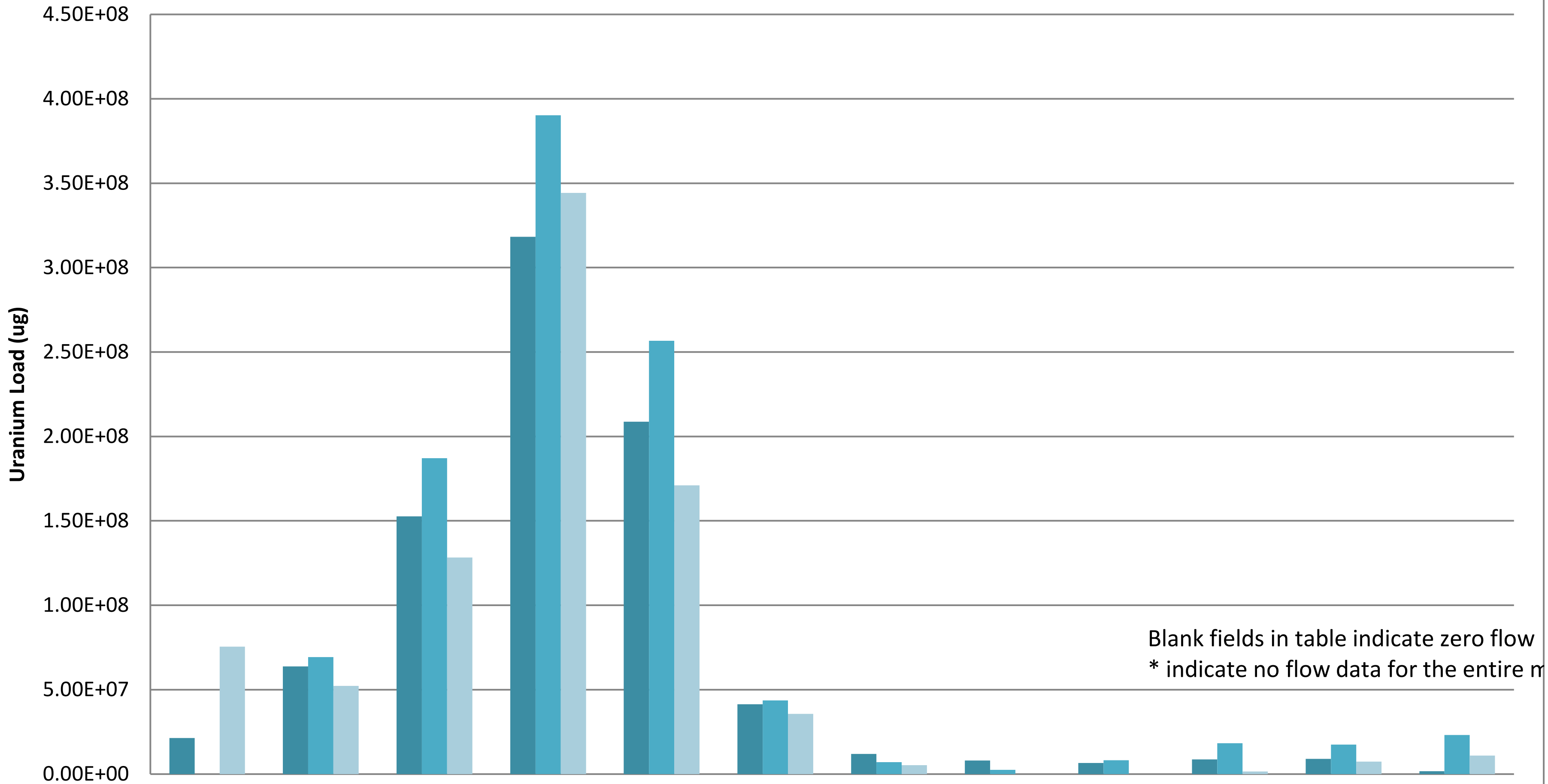
Figure C.10b
Monthly Uranium Load in South Walnut Creek
2015



	Jan-15	Feb-15	Mar-15	Apr-15	May-15	Jun-15	Jul-15	Aug-15	Sep-15	Oct-15	Nov-15	Dec-15
GS10	3.47E+07	4.77E+07	2.23E+08	2.45E+08	7.38E+08	3.63E+08	6.33E+07	1.79E+07	6.24E+06	1.71E+07	3.27E+07	3.21E+07
B5INFLOW	3.00E+07	5.94E+07	2.52E+08	2.50E+08	6.70E+08	3.98E+08	8.20E+07	2.47E+07	1.28E+07	2.91E+07	4.88E+07	4.66E+07
GS08	1.42E+07	3.51E+07	1.79E+08	2.16E+08	6.84E+08	3.43E+08	8.74E+07	2.15E+07	2.82E+06	2.44E+07	3.30E+07	4.96E+07

Please refer to table for details regarding available data

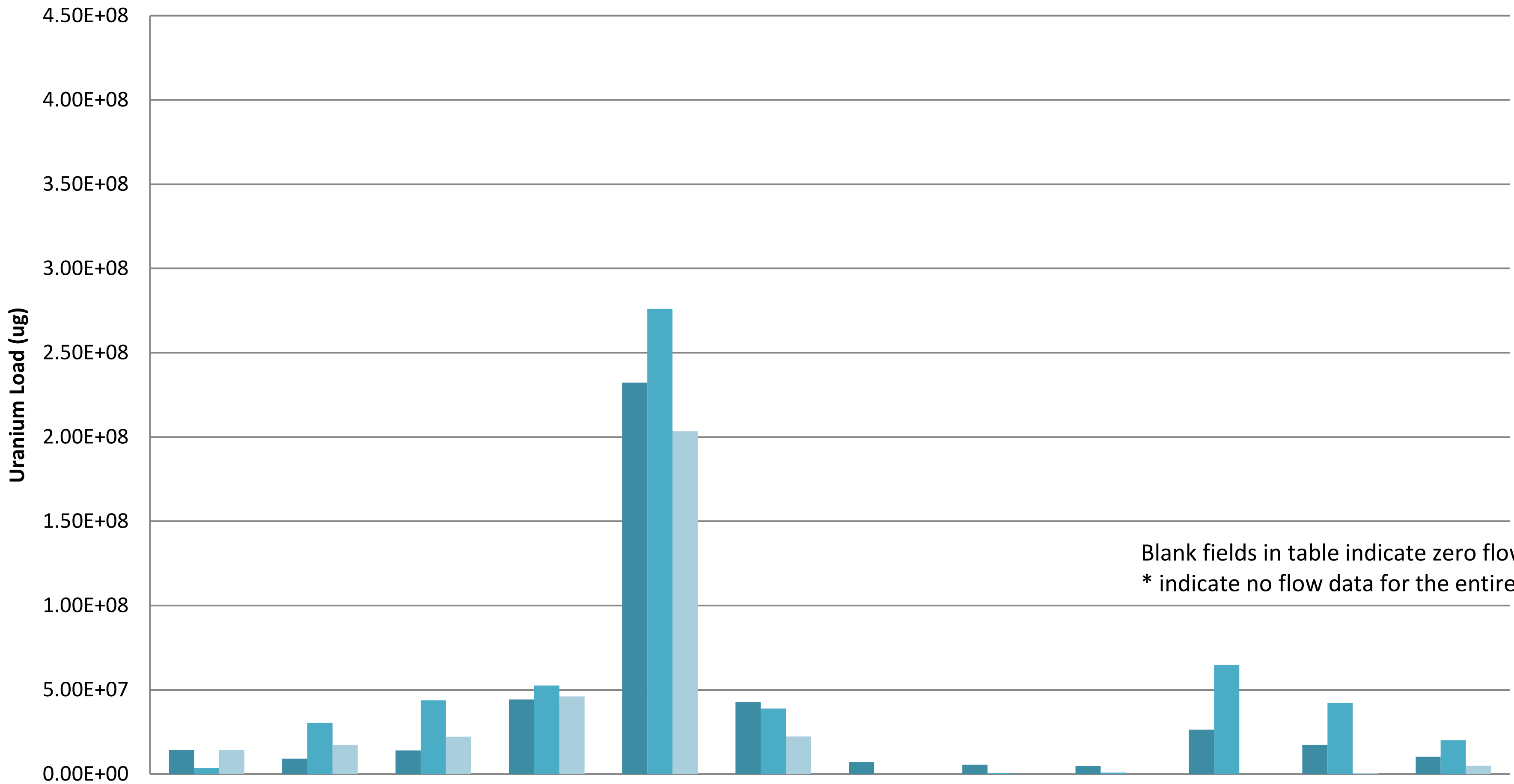
Figure C.11
Monthly Uranium Load in South Walnut Creek
2016



	Jan-16	Feb-16	Mar-16	Apr-16	May-16	Jun-16	Jul-16	Aug-16	Sep-16	Oct-16	Nov-16	Dec-16
GS10	2.13E+07	6.38E+07	1.53E+08	3.18E+08	2.09E+08	4.13E+07	1.19E+07	8.04E+06	6.59E+06	8.63E+06	9.09E+06	1.65E+06
B5INFLOW		6.93E+07	1.87E+08	3.90E+08	2.57E+08	4.36E+07	7.13E+06	2.49E+06	8.28E+06	1.83E+07	1.74E+07	2.32E+07
GS08	7.55E+07	5.22E+07	1.28E+08	3.44E+08	1.71E+08	3.56E+07	5.24E+06			1.59E+06	7.45E+06	1.09E+07

Figure C.12
Monthly Uranium Load in South Walnut Creek
2017

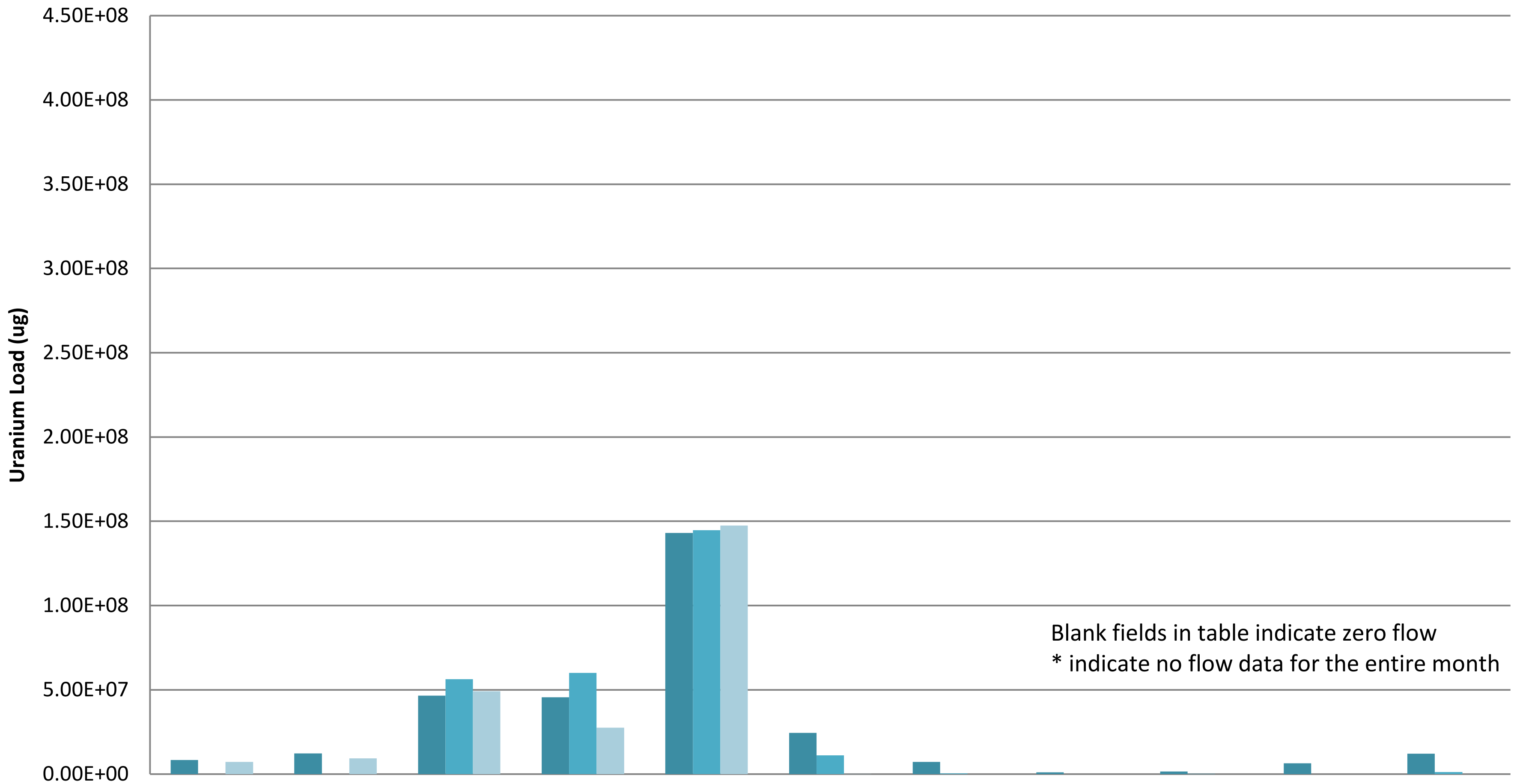
Please refer to table for details regarding available data



	Jan-17	Feb-17	Mar-17	Apr-17	May-17	Jun-17	Jul-17	Aug-17	Sep-17	Oct-17	Nov-17	Dec-17
GS10	1.44E+07	9.17E+06	1.40E+07	4.43E+07	2.32E+08	4.29E+07	7.14E+06	5.67E+06	4.84E+06	2.65E+07	1.74E+07	1.03E+07
B5INFLOW	3.73E+06	3.06E+07	4.39E+07	5.26E+07	2.76E+08	3.90E+07		7.44E+05	8.52E+05	6.48E+07	4.21E+07	2.01E+07
GS08	1.44E+07	1.73E+07	2.22E+07	4.60E+07	2.03E+08	2.23E+07					6.56E+05	4.98E+06

Please refer to table for details regarding available data

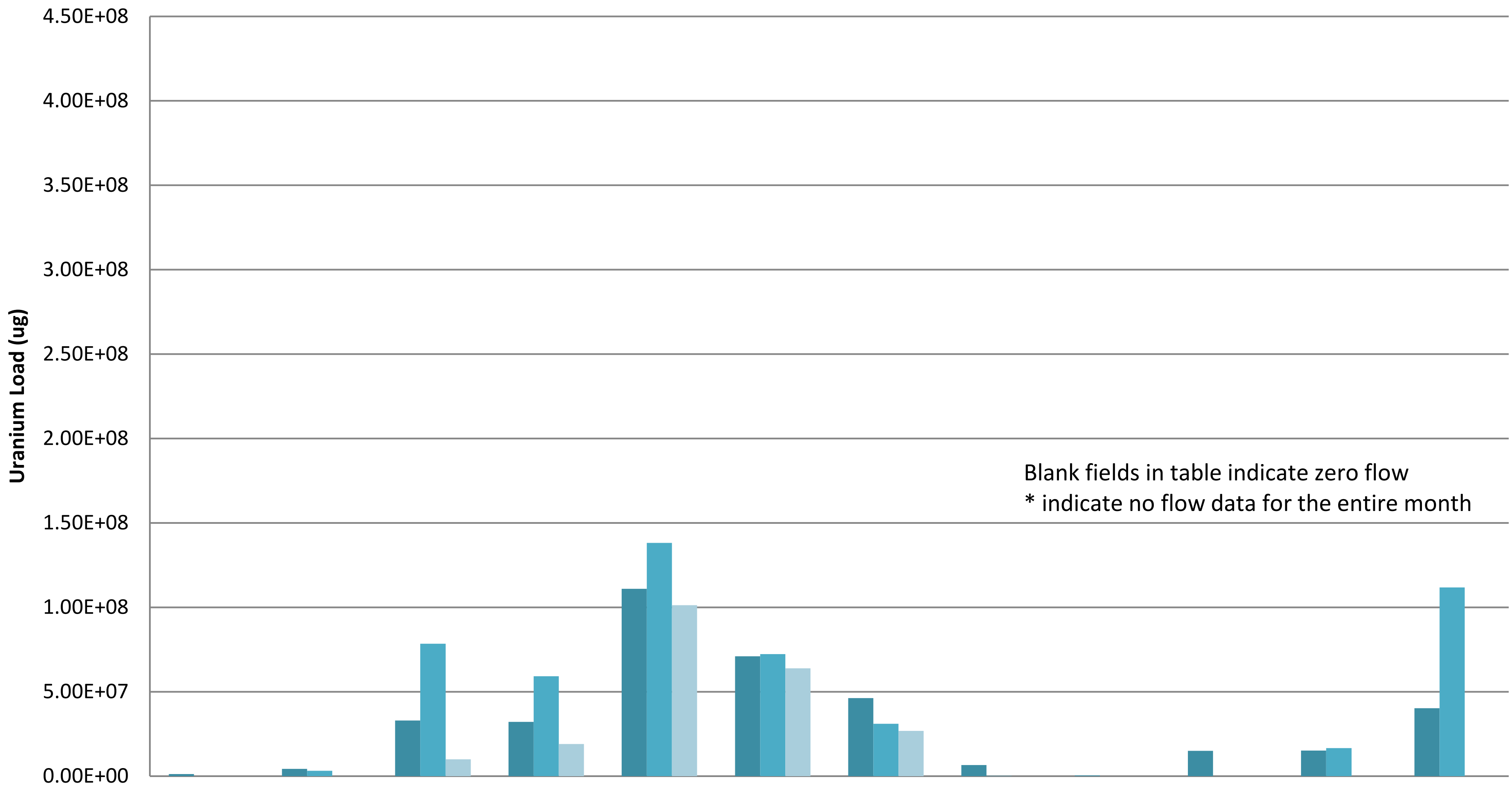
Figure C.13
Monthly Uranium Load in South Walnut Creek
2018



	Jan-18	Feb-18	Mar-18	Apr-18	May-18	Jun-18	Jul-18	Aug-18	Sep-18	Oct-18	Nov-18
GS10	8.30E+06	1.23E+07	4.65E+07	4.55E+07	1.43E+08	2.45E+07	7.16E+06	1.03E+06	1.61E+06	6.46E+06	1.21E+07
B5INFLOW			5.63E+07	6.00E+07	1.45E+08	1.12E+07	4.63E+05		1.57E+05		1.17E+06
GS08	7.23E+06	9.42E+06	4.91E+07	2.76E+07	1.47E+08	1.72E+05					

Please refer to table for details regarding available data

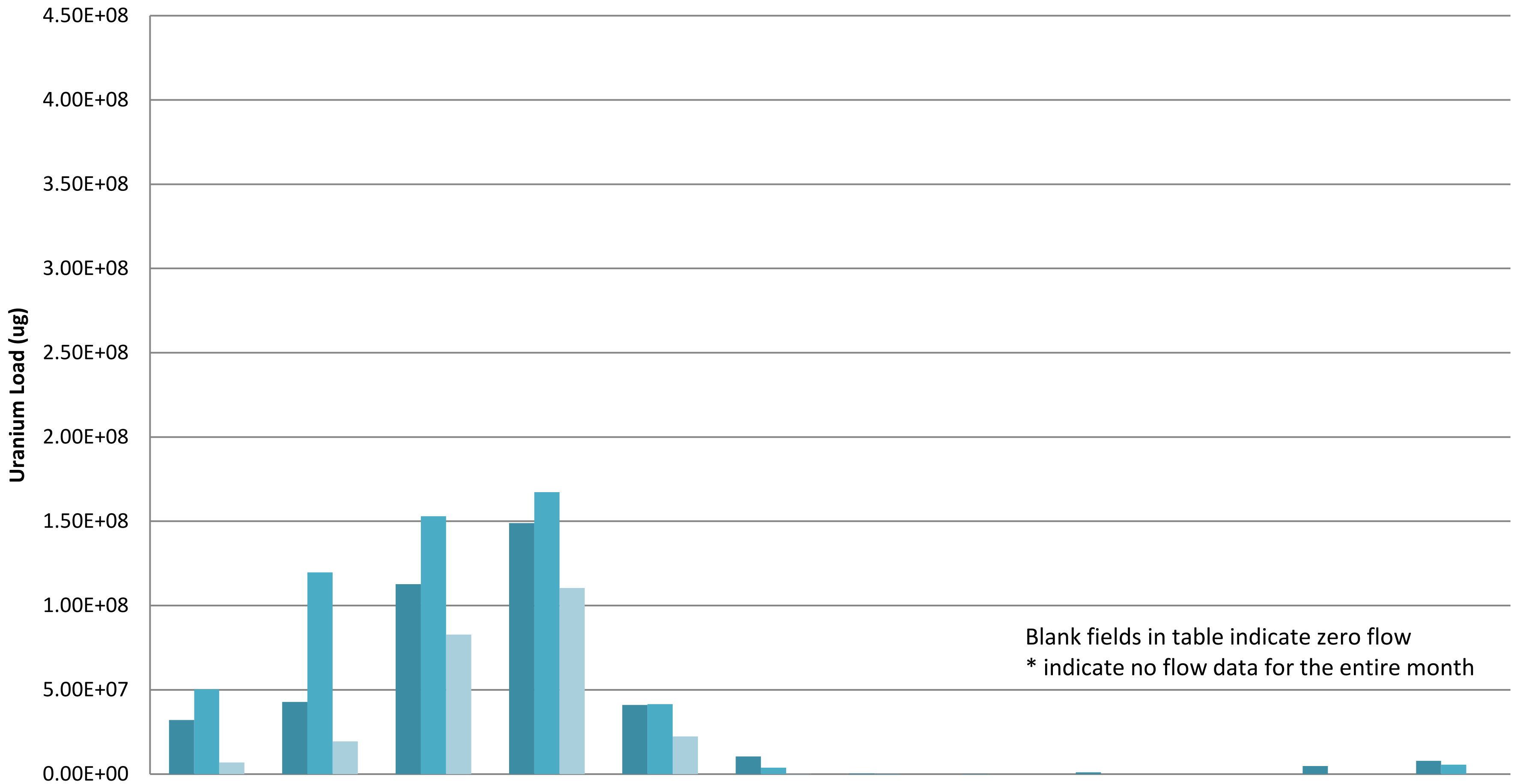
Figure C.14
Monthly Uranium Load in South Walnut Creek
2019



	Jan-19	Feb-19	Mar-19	Apr-19	May-19	Jun-19	Jul-19	Aug-19	Sep-19	Oct-19	Nov-19	Dec-19
GS10	1.29E+06	4.34E+06	3.31E+07	3.21E+07	1.11E+08	7.10E+07	4.62E+07	6.58E+06	3.79E+05	1.50E+07	1.52E+07	4.03E+07
B5INFLOW	*	3.24E+06	7.85E+07	5.93E+07	1.38E+08	7.22E+07	3.11E+07	1.64E+03			1.66E+07	1.12E+08
GS08			1.00E+07	1.91E+07	1.01E+08	6.39E+07	2.68E+07					

Please refer to table for details regarding available data

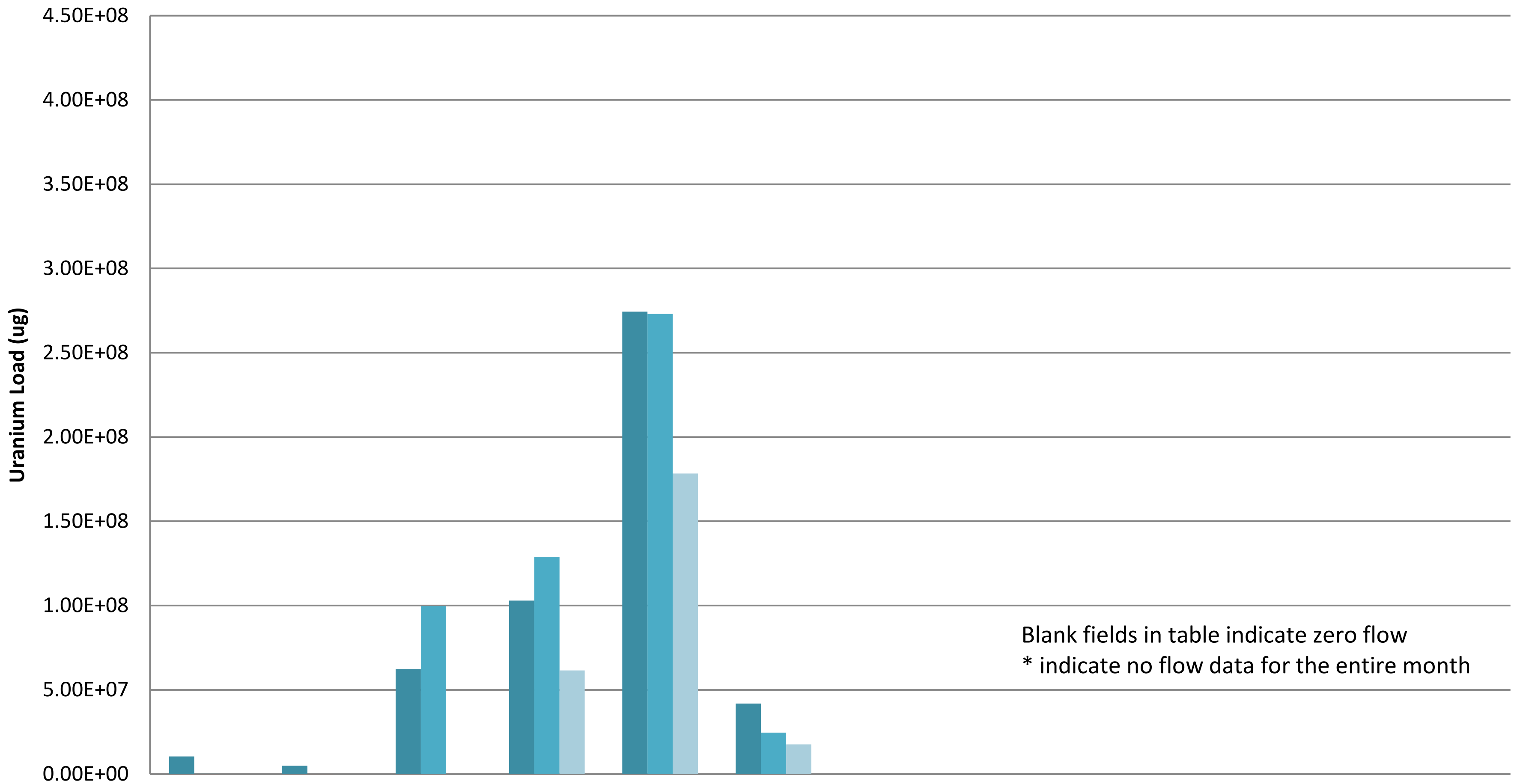
Figure C.15
Monthly Uranium Load in South Walnut Creek
2020



	Jan-20	Feb-20	Mar-20	Apr-20	May-20	Jun-20	Jul-20	Aug-20	Sep-20	Oct-20	Nov-20	Dec-20
GS10	3.21E+07	4.28E+07	1.13E+08	1.49E+08	4.10E+07	1.05E+07	4.50E+05	5.13E+04	1.13E+06		4.78E+06	7.92E+06
B5INFLOW	5.02E+07	1.20E+08	1.53E+08	1.67E+08	4.15E+07	3.77E+06	2.07E+04					5.63E+06
GS08	7.00E+06	1.94E+07	8.28E+07	1.10E+08	2.24E+07	1.70E+05						

Please refer to table for details regarding available data

Figure C.16
Monthly Uranium Load in South Walnut Creek
2021



	Jan-21	Feb-21	Mar-21	Apr-21	May-21	Jun-21	Jul-21	Aug-21	Sep-21	Oct-21	Nov-21	Dec-21
GS10	1.05E+07	4.90E+06	6.23E+07	1.03E+08	2.74E+08	4.18E+07						
B5INFLOW	2.53E+05	1.32E+05	9.98E+07	1.29E+08	2.73E+08	2.46E+07						
GS08				6.16E+07	1.78E+08	1.76E+07						

Figure C.17
South Walnut Creek Monitoring Locations
Average Concentrations of Uranium (1/27/10 - 9/15/21)

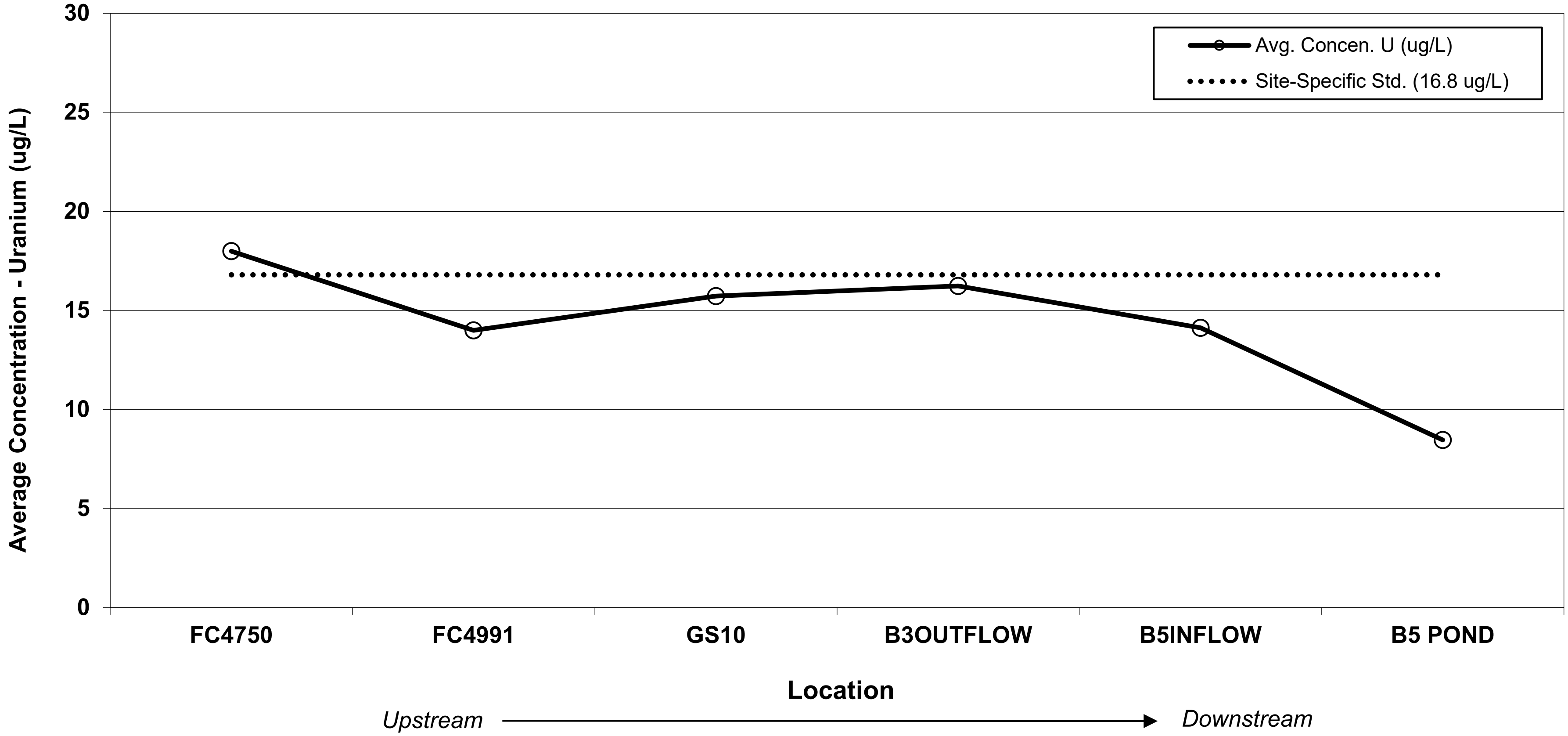
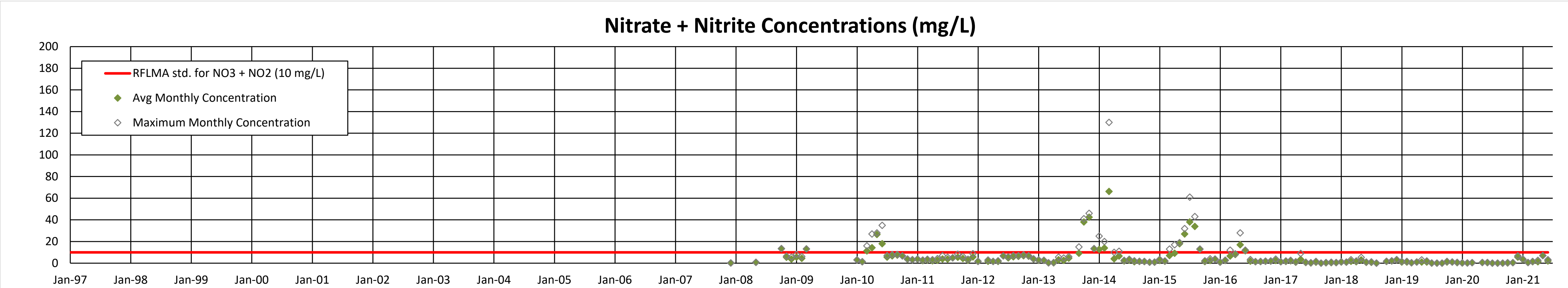
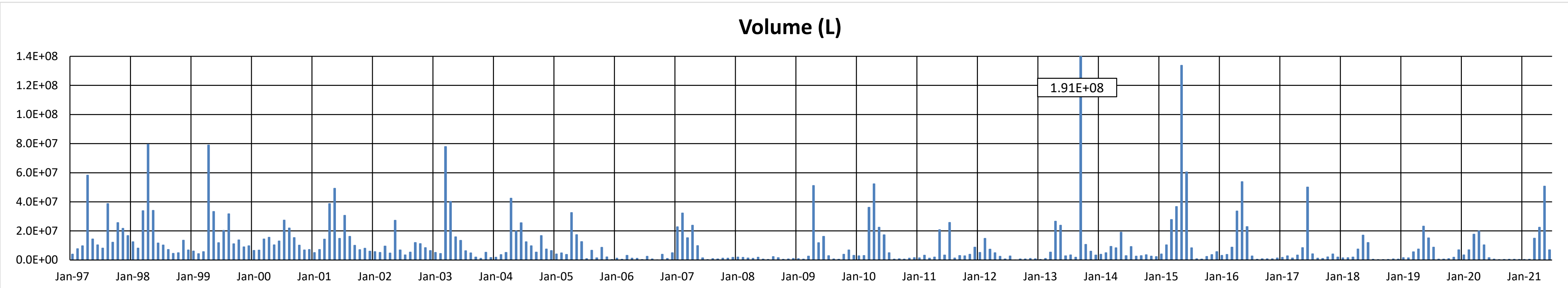


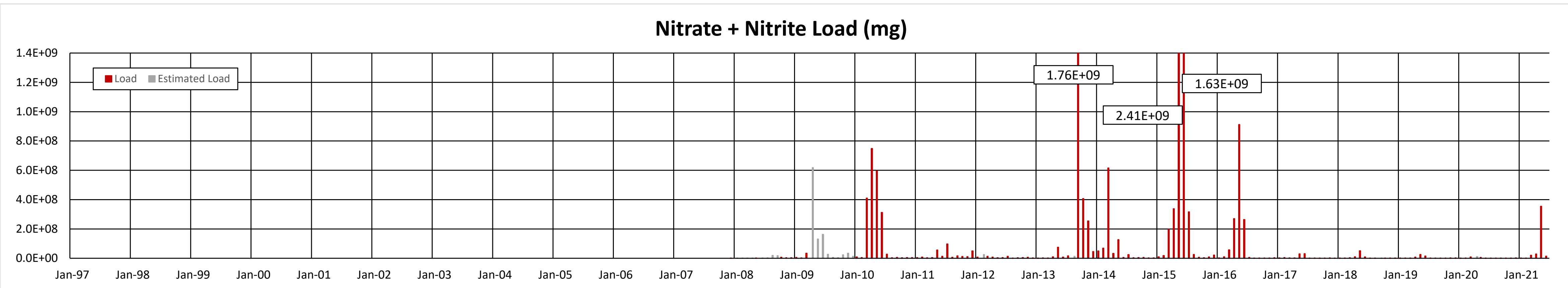
Table C.1

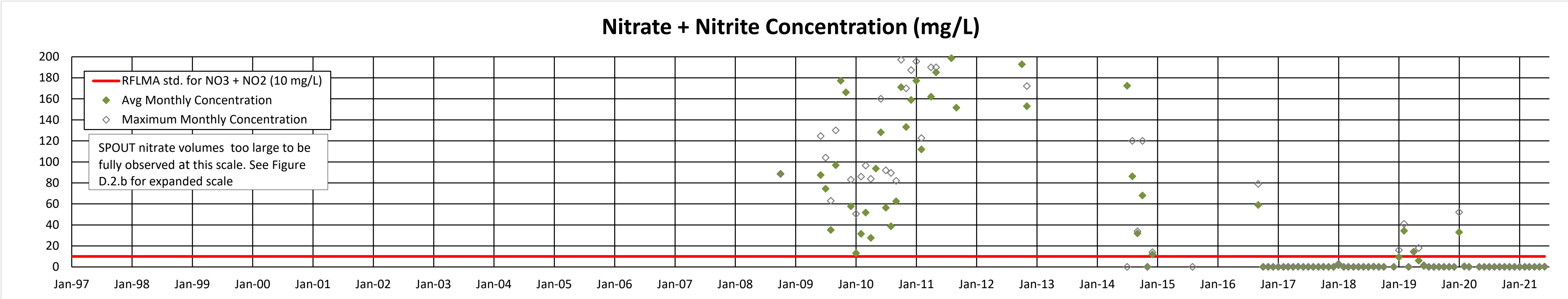
	Uranium Load (µg)				
Date	**GS10**	+/-	**B5INFLOW**	+/-	**GS08**
Jan-09	1.53E+07	--		--	
Feb-09	1.34E+07	--		--	
Mar-09	2.28E+07	--		--	
Apr-09	2.37E+08	--		--	
May-09	1.38E+08	--		--	2.48E+08
Jun-09	1.37E+08	--		--	7.53E+07
Jul-09	3.36E+07	--		--	
Aug-09	9.33E+06	--		--	
Sep-09	8.43E+06	--		--	
Oct-09	2.35E+07	--		--	
Nov-09	7.70E+07	--		--	
Dec-09	3.55E+07	--		--	
2009	**7.50E+08**	***-7.50E+08***	**0.00E+00**	***3.23E+08***	**3.23E+08**
Jan-10	5.44E+07	--		--	
Feb-10	6.36E+07	--		--	
Mar-10	2.15E+08	--		--	
Apr-10	3.93E+08	--		--	4.22E+08
May-10	2.08E+08	--		--	3.21E+08
Jun-10	1.20E+08	*-1.02E+08*	1.79E+07	*-1.79E+07*	
Jul-10	3.78E+07	*-2.68E+07*	1.10E+07	*-1.10E+07*	
Aug-10	1.56E+07	*-1.45E+07*	1.04E+06	*-1.04E+06*	
Sep-10	1.08E+07	*-1.08E+07*		*0.00E+00*	
Oct-10	1.46E+07	*-9.92E+06*	4.66E+06	*-4.66E+06*	
Nov-10	2.23E+07	*-1.21E+07*	1.02E+07	*-1.02E+07*	
Dec-10	2.03E+07	*-1.10E+07*	9.28E+06	*-9.28E+06*	
2010	**1.18E+09**	***-1.12E+09***	**5.42E+07**	***6.89E+08***	**7.43E+08**
Jan-11	4.09E+07	*-2.04E+07*	2.05E+07	*-2.05E+07*	
Feb-11	4.22E+07	*-2.68E+07*	1.54E+07	*-1.54E+07*	
Mar-11	5.33E+07	*-4.16E+07*	1.17E+07	*9.05E+07*	1.02E+08
Apr-11	5.83E+07	*-4.34E+07*	1.50E+07	*-1.50E+07*	
May-11	2.55E+08	*-1.44E+08*	1.11E+08	*-1.11E+08*	
Jun-11	4.41E+07	*-3.17E+07*	1.24E+07	*-1.24E+07*	
Jul-11	8.71E+07	*-9.23E+06*	7.78E+07	*-7.78E+07*	
Aug-11	1.09E+07	*-8.18E+06*	2.69E+06	*-2.69E+06*	
Sep-11	1.17E+07	*-3.63E+06*	8.06E+06	*1.30E+08*	1.38E+08
Oct-11	1.82E+07	*1.97E+06*	2.02E+07	*-1.25E+07*	7.68E+06
Nov-11	4.55E+07	*-3.16E+07*	1.39E+07	*9.10E+06*	2.30E+07
Dec-11	1.02E+08	*-8.37E+07*	1.87E+07	*2.57E+07*	4.44E+07
2011	**7.70E+08**	***-4.42E+08***	**3.27E+08**	***-1.18E+07***	**3.15E+08**
Jan-12	1.41E+08	*-9.94E+07*	4.12E+07	*2.45E+06*	4.36E+07
Feb-12	1.75E+08	*-1.08E+08*	6.63E+07	*-2.64E+07*	3.99E+07
Mar-12	1.27E+08	*-7.65E+07*	5.02E+07	*-3.32E+07*	1.70E+07
Apr-12	1.27E+08	*-1.06E+08*	2.04E+07	*-1.61E+06*	1.88E+07
May-12	4.89E+07	*-3.20E+07*	1.69E+07	*-8.87E+06*	8.03E+06
Jun-12	1.48E+07	*-1.48E+07*		*0.00E+00*	
Jul-12	6.76E+06	*-6.76E+06*		*0.00E+00*	
Aug-12	2.71E+06	*-2.71E+06*		*0.00E+00*	
Sep-12	4.04E+06	*-4.04E+06*		*0.00E+00*	
Oct-12	4.76E+06	*-4.76E+06*		*0.00E+00*	
Nov-12	8.58E+06	*-8.58E+06*		*0.00E+00*	
Dec-12	1.47E+07	*-1.47E+07*		*0.00E+00*	
2012	**6.74E+08**	***-4.79E+08***	**1.95E+08**	***-6.76E+07***	**1.27E+08**
Jan-13		--		*0.00E+00*	
Feb-13		--		*0.00E+00*	
Mar-13	3.98E+07	*2.55E+07*	6.53E+07	*-6.53E+07*	
Apr-13	1.73E+08	*5.23E+06*	1.78E+08	*-1.03E+08*	7.51E+07
May-13	2.17E+08	*-4.83E+07*	1.69E+08	*-7.61E+07*	9.31E+07
Jun-13	7.70E+07	*-6.73E+07*	9.72E+06	*-8.53E+06*	1.19E+06
Jul-13	4.68E+07	*-4.12E+07*	5.58E+06	*-5.58E+06*	
Aug-13	9.53E+06	*-6.59E+06*	2.94E+06	*-2.94E+06*	
Sep-13	5.19E+08	*7.15E+08*	1.23E+09	*-7.72E+08*	4.62E+08
Oct-13	9.10E+07	*-1.60E+07*	7.50E+07	*-1.79E+07*	5.71E+07
Nov-13	5.84E+07	*-2.35E+07*	3.49E+07	*2.01E+06*	3.69E+07
Dec-13	3.15E+07	*-9.46E+06*	2.21E+07	*3.26E+06*	2.53E+07
2013	**1.26E+09**	***5.33E+08***	**1.80E+09**	***-1.05E+09***	**7.50E+08**
Jan-14	4.83E+07	*-4.17E+06*	4.42E+07	*-1.75E+07*	2.67E+07
Feb-14	3.35E+07	*2.06E+07*	5.41E+07	*-1.97E+07*	3.45E+07
Mar-14	8.48E+07	*-2.05E+06*	8.27E+07	*-1.92E+07*	6.35E+07
Apr-14	8.51E+07	*-2.25E+07*	6.26E+07	*1.59E+06*	6.42E+07
May-14	1.47E+08	*-5.15E+06*	1.42E+08	*-8.77E+06*	1.33E+08
Jun-14	2.62E+07	*-1.27E+07*	1.34E+07	*-6.01E+05*	1.28E+07
Jul-14	3.26E+07	*2.85E+06*	3.54E+07	*-1.68E+07*	1.86E+07
Aug-14	1.87E+07	*-4.16E+06*	1.45E+07	*-5.50E+06*	9.04E+06
Sep-14	1.71E+07	*-4.73E+06*	1.24E+07	*-6.71E+06*	5.70E+06
Oct-14	2.57E+07	*-4.81E+06*	2.08E+07	*-1.45E+07*	6.35E+06
Nov-14	2.16E+07	*2.06E+05*	2.18E+07	*-1.23E+07*	9.56E+06
Dec-14	1.90E+07	*3.79E+06*	2.28E+07	*-1.16E+07*	1.12E+07
2014	**5.60E+08**	***-3.28E+07***	**5.27E+08**	***-1.32E+08***	**3.96E+08**
Jan-15	3.47E+07	*-4.66E+06*	3.00E+07	*-1.58E+07*	1.42E+07
Feb-15	4.77E+07	*1.18E+07*	5.94E+07	*-2.43E+07*	3.51E+07
Mar-15	2.23E+08	*2.85E+07*	2.52E+08	*-7.27E+07*	1.79E+08
Apr-15	2.45E+08	*5.47E+06*	2.50E+08	*-3.40E+07*	2.16E+08
May-15	7.38E+08	*-6.74E+07*	6.70E+08	*1.40E+07*	6.84E+08
Jun-15	3.63E+08	*3.50E+07*	3.98E+08	*-5.50E+07*	3.43E+08
Jul-15	6.33E+07	*1.87E+07*	8.20E+07	*5.34E+06*	8.74E+07
Aug-15	1.79E+07	*6.79E+06*	2.47E+07	*-3.19E+06*	2.15E+07
Sep-15	6.24E+06	*6.54E+06*	1.28E+07	*-9.95E+06*	2.82E+06
Oct-15	1.71E+07	*1.20E+07*	2.91E+07	*-4.74E+06*	2.44E+07
Nov-15	3.27E+07	*1.61E+07*	4.88E+07	*-1.58E+07*	3.30E+07
Dec-15	3.21E+07	*1.45E+07*	4.66E+07	*3.01E+06*	4.96E+07
2015	**1.82E+09**	***8.33E+07***	**1.90E+09**	***-2.13E+08***	**1.69E+09**
Jan-16	2.13E+07	*-2.13E+07*		*7.55E+07*	7.55E+07
Feb-16	6.38E+07	*5.54E+06*	6.93E+07	*-1.71E+07*	5.22E+07
Mar-16	1.53E+08	*3.44E+07*	1.87E+08	*-5.89E+07*	1.28E+08
Apr-16	3.18E+08	*7.21E+07*	3.90E+08	*-4.60E+07*	3.44E+08
May-16	2.09E+08	*4.80E+07*	2.57E+08	*-8.56E+07*	1.71E+08
Jun-16	4.13E+07	*2.32E+06*	4.36E+07	*-7.99E+06*	3.56E+07
Jul-16	1.19E+07	*-4.82E+06*	7.13E+06	*-1.89E+06*	5.24E+06
Aug-16	8.04E+06	*-5.54E+06*	2.49E+06	*-2.49E+06*	
Sep-16	6.59E+06	*1.70E+06*	8.28E+06	*-8.28E+06*	
Oct-16	8.63E+06	*9.64E+06*	1.83E+07	*-1.67E+07*	1.59E+06
Nov-16	9.09E+06	*8.34E+06*	1.74E+07	*-9.98E+06*	7.45E+06
Dec-16	1.65E+06	*2.15E+07*	2.32E+07	*-1.23E+07*	1.09E+07
2016	**8.52E+08**	***1.72E+08***	**1.02E+09**	***-1.92E+08***	**8.32E+08**
Jan-17	1.44E+07	*-1.06E+07*	3.73E+06	*1.06E+07*	1.44E+07
Feb-17	9.17E+06	*2.14E+07*	3.06E+07	*-1.32E+07*	1.73E+07
Mar-17	1.40E+07	*2.99E+07*	4.39E+07	*-2.17E+07*	2.22E+07
Apr-17	4.43E+07	*8.31E+06*	5.26E+07	*-6.57E+06*	4.60E+07
May-17	2.32E+08	*4.37E+07*	2.76E+08	*-7.27E+07*	2.03E+08
Jun-17	4.29E+07	*-3.89E+06*	3.90E+07	*-1.67E+07*	2.23E+07
Jul-17	7.14E+06	*-7.14E+06*		*0.00E+00*	
Aug-17	5.67E+06	*-4.93E+06*	7.44E+05	*-7.44E+05*	
Sep-17	4.84E+06	*-3.99E+06*	8.52E+05	*-8.52E+05*	
Oct-17	2.65E+07	*3.84E+07*	6.48E+07	*-6.48E+07*	
Nov-17	1.74E+07	*2.48E+07*	4.21E+07	*-4.15E+07*	6.56E+05
Dec-17	1.03E+07	*9.71E+06*	2.01E+07	*-1.51E+07*	4.98E+06
2017	**4.29E+08**	***1.45E+08***	**5.74E+08**	***-2.43E+08***	**3.31E+08**
Jan-18	8.30E+06	*-8.30E+06*		*7.23E+06*	7.23E+06
Feb-18	1.23E+07	*-1.23E+07*		*9.42E+06*	9.42E+06
Mar-18	4.65E+07	*9.76E+06*	5.63E+07	*-7.15E+06*	4.91E+07
Apr-18	4.55E+07	*1.45E+07*	6.00E+07	*-3.24E+07*	2.76E+07
May-18	1.43E+08	*1.61E+06*	1.45E+08	*2.82E+06*	1.47E+08
Jun-18	2.45E+07	*-1.33E+07*	1.12E+07	*-1.10E+07*	1.72E+05
Jul-18	7.16E+06	*-6.70E+06*	4.63E+05	*-4.63E+05*	
Aug-18	1.03E+06	*-1.03E+06*		*0.00E+00*	
Sep-18	1.61E+06	*-1.45E+06*	1.57E+05	*-1.57E+05*	
Oct-18	6.46E+06	*-6.46E+06*		*0.00E+00*	
Nov-18	1.21E+07	*-1.09E+07*	1.17E+06	*-1.17E+06*	
Dec-18	1.29E+06	*-8.52E+05*	4.38E+05	*-4.38E+05*	
2018	**3.10E+08**	***-3.55E+07***	**2.74E+08**	***-3.33E+07***	**2.41E+08**
Jan-19	1.29E+06	*-1.29E+06*		*0.00E+00*	
Feb-19	4.34E+06	*-1.10E+06*	3.24E+06	*-3.24E+06*	
Mar-19	3.31E+07	*4.54E+07*	7.85E+07	*-6.85E+07*	1.00E+07
Apr-19	3.21E+07	*2.71E+07*	5.93E+07	*-4.02E+07*	1.91E+07
May-19	1.11E+08	*2.72E+07*	1.38E+08	*-3.69E+07*	1.01E+08
Jun-19	7.10E+07	*1.23E+06*	7.22E+07	*-8.30E+06*	6.39E+07
Jul-19	4.62E+07	*-1.51E+07*	3.11E+07	*-4.31E+06*	2.68E+07
Aug-19	6.58E+06	*-6.58E+06*	1.64E+03	*-1.64E+03*	
Sep-19	3.79E+05	*-3.79E+05*		*0.00E+00*	
Oct-19	1.50E+07	*-1.50E+07*		*0.00E+00*	
Nov-19	1.52E+07	*1.48E+06*	1.66E+07	*-1.66E+07*	
Dec-19	4.03E+07	*7.16E+07*	1.12E+08	*-1.12E+08*	
2019	**3.76E+08**	***1.35E+08***	**5.11E+08**	***-2.90E+08***	**2.21E+08**
Jan-20	3.21E+07	*1.82E+07*	5.02E+07	*-4.32E+07*	7.00E+06
Feb-20	4.28E+07	*7.70E+07*	1.20E+08	*-1.00E+08*	1.94E+07
Mar-20	1.13E+08	*4.03E+07*	1.53E+08	*-7.03E+07*	8.28E+07
Apr-20	1.49E+08	*1.83E+07*	1.67E+08	*-5.69E+07*	1.10E+08
May-20	4.10E+07	*4.21E+05*	4.15E+07	*-1.90E+07*	2.24E+07
Jun-20	1.05E+07	*-6.74E+06*	3.77E+06	*-3.60E+06*	1.70E+05
Jul-20	4.50E+05	*-4.29E+05*	2.07E+04	*-2.07E+04*	
Aug-20	5.13E+04	*-5.13E+04*		*0.00E+00*	
Sep-20	1.13E+06	*-1.13E+06*		*0.00E+00*	
Oct-20		*0.00E+00*		*0.00E+00*	
Nov-20	4.78E+06	*-4.78E+06*		*0.00E+00*	
Dec-20	7.92E+06	*-2.30E+06*	5.63E+06	*-5.63E+06*	
2020	**4.02E+08**	***1.39E+08***	**5.41E+08**	***-2.99E+08***	**2.42E+08**
Jan-21	1.05E+07	*-1.02E+07*	2.53E+05	*-2.53E+05*	
Feb-21	4.90E+06	*-4.77E+06*	1.32E+05	*-1.32E+05*	
Mar-21	6.23E+07	*3.74E+07*	9.98E+07	*-9.98E+07*	
Apr-21	1.03E+08	*2.60E+07*	1.29E+08	*-6.74E+07*	6.16E+07
May-21	2.74E+08	*-1.31E+06*	2.73E+08	*-9.47E+07*	1.78E+08
Jun-21	4.18E+07	*-1.72E+07*	2.46E+07	*-6.95E+06*	1.76E+07
Jul-21		*0.00E+00*		*0.00E+00*	
Aug-21		*0.00E+00*		*0.00E+00*	
Sep-21		*0.00E+00*		*0.00E+00*	
Oct-21		*0.00E+00*		*0.00E+00*	
Nov-21		*0.00E+00*		*0.00E+00*	
Dec-21		*0.00E+00*		*0.00E+00*	
2021	**4.97E+08**	***2.99E+07***	**5.27E+08**	***-2.69E+08***	**2.58E+08**

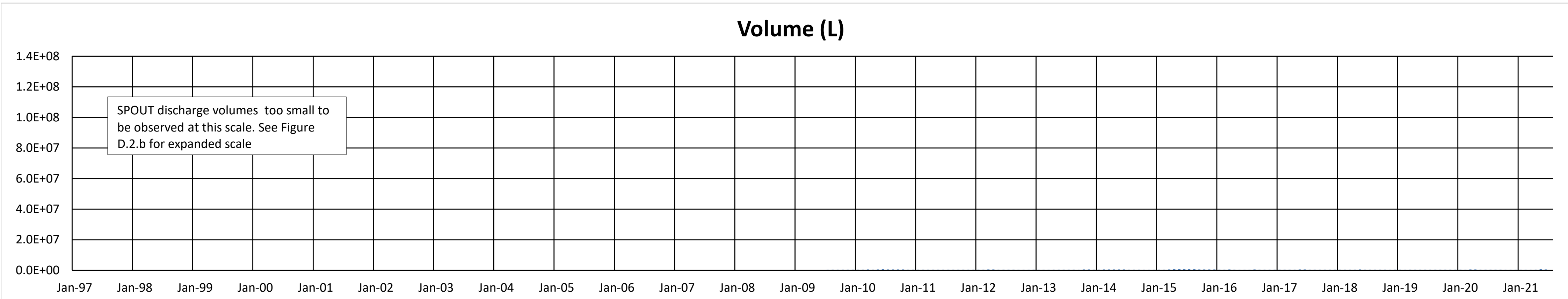
Notes:
Zero flow was recorded for that month.
NO FLOW DATA OR SOME FLOW DATA MISSING


Nitrate + Nitrite Concentrations (mg/L)
RFLMA std. for NO3 + NO2 (10 mg/L)
Avg Monthly Concentration
Maximum Monthly Concentration
200
180
160
140
120
100
80
60
40
20
0
Jan-97
Jan-98
Jan-99
Jan-00
Jan-01
Jan-02
Jan-03
Jan-04
Jan-05
Jan-06
Jan-07
Jan-08
Jan-09
Jan-10
Jan-11
Jan-12
Jan-13
Jan-14
Jan-15
Jan-16
Jan-17
Jan-18
Jan-19
Jan-20
Jan-21


Volume (L)
1.4E+08
1.2E+08
1.0E+08
8.0E+07
6.0E+07
4.0E+07
2.0E+07
0.0E+00
1.91E+08
Jan-97
Jan-98
Jan-99
Jan-00
Jan-01
Jan-02
Jan-03
Jan-04
Jan-05
Jan-06
Jan-07
Jan-08
Jan-09
Jan-10
Jan-11
Jan-12
Jan-13
Jan-14
Jan-15
Jan-16
Jan-17
Jan-18
Jan-19
Jan-20
Jan-21


Nitrate + Nitrite Load (mg)
Load
Estimated Load
1.4E+09
1.2E+09
1.0E+09
8.0E+08
6.0E+08
4.0E+08
2.0E+08
0.0E+00
1.76E+09
2.41E+09
1.63E+09
Jan-97
Jan-98
Jan-99
Jan-00
Jan-01
Jan-02
Jan-03
Jan-04
Jan-05
Jan-06
Jan-07
Jan-08
Jan-09
Jan-10
Jan-11
Jan-12
Jan-13
Jan-14
Jan-15
Jan-16
Jan-17
Jan-18
Jan-19
Jan-20
Jan-21


Nitrate + Nitrite Concentration (mg/L)
RFLMA std. for NO3 + NO2 (10 mg/L)
Avg Monthly Concentration
Maximum Monthly Concentration
SPOUT nitrate volumes too large to be fully observed at this scale. See Figure D.2.b for expanded scale
200
180
160
140
120
100
80
60
40
20
0
Jan-97 Jan-98 Jan-99 Jan-00 Jan-01 Jan-02 Jan-03 Jan-04 Jan-05 Jan-06 Jan-07 Jan-08 Jan-09 Jan-10 Jan-11 Jan-12 Jan-13 Jan-14 Jan-15 Jan-16 Jan-17 Jan-18 Jan-19 Jan-20 Jan-21


Volume (L)
SPOUT discharge volumes too small to be observed at this scale. See Figure D.2.b for expanded scale
1.4E+08
1.2E+08
1.0E+08
8.0E+07
6.0E+07
4.0E+07
2.0E+07
0.0E+00
Jan-97 Jan-98 Jan-99 Jan-00 Jan-01 Jan-02 Jan-03 Jan-04 Jan-05 Jan-06 Jan-07 Jan-08 Jan-09 Jan-10 Jan-11 Jan-12 Jan-13 Jan-14 Jan-15 Jan-16 Jan-17 Jan-18 Jan-19 Jan-20 Jan-21

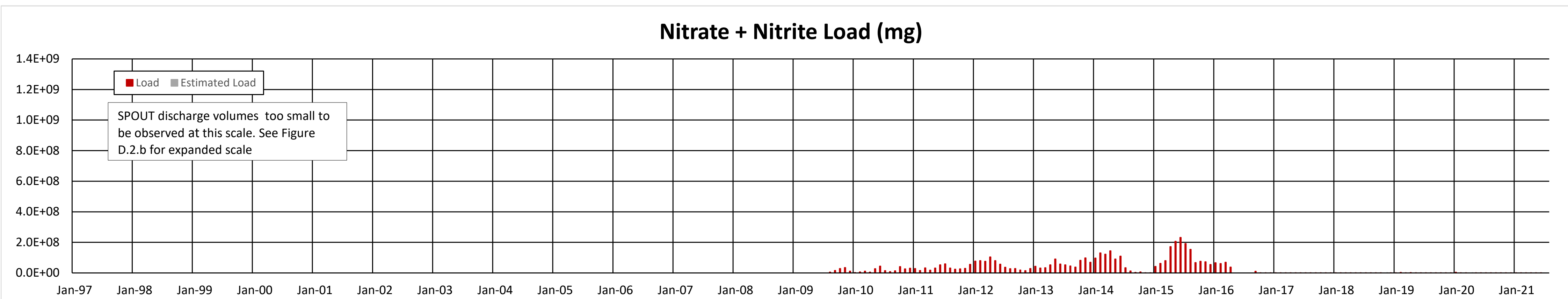
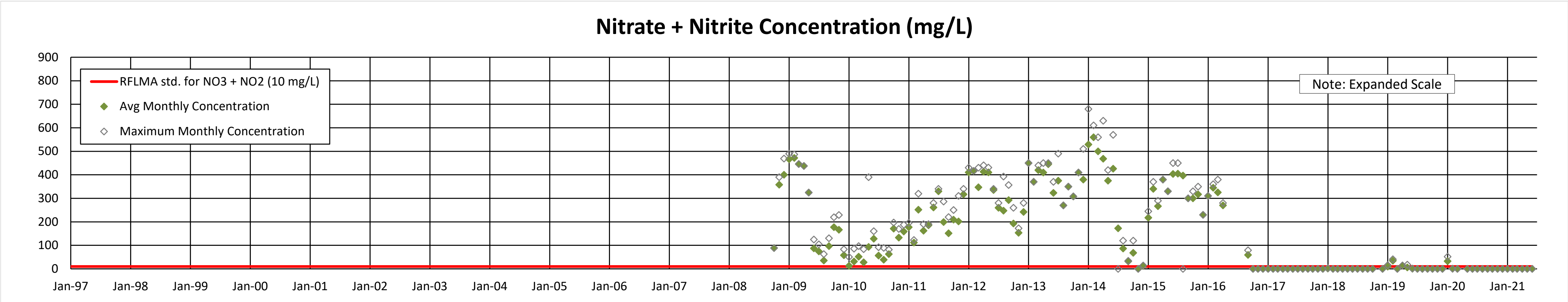
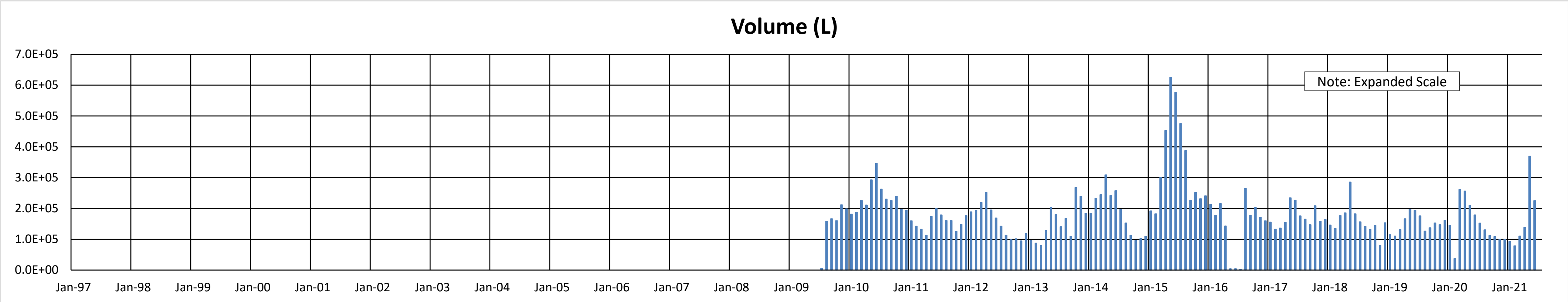
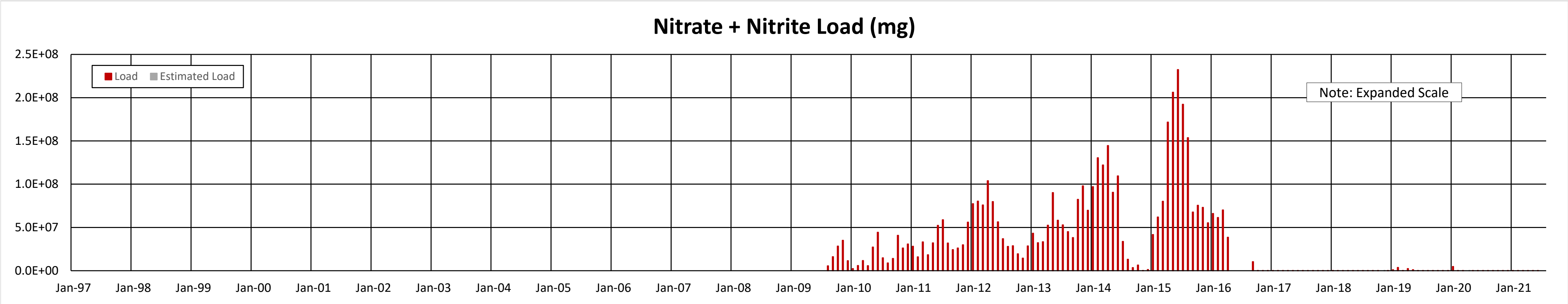

Nitrate + Nitrite Load (mg)
Load
Estimated Load
SPOUT discharge volumes too small to be observed at this scale. See Figure D.2.b for expanded scale
1.4E+09
1.2E+09
1.0E+09
8.0E+08
6.0E+08
4.0E+08
2.0E+08
0.0E+00
Jan-97 Jan-98 Jan-99 Jan-00 Jan-01 Jan-02 Jan-03 Jan-04 Jan-05 Jan-06 Jan-07 Jan-08 Jan-09 Jan-10 Jan-11 Jan-12 Jan-13 Jan-14 Jan-15 Jan-16 Jan-17 Jan-18 Jan-19 Jan-20 Jan-21

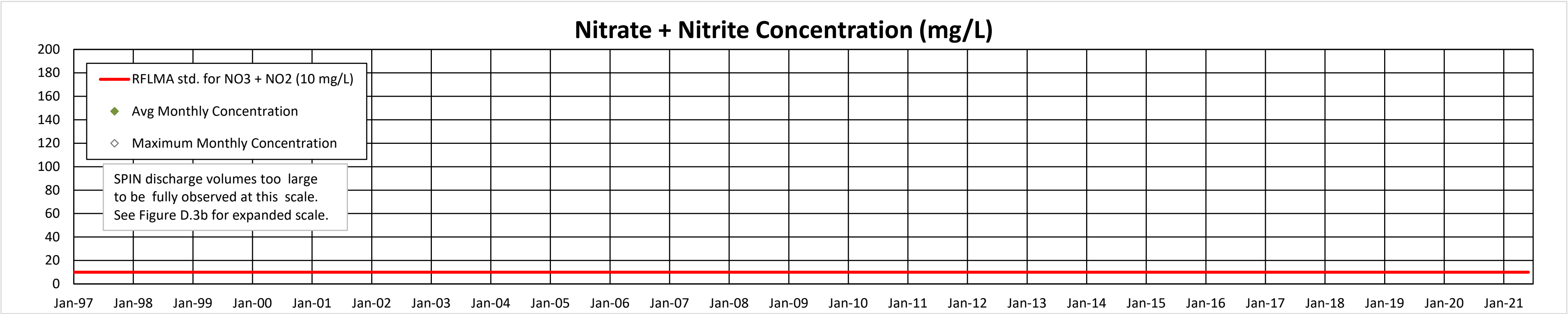
Figure D.2b
Location: SPOUT, Jan 1997 - June 2021

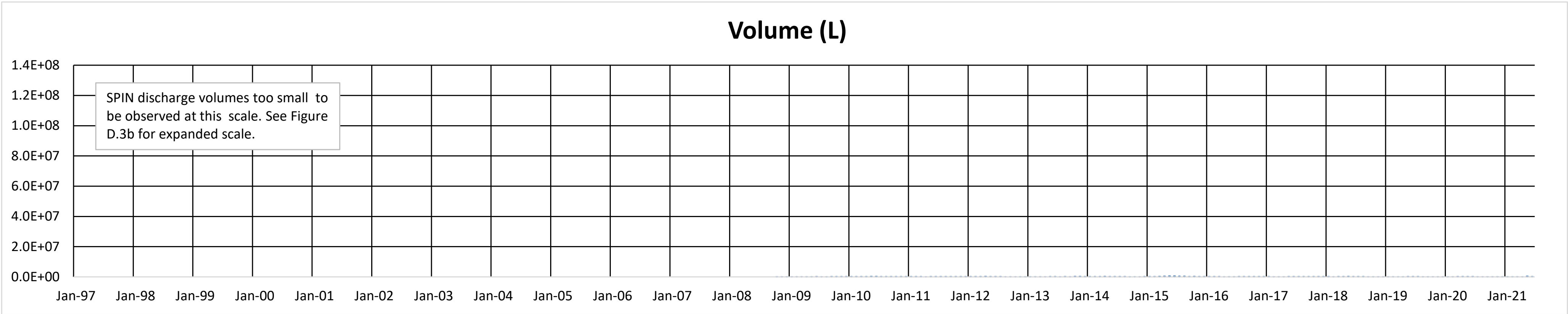
North Walnut Creek-2A
(SPPTS Discharge)








Nitrate + Nitrite Concentration (mg/L)
200
180
160
140
120
100
80
60
40
20
0
RFLMA std. for NO3 + NO2 (10 mg/L)
Avg Monthly Concentration
Maximum Monthly Concentration
SPIN discharge volumes too large to be fully observed at this scale. See Figure D.3b for expanded scale.
Jan-97 Jan-98 Jan-99 Jan-00 Jan-01 Jan-02 Jan-03 Jan-04 Jan-05 Jan-06 Jan-07 Jan-08 Jan-09 Jan-10 Jan-11 Jan-12 Jan-13 Jan-14 Jan-15 Jan-16 Jan-17 Jan-18 Jan-19 Jan-20 Jan-21


Volume (L)
1.4E+08
1.2E+08
1.0E+08
8.0E+07
6.0E+07
4.0E+07
2.0E+07
0.0E+00
SPIN discharge volumes too small to be observed at this scale. See Figure D.3b for expanded scale.
Jan-97 Jan-98 Jan-99 Jan-00 Jan-01 Jan-02 Jan-03 Jan-04 Jan-05 Jan-06 Jan-07 Jan-08 Jan-09 Jan-10 Jan-11 Jan-12 Jan-13 Jan-14 Jan-15 Jan-16 Jan-17 Jan-18 Jan-19 Jan-20 Jan-21

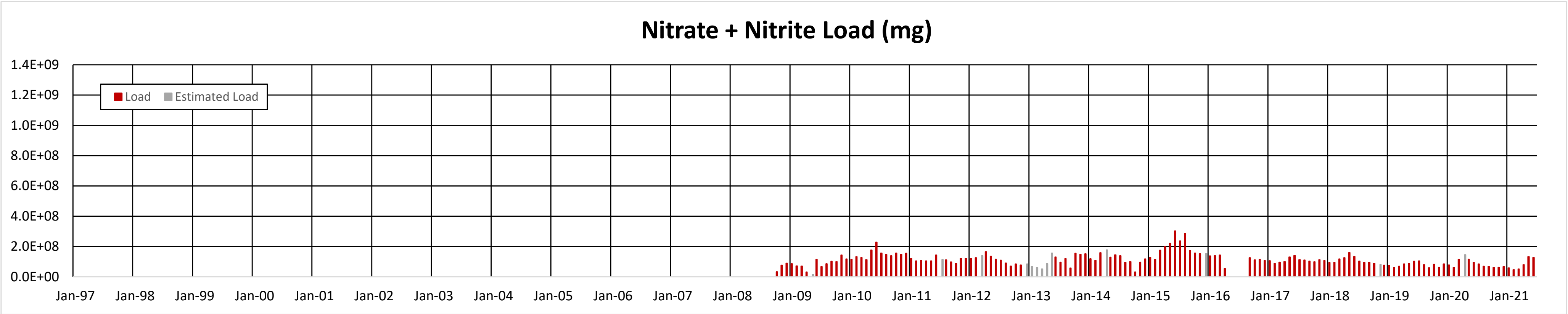

Nitrate + Nitrite Load (mg)
1.4E+09
1.2E+09
1.0E+09
8.0E+08
6.0E+08
4.0E+08
2.0E+08
0.0E+00
Load
Estimated Load
Jan-97 Jan-98 Jan-99 Jan-00 Jan-01 Jan-02 Jan-03 Jan-04 Jan-05 Jan-06 Jan-07 Jan-08 Jan-09 Jan-10 Jan-11 Jan-12 Jan-13 Jan-14 Jan-15 Jan-16 Jan-17 Jan-18 Jan-19 Jan-20 Jan-21

Figure D.3b
Location: SPIN, Jan 1997 - June 2021

North Walnut Creek-2B
(SPPTS Inflow)

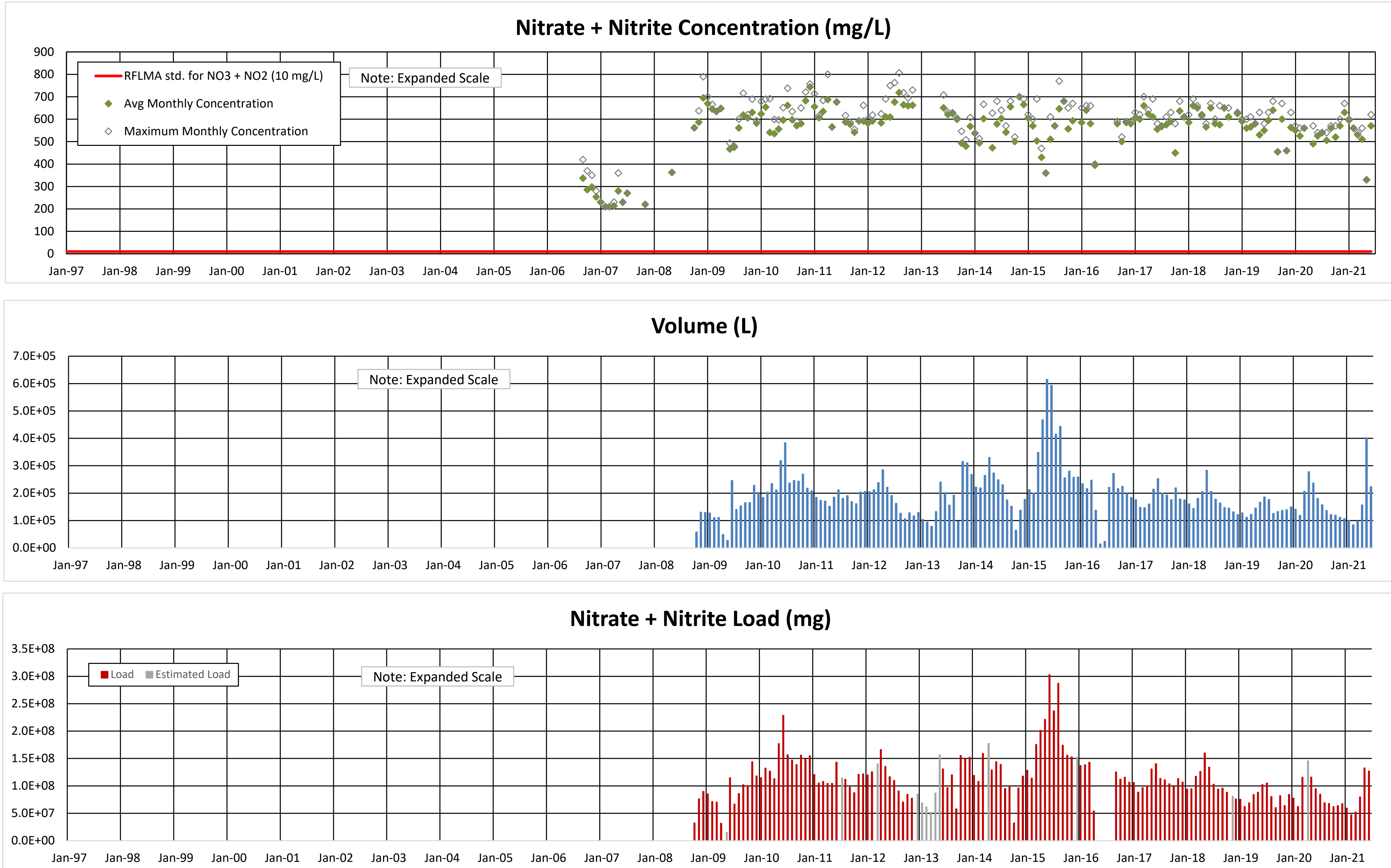
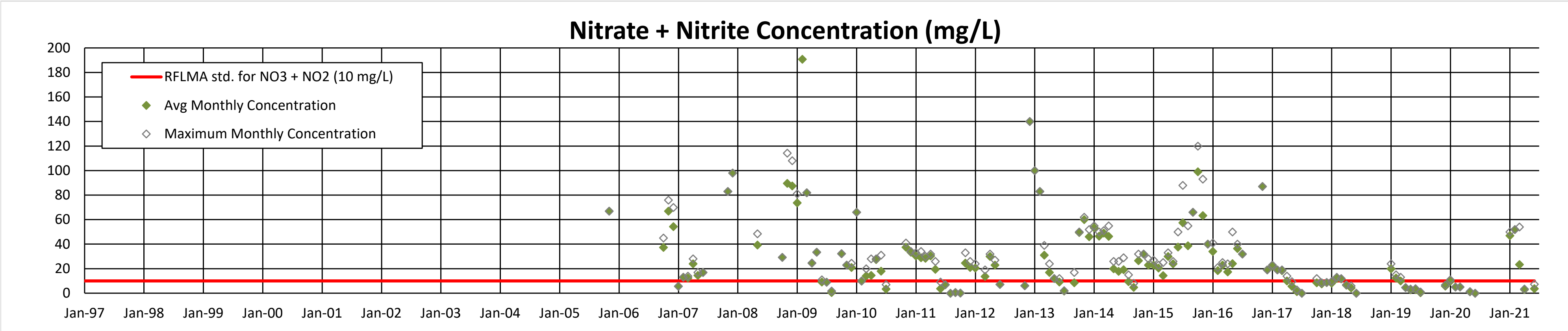
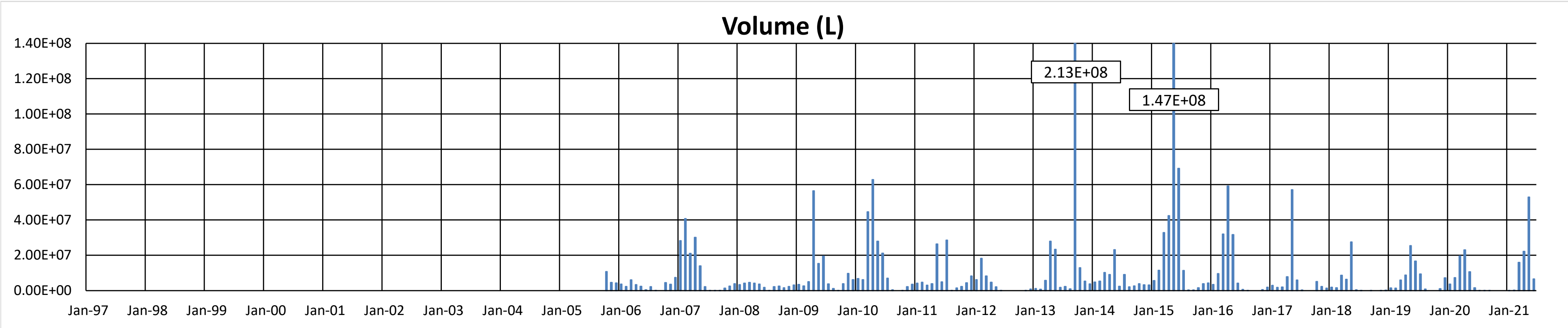
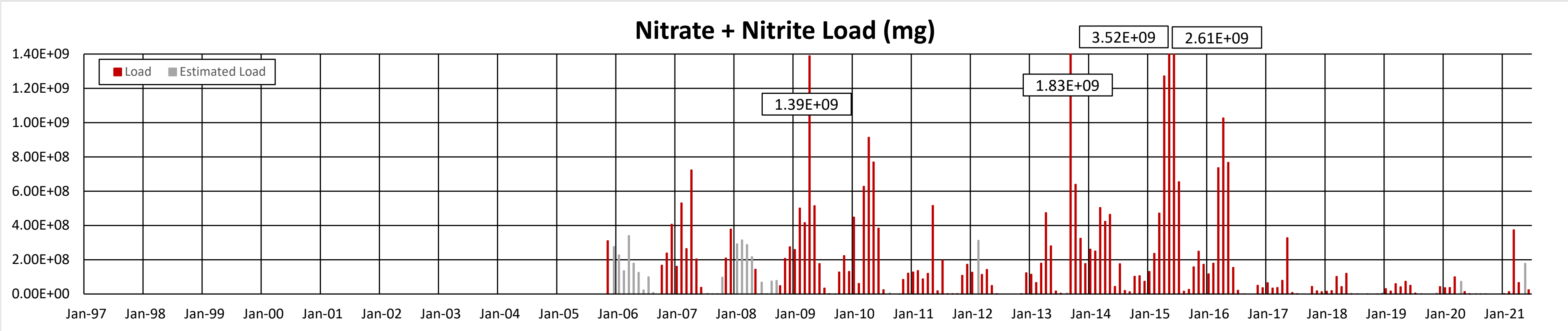


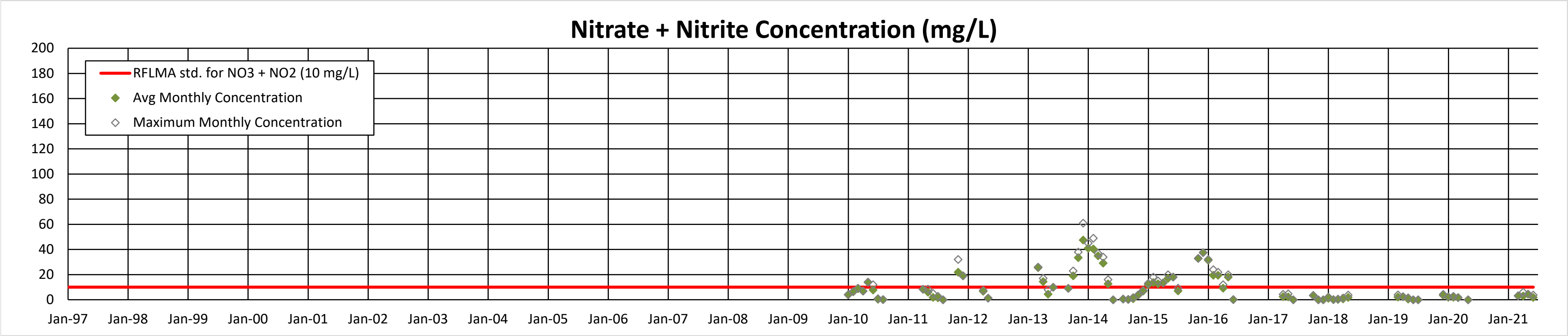
Figure D.4
Location: GS13, Jan 1997 - June 2021

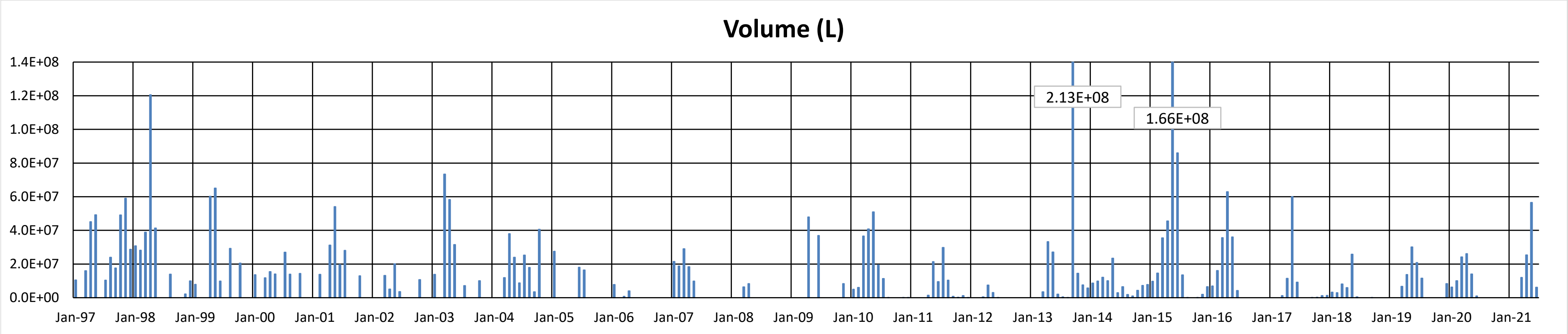
North Walnut Creek - 3
(Upstream A1)

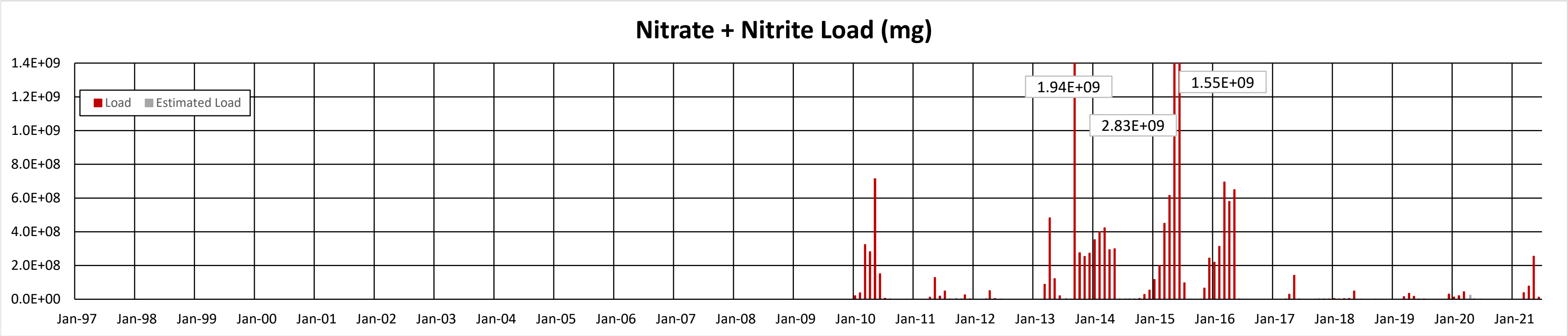


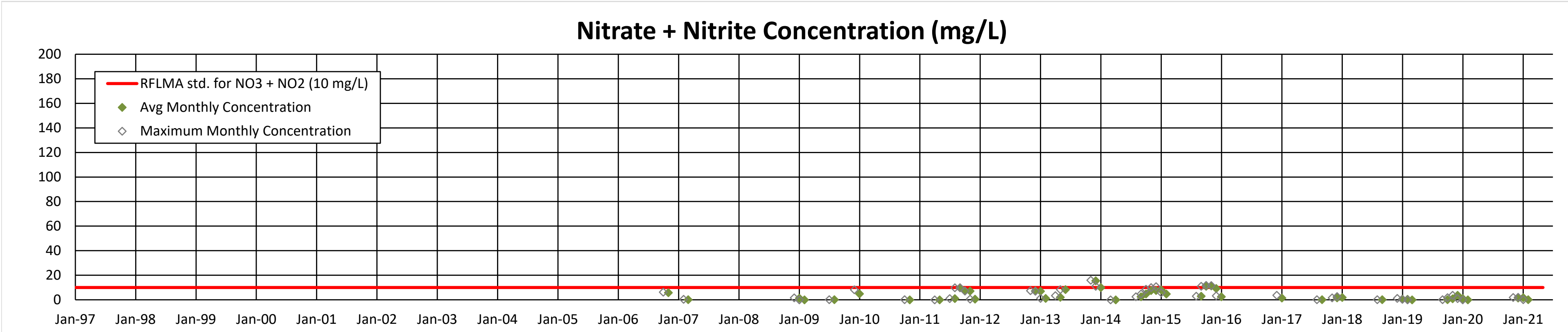


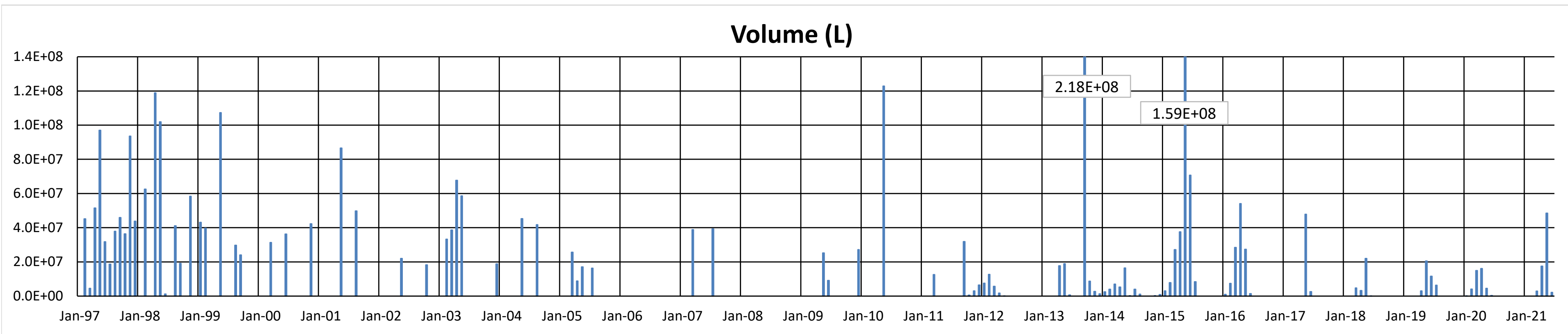



Nitrate + Nitrite Concentration (mg/L)
RFLMA std. for NO3 + NO2 (10 mg/L)
Avg Monthly Concentration
Maximum Monthly Concentration
200
180
160
140
120
100
80
60
40
20
0
Jan-97 Jan-98 Jan-99 Jan-00 Jan-01 Jan-02 Jan-03 Jan-04 Jan-05 Jan-06 Jan-07 Jan-08 Jan-09 Jan-10 Jan-11 Jan-12 Jan-13 Jan-14 Jan-15 Jan-16 Jan-17 Jan-18 Jan-19 Jan-20 Jan-21


Volume (L)
1.4E+08
1.2E+08
1.0E+08
8.0E+07
6.0E+07
4.0E+07
2.0E+07
0.0E+00
2.13E+08
1.66E+08
Jan-97 Jan-98 Jan-99 Jan-00 Jan-01 Jan-02 Jan-03 Jan-04 Jan-05 Jan-06 Jan-07 Jan-08 Jan-09 Jan-10 Jan-11 Jan-12 Jan-13 Jan-14 Jan-15 Jan-16 Jan-17 Jan-18 Jan-19 Jan-20 Jan-21


Nitrate + Nitrite Load (mg)
Load
Estimated Load
1.4E+09
1.2E+09
1.0E+09
8.0E+08
6.0E+08
4.0E+08
2.0E+08
0.0E+00
1.94E+09
2.83E+09
1.55E+09
Jan-97 Jan-98 Jan-99 Jan-00 Jan-01 Jan-02 Jan-03 Jan-04 Jan-05 Jan-06 Jan-07 Jan-08 Jan-09 Jan-10 Jan-11 Jan-12 Jan-13 Jan-14 Jan-15 Jan-16 Jan-17 Jan-18 Jan-19 Jan-20 Jan-21


Nitrate + Nitrite Concentration (mg/L)
RFLMA std. for NO3 + NO2 (10 mg/L)
Avg Monthly Concentration
Maximum Monthly Concentration
200
180
160
140
120
100
80
60
40
20
0
Jan-97 Jan-98 Jan-99 Jan-00 Jan-01 Jan-02 Jan-03 Jan-04 Jan-05 Jan-06 Jan-07 Jan-08 Jan-09 Jan-10 Jan-11 Jan-12 Jan-13 Jan-14 Jan-15 Jan-16 Jan-17 Jan-18 Jan-19 Jan-20 Jan-21


Volume (L)
2.18E+08
1.59E+08
1.4E+08
1.2E+08
1.0E+08
8.0E+07
6.0E+07
4.0E+07
2.0E+07
0.0E+00
Jan-97 Jan-98 Jan-99 Jan-00 Jan-01 Jan-02 Jan-03 Jan-04 Jan-05 Jan-06 Jan-07 Jan-08 Jan-09 Jan-10 Jan-11 Jan-12 Jan-13 Jan-14 Jan-15 Jan-16 Jan-17 Jan-18 Jan-19 Jan-20 Jan-21

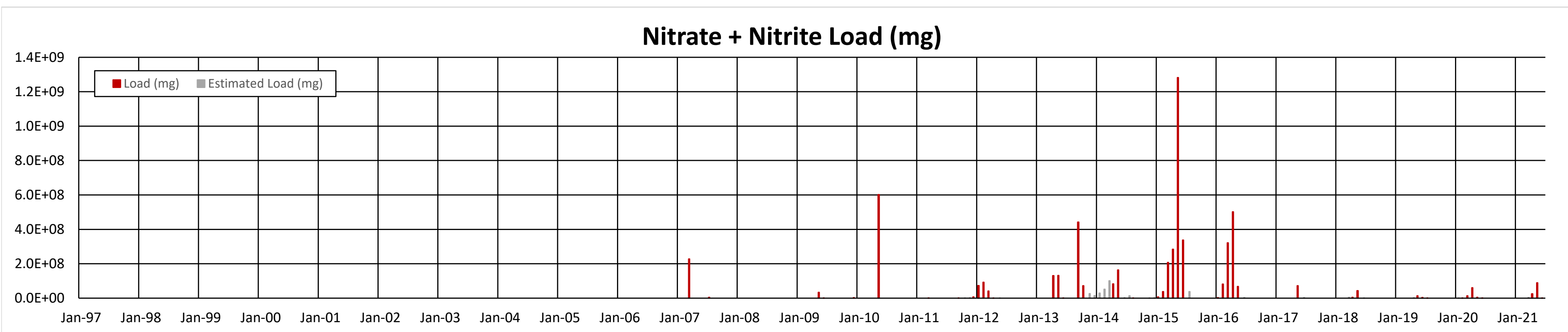
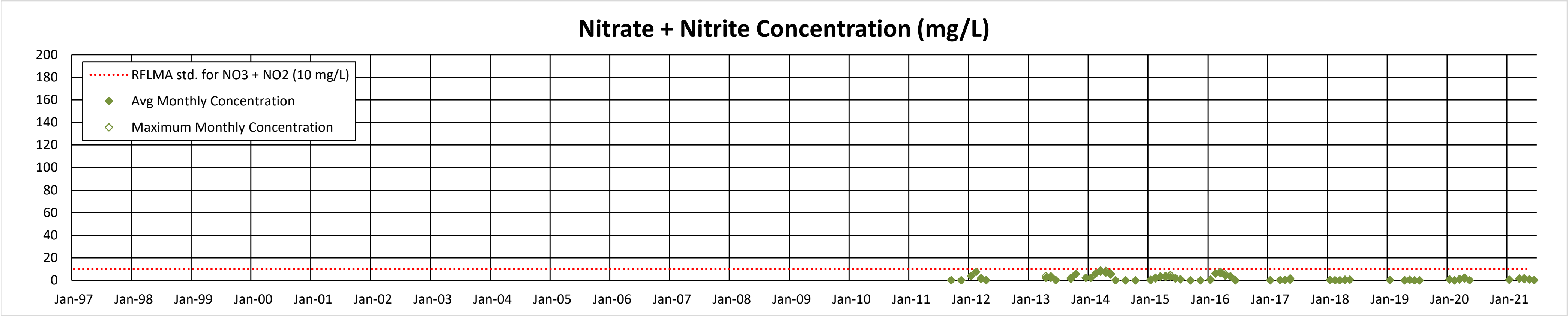
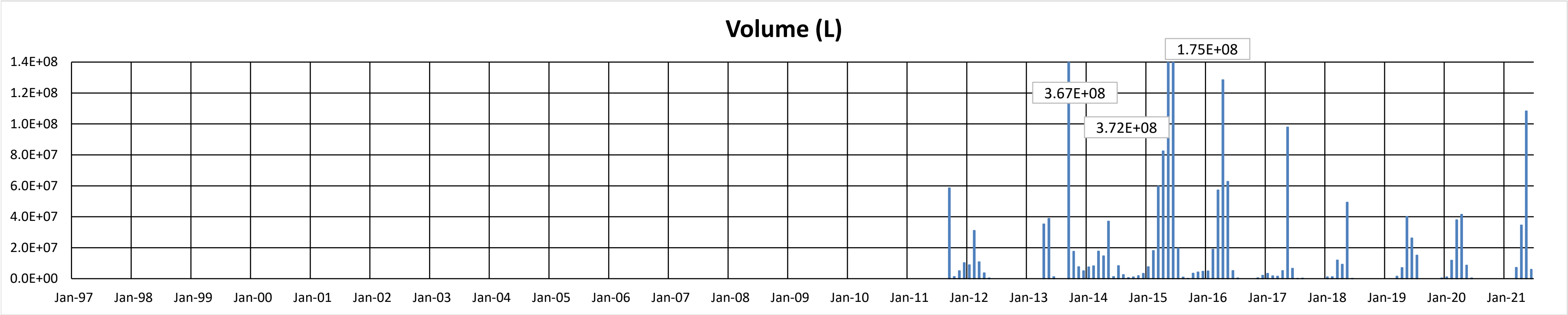
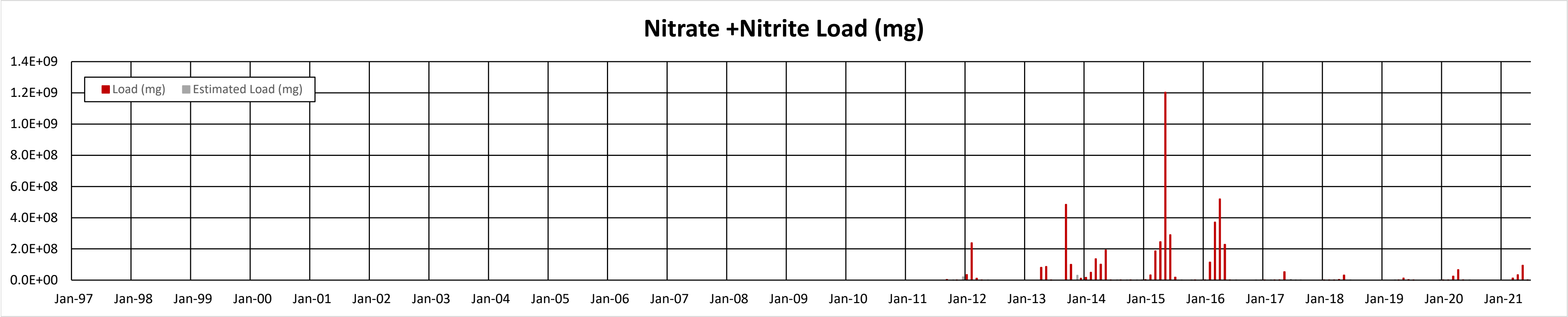

Nitrate + Nitrite Load (mg)
Load (mg)
Estimated Load (mg)
1.4E+09
1.2E+09
1.0E+09
8.0E+08
6.0E+08
4.0E+08
2.0E+08
0.0E+00
Jan-97 Jan-98 Jan-99 Jan-00 Jan-01 Jan-02 Jan-03 Jan-04 Jan-05 Jan-06 Jan-07 Jan-08 Jan-09 Jan-10 Jan-11 Jan-12 Jan-13 Jan-14 Jan-15 Jan-16 Jan-17 Jan-18 Jan-19 Jan-20 Jan-21

Figure D.7
Location: WALPOC, Jan 1997 - June 2021



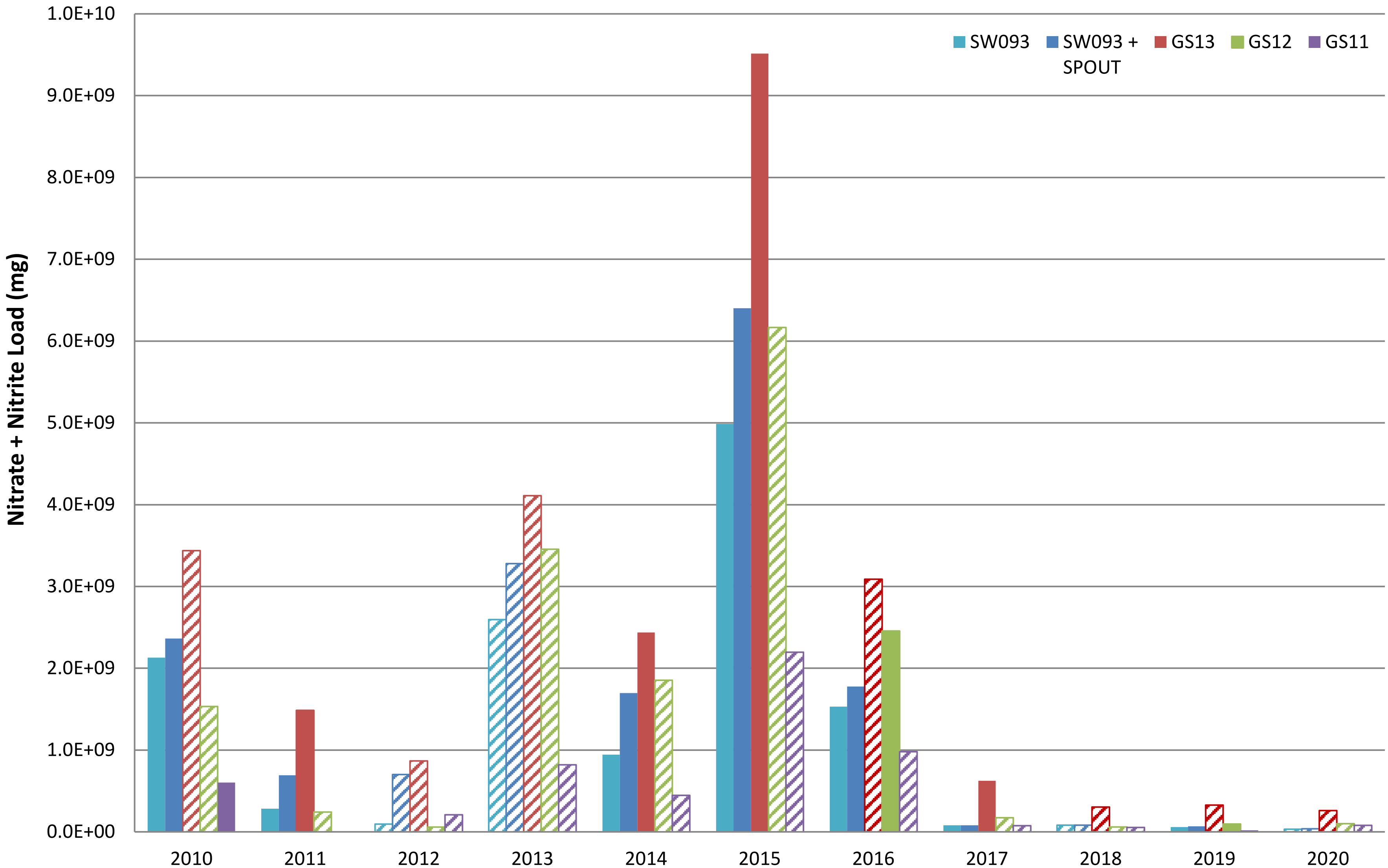




Please refer to table for details regarding available data

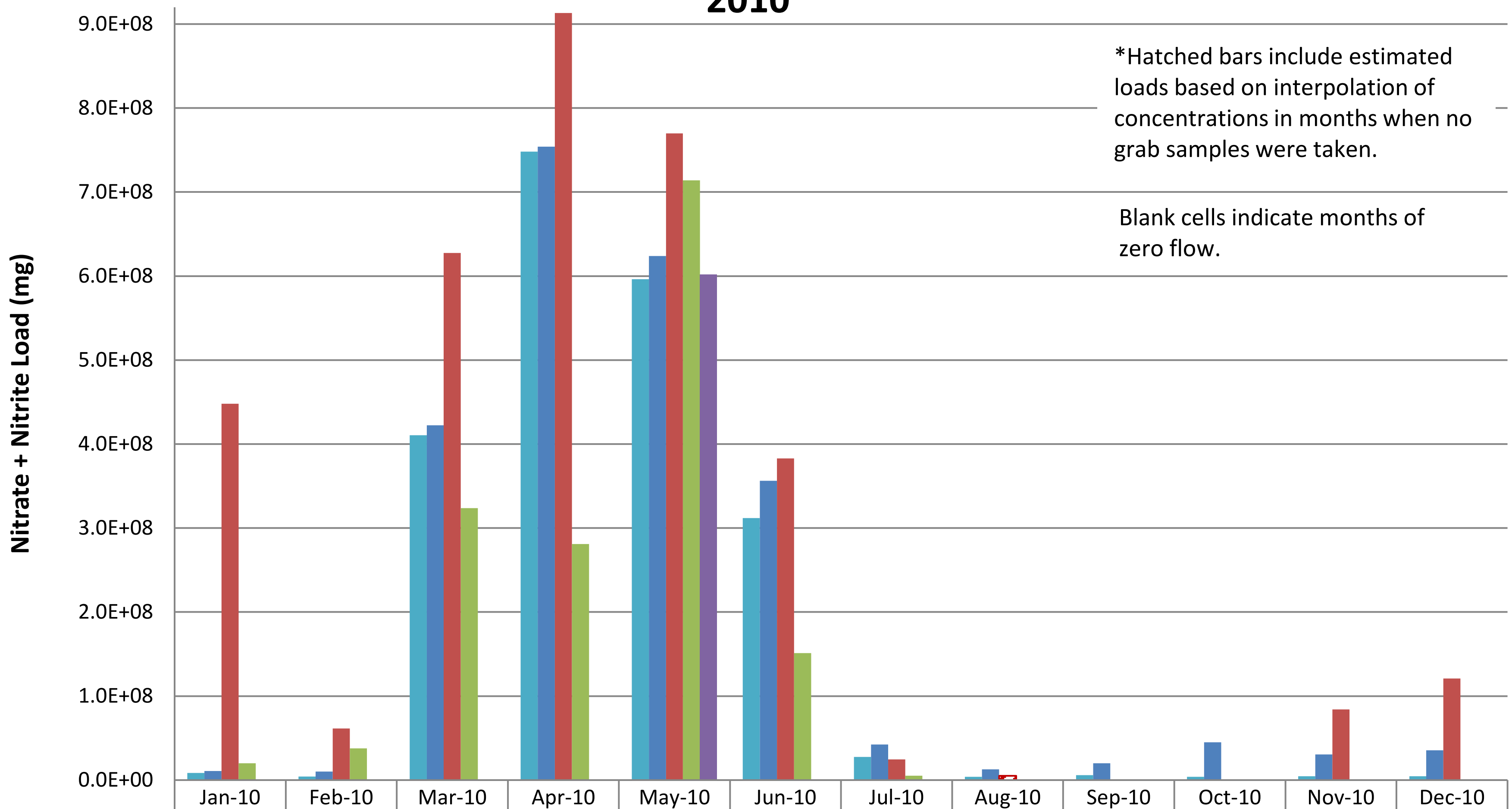
Figure D.8
Annual Total Nitrate + Nitrite Load
North Walnut Creek

*Hatched bars include estimated loads based on interpolation of concentrations in months when no grab samples were taken.



Please refer to table for details regarding available data

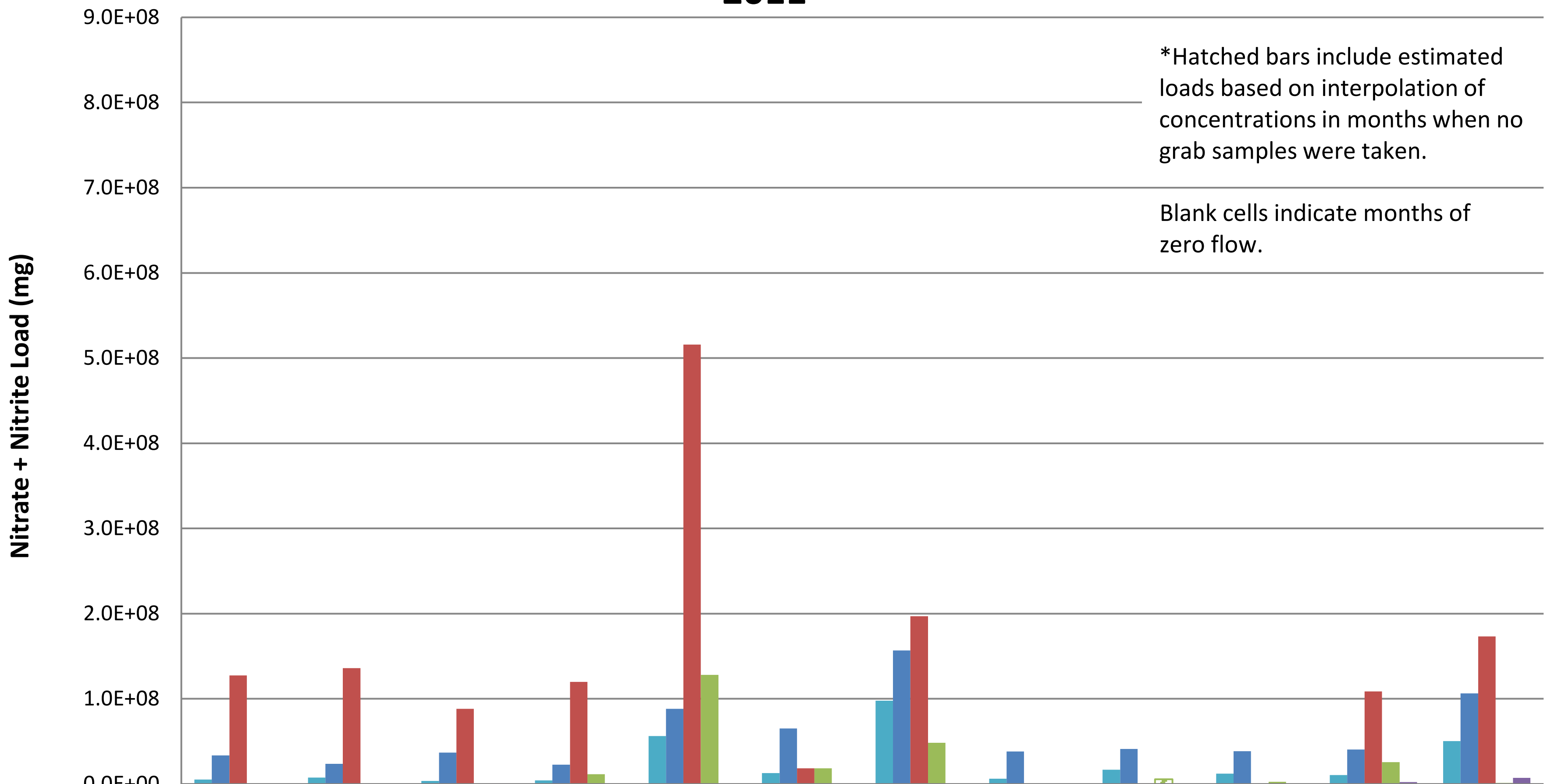
Figure D.9
Monthly Nitrate + Nitrite Load in North Walnut Creek
2010



	Jan-10	Feb-10	Mar-10	Apr-10	May-10	Jun-10	Jul-10	Aug-10	Sep-10	Oct-10	Nov-10	Dec-10
SW093	8.56E+06	4.22E+06	4.11E+08	7.48E+08	5.96E+08	3.12E+08	2.75E+07	3.84E+06	5.99E+06	3.93E+06	4.41E+06	4.73E+06
SW093 + SPOUT	1.09E+07	1.01E+07	4.22E+08	7.54E+08	6.24E+08	3.56E+08	4.23E+07	1.28E+07	2.01E+07	4.49E+07	3.06E+07	3.56E+07
GS13	4.48E+08	6.14E+07	6.28E+08	9.13E+08	7.70E+08	3.83E+08	2.46E+07	5.09E+06		1.11E+04	8.43E+07	1.21E+08
GS12	2.01E+07	3.79E+07	3.24E+08	2.81E+08	7.14E+08	1.51E+08	5.19E+06	1.40E+04			6.34E+04	1.00E+05
GS11					6.02E+08							

Please refer to table for details regarding available data

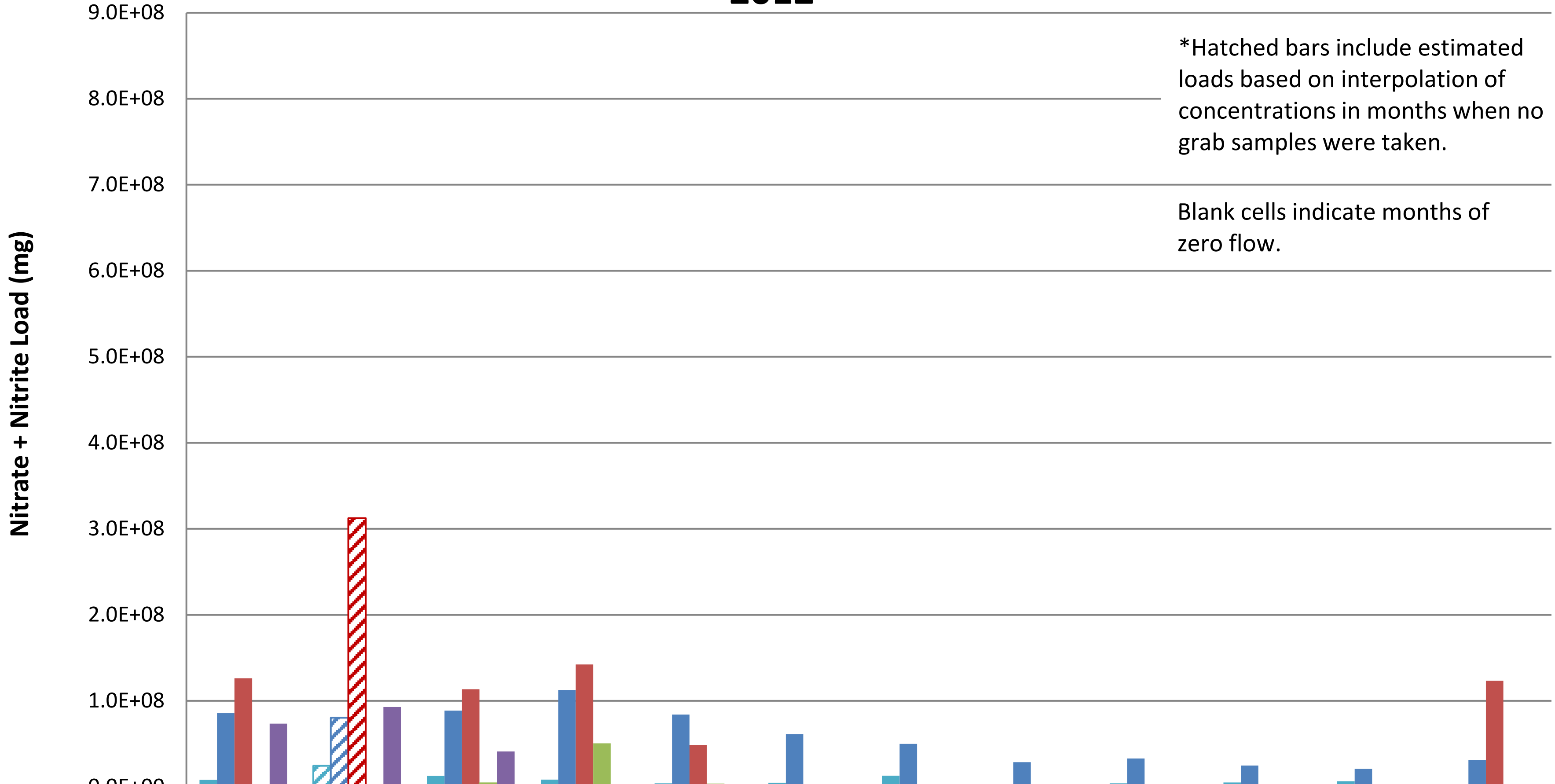
Figure D.10
Monthly Nitrate + Nitrite Load in North Walnut Creek
2011



	Jan-11	Feb-11	Mar-11	Apr-11	May-11	Jun-11	Jul-11	Aug-11	Sep-11	Oct-11	Nov-11	Dec-11
SW093	5.17E+06	7.66E+06	3.61E+06	4.41E+06	5.62E+07	1.28E+07	9.79E+07	6.31E+06	1.68E+07	1.21E+07	1.07E+07	5.03E+07
SW093 + SPOUT	3.34E+07	2.36E+07	3.69E+07	2.27E+07	8.84E+07	6.51E+07	1.57E+08	3.82E+07	4.11E+07	3.84E+07	4.06E+07	1.06E+08
GS13	1.27E+08	1.36E+08	8.84E+07	1.20E+08	5.16E+08	1.83E+07	1.97E+08	6.59E+02	9.79E+05	2.05E+05	1.09E+08	1.73E+08
GS12				1.17E+07	1.28E+08	1.84E+07	4.83E+07	2.94E+05	5.56E+06	2.65E+06	2.57E+07	1.42E+06
GS11			8.89E+05						7.02E+05	2.27E+05	2.22E+06	7.13E+06

Please refer to table for details regarding available data

Figure D.11
Monthly Nitrate + Nitrite Load in North Walnut Creek
2012

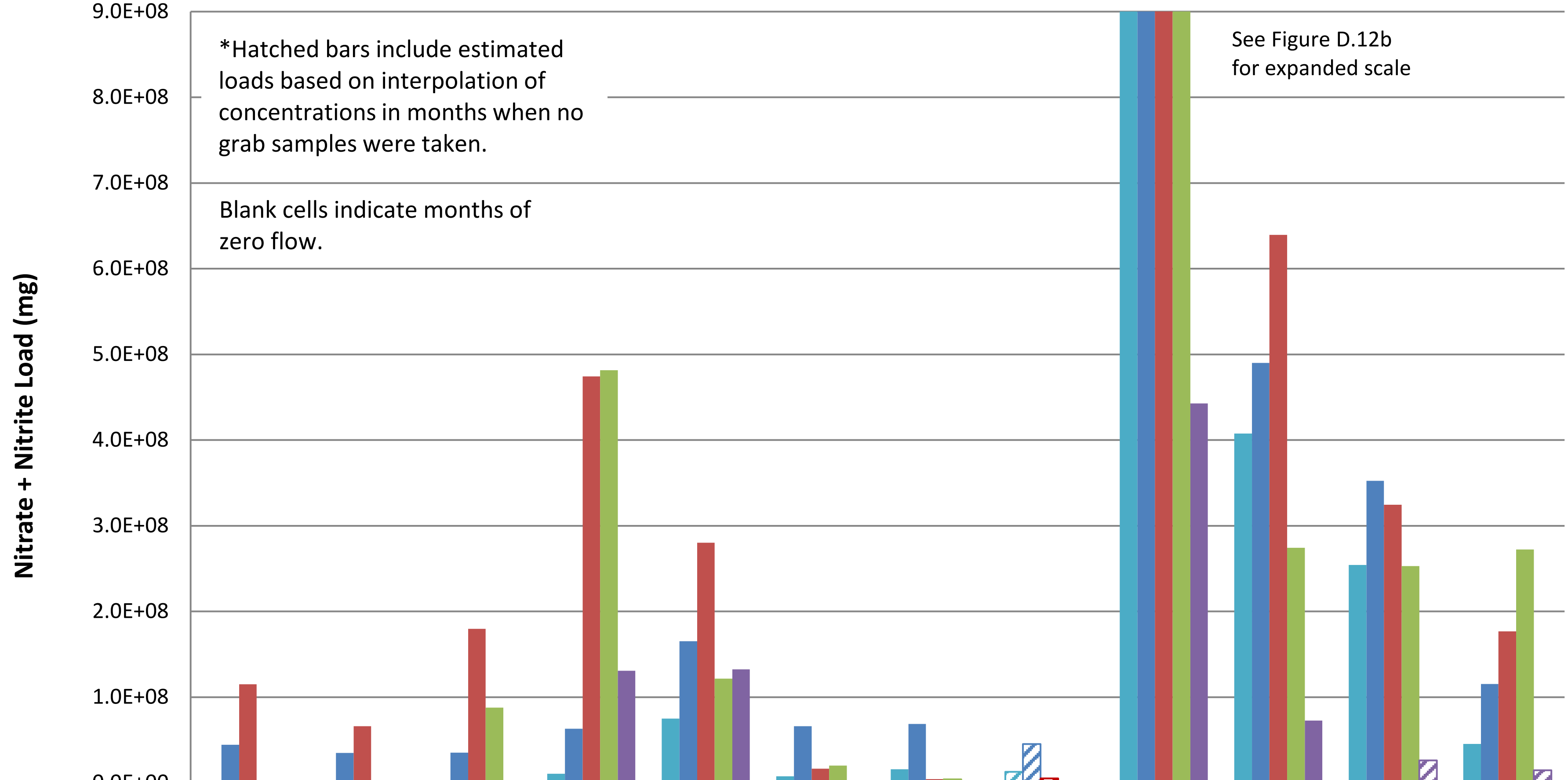


	Jan-12	Feb-12	Mar-12	Apr-12	May-12	Jun-12	Jul-12	Aug-12	Sep-12	Oct-12	Nov-12	Dec-12
SW093	8.26E+06	2.45E+07	1.27E+07	8.32E+06	4.04E+06	4.70E+06	1.29E+07	6.51E+05	4.13E+06	5.15E+06	6.35E+06	2.92E+06
SW093 + SPOUT	8.57E+07	8.04E+07	8.87E+07	1.12E+08	8.40E+07	6.12E+07	4.99E+07	2.86E+07	3.30E+07	2.47E+07	2.08E+07	3.15E+07
GS13	1.26E+08	3.12E+08	1.13E+08	1.42E+08	4.88E+07	3.37E+05					1.55E+05	1.23E+08
GS12	2.40E+02		4.17E+06	5.05E+07	3.88E+06	5.87E+04						
GS11	7.37E+07	9.29E+07	4.10E+07	1.09E+06	4.29E+04							

Please refer to table for details regarding available data

Figure D.12a

Monthly Nitrate + Nitrite Load in North Walnut Creek 2013

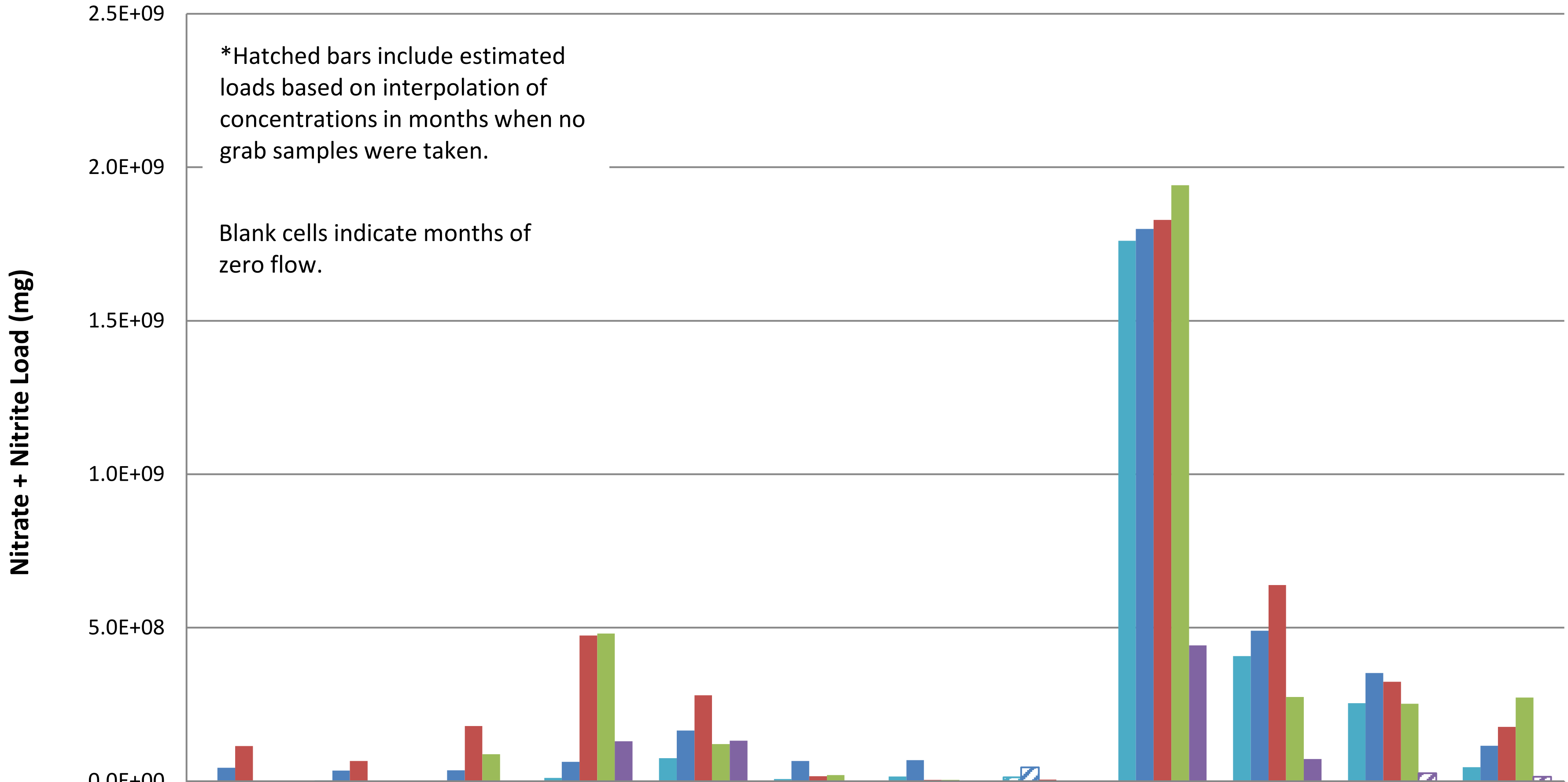


	Jan-13	Feb-13	Mar-13	Apr-13	May-13	Jun-13	Jul-13	Aug-13	Sep-13	Oct-13	Nov-13	Dec-13
SW093	1.01E+06	2.74E+06	1.82E+06	1.05E+07	7.48E+07	7.55E+06	1.58E+07	1.28E+07	1.76E+09	4.08E+08	2.54E+08	4.53E+07
SW093 + SPOUT	4.43E+07	3.50E+07	3.53E+07	6.31E+07	1.65E+08	6.59E+07	6.87E+07	4.52E+07	1.80E+09	4.90E+08	3.52E+08	1.15E+08
GS13	1.15E+08	6.61E+07	1.80E+08	4.74E+08	2.80E+08	1.65E+07	4.25E+06	5.07E+06	1.83E+09	6.40E+08	3.24E+08	1.77E+08
GS12			8.77E+07	4.81E+08	1.21E+08	2.01E+07	3.99E+06	6.21E+02	1.94E+09	2.74E+08	2.53E+08	2.72E+08
GS11				1.31E+08	1.32E+08	8.11E+05			4.43E+08	7.25E+07	2.61E+07	1.46E+07

Please refer to table for details regarding available data

Figure D.12b

Monthly Nitrate + Nitrite Load in North Walnut Creek 2013

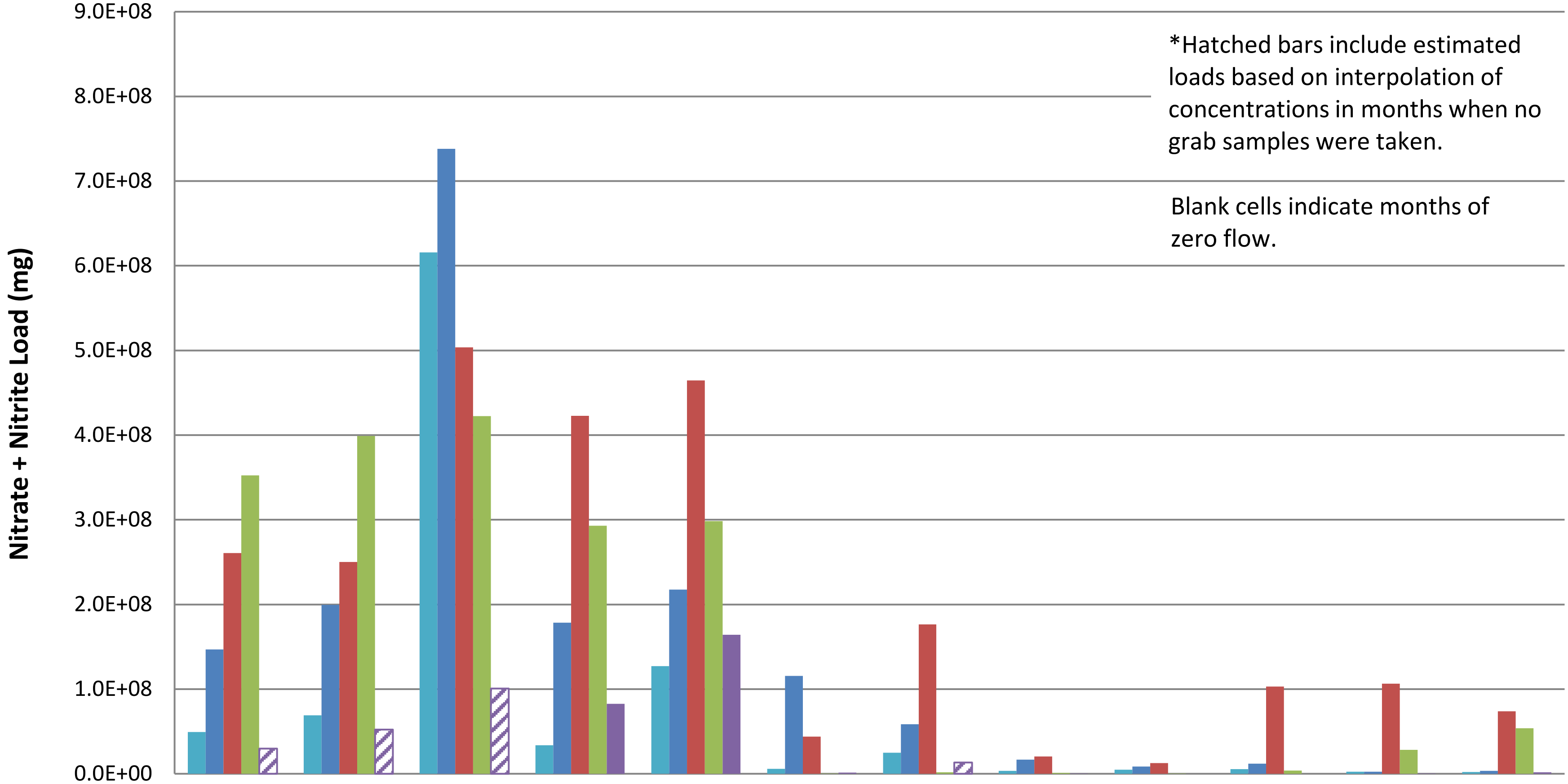


	Jan-13	Feb-13	Mar-13	Apr-13	May-13	Jun-13	Jul-13	Aug-13	Sep-13	Oct-13	Nov-13	Dec-13
SW093	1.01E+06	2.74E+06	1.82E+06	1.05E+07	7.48E+07	7.55E+06	1.58E+07	1.28E+07	1.76E+09	4.08E+08	2.54E+08	4.53E+07
SW093 + SPOUT	4.43E+07	3.50E+07	3.53E+07	6.31E+07	1.65E+08	6.59E+07	6.87E+07	4.52E+07	1.80E+09	4.90E+08	3.52E+08	1.15E+08
GS13	1.15E+08	6.61E+07	1.80E+08	4.74E+08	2.80E+08	1.65E+07	4.25E+06	5.07E+06	1.83E+09	6.40E+08	3.24E+08	1.77E+08
GS12			8.77E+07	4.81E+08	1.21E+08	2.01E+07	3.99E+06	6.21E+02	1.94E+09	2.74E+08	2.53E+08	2.72E+08
GS11				1.31E+08	1.32E+08	8.11E+05			4.43E+08	7.25E+07	2.61E+07	1.46E+07

Please refer to table for details regarding available data

Figure D.13

Monthly Nitrate + Nitrite Load in North Walnut Creek 2014

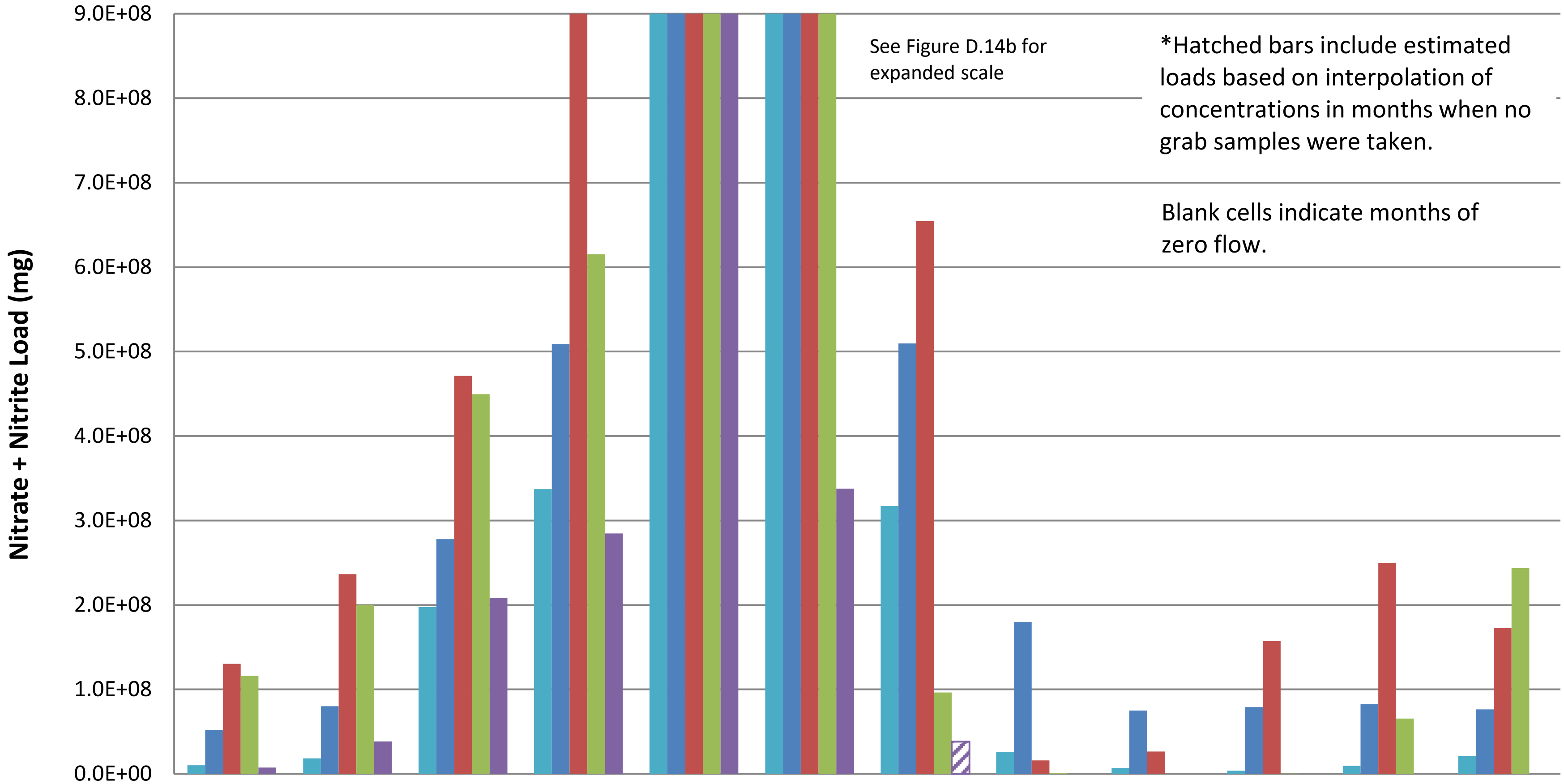


	Jan-14	Feb-14	Mar-14	Apr-14	May-14	Jun-14	Jul-14	Aug-14	Sep-14	Oct-14	Nov-14	Dec-14
SW093	4.95E+07	6.92E+07	6.16E+08	3.36E+07	1.27E+08	5.93E+06	2.48E+07	3.58E+06	4.85E+06	5.46E+06	2.59E+06	2.13E+06
SW093 + SPOUT	1.47E+08	2.00E+08	7.38E+08	1.78E+08	2.18E+08	1.16E+08	5.87E+07	1.68E+07	8.48E+06	1.20E+07	2.59E+06	3.44E+06
GS13	2.61E+08	2.50E+08	5.04E+08	4.23E+08	4.64E+08	4.38E+07	1.76E+08	2.03E+07	1.27E+07	1.03E+08	1.06E+08	7.38E+07
GS12	3.52E+08	3.99E+08	4.22E+08	2.93E+08	2.98E+08	2.78E+04	1.75E+06	9.60E+05	3.16E+05	3.89E+06	2.81E+07	5.36E+07
GS11	2.97E+07	5.22E+07	1.01E+08	8.25E+07	1.64E+08	1.43E+06	1.33E+07	1.03E+04			3.73E+05	1.76E+06

Please refer to table for details regarding available data

Figure D.14a

Monthly Nitrate + Nitrite Load in North Walnut Creek 2015

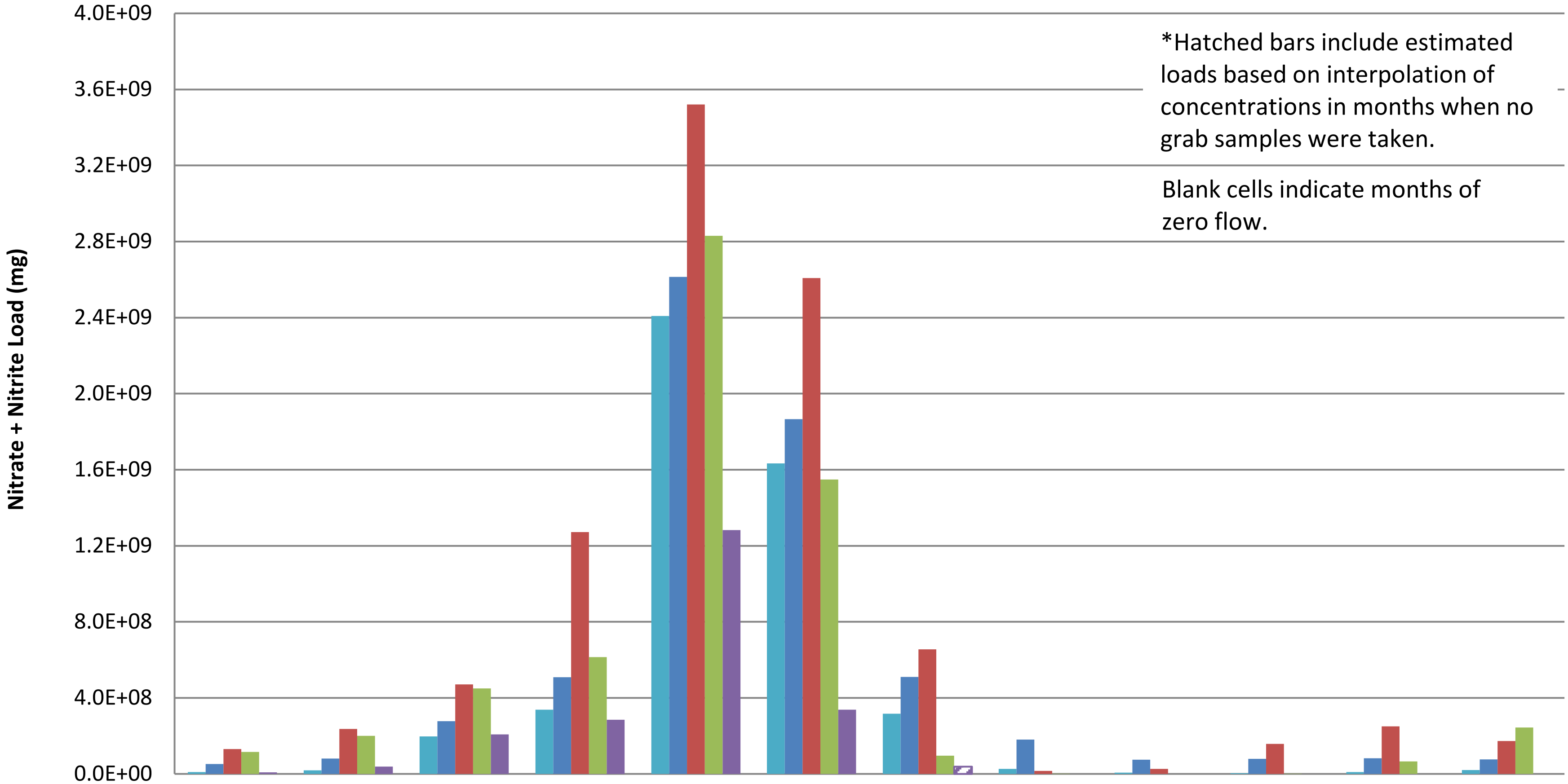


	Jan-15	Feb-15	Mar-15	Apr-15	May-15	Jun-15	Jul-15	Aug-15	Sep-15	Oct-15	Nov-15	Dec-15
SW093	1.03E+07	1.82E+07	1.98E+08	3.37E+08	2.41E+09	1.63E+09	3.17E+08	2.62E+07	7.09E+06	3.66E+06	9.36E+06	2.10E+07
SW093 + SPOUT	5.21E+07	8.02E+07	2.78E+08	5.09E+08	2.61E+09	1.87E+09	5.10E+08	1.80E+08	7.49E+07	7.92E+07	8.26E+07	7.64E+07
GS13	1.30E+08	2.37E+08	4.71E+08	1.27E+09	3.52E+09	2.61E+09	6.55E+08	1.58E+07	2.64E+07	1.57E+08	2.49E+08	1.73E+08
GS12	1.16E+08	2.00E+08	4.50E+08	6.15E+08	2.83E+09	1.55E+09	9.63E+07	9.53E+05		2.75E+05	6.55E+07	2.43E+08
GS11	7.56E+06	3.83E+07	2.08E+08	2.85E+08	1.28E+09	3.38E+08	3.81E+07					

Please refer to table for details regarding available data

Figure D.14b

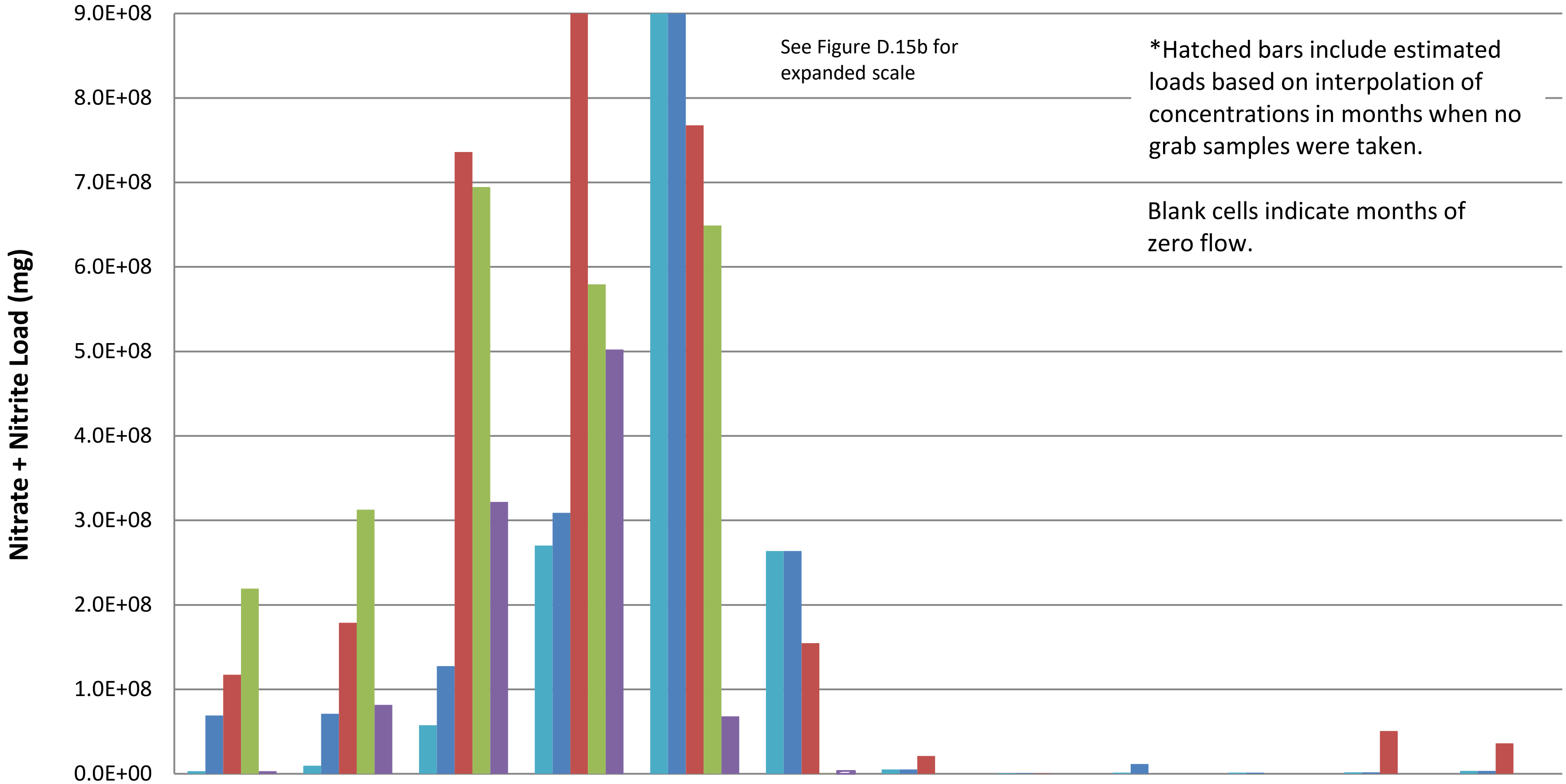
Monthly Nitrate + Nitrite Load in North Walnut Creek
2015



	Jan-15	Feb-15	Mar-15	Apr-15	May-15	Jun-15	Jul-15	Aug-15	Sep-15	Oct-15	Nov-15	Dec-15
SW093	1.03E+07	1.82E+07	1.98E+08	3.37E+08	2.41E+09	1.63E+09	3.17E+08	2.62E+07	7.09E+06	3.66E+06	9.36E+06	2.10E+07
SW093 + SPOUT	5.21E+07	8.02E+07	2.78E+08	5.09E+08	2.61E+09	1.87E+09	5.10E+08	1.80E+08	7.49E+07	7.92E+07	8.26E+07	7.64E+07
GS13	1.30E+08	2.37E+08	4.71E+08	1.27E+09	3.52E+09	2.61E+09	6.55E+08	1.58E+07	2.64E+07	1.57E+08	2.49E+08	1.73E+08
GS12	1.16E+08	2.00E+08	4.50E+08	6.15E+08	2.83E+09	1.55E+09	9.63E+07	9.53E+05		2.75E+05	6.55E+07	2.43E+08
GS11	7.56E+06	3.83E+07	2.08E+08	2.85E+08	1.28E+09	3.38E+08	3.81E+07					

Please refer to table for details regarding available data

Figure D.15a
Monthly Nitrate + Nitrite Load in North Walnut Creek 2016

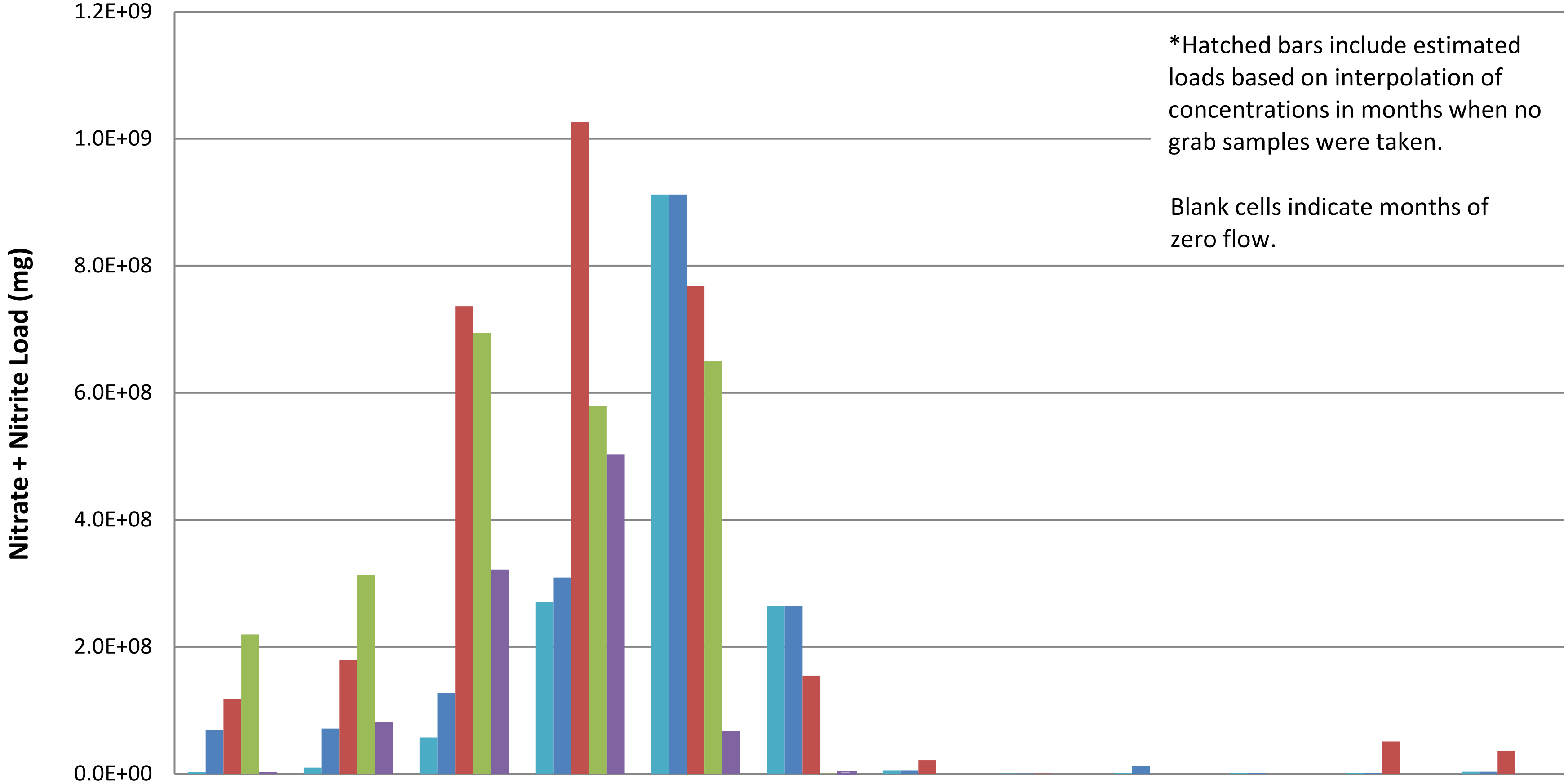


	Jan-16	Feb-16	Mar-16	Apr-16	May-16	Jun-16	Jul-16	Aug-16	Sep-16	Oct-16	Nov-16	Dec-16
SW093	2.98E+06	9.58E+06	5.74E+07	2.70E+08	9.12E+08	2.64E+08	5.30E+06	6.73E+05	1.26E+06	1.43E+06	1.64E+06	3.37E+06
SW093 + SPOUT	6.90E+07	7.10E+07	1.28E+08	3.09E+08	9.12E+08	2.64E+08	5.30E+06	6.73E+05	1.18E+07	1.43E+06	1.64E+06	3.37E+06
GS13	1.17E+08	1.79E+08	7.36E+08	1.03E+09	7.68E+08	1.55E+08	2.11E+07	8.67E+04			5.07E+07	3.62E+07
GS12	2.19E+08	3.13E+08	6.94E+08	5.79E+08	6.49E+08	4.03E+05						
GS11	2.95E+06	8.16E+07	3.22E+08	5.02E+08	6.78E+07	3.34E+06						

Please refer to table for details regarding available data

Figure D.15b

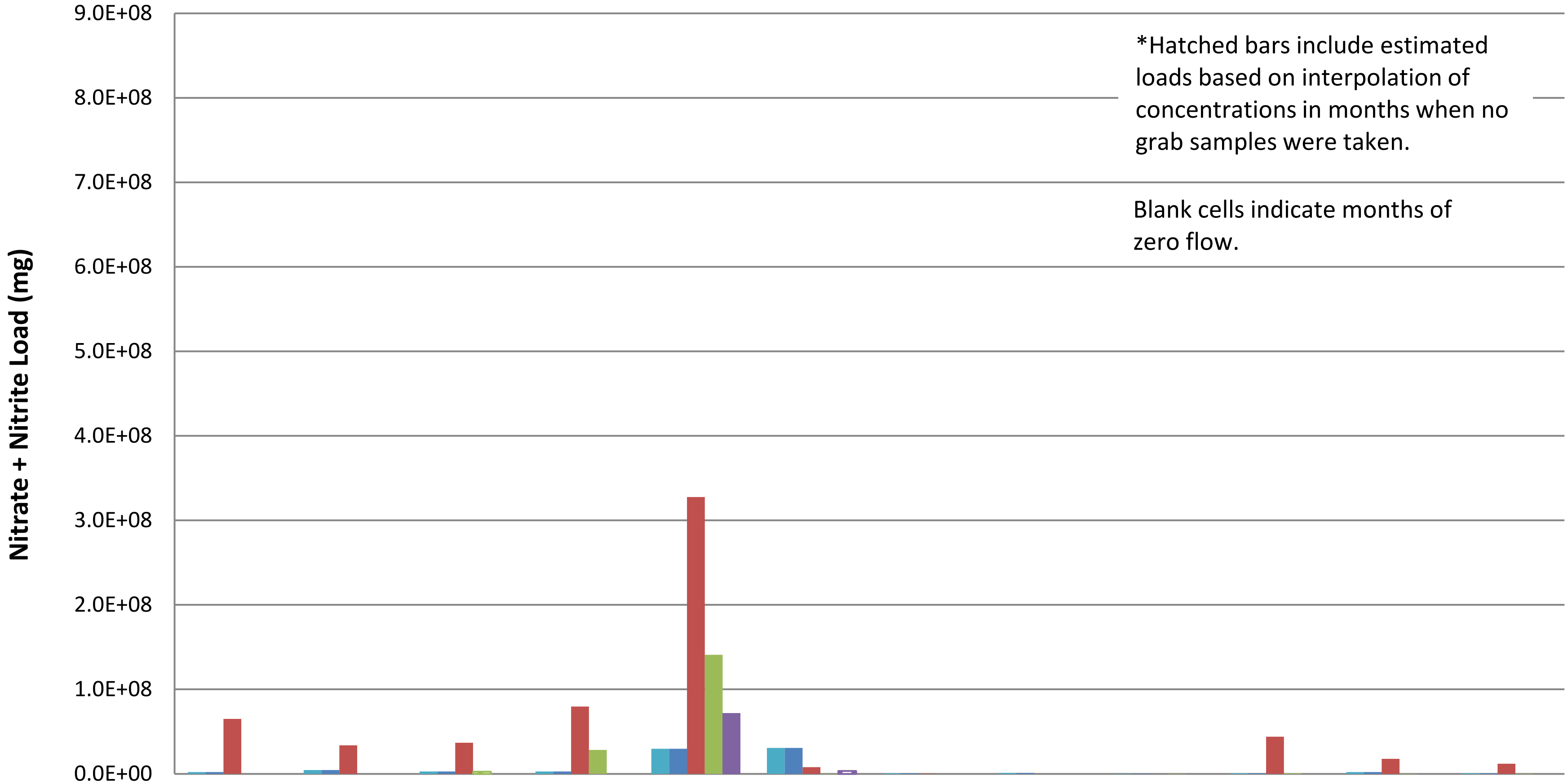
Monthly Nitrate + Nitrite Load in North Walnut Creek 2016



	Jan-16	Feb-16	Mar-16	Apr-16	May-16	Jun-16	Jul-16	Aug-16	Sep-16	Oct-16	Nov-16	Dec-16
SW093	2.98E+06	9.58E+06	5.74E+07	2.70E+08	9.12E+08	2.64E+08	5.30E+06	6.73E+05	1.26E+06	1.43E+06	1.64E+06	3.37E+06
SW093 + SPOUT	6.90E+07	7.10E+07	1.28E+08	3.09E+08	9.12E+08	2.64E+08	5.30E+06	6.73E+05	1.18E+07	1.43E+06	1.64E+06	3.37E+06
GS13	1.17E+08	1.79E+08	7.36E+08	1.03E+09	7.68E+08	1.55E+08	2.11E+07	8.67E+04			5.07E+07	3.62E+07
GS12	2.19E+08	3.13E+08	6.94E+08	5.79E+08	6.49E+08	4.03E+05						
GS11	2.95E+06	8.16E+07	3.22E+08	5.02E+08	6.78E+07	3.34E+06						

Please refer to table for details regarding available data

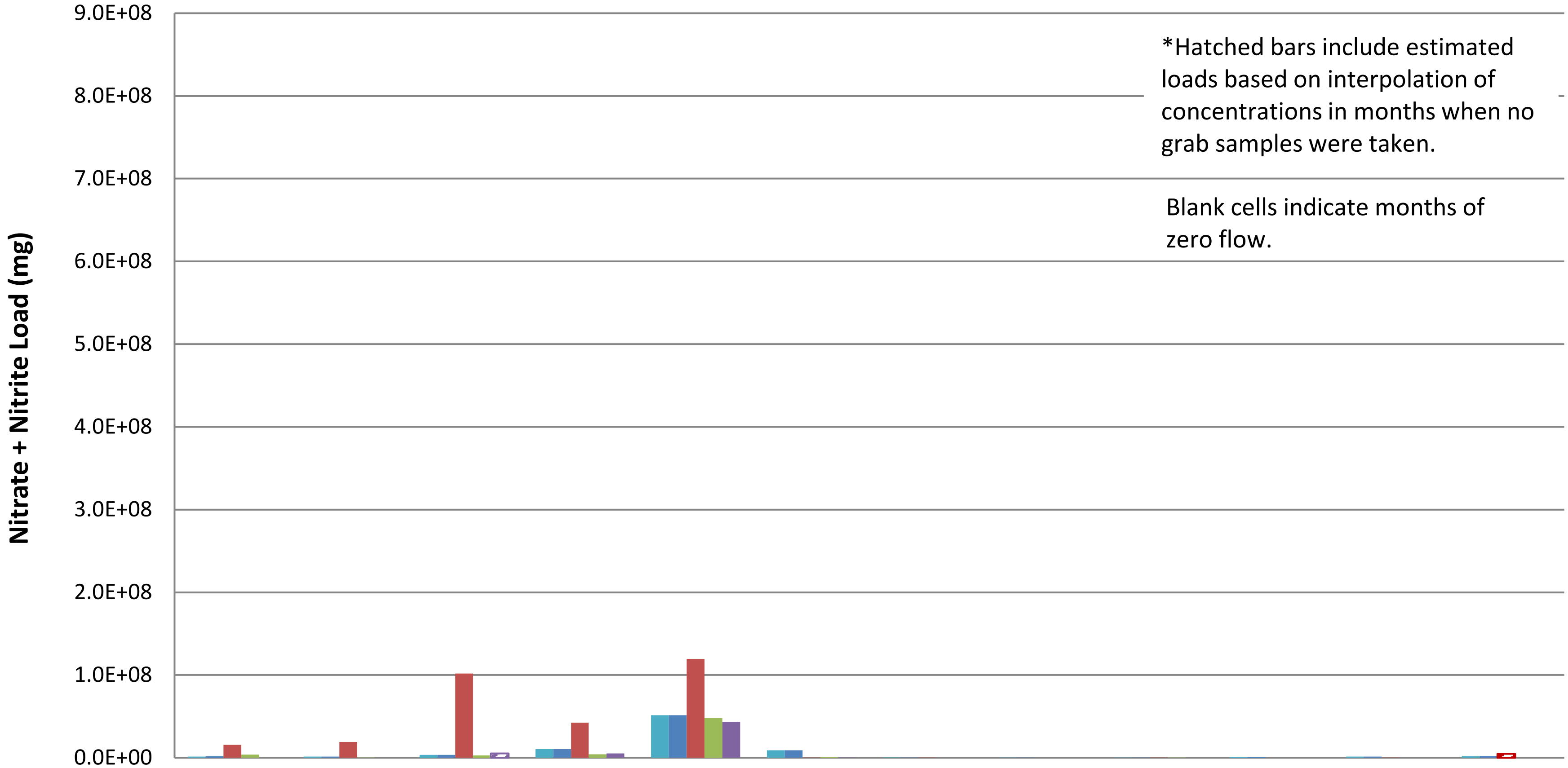
Figure D.16
Monthly Nitrate + Nitrite Load in North Walnut Creek
2017



	Jan-17	Feb-17	Mar-17	Apr-17	May-17	Jun-17	Jul-17	Aug-17	Sep-17	Oct-17	Nov-17	Dec-17
SW093	2.33E+06	4.55E+06	3.03E+06	2.88E+06	2.98E+07	3.09E+07	9.90E+05	1.16E+06	3.19E+04	8.31E+05	2.11E+06	9.22E+05
SW093 + SPOUT	2.33E+06	4.56E+06	3.04E+06	2.88E+06	2.98E+07	3.09E+07	1.00E+06	1.16E+06	3.44E+04	8.52E+05	2.11E+06	9.25E+05
GS13	6.50E+07	3.38E+07	3.69E+07	7.96E+07	3.28E+08	8.14E+06	3.13E+03			4.41E+07	1.79E+07	1.21E+07
GS12			2.60E+06	2.85E+07	1.41E+08	8.71E+04			3.87E+04	8.32E+05	1.12E+04	1.25E+04
GS11					7.18E+07	3.50E+06						

Please refer to table for details regarding available data

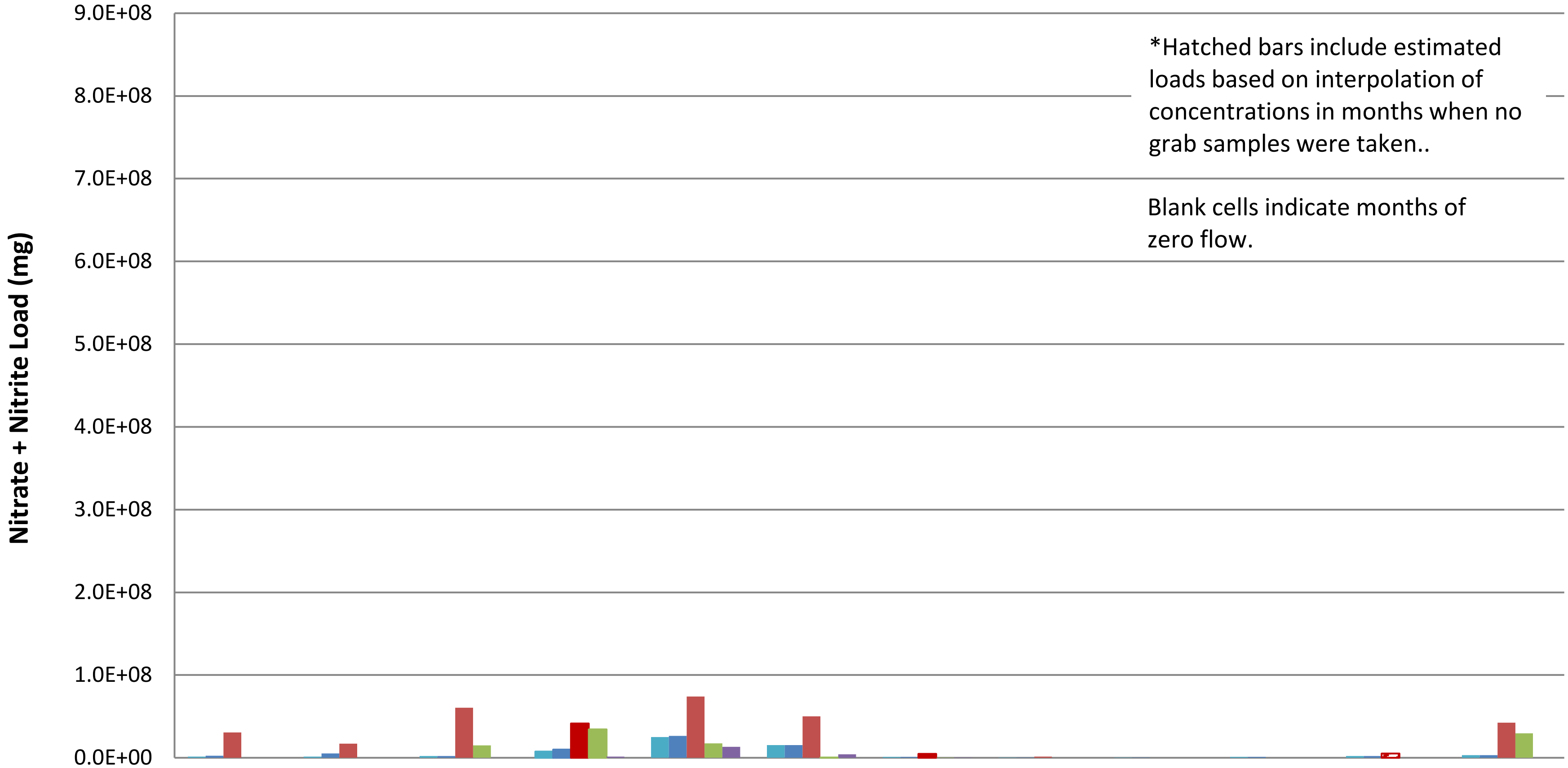
Figure D.17
Monthly Nitrate + Nitrite Load in North Walnut Creek
2018



	Jan-18	Feb-18	Mar-18	Apr-18	May-18	Jun-18	Jul-18	Aug-18	Sep-18	Oct-18	Nov-18	Dec-18
SW093	1.47E+06	1.42E+06	3.51E+06	1.04E+07	5.14E+07	8.92E+06	3.99E+05	2.60E+03	2.46E+05	6.61E+05	1.46E+06	1.95E+06
SW093 + SPOUT	1.69E+06	1.43E+06	3.51E+06	1.04E+07	5.14E+07	8.93E+06	4.02E+05	2.83E+04	2.51E+05	6.62E+05	1.46E+06	1.96E+06
GS13	1.58E+07	1.90E+07	1.02E+08	4.24E+07	1.20E+08	4.11E+03	5.82E+03		2.86E+03		1.94E+05	4.73E+06
GS12	3.70E+06	2.52E+05	2.69E+06	4.23E+06	4.81E+07	7.66E+05			1.90E+04			
GS11			5.25E+06	5.12E+06	4.35E+07	9.98E+04						

Please refer to table for details regarding available data

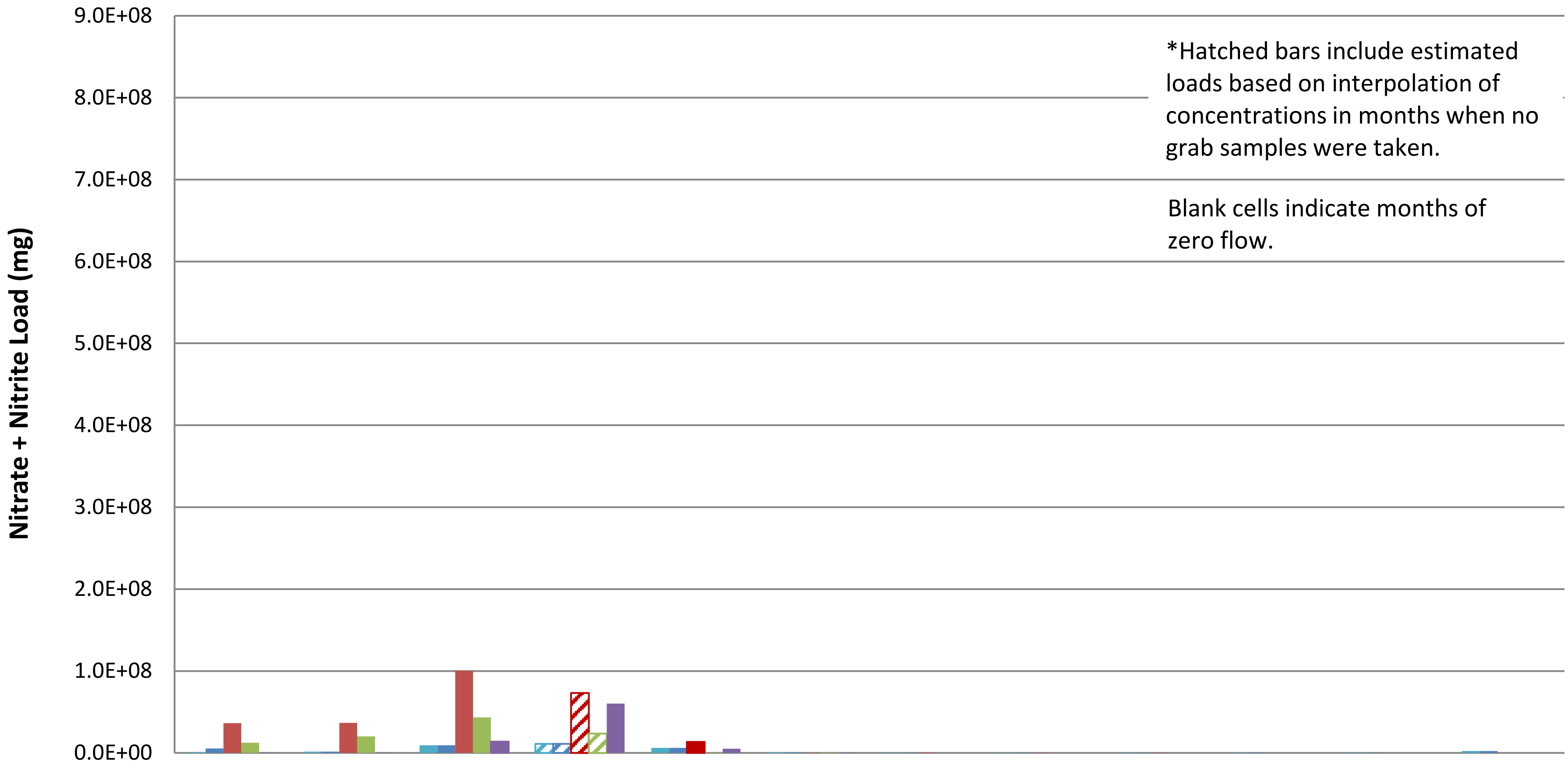
Figure D.18
Monthly Nitrate + Nitrite Load in North Walnut Creek
2019



	Jan-19	Feb-19	Mar-19	Apr-19	May-19	Jun-19	Jul-19	Aug-19	Sep-19	Oct-19	Nov-19	Dec-19
SW093	1.52E+06	1.50E+06	2.01E+06	7.53E+06	2.52E+07	1.52E+07	1.10E+06	5.26E+03	4.02E+04	9.72E+05	2.07E+06	3.05E+06
SW093 + SPOUT	2.58E+06	5.30E+06	2.01E+06	9.94E+06	2.64E+07	1.54E+07	1.10E+06	6.46E+03	4.15E+04	9.73E+05	2.07E+06	3.05E+06
GS13	3.06E+07	1.71E+07	6.04E+07	4.15E+07	7.40E+07	5.01E+07	4.73E+06	1.45E+06			5.15E+06	4.23E+07
GS12			1.49E+07	3.43E+07	1.74E+07	1.98E+05	1.10E+05					2.96E+07
GS11				1.55E+06	1.32E+07	4.38E+06	5.37E+04					

Please refer to table for details regarding available data

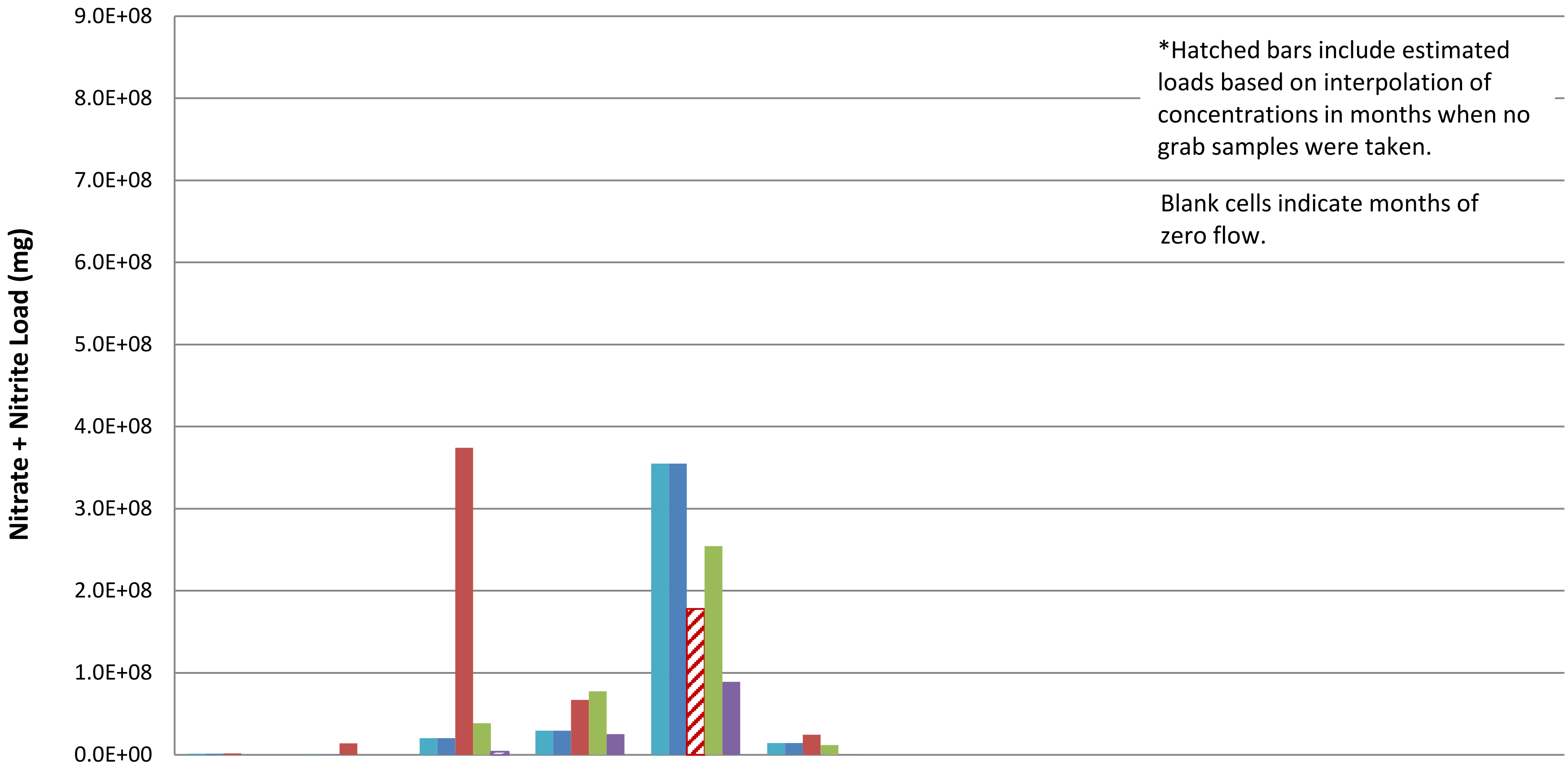
Figure D.19
Monthly Nitrate + Nitrite Load in North Walnut Creek 2020



	Jan-20	Feb-20	Mar-20	Apr-20	May-20	Jun-20	Jul-20	Aug-20	Sep-20	Oct-20	Nov-20	Dec-20
SW093	7.02E+05	1.64E+06	9.38E+06	1.10E+07	6.02E+06	8.61E+05	3.37E+04	5.17E+03	1.52E+04	1.40E+05	2.42E+05	2.36E+06
SW093 + SPOUT	5.50E+06	1.65E+06	9.39E+06	1.10E+07	6.02E+06	8.62E+05	3.52E+04	6.41E+03	1.63E+04	1.43E+05	2.44E+05	2.36E+06
GS13	3.64E+07	3.68E+07	1.00E+08	7.31E+07	1.34E+07	1.55E+04	5.17E+05	7.85E+02	3.82E+03			
GS12	1.26E+07	2.02E+07	4.35E+07	2.36E+07	1.33E+05	3.12E+05						
GS11	1.29E+04	3.39E+05	1.38E+07	6.03E+07	5.04E+06	2.52E+03						

Please refer to table for details regarding available data

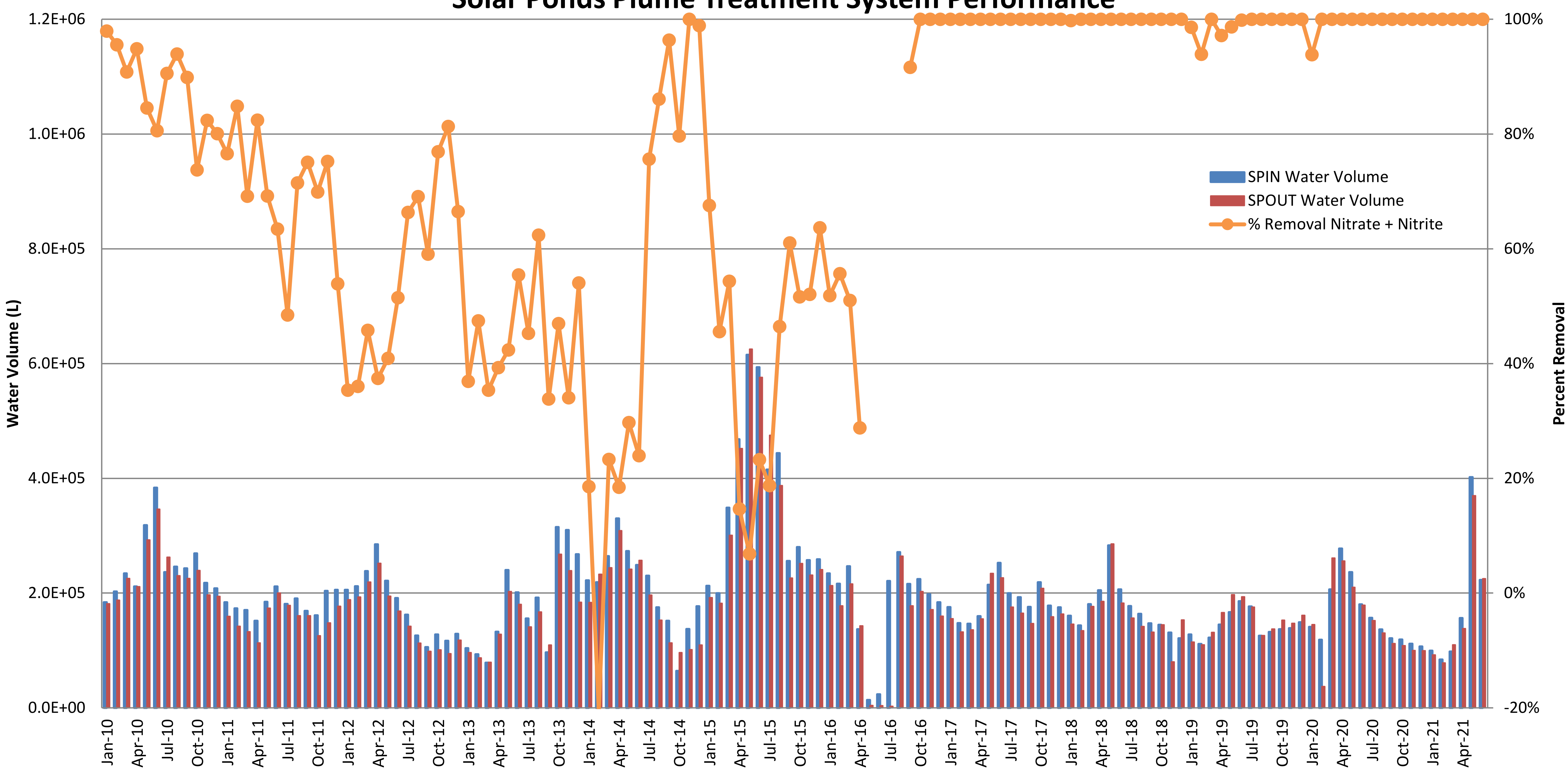
Figure D.20
Monthly Nitrate + Nitrite Load in North Walnut Creek
2021



	Jan-21	Feb-21	Mar-21	Apr-21	May-21	Jun-21	Jul-21	Aug-21	Sep-21	Oct-21	Nov-21	Dec-21
SW093	1.32E+06	3.36E+05	2.04E+07	2.94E+07	3.55E+08	1.42E+07						
SW093 + SPOUT	1.33E+06	3.42E+05	2.04E+07	2.94E+07	3.55E+08	1.43E+07						
GS13	1.69E+06	1.39E+07	3.74E+08	6.69E+07	1.78E+08	2.44E+07						
GS12			3.84E+07	7.74E+07	2.54E+08	1.18E+07						
GS11			3.79E+06	2.52E+07	8.91E+07	1.80E+05						

Figure D.21

Solar Ponds Plume Treatment System Performance



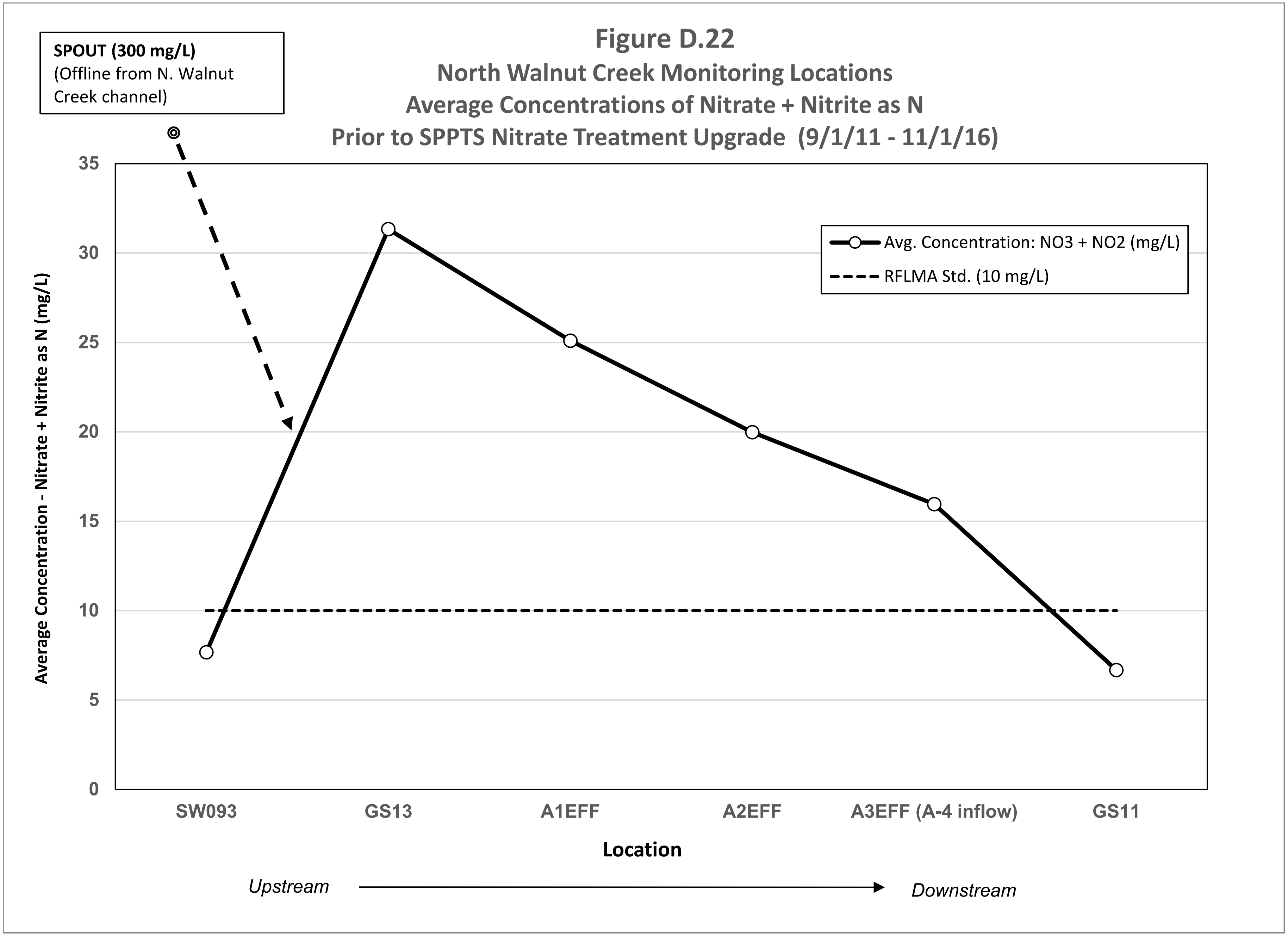
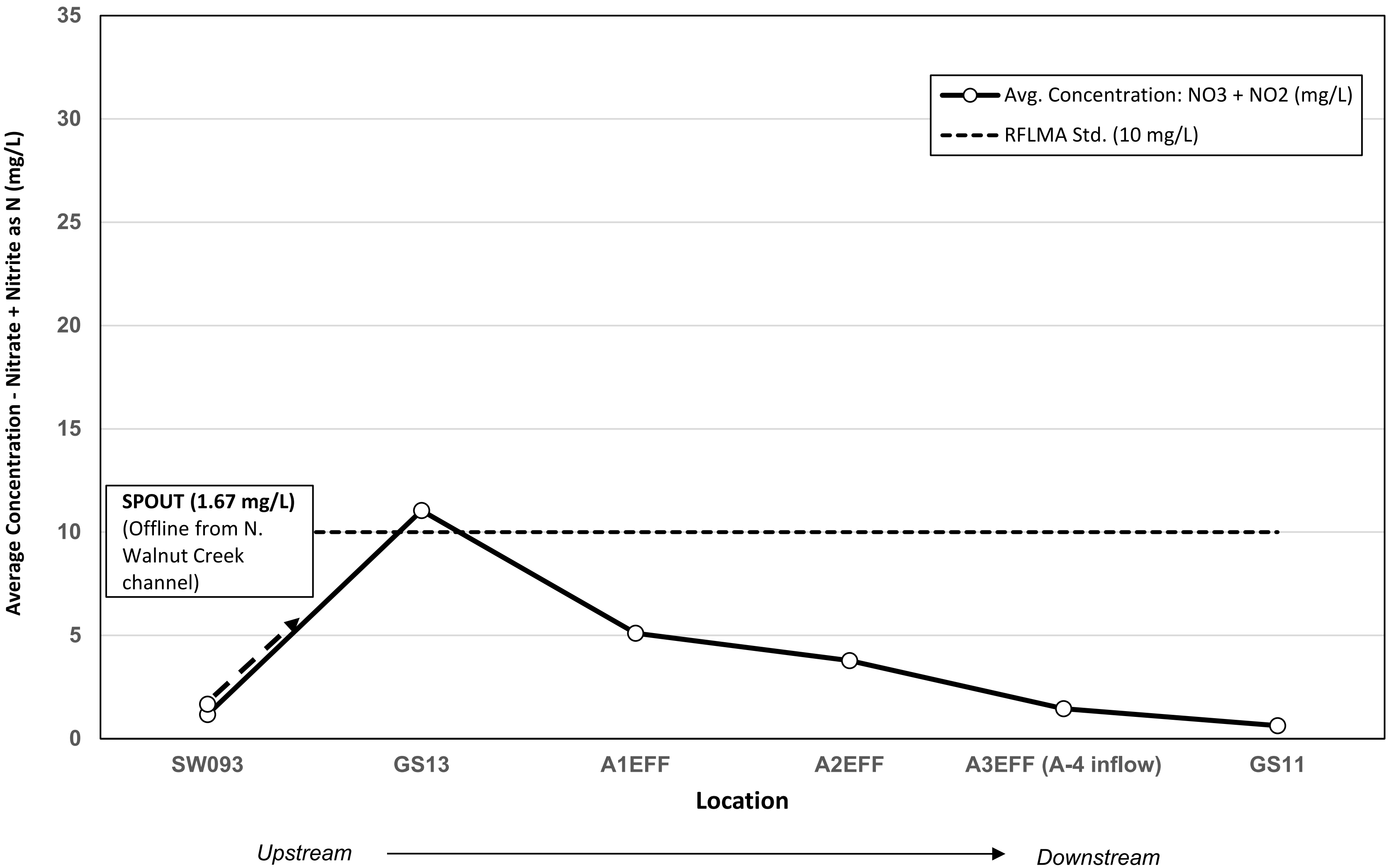


Figure D.22
North Walnut Creek Monitoring Locations
Average Concentrations of Nitrate + Nitrite as N
Prior to SPPTS Nitrate Treatment Upgrade (9/1/11 - 11/1/16)
SPOUT (300 mg/L)
(Offline from N. Walnut Creek channel)
Avg. Concentration: NO3 + NO2 (mg/L)
RFLMA Std. (10 mg/L)
Average Concentration - Nitrate + Nitrite as N (mg/L)
35
30
25
20
15
10
5
0
SW093
GS13
A1EFF
A2EFF
A3EFF (A-4 inflow)
GS11
Location
Upstream
Downstream

Figure D.23
North Walnut Creek Monitoring Locations
Average Concentrations of Nitrate + Nitrite as N
After SPPTS Nitrate Treatment Upgrade (11/1/16 - 9/15/21)



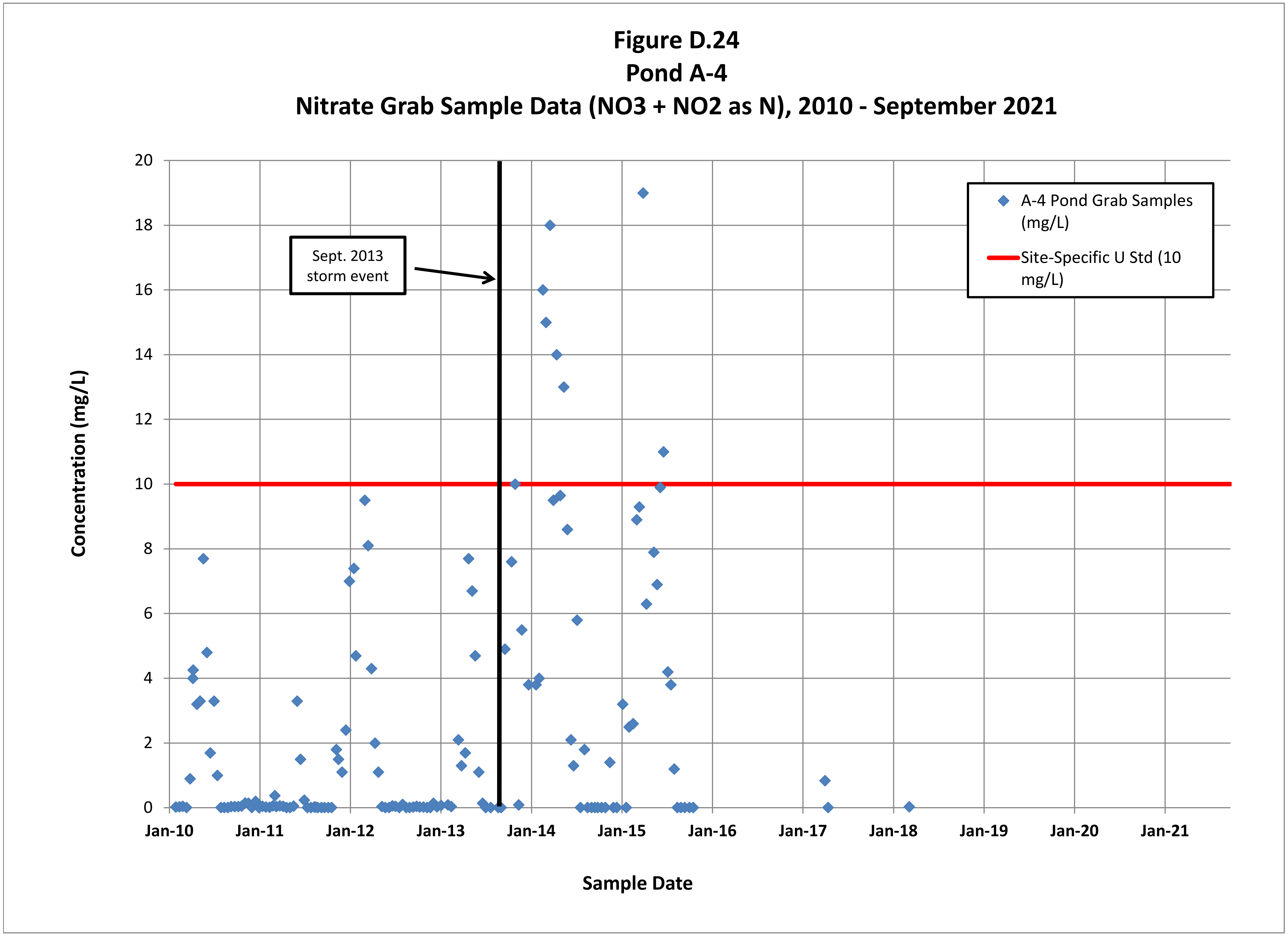


Figure D.24
Pond A-4
Nitrate Grab Sample Data (NO3 + NO2 as N), 2010 - September 2021
Sept. 2013 storm event
A-4 Pond Grab Samples (mg/L)
Site-Specific U Std (10 mg/L)
Concentration (mg/L)
Sample Date
0
2
4
6
8
10
12
14
16
18
20
Jan-10
Jan-11
Jan-12
Jan-13
Jan-14
Jan-15
Jan-16
Jan-17
Jan-18
Jan-19
Jan-20
Jan-21

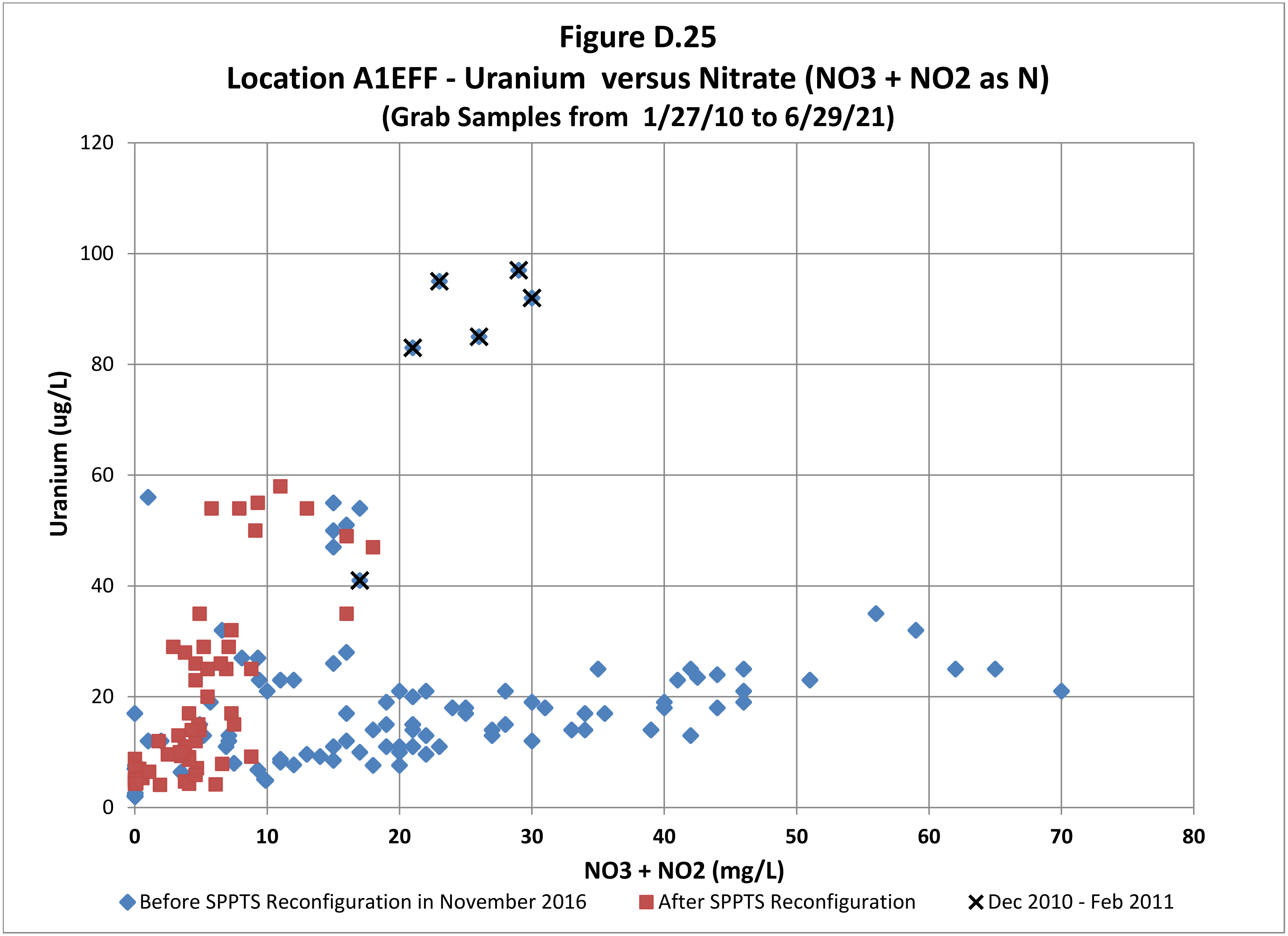


Figure D.25
Location A1EFF - Uranium versus Nitrate (NO3 + NO2 as N)
(Grab Samples from 1/27/10 to 6/29/21)
Uranium (ug/L)
120
100
80
60
40
20
0
0
10
20
30
40
50
60
70
80
NO3 + NO2 (mg/L)
Before SPPTS Reconfiguration in November 2016
After SPPTS Reconfiguration
Dec 2010 - Feb 2011

Table D.1

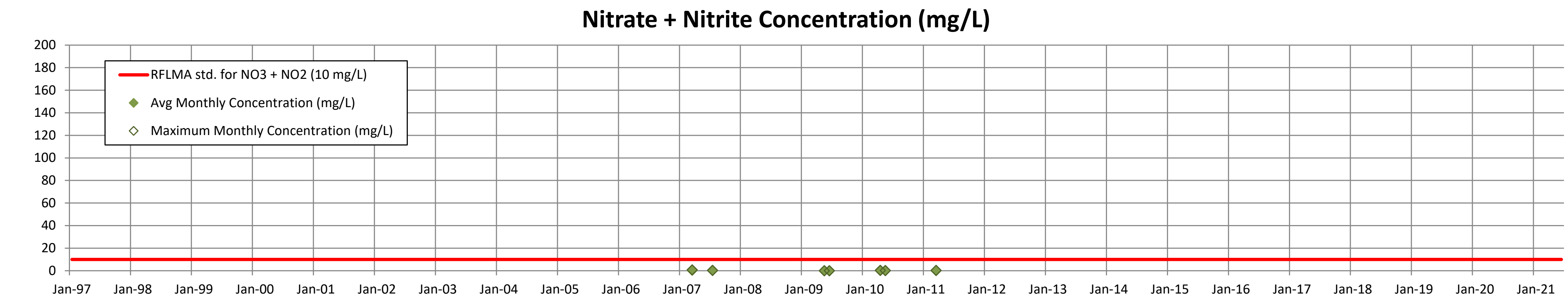
	Nitrate + Nitrite Load (mg)								
Date	SW093	SPOUT	SW093 + SPOUT	+/-	GS13	+/-	GS12	+/-	GS11
Jan-09	5.24E+06	no flow data	5.24E+06	*2.54E+08*	2.59E+08	--	0	--	0
Feb-09	2.68E+06	no flow data	2.68E+06	*4.98E+08*	5.01E+08	--	0	--	0
Mar-09	3.37E+07	no flow data	3.37E+07	*3.82E+08*	4.15E+08	--	0	--	0
Apr-09	6.18E+08	no flow data	--	--	1.39E+09	--		--	0
May-09	1.32E+08	no flow data	--	--	5.14E+08	--	0	--	3.37E+07
Jun-09	1.63E+08	no flow data	--	--	1.77E+08	--		--	2.25E+05
Jul-09	2.67E+07	no flow data	--	--	3.44E+07	--	0	--	0
Aug-09	5.67E+06	5560294	5.56E+06	*-4.79E+06*	7.75E+05	--	0	--	0
Sep-09	3.59E+06	16118700	1.61E+07	--	1.30E+04	--	0	--	0
Oct-09	2.32E+07	28395381	2.84E+07	*9.94E+07*	1.28E+08	--	0	--	0
Nov-09	3.43E+07	35175674	3.52E+07	*1.88E+08*	2.23E+08	--		--	0
Dec-09	1.26E+07	11459528	1.15E+07	*1.19E+08*	1.30E+08	--	0	--	2.53E+06
2009	**1.06E+09**	**9.67E+07**	**1.38E+08**	***3.63E+09***	**3.77E+09**	**--**	**--**	**--**	**3.64E+07**
Jan-10	8.56E+06	2.38E+06	1.09E+07	*4.37E+08*	4.48E+08	*-4.28E+08*	2.01E+07	*-2.01E+07*	
Feb-10	4.22E+06	5.91E+06	1.01E+07	*5.13E+07*	6.14E+07	*-2.35E+07*	3.79E+07	*-3.79E+07*	
Mar-10	4.11E+08	1.17E+07	4.22E+08	*2.05E+08*	6.28E+08	*-3.04E+08*	3.24E+08	*-3.24E+08*	
Apr-10	7.48E+08	5.84E+06	7.54E+08	*1.59E+08*	9.13E+08	*-6.32E+08*	2.81E+08	*-2.81E+08*	
May-10	5.96E+08	2.74E+07	6.24E+08	*1.46E+08*	7.70E+08	*-5.60E+07*	7.14E+08	*-1.12E+08*	6.02E+08
Jun-10	3.12E+08	4.44E+07	3.56E+08	*2.66E+07*	3.83E+08	*-2.32E+08*	1.51E+08	*-1.51E+08*	
Jul-10	2.75E+07	1.48E+07	4.23E+07	*-1.77E+07*	2.46E+07	*-1.94E+07*	5.19E+06	*-5.19E+06*	
Aug-10	3.84E+06	8.91E+06	1.28E+07	--	5.09E+06	*-5.08E+06*	1.40E+04	*-1.40E+04*	
Sep-10	5.99E+06	1.41E+07	2.01E+07	--		--		--	
Oct-10	3.93E+06	4.09E+07	4.49E+07	--	1.11E+04	--		--	
Nov-10	4.41E+06	2.62E+07	3.06E+07	*5.36E+07*	8.43E+07	*-8.42E+07*	6.34E+04	--	
Dec-10	4.73E+06	3.09E+07	3.56E+07	*8.53E+07*	1.21E+08	*-1.21E+08*	1.00E+05	--	
2010	**2.13E+09**	**2.33E+08**	**2.36E+09**	***1.07E+09***	**3.44E+09**	***-1.90E+09***	**1.53E+09**	***-9.31E+08***	**6.02E+08**
Jan-11	5.17E+06	2.83E+07	3.34E+07	*9.39E+07*	1.27E+08	--		--	
Feb-11	7.66E+06	1.59E+07	2.36E+07	*1.12E+08*	1.36E+08	--		--	
Mar-11	3.61E+06	3.33E+07	3.69E+07	*5.14E+07*	8.84E+07	--		--	8.89E+05
Apr-11	4.41E+06	1.83E+07	2.27E+07	*9.71E+07*	1.20E+08	*-1.08E+08*	1.17E+07	*-1.17E+07*	
May-11	5.62E+07	3.22E+07	8.84E+07	*4.27E+08*	5.16E+08	*-3.88E+08*	1.28E+08	*-1.28E+08*	
Jun-11	1.28E+07	5.23E+07	6.51E+07	*-4.68E+07*	1.83E+07	*6.80E+04*	1.84E+07	*-1.84E+07*	
Jul-11	9.79E+07	5.90E+07	1.57E+08	*4.01E+07*	1.97E+08	*-1.49E+08*	4.83E+07	*-4.83E+07*	
Aug-11	6.31E+06	3.19E+07	3.82E+07	*-3.82E+07*	6.59E+02	*2.93E+05*	2.94E+05	*-2.94E+05*	
Sep-11	1.68E+07	2.43E+07	4.11E+07	*-4.01E+07*	9.79E+05	*4.58E+06*	5.56E+06	--	7.02E+05
Oct-11	1.21E+07	2.63E+07	3.84E+07	*-3.82E+07*	2.05E+05	*2.44E+06*	2.65E+06	--	2.27E+05
Nov-11	1.07E+07	2.99E+07	4.06E+07	*6.82E+07*	1.09E+08	*-8.31E+07*	2.57E+07	*-2.35E+07*	2.22E+06
Dec-11	5.03E+07	5.61E+07	1.06E+08	*6.69E+07*	1.73E+08	*-1.72E+08*	1.42E+06	*5.71E+06*	7.13E+06
2011	**2.84E+08**	**4.08E+08**	**6.92E+08**	***7.94E+08***	**1.49E+09**	***-1.24E+09***	**2.42E+08**	***-2.31E+08***	**1.12E+07**
Jan-12	8.26E+06	7.74E+07	8.57E+07	*4.07E+07*	1.26E+08	*-1.26E+08*	2.40E+02	--	7.37E+07
Feb-12	2.45E+07	8.04E+07	8.04E+07	*2.32E+08*	3.12E+08	--		*9.29E+07*	9.29E+07
Mar-12	1.27E+07	7.60E+07	8.87E+07	*2.48E+07*	1.13E+08	*-1.09E+08*	4.17E+06	--	4.10E+07
Apr-12	8.32E+06	1.04E+08	1.12E+08	*3.00E+07*	1.42E+08	*-9.18E+07*	5.05E+07	*-4.94E+07*	1.09E+06
May-12	4.04E+06	7.99E+07	8.40E+07	*-3.52E+07*	4.88E+07	*-4.49E+07*	3.88E+06	--	4.29E+04
Jun-12	4.70E+06	5.65E+07	6.12E+07	*-6.09E+07*	3.37E+05	*-2.79E+05*	5.87E+04	--	
Jul-12	1.29E+07	3.70E+07	4.99E+07	--		--		*0.00E+00*	
Aug-12	6.51E+05	2.80E+07	2.86E+07	--		--		*0.00E+00*	
Sep-12	4.13E+06	2.88E+07	3.30E+07	--		--		*0.00E+00*	
Oct-12	5.15E+06	1.95E+07	2.47E+07	--		--		*0.00E+00*	
Nov-12	6.35E+06	1.45E+07	2.08E+07	*-2.07E+07*	1.55E+05	--		*0.00E+00*	
Dec-12	2.92E+06	2.85E+07	3.15E+07	*9.20E+07*	1.23E+08	--		*0.00E+00*	
2012	**9.47E+07**	**6.31E+08**	**7.01E+08**	***1.67E+08***	**8.67E+08**	***-8.09E+08***	**5.86E+07**	***1.50E+08***	**2.09E+08**
Jan-13	1.01E+06	4.33E+07	4.43E+07	*7.06E+07*	1.15E+08	--		*0.00E+00*	
Feb-13	2.74E+06	3.22E+07	3.50E+07	*3.11E+07*	6.61E+07	--		*0.00E+00*	
Mar-13	1.82E+06	3.34E+07	3.53E+07	*1.44E+08*	1.80E+08	*-9.20E+07*	8.77E+07	*-8.77E+07*	
Apr-13	1.05E+07	5.26E+07	6.31E+07	*4.11E+08*	4.74E+08	*7.24E+06*	4.81E+08	*-3.51E+08*	1.31E+08
May-13	7.48E+07	9.03E+07	1.65E+08	*1.15E+08*	2.80E+08	*-1.59E+08*	1.21E+08	*1.10E+07*	1.32E+08
Jun-13	7.55E+06	5.84E+07	6.59E+07	*-4.94E+07*	1.65E+07	*3.57E+06*	2.01E+07	*-1.92E+07*	8.11E+05
Jul-13	1.58E+07	5.29E+07	6.87E+07	*-6.44E+07*	4.25E+06	*-2.54E+05*	3.99E+06	*-3.99E+06*	
Aug-13	1.28E+07	4.52E+07	4.52E+07	*-4.01E+07*	5.07E+06	*-5.07E+06*	6.21E+02	*-6.21E+02*	
Sep-13	1.76E+09	3.83E+07	1.80E+09	*2.89E+07*	1.83E+09	*1.13E+08*	1.94E+09	*-1.50E+09*	4.43E+08
Oct-13	4.08E+08	8.25E+07	4.90E+08	*1.49E+08*	6.40E+08	*-3.65E+08*	2.74E+08	*-2.02E+08*	7.25E+07
Nov-13	2.54E+08	9.81E+07	3.52E+08	*-2.81E+07*	3.24E+08	*-7.16E+07*	2.53E+08	*-2.27E+08*	2.61E+07
Dec-13	4.53E+07	6.99E+07	1.15E+08	*6.14E+07*	1.77E+08	*9.55E+07*	2.72E+08	*-2.58E+08*	1.46E+07
2013	**2.60E+09**	**6.97E+08**	**3.28E+09**	***8.30E+08***	**4.11E+09**	***-6.54E+08***	**3.46E+09**	***-2.64E+09***	**8.20E+08**
Jan-14	4.95E+07	9.72E+07	1.47E+08	*1.14E+08*	2.61E+08	*9.18E+07*	3.52E+08	*-3.23E+08*	2.97E+07
Feb-14	6.92E+07	1.30E+08	2.00E+08	*5.06E+07*	2.50E+08	*1.49E+08*	3.99E+08	*-3.47E+08*	5.22E+07
Mar-14	6.16E+08	1.22E+08	7.38E+08	*-2.34E+08*	5.04E+08	*-8.12E+07*	4.22E+08	*-3.22E+08*	1.01E+08
Apr-14	3.36E+07	1.45E+08	1.78E+08	*2.45E+08*	4.23E+08	*-1.30E+08*	2.93E+08	*-2.10E+08*	8.25E+07
May-14	1.27E+08	9.07E+07	2.18E+08	*2.47E+08*	4.64E+08	*-1.66E+08*	2.98E+08	*-1.34E+08*	1.64E+08
Jun-14	5.93E+06	1.10E+08	1.16E+08	*-7.17E+07*	4.38E+07	*-4.38E+07*	2.78E+04	*1.40E+06*	1.43E+06
Jul-14	2.48E+07	3.39E+07	5.87E+07	*1.18E+08*	1.76E+08	*-1.75E+08*	1.75E+06	*1.15E+07*	1.33E+07
Aug-14	3.58E+06	1.32E+07	1.68E+07	*3.53E+06*	2.03E+07	*-1.94E+07*	9.60E+05	*-9.49E+05*	1.03E+04
Sep-14	4.85E+06	3.62E+06	8.48E+06	*4.24E+06*	1.27E+07	*-1.24E+07*	3.16E+05	*-3.16E+05*	
Oct-14	5.46E+06	6.54E+06	1.20E+07	*9.10E+07*	1.03E+08	*-9.91E+07*	3.89E+06	*-3.89E+06*	
Nov-14	2.59E+06	4.47E+03	2.59E+06	*1.04E+08*	1.06E+08	*-7.83E+07*	2.81E+07	*-2.78E+07*	3.73E+05
Dec-14	2.13E+06	1.31E+06	3.44E+06	*7.04E+07*	7.38E+07	*-2.02E+07*	5.36E+07	*-5.18E+07*	1.76E+06
2014	**9.44E+08**	**7.53E+08**	**1.70E+09**	***7.41E+08***	**2.44E+09**	***-5.85E+08***	**1.85E+09**	***-1.41E+09***	**4.46E+08**
Jan-15	1.03E+07	4.18E+07	5.21E+07	*7.83E+07*	1.30E+08	*-1.42E+07*	1.16E+08	*-1.09E+08*	7.56E+06
Feb-15	1.82E+07	6.20E+07	8.02E+07	*1.56E+08*	2.37E+08	*-3.63E+07*	2.00E+08	*-1.62E+08*	3.83E+07
Mar-15	1.98E+08	8.02E+07	2.78E+08	*1.94E+08*	4.71E+08	*-2.17E+07*	4.50E+08	*-2.41E+08*	2.08E+08
Apr-15	3.37E+08	1.72E+08	5.09E+08	*7.63E+08*	1.27E+09	*-6.57E+08*	6.15E+08	*-3.30E+08*	2.85E+08
May-15	2.41E+09	2.06E+08	2.61E+09	*9.06E+08*	3.52E+09	*-6.90E+08*	2.83E+09	*-1.55E+09*	1.28E+09
Jun-15	1.63E+09	2.32E+08	1.87E+09	*7.42E+08*	2.61E+09	*-1.06E+09*	1.55E+09	*-1.21E+09*	3.38E+08
Jul-15	3.17E+08	1.92E+08	5.10E+08	*1.45E+08*	6.55E+08	*-5.58E+08*	9.63E+07	*-5.82E+07*	3.81E+07
Aug-15	2.62E+07	1.54E+08	1.80E+08	*-1.64E+08*	1.58E+07	*-1.49E+07*	9.53E+05	*-9.53E+05*	
Sep-15	7.09E+06	6.78E+07	7.49E+07	*-4.86E+07*	2.64E+07	--		*0.00E+00*	
Oct-15	3.66E+06	7.55E+07	7.92E+07	*7.80E+07*	1.57E+08	*-1.57E+08*	2.75E+05	*-2.75E+05*	
Nov-15	9.36E+06	7.33E+07	8.26E+07	*1.67E+08*	2.49E+08	*-1.84E+08*	6.55E+07	*-6.55E+07*	
Dec-15	2.10E+07	5.54E+07	7.64E+07	*9.64E+07*	1.73E+08	*7.06E+07*	2.43E+08	*-2.43E+08*	
2015	**4.99E+09**	**1.41E+09**	**6.40E+09**	*3.11E+09*	**9.51E+09**	*-3.35E+09*	**6.17E+09**	*-3.97E+09*	**2.20E+09**
Jan-16	2.98E+06	6.60E+07	6.90E+07	*4.82E+07*	1.17E+08	*1.02E+08*	2.19E+08	*-2.16E+08*	2.95E+06
Feb-16	9.58E+06	6.14E+07	7.10E+07	*1.08E+08*	1.79E+08	*1.34E+08*	3.13E+08	*-2.31E+08*	8.16E+07
Mar-16	5.74E+07	7.02E+07	1.28E+08	*6.09E+08*	7.36E+08	*-4.17E+07*	6.94E+08	*-3.73E+08*	3.22E+08
Apr-16	2.70E+08	3.86E+07	3.09E+08	*7.17E+08*	1.03E+09	*-4.47E+08*	5.79E+08	*-7.69E+07*	5.02E+08
May-16	9.12E+08		9.12E+08	*-1.44E+08*	7.68E+08	*-1.19E+08*	6.49E+08	*-5.81E+08*	6.78E+07
Jun-16	2.64E+08		2.64E+08	*-1.09E+08*	1.55E+08	*-1.54E+08*	4.03E+05	*2.93E+06*	3.34E+06
Jul-16	5.30E+06		5.30E+06	*1.58E+07*	2.11E+07	--		*0.00E+00*	
Aug-16	6.73E+05		6.73E+05	*-5.86E+05*	8.67E+04	--		*0.00E+00*	
Sep-16	1.26E+06	1.05E+07	1.18E+07	*-1.18E+07*		--		*0.00E+00*	
Oct-16	1.43E+06	1.92E+03	1.43E+06	*-1.43E+06*		--		*0.00E+00*	
Nov-16	1.64E+06	1.63E+03	1.64E+06	*4.90E+07*	5.07E+07	--		*0.00E+00*	
Dec-16	3.37E+06	1.52E+03	3.37E+06	*3.28E+07*	3.62E+07	--		*0.00E+00*	
2016	**1.53E+09**	**2.47E+08**	**1.78E+09**	**1.31E+09**	**3.09E+09**	**-5.26E+08**	**2.46E+09**	**-1.48E+09**	**9.80E+08**
Jan-17	2.33E+06	1.48E+03	2.33E+06	*6.27E+07*	6.50E+07	--		*0.00E+00*	
Feb-17	4.55E+06	6.19E+03	4.56E+06	*2.93E+07*	3.38E+07	--		*0.00E+00*	
Mar-17	3.03E+06	1.15E+04	3.04E+06	*3.38E+07*	3.69E+07	*-3.43E+07*	2.60E+06	*-2.60E+06*	
Apr-17	2.88E+06	1.47E+03	2.88E+06	*7.67E+07*	7.96E+07	*-5.12E+07*	2.85E+07	*-2.85E+07*	
May-17	2.98E+07	3.83E+04	2.98E+07	*2.98E+08*	3.28E+08	*-1.87E+08*	1.41E+08	*-6.91E+07*	7.18E+07
Jun-17	3.09E+07	5.04E+03	3.09E+07	*-2.28E+07*	8.14E+06	*-8.05E+06*	8.71E+04	*3.41E+06*	3.50E+06
Jul-17	9.90E+05	1.40E+04	1.00E+06	*-1.00E+06*	3.13E+03	--		*0.00E+00*	
Aug-17	1.16E+06	7.92E+03	1.16E+06	*-1.16E+06*		--		*0.00E+00*	
Sep-17	3.19E+04	2.54E+03	3.44E+04	*-3.44E+04*		--	3.87E+04	*-3.87E+04*	
Oct-17	8.31E+05	2.08E+04	8.52E+05	*4.32E+07*	4.41E+07	*-4.33E+07*	8.32E+05	*-8.32E+05*	
Nov-17	2.11E+06	1.51E+03	2.11E+06	*1.58E+07*	1.79E+07	*-1.79E+07*	1.12E+04	*-1.12E+04*	
Dec-17	9.22E+05	2.90E+03	9.25E+05	*1.12E+07*	1.21E+07	*-1.21E+07*	1.25E+04	*-1.25E+04*	
2017	**7.95E+07**	**1.14E+05**	**7.96E+07**	**5.46E+08**	**6.25E+08**	**-3.53E+08**	**1.73E+08**	**-9.76E+07**	**7.53E+07**
Jan-18	1.47E+06	2.24E+05	1.69E+06	*1.41E+07*	1.58E+07	*-1.21E+07*	3.70E+06	*-3.70E+06*	
Feb-18	1.42E+06	1.46E+04	1.43E+06	*1.76E+07*	1.90E+07	*-1.88E+07*	2.52E+05	*-2.52E+05*	
Mar-18	3.51E+06	3.16E+03	3.51E+06	*9.82E+07*	1.02E+08	*-9.90E+07*	2.69E+06	*2.56E+06*	5.25E+06
Apr-18	1.04E+07	1.76E+03	1.04E+07	*3.20E+07*	4.24E+07	*-3.81E+07*	4.23E+06	*8.90E+05*	5.12E+06
May-18	5.14E+07	7.00E+03	5.14E+07	*6.83E+07*	1.20E+08	*-7.16E+07*	4.81E+07	*-4.62E+06*	4.35E+07
Jun-18	8.92E+06	2.88E+03	8.93E+06	*-8.92E+06*	4.11E+03	*7.62E+05*	7.66E+05	*-6.66E+05*	9.98E+04
Jul-18	3.99E+05	3.17E+03	4.02E+05	*-3.97E+05*	5.82E+03	*-5.82E+03*		*0.00E+00*	
Aug-18	2.60E+03	2.57E+04	2.83E+04	*-2.83E+04*		--		*0.00E+00*	
Sep-18	2.46E+05	4.75E+03	2.51E+05	*-2.48E+05*	2.86E+03	*1.61E+04*	1.90E+04	*-1.90E+04*	
Oct-18	6.61E+05	1.38E+03	6.62E+05	*-6.62E+05*		--		*0.00E+00*	
Nov-18	1.46E+06	1.13E+03	1.46E+06	*-1.26E+06*	1.94E+05	--		*0.00E+00*	
Dec-18	1.95E+06	2.87E+03	1.96E+06	*2.78E+06*	4.73E+06	--		*0.00E+00*	
2018	**8.18E+07**	**2.92E+05**	**8.21E+07**	***2.21E+08***	**3.04E+08**	***-2.39E+08***	**5.97E+07**	***-5.81E+06***	**5.39E+07**
Jan-19	1.52E+06	1.06E+06	2.58E+06	*2.81E+07*	3.06E+07	--		*0.00E+00*	
Feb-19	1.50E+06	3.80E+06	5.30E+06	*1.18E+07*	1.71E+07	--		*0.00E+00*	
Mar-19	2.01E+06	3.78E+03	2.01E+06	*5.84E+07*	6.04E+07	*-4.55E+07*	1.49E+07	*-1.49E+07*	
Apr-19	7.53E+06	2.41E+06	9.94E+06	*3.15E+07*	4.15E+07	*-7.13E+06*	3.43E+07	*-3.28E+07*	1.55E+06
May-19	2.52E+07	1.18E+06	2.64E+07	*4.76E+07*	7.40E+07	*-5.66E+07*	1.74E+07	*-4.20E+06*	1.32E+07
Jun-19	1.52E+07	1.57E+05	1.54E+07	*3.47E+07*	5.01E+07	*-4.99E+07*	1.98E+05	*4.18E+06*	4.38E+06
Jul-19	1.10E+06	1.67E+03	1.10E+06	*3.63E+06*	4.73E+06	*-4.62E+06*	1.10E+05	*-5.62E+04*	5.37E+04
Aug-19	5.26E+03	1.20E+03	6.46E+03	*1.45E+06*	1.45E+06	--		*0.00E+00*	
Sep-19	4.02E+04	1.30E+03	4.15E+04	*-4.15E+04*		--		*0.00E+00*	
Oct-19	9.72E+05	1.45E+03	9.73E+05	*-9.73E+05*		--		*0.00E+00*	
Nov-19	2.07E+06	1.40E+03	2.07E+06	*3.08E+06*	5.15E+06	--		*0.00E+00*	
Dec-19	3.05E+06	2.20E+03	3.05E+06	*3.93E+07*	4.23E+07	*-1.27E+07*	2.96E+07	*-2.96E+07*	
2019	**6.02E+07**	**8.61E+06**	**6.88E+07**	***2.58E+08***	**3.27E+08**	***-1.76E+08***	**9.66E+07**	***-7.74E+07***	**1.92E+07**
Jan-20	7.02E+05	4.79E+06	5.50E+06	*3.09E+07*	3.64E+07	*-2.38E+07*	1.26E+07	*-1.26E+07*	1.29E+04
Feb-20	1.64E+06	1.34E+04	1.65E+06	*3.51E+07*	3.68E+07	*-1.66E+07*	2.02E+07	*-1.98E+07*	3.39E+05
Mar-20	9.38E+06	1.36E+04	9.39E+06	*9.07E+07*	1.00E+08	*-5.67E+07*	4.35E+07	*-2.97E+07*	1.38E+07
Apr-20	1.10E+07	7.87E+03	1.10E+07	*6.21E+07*	7.31E+07	*-4.95E+07*	2.36E+07	*3.67E+07*	6.03E+07
May-20	6.02E+06	2.00E+03	6.02E+06	*7.38E+06*	1.34E+07	*-1.33E+07*	1.33E+05	*4.91E+06*	5.04E+06
Jun-20	8.61E+05	1.70E+03	8.62E+05	*-8.47E+05*	1.55E+04	*2.97E+05*	3.12E+05	*-3.10E+05*	2.52E+03
Jul-20	3.37E+04	1.45E+03	3.52E+04	*4.82E+05*	5.17E+05	--		*0.00E+00*	
Aug-20	5.17E+03	1.24E+03	6.41E+03	*-5.62E+03*	7.85E+02	--		*0.00E+00*	
Sep-20	1.52E+04	1.07E+03	1.63E+04	*-1.25E+04*	3.82E+03	--		*0.00E+00*	
Oct-20	1.40E+05	3.00E+03	1.43E+05	*-1.43E+05*		--		*0.00E+00*	
Nov-20	2.42E+05	1.63E+03	2.44E+05	*-2.44E+05*		--		*0.00E+00*	
Dec-20	2.36E+06	4.36E+03	2.36E+06	*-2.36E+06*		--		*0.00E+00*	
2020	**3.24E+07**	**4.85E+06**	**3.73E+07**	***2.23E+08***	**2.60E+08**	***-1.60E+08***	**1.00E+08**	***-2.08E+07***	**7.95E+07**
Jan-21	1.32E+06	7.89E+03	1.33E+06	*3.65E+05*	1.69E+06	--		*0.00E+00*	
Feb-21	3.36E+05	6.03E+03	3.42E+05	*1.36E+07*	1.39E+07	--		*0.00E+00*	
Mar-21	2.04E+07	3.12E+03	2.04E+07	*3.54E+08*	3.74E+08	*-3.36E+08*	3.84E+07	*-3.46E+07*	3.79E+06
Apr-21	2.94E+07	2.17E+03	2.94E+07	*3.75E+07*	6.69E+07	*1.05E+07*	7.74E+07	*-5.22E+07*	2.52E+07
May-21	3.55E+08	3.14E+03	3.55E+08	*-1.77E+08*	1.78E+08	*7.67E+07*	2.54E+08	*-1.65E+08*	8.91E+07
Jun-21	1.42E+07	3.67E+04	1.43E+07	*1.01E+07*	2.44E+07	*-1.26E+07*	1.18E+07	*-1.16E+07*	1.80E+05
Jul-21				*0.00E+00*		*0.00E+00*		*0.00E+00*	
Aug-21				*0.00E+00*		*0.00E+00*		*0.00E+00*	
Sep-21				*0.00E+00*		*0.00E+00*		*0.00E+00*	
Oct-21				*0.00E+00*		*0.00E+00*		*0.00E+00*	
Nov-21				*0.00E+00*		*0.00E+00*		*0.00E+00*	
Dec-21				*0.00E+00*		*0.00E+00*		*0.00E+00*	
2021	**4.21E+08**	**5.90E+04**	**4.21E+08**	***2.38E+08***	**6.59E+08**	***-2.61E+08***	**3.82E+08**	***-2.64E+08***	**1.18E+08**

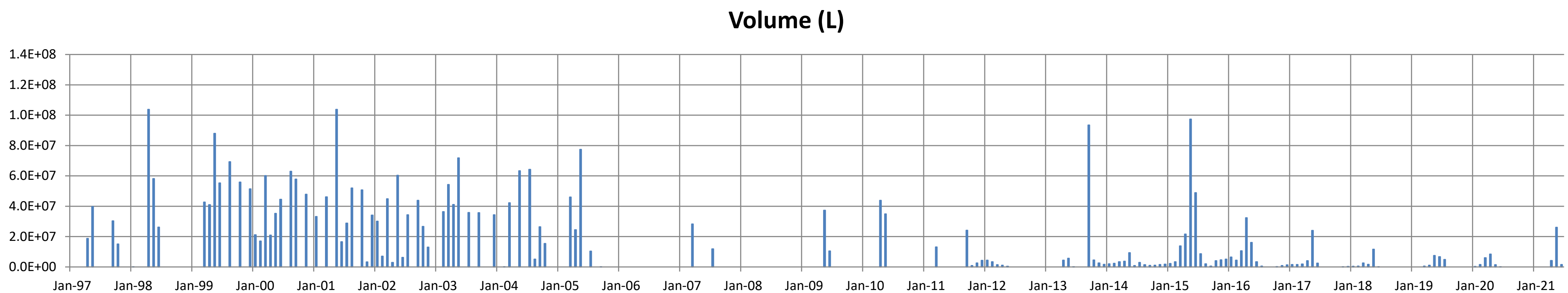
Notes:

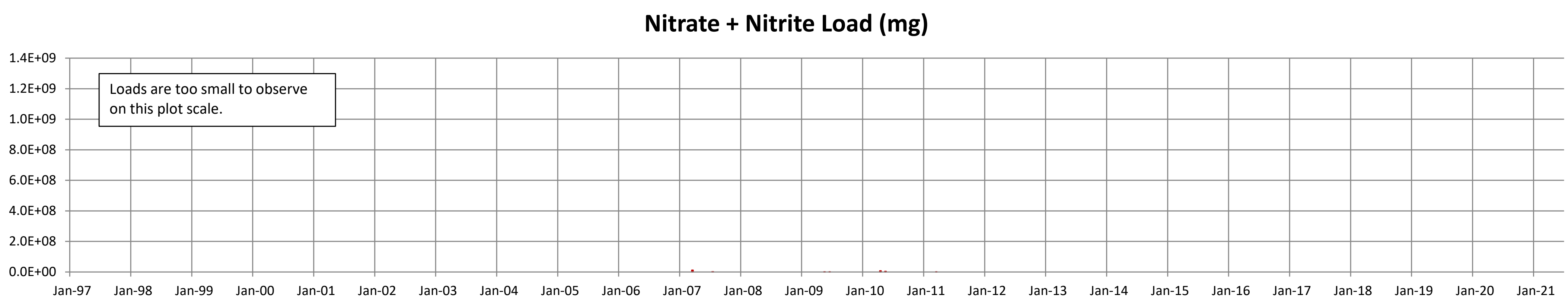
Nitrate only data used in highlighted months when no nitrate + nitrite data was available (GS13 only).
ESTIMATED VALUE BASED ON INTERPOLATED CONCENTRATION.
NO CONCENTRATION DATA
NO FLOW DATA OR SOME FLOW DATA MISSING
Zero flow

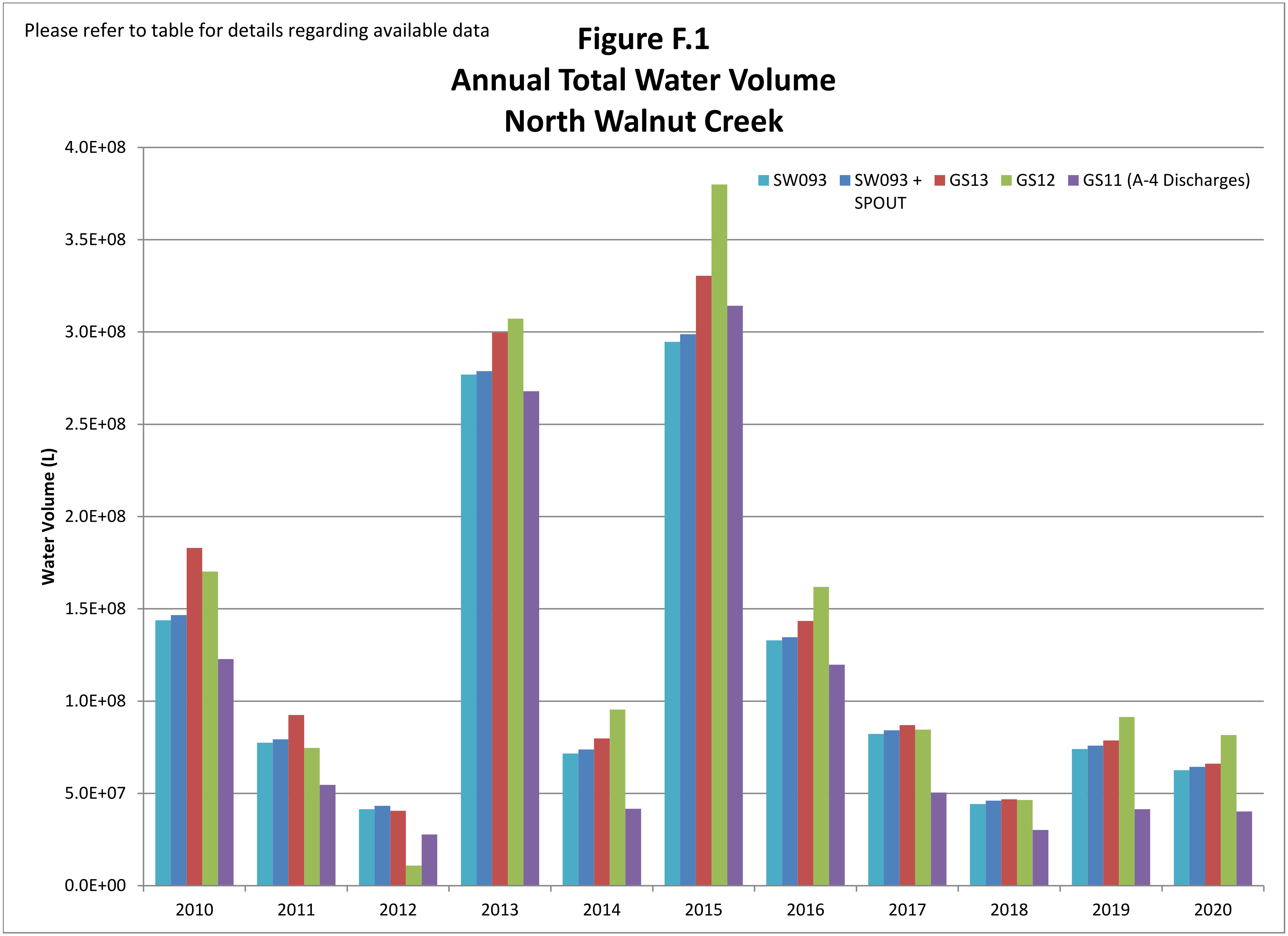
Figure E.1
Location: GS08, Jan 1997 - June 2021

South Walnut Creek-3
(B5 Out)





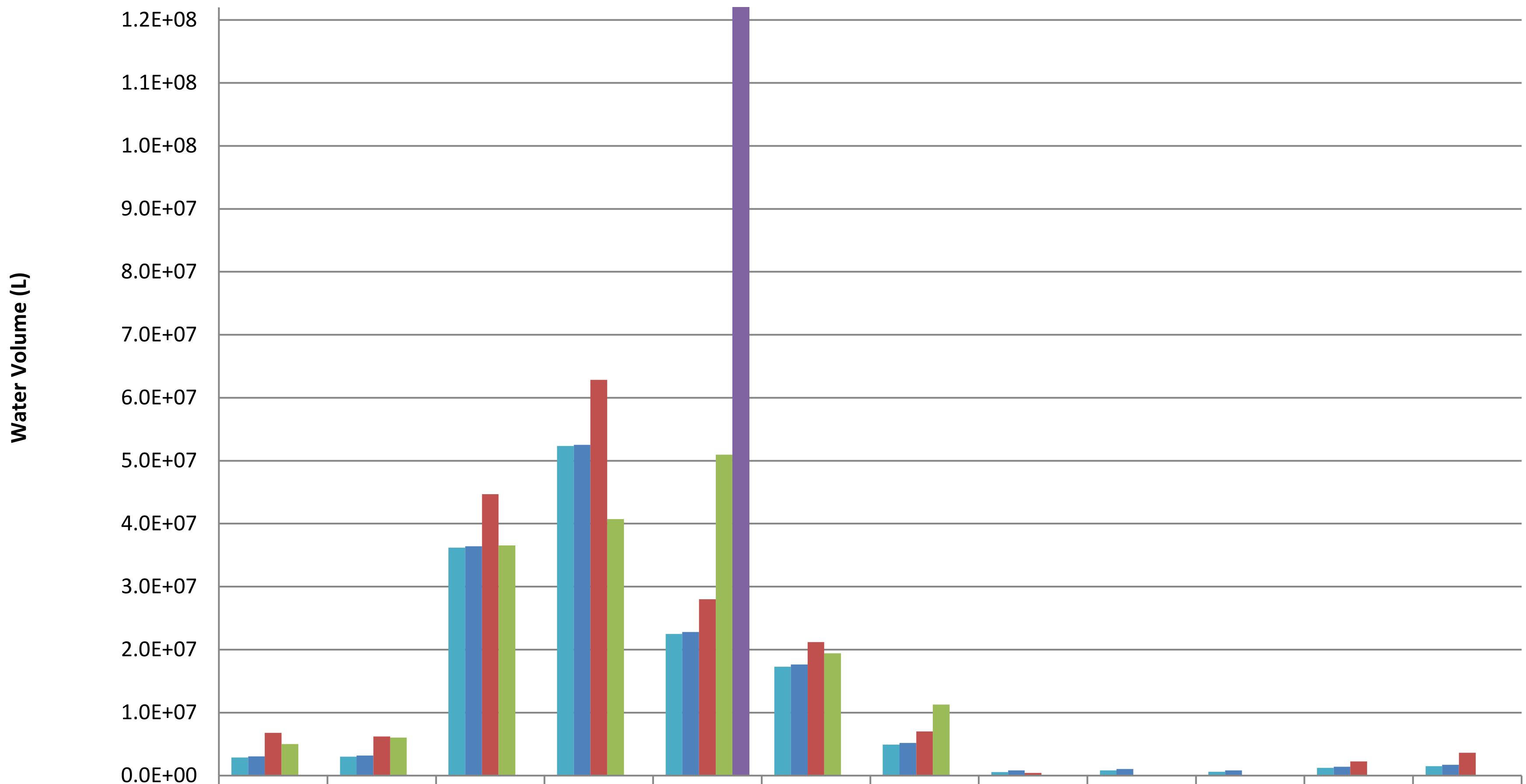




Please refer to table for details regarding available data
Figure F.1
Annual Total Water Volume
North Walnut Creek
Water Volume (L)
4.0E+08
3.5E+08
3.0E+08
2.5E+08
2.0E+08
1.5E+08
1.0E+08
5.0E+07
0.0E+00
SW093
SW093 + SPOUT
GS13
GS12
GS11 (A-4 Discharges)
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020

Please refer to table for details regarding available data

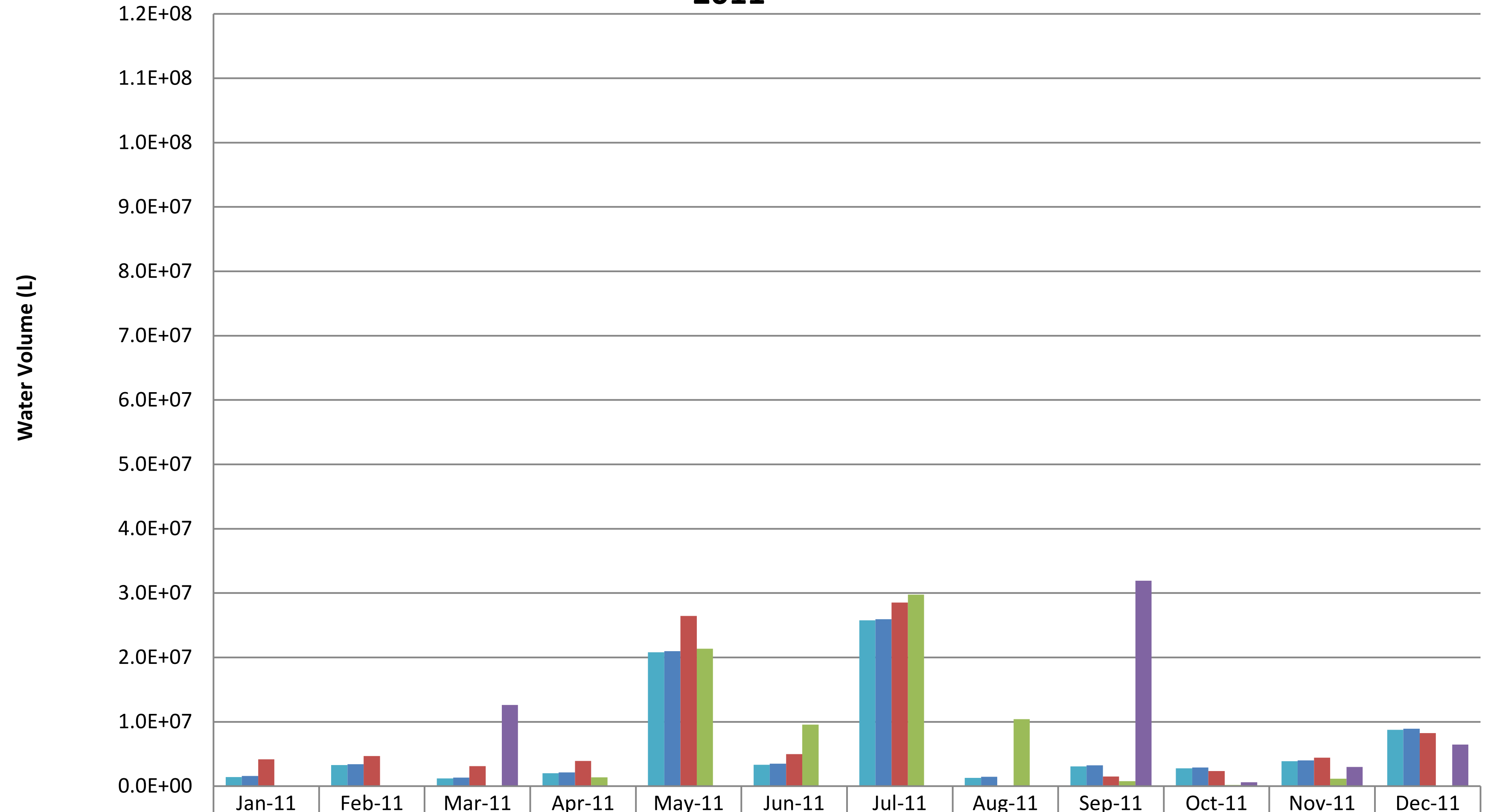
Figure F.2
Water Volume in North Walnut Creek
2010



	Jan-10	Feb-10	Mar-10	Apr-10	May-10	Jun-10	Jul-10	Aug-10	Sep-10	Oct-10	Nov-10	Dec-10
SW093	2.85E+06	3.01E+06	3.62E+07	5.23E+07	2.25E+07	1.73E+07	4.91E+06	5.74E+05	8.10E+05	5.83E+05	1.23E+06	1.50E+06
SW093 + SPOUT	3.03E+06	3.20E+06	3.64E+07	5.25E+07	2.28E+07	1.76E+07	5.18E+06	8.04E+05	1.04E+06	8.22E+05	1.42E+06	1.70E+06
GS13	6.79E+06	6.20E+06	4.47E+07	6.28E+07	2.80E+07	2.12E+07	7.03E+06	4.24E+05	0	3.82E+02	2.25E+06	3.61E+06
GS12	5.02E+06	6.01E+06	3.66E+07	4.07E+07	5.10E+07	1.94E+07	1.13E+07	8.73E+04	0	0	1.95E+04	2.34E+04
GS11 (A-4 Discharges)	0	0	0	0	1.23E+08	0	0	0	0	0	0	0

Please refer to table for details regarding available data

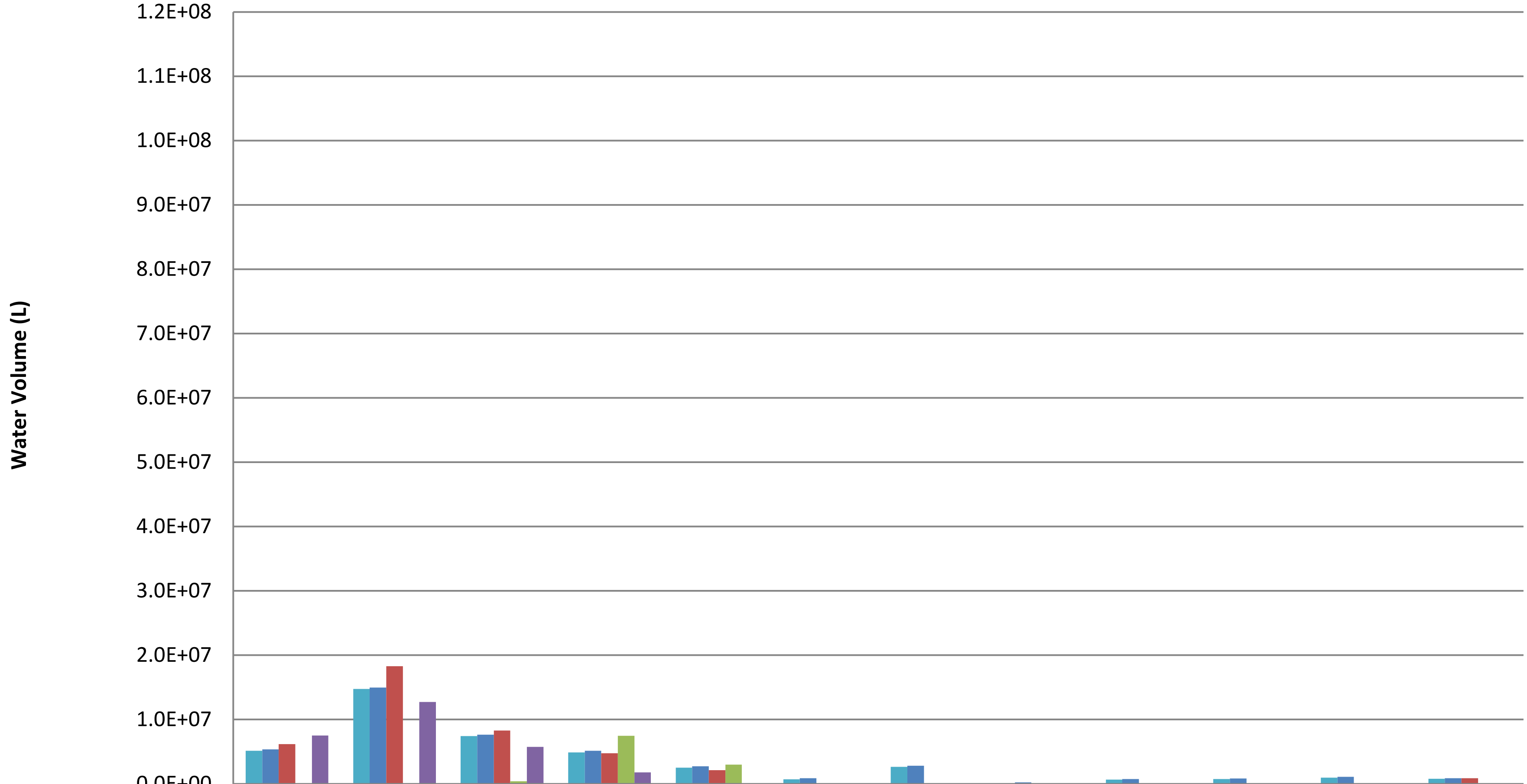
Figure F.3
Water Volume in North Walnut Creek
2011



	Jan-11	Feb-11	Mar-11	Apr-11	May-11	Jun-11	Jul-11	Aug-11	Sep-11	Oct-11	Nov-11	Dec-11
SW093	1.42E+06	3.26E+06	1.18E+06	2.00E+06	2.08E+07	3.31E+06	2.58E+07	1.30E+06	3.08E+06	2.77E+06	3.85E+06	8.74E+06
SW093 + SPOUT	1.58E+06	3.40E+06	1.32E+06	2.12E+06	2.10E+07	3.51E+06	2.59E+07	1.46E+06	3.24E+06	2.90E+06	4.00E+06	8.92E+06
GS13	4.17E+06	4.69E+06	3.10E+06	3.93E+06	2.64E+07	4.99E+06	2.85E+07	6.93E+04	1.51E+06	2.35E+06	4.41E+06	8.25E+06
GS12	0	0	0	1.39E+06	2.14E+07	9.55E+06	2.97E+07	1.04E+07	7.56E+05	1.80E+05	1.17E+06	7.47E+04
GS11 (A-4 Discharges)	0	0	1.26E+07	0	0	0	0	0	3.19E+07	5.96E+05	2.99E+06	6.48E+06

Please refer to table for details regarding available data

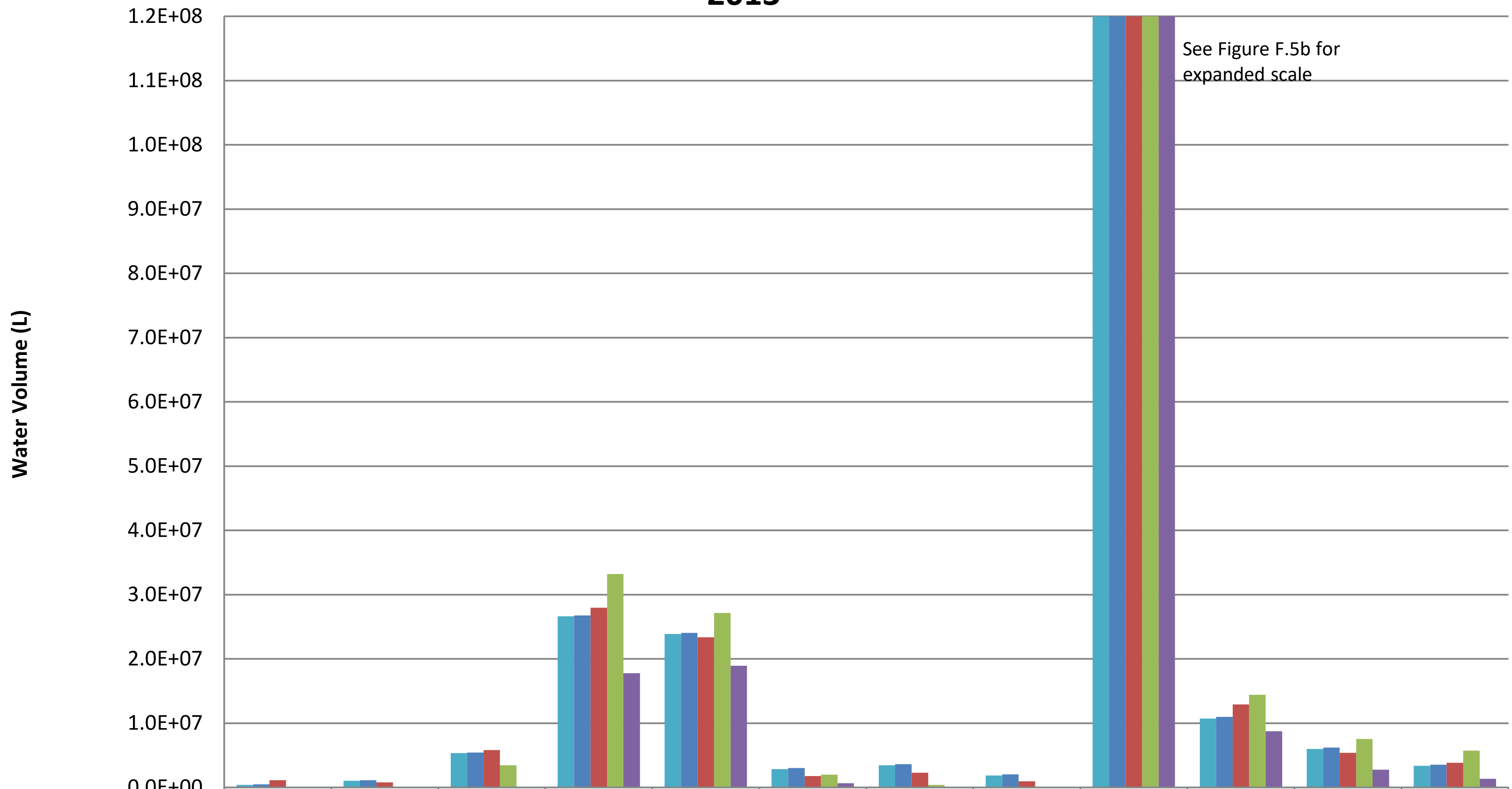
Figure F.4
Water Volume in North Walnut Creek
2012



	Jan-12	Feb-12	Mar-12	Apr-12	May-12	Jun-12	Jul-12	Aug-12	Sep-12	Oct-12	Nov-12	Dec-12
SW093	5.16E+06	1.48E+07	7.42E+06	4.90E+06	2.52E+06	7.01E+05	2.67E+06	1.10E+05	6.55E+05	7.49E+05	9.85E+05	7.79E+05
SW093 + SPOUT	5.35E+06	1.50E+07	7.64E+06	5.15E+06	2.72E+06	8.70E+05	2.81E+06	2.23E+05	7.54E+05	8.50E+05	1.08E+06	8.97E+05
GS13	6.17E+06	1.83E+07	8.30E+06	4.75E+06	2.12E+06	4.68E+04	0	0	0	0	2.54E+04	8.82E+05
GS12	1.51E+01	0	4.25E+05	7.49E+06	2.99E+06	1.58E+04	0	0	0	0	0	0
GS11 (A-4 Discharges)	7.52E+06	1.27E+07	5.74E+06	1.79E+06	3.66E+04	0	0	0	0	0	0	0

Please refer to table for details regarding available data

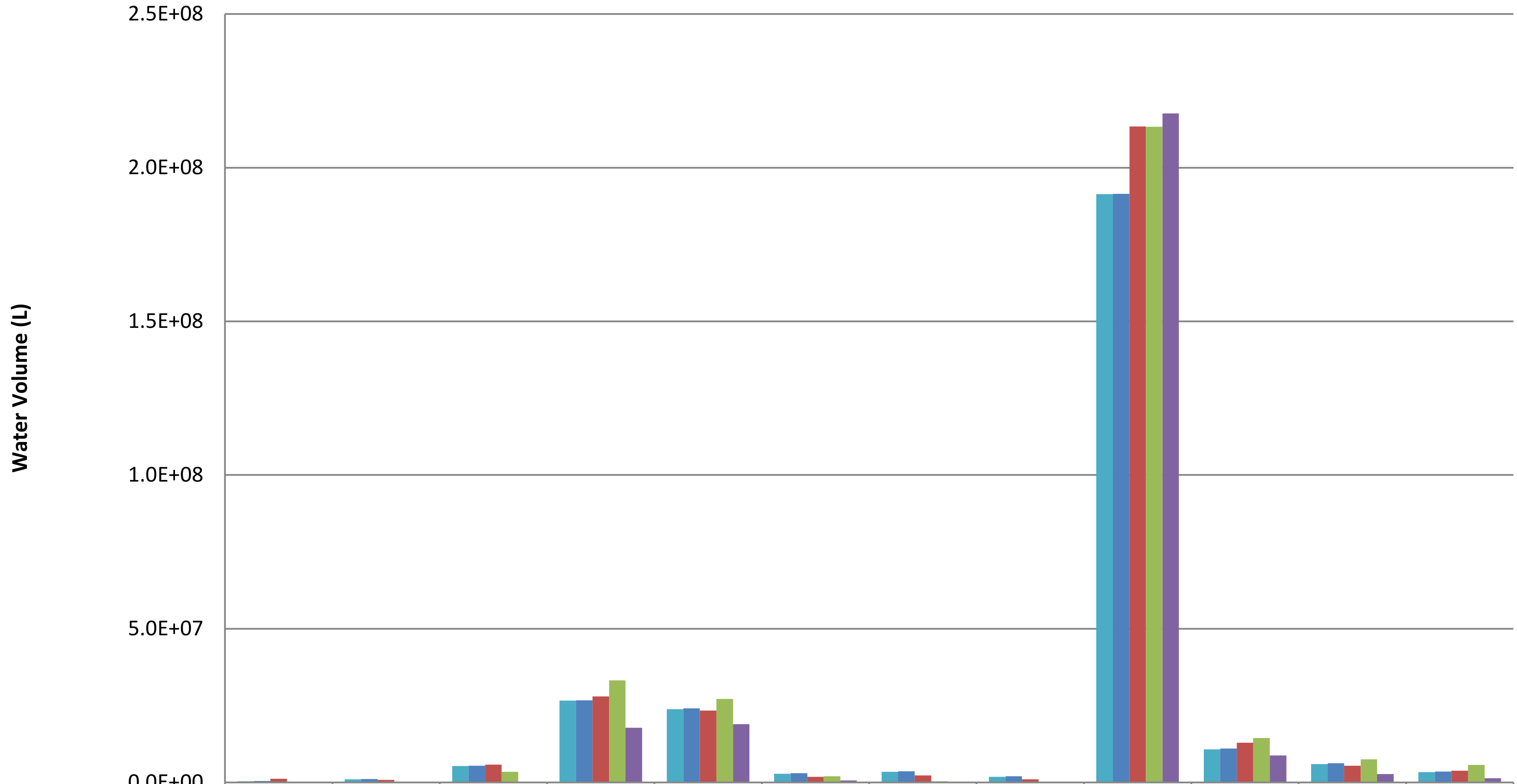
Figure F.5a
Water Volume in North Walnut Creek
2013



	Jan-13	Feb-13	Mar-13	Apr-13	May-13	Jun-13	Jul-13	Aug-13	Sep-13	Oct-13	Nov-13	Dec-13
SW093	3.82E+05	1.05E+06	5.36E+06	2.66E+07	2.39E+07	2.86E+06	3.47E+06	1.85E+06	1.91E+08	1.07E+07	5.98E+06	3.36E+06
SW093 + SPOUT	4.78E+05	1.14E+06	5.44E+06	2.68E+07	2.41E+07	3.04E+06	3.61E+06	2.02E+06	1.92E+08	1.10E+07	6.22E+06	3.54E+06
GS13	1.15E+06	7.96E+05	5.80E+06	2.80E+07	2.34E+07	1.79E+06	2.30E+06	9.74E+05	2.13E+08	1.29E+07	5.41E+06	3.84E+06
GS12	0	0	3.44E+06	3.32E+07	2.71E+07	2.01E+06	4.12E+05	6.60E+01	2.13E+08	1.44E+07	7.54E+06	5.73E+06
GS11 (A-4 Discharges)	0	0	0	1.78E+07	1.89E+07	6.76E+05	0	0	2.18E+08	8.73E+06	2.75E+06	1.36E+06

Please refer to table for details regarding available data

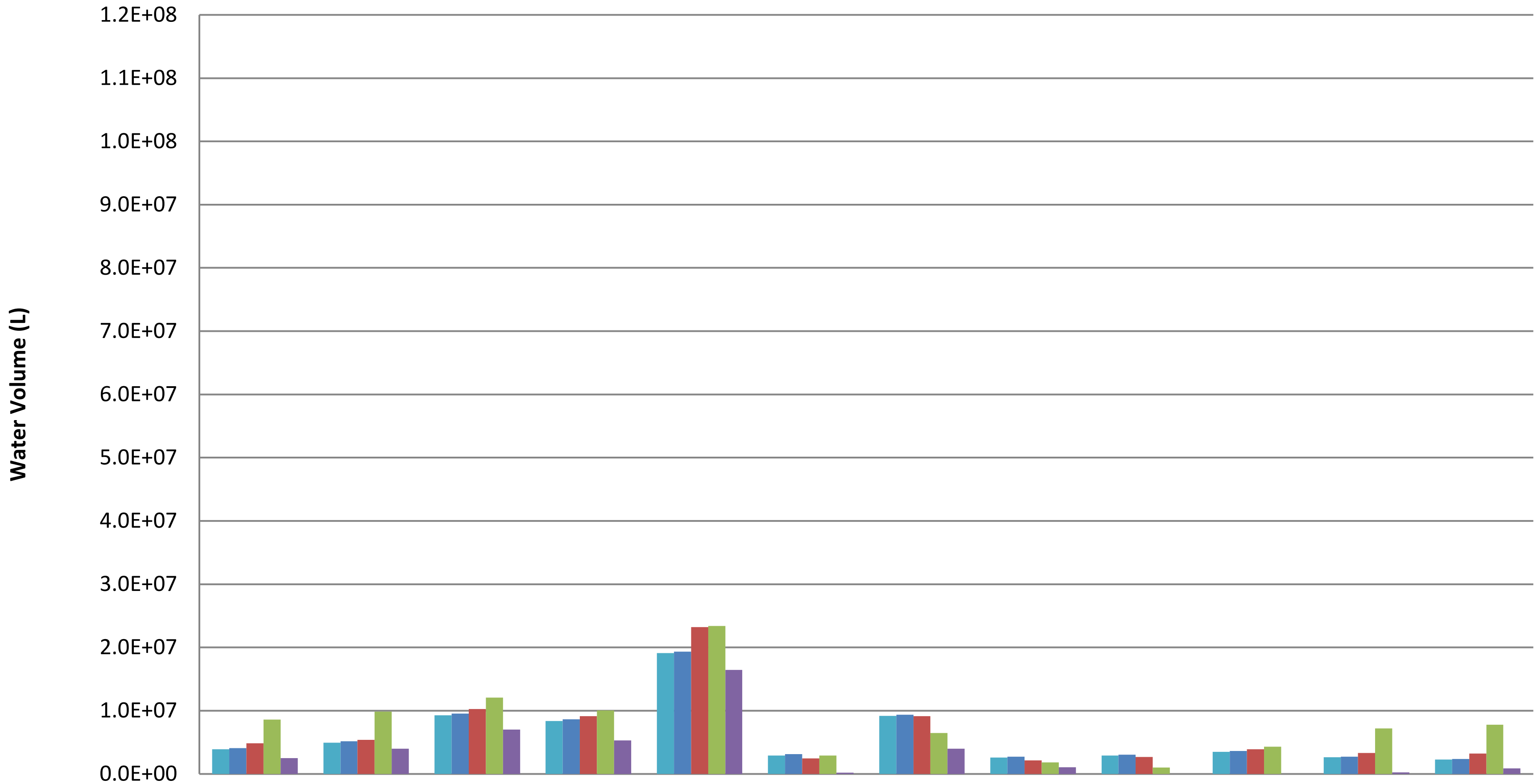
Figure F.5b
Water Volume in North Walnut Creek
2013



	Jan-13	Feb-13	Mar-13	Apr-13	May-13	Jun-13	Jul-13	Aug-13	Sep-13	Oct-13	Nov-13	Dec-13
SW093	3.82E+05	1.05E+06	5.36E+06	2.66E+07	2.39E+07	2.86E+06	3.47E+06	1.85E+06	1.91E+08	1.07E+07	5.98E+06	3.36E+06
SW093 + SPOUT	4.78E+05	1.14E+06	5.44E+06	2.68E+07	2.41E+07	3.04E+06	3.61E+06	2.02E+06	1.92E+08	1.10E+07	6.22E+06	3.54E+06
GS13	1.15E+06	7.96E+05	5.80E+06	2.80E+07	2.34E+07	1.79E+06	2.30E+06	9.74E+05	2.13E+08	1.29E+07	5.41E+06	3.84E+06
GS12	0	0	3.44E+06	3.32E+07	2.71E+07	2.01E+06	4.12E+05	6.60E+01	2.13E+08	1.44E+07	7.54E+06	5.73E+06
GS11 (A-4 Discharges)	0	0	0	1.78E+07	1.89E+07	6.76E+05	0	0	2.18E+08	8.73E+06	2.75E+06	1.36E+06

Please refer to table for details regarding available data

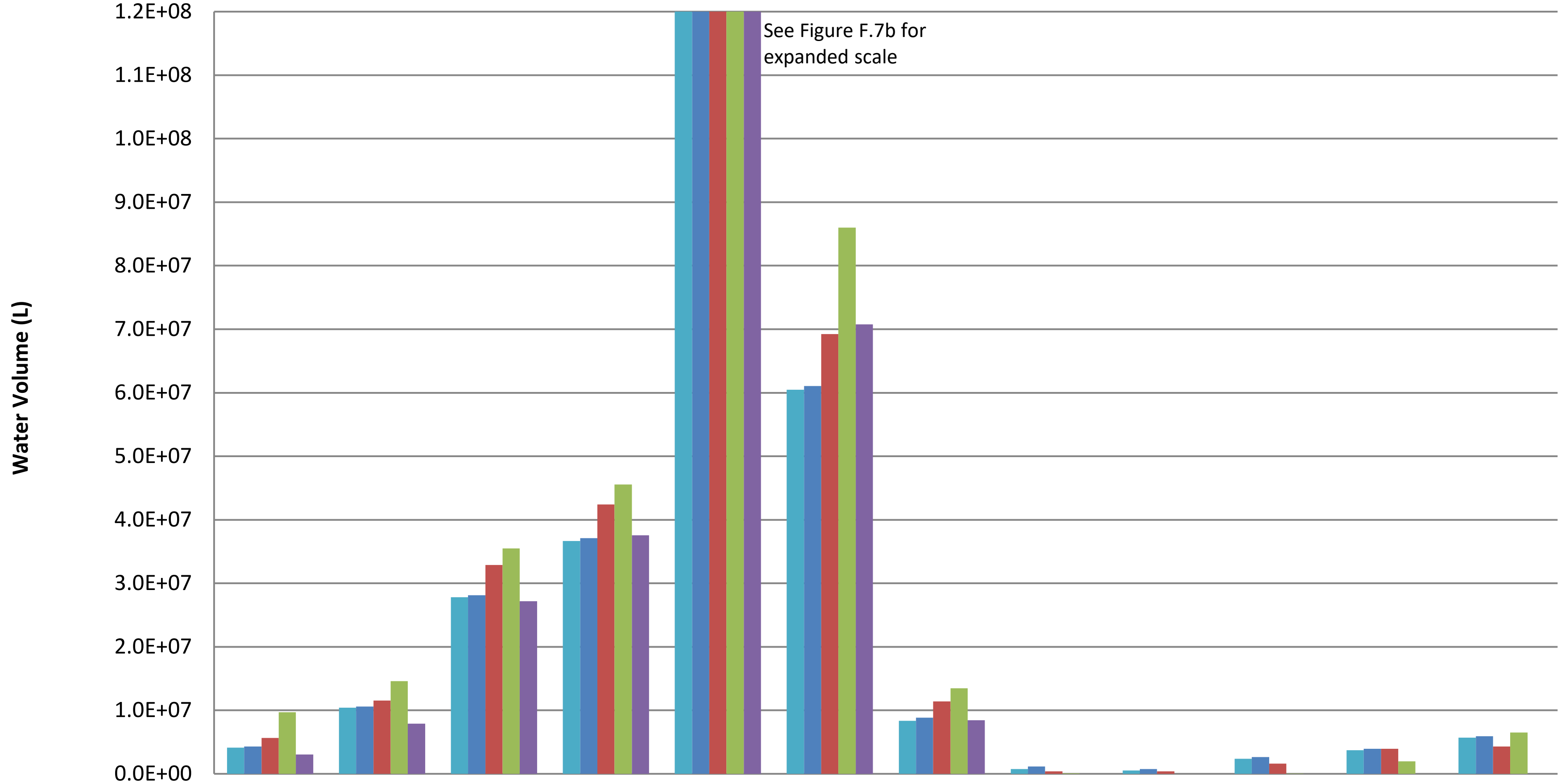
Figure F.6
Water Volume in North Walnut Creek
2014



	Jan-14	Feb-14	Mar-14	Apr-14	May-14	Jun-14	Jul-14	Aug-14	Sep-14	Oct-14	Nov-14	Dec-14
SW093	3.90E+06	4.94E+06	9.29E+06	8.35E+06	1.91E+07	2.89E+06	9.18E+06	2.58E+06	2.91E+06	3.52E+06	2.64E+06	2.27E+06
SW093 + SPOUT	4.09E+06	5.17E+06	9.53E+06	8.66E+06	1.93E+07	3.15E+06	9.37E+06	2.73E+06	3.03E+06	3.62E+06	2.74E+06	2.38E+06
GS13	4.87E+06	5.38E+06	1.03E+07	9.13E+06	2.32E+07	2.46E+06	9.16E+06	2.16E+06	2.69E+06	3.89E+06	3.33E+06	3.21E+06
GS12	8.60E+06	9.85E+06	1.21E+07	1.00E+07	2.34E+07	2.92E+06	6.48E+06	1.81E+06	1.02E+06	4.30E+06	7.22E+06	7.76E+06
GS11 (A-4 Discharges)	2.50E+06	3.98E+06	7.04E+06	5.32E+06	1.64E+07	2.15E+05	3.98E+06	1.08E+06	0	0	2.50E+05	8.88E+05

Please refer to table for details regarding available data

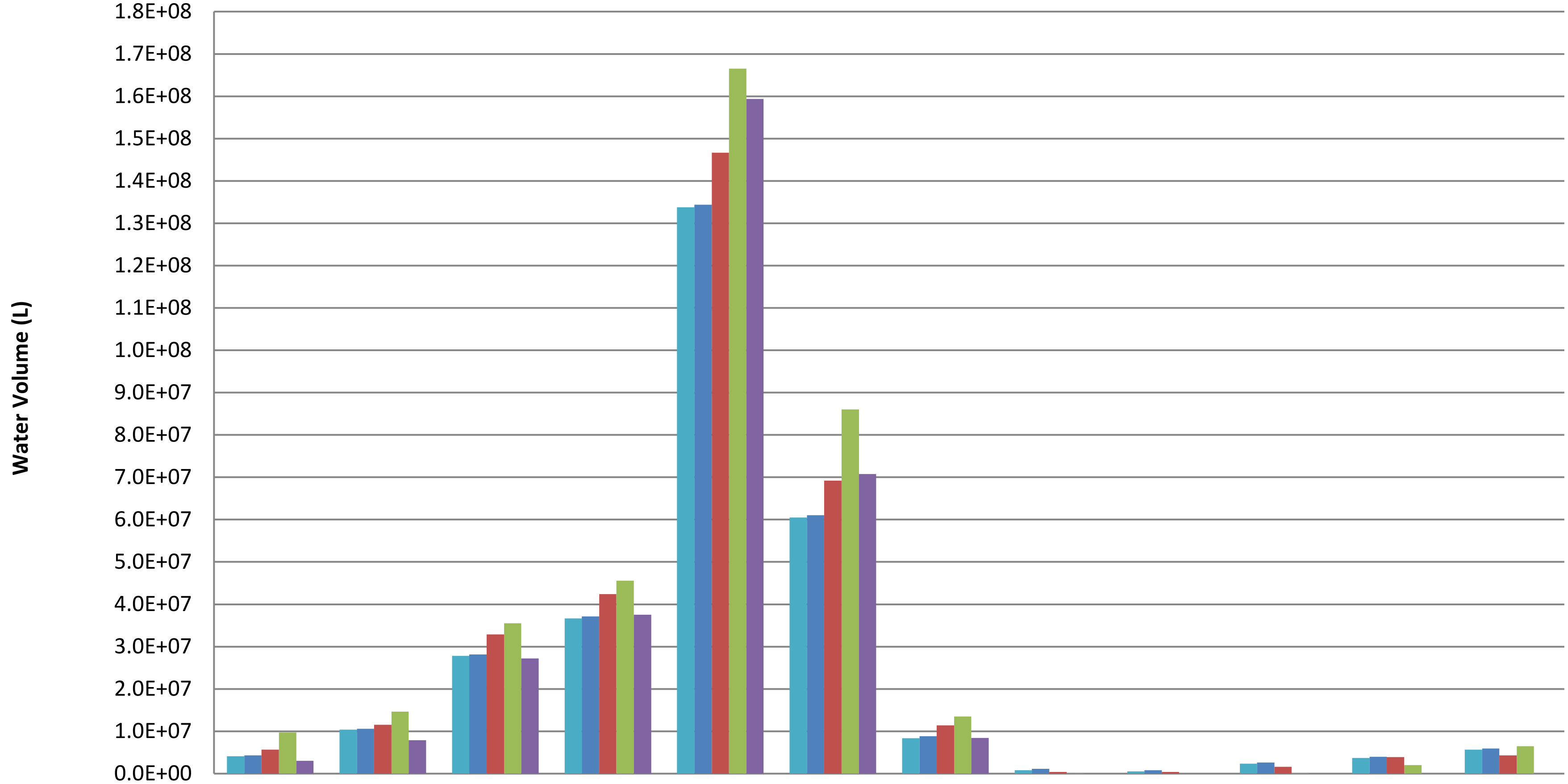
Figure F.7a
Water Volume in North Walnut Creek
2015



	Jan-15	Feb-15	Mar-15	Apr-15	May-15	Jun-15	Jul-15	Aug-15	Sep-15	Oct-15	Nov-15	Dec-15
SW093	4.13E+06	1.04E+07	2.78E+07	3.67E+07	1.34E+08	6.05E+07	8.35E+06	7.70E+05	5.46E+05	2.37E+06	3.72E+06	5.68E+06
SW093 + SPOUT	4.32E+06	1.06E+07	2.81E+07	3.71E+07	1.34E+08	6.11E+07	8.82E+06	1.16E+06	7.72E+05	2.62E+06	3.95E+06	5.92E+06
GS13	5.67E+06	1.15E+07	3.29E+07	4.24E+07	1.47E+08	6.92E+07	1.14E+07	4.09E+05	4.00E+05	1.59E+06	3.94E+06	4.32E+06
GS12	9.68E+06	1.46E+07	3.55E+07	4.56E+07	1.66E+08	8.60E+07	1.35E+07	7.00E+04	0	1.03E+04	1.98E+06	6.49E+06
GS11 (A-4 Discharges)	3.05E+06	7.91E+06	2.72E+07	3.75E+07	1.59E+08	7.08E+07	8.44E+06	0	0	0	0	0

Please refer to table for details regarding available data

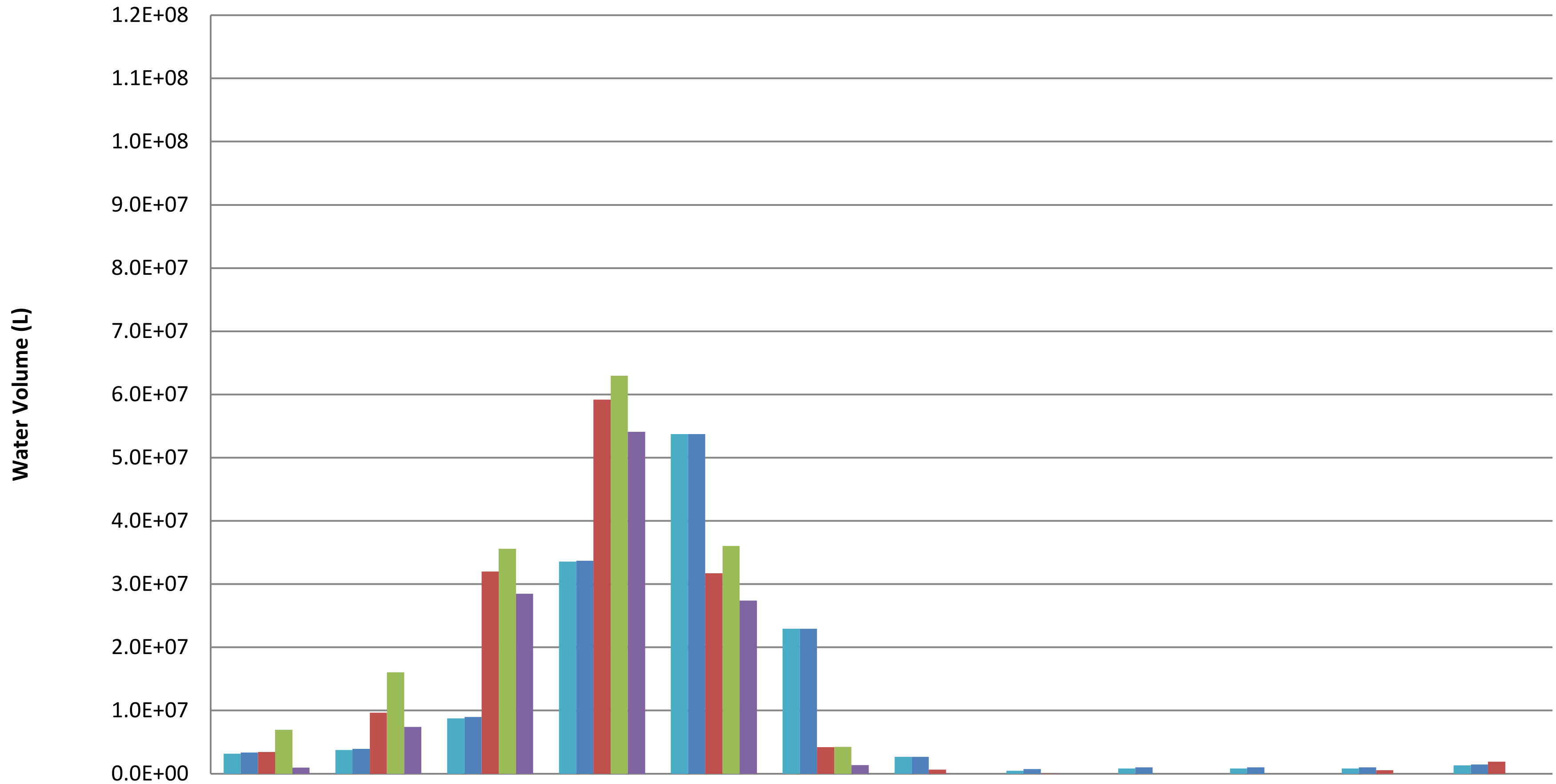
Figure F.7b
Water Volume in North Walnut Creek
2015



	Jan-15	Feb-15	Mar-15	Apr-15	May-15	Jun-15	Jul-15	Aug-15	Sep-15	Oct-15	Nov-15	Dec-15
SW093	4.13E+06	1.04E+07	2.78E+07	3.67E+07	1.34E+08	6.05E+07	8.35E+06	7.70E+05	5.46E+05	2.37E+06	3.72E+06	5.68E+06
SW093 + SPOUT	4.32E+06	1.06E+07	2.81E+07	3.71E+07	1.34E+08	6.11E+07	8.82E+06	1.16E+06	7.72E+05	2.62E+06	3.95E+06	5.92E+06
GS13	5.67E+06	1.15E+07	3.29E+07	4.24E+07	1.47E+08	6.92E+07	1.14E+07	4.09E+05	4.00E+05	1.59E+06	3.94E+06	4.32E+06
GS12	9.68E+06	1.46E+07	3.55E+07	4.56E+07	1.66E+08	8.60E+07	1.35E+07	7.00E+04	0	1.03E+04	1.98E+06	6.49E+06
GS11 (A-4 Discharges)	3.05E+06	7.91E+06	2.72E+07	3.75E+07	1.59E+08	7.08E+07	8.44E+06	0	0	0	0	0

Please refer to table for details regarding available data

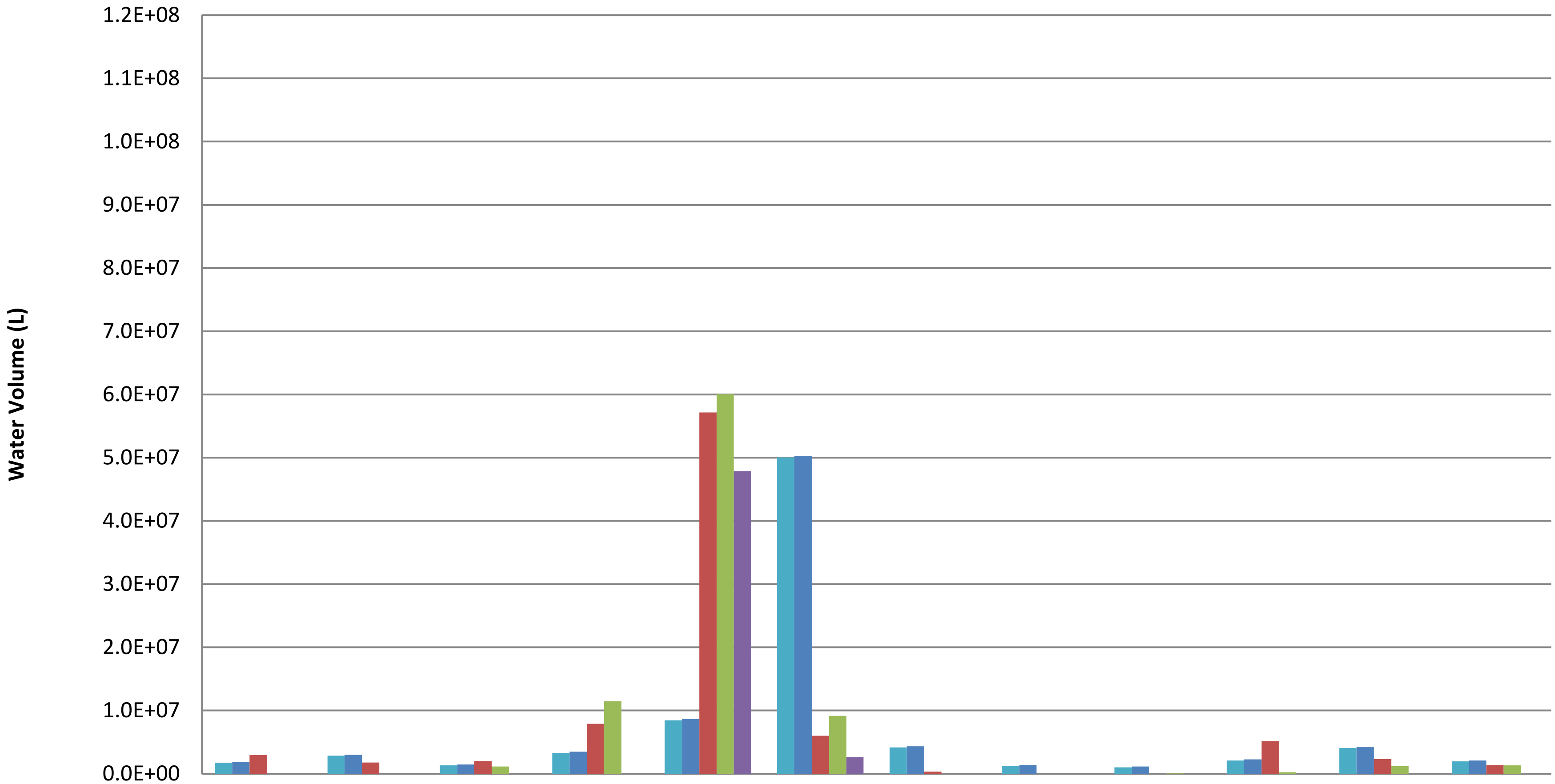
Figure F.8
Water Volume in North Walnut Creek
2016



	Jan-16	Feb-16	Mar-16	Apr-16	May-16	Jun-16	Jul-16	Aug-16	Sep-16	Oct-16	Nov-16	Dec-16
SW093	3.17E+06	3.76E+06	8.76E+06	3.36E+07	5.37E+07	2.29E+07	2.67E+06	4.93E+05	8.43E+05	8.17E+05	8.39E+05	1.32E+06
SW093 + SPOUT	3.38E+06	3.94E+06	8.97E+06	3.37E+07	5.37E+07	2.29E+07	2.67E+06	7.57E+05	1.02E+06	1.02E+06	1.01E+06	1.48E+06
GS13	3.45E+06	9.66E+06	3.20E+07	5.92E+07	3.17E+07	4.24E+06	6.61E+05	1.90E+03	0	0	5.82E+05	1.90E+06
GS12	6.96E+06	1.60E+07	3.56E+07	6.30E+07	3.61E+07	4.26E+06	0	0	0	0	0	0
GS11 (A-4 Discharges)	9.82E+05	7.42E+06	2.85E+07	5.41E+07	2.74E+07	1.39E+06	0	0	0	0	0	0

Please refer to table for details regarding available data

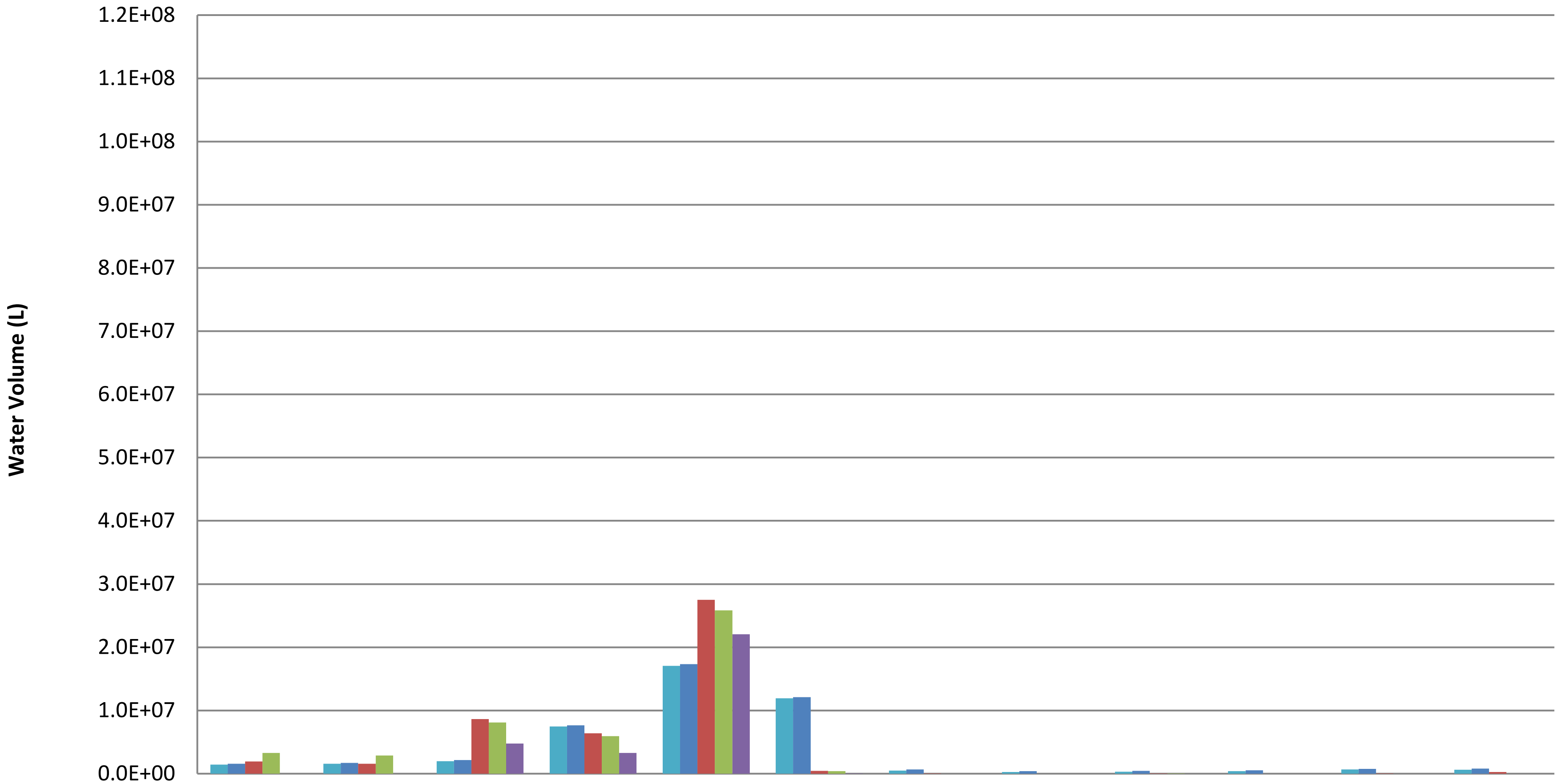
Figure F.9
Water Volume in North Walnut Creek
2017



	Jan-17	Feb-17	Mar-17	Apr-17	May-17	Jun-17	Jul-17	Aug-17	Sep-17	Oct-17	Nov-17	Dec-17
SW093	1.73E+06	2.84E+06	1.35E+06	3.33E+06	8.43E+06	5.00E+07	4.18E+06	1.22E+06	9.96E+05	2.08E+06	4.06E+06	1.94E+06
SW093 + SPOUT	1.88E+06	2.98E+06	1.48E+06	3.48E+06	8.66E+06	5.03E+07	4.35E+06	1.39E+06	1.14E+06	2.29E+06	4.22E+06	2.10E+06
GS13	2.95E+06	1.78E+06	1.99E+06	7.88E+06	5.71E+07	6.01E+06	3.29E+05	0	0	5.15E+06	2.33E+06	1.39E+06
GS12	0	0	1.16E+06	1.14E+07	6.00E+07	9.16E+06	0	0	1.52E+04	2.45E+05	1.18E+06	1.32E+06
GS11 (A-4 Discharges)	0	0	0	0	4.79E+07	2.63E+06	0	0	0	0	0	0

Please refer to table for details regarding available data

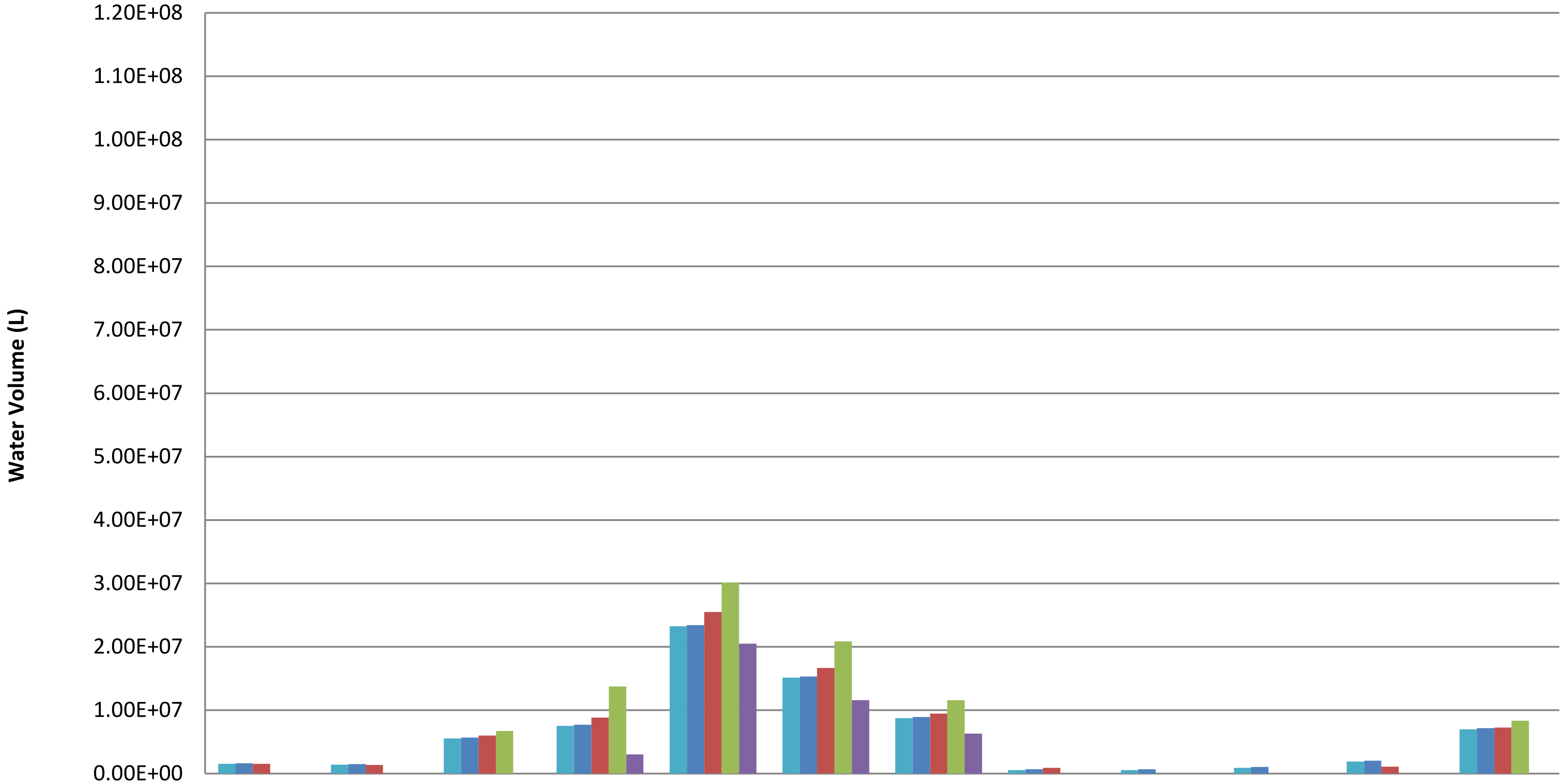
Figure F.10
Water Volume in North Walnut Creek
2018



	Jan-18	Feb-18	Mar-18	Apr-18	May-18	Jun-18	Jul-18	Aug-18	Sep-18	Oct-18	Nov-18	Dec-18
SW093	1.42E+06	1.57E+06	1.97E+06	7.47E+06	1.71E+07	1.19E+07	4.96E+05	2.73E+05	2.92E+05	3.95E+05	6.86E+05	6.41E+05
SW093 + SPOUT	1.56E+06	1.70E+06	2.15E+06	7.65E+06	1.73E+07	1.21E+07	6.52E+05	4.15E+05	4.24E+05	5.39E+05	7.66E+05	7.94E+05
GS13	1.93E+06	1.59E+06	8.65E+06	6.37E+06	2.75E+07	4.32E+05	2.03E+03	0	3.33E+02	0	1.36E+04	2.76E+05
GS12	3.29E+06	2.88E+06	8.11E+06	5.93E+06	2.58E+07	4.04E+05	0	0	9.48E+03	0	0	0
GS11 (A-4 Discharges)	0	0	4.79E+06	3.26E+06	2.21E+07	5.74E+04	0	0	0	0	0	0

Please refer to table for details regarding available data

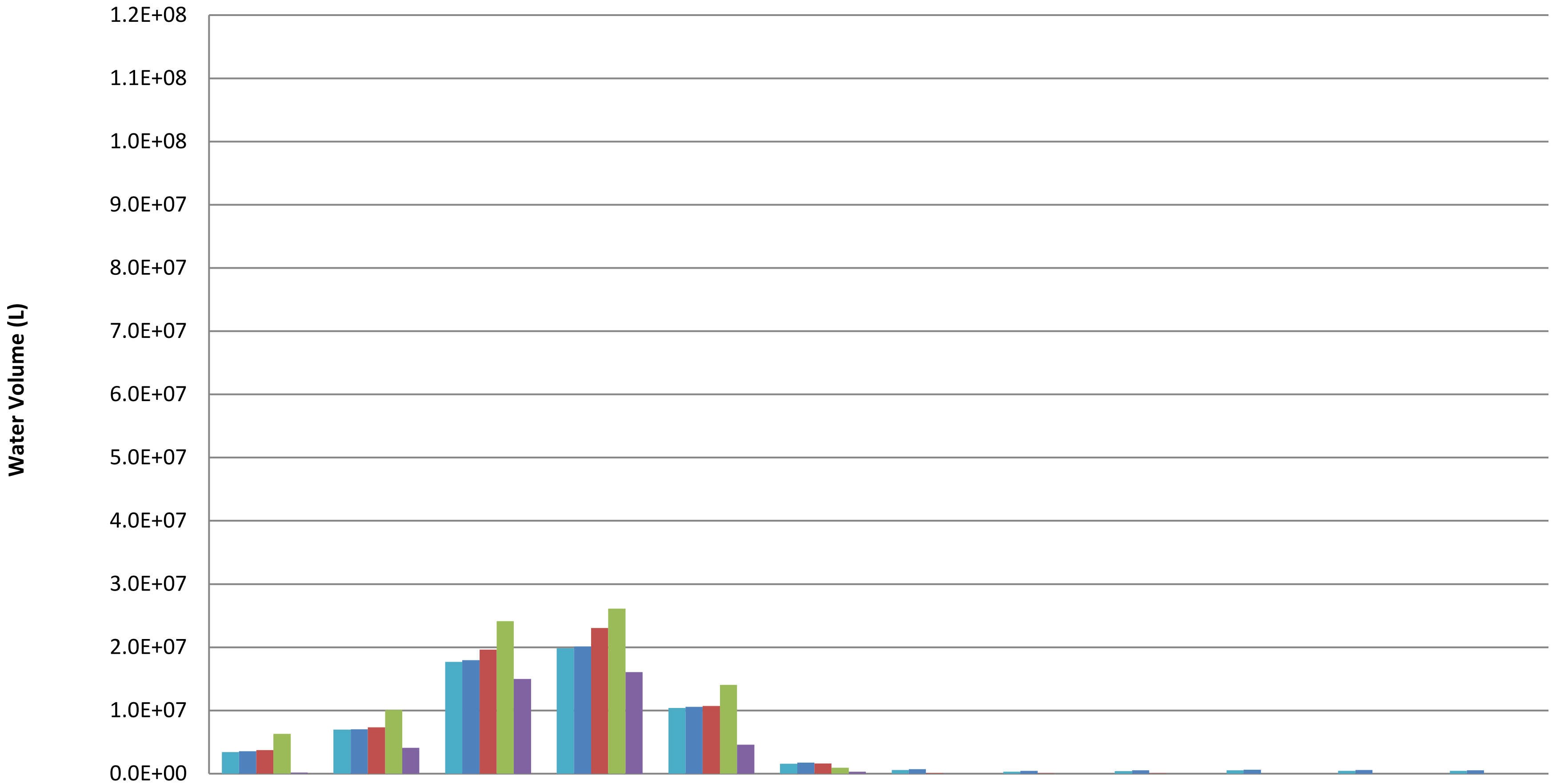
Figure F.11
Water Volume in North Walnut Creek
2019



	Jan-19	Feb-19	Mar-19	Apr-19	May-19	Jun-19	Jul-19	Aug-19	Sep-19	Oct-19	Nov-19	Dec-19
SW093	1.52E+06	1.41E+06	5.57E+06	7.53E+06	2.32E+07	1.51E+07	8.76E+06	5.54E+05	5.50E+05	9.15E+05	1.88E+06	6.99E+06
SW093 + SPOUT	1.64E+06	1.52E+06	5.70E+06	7.70E+06	2.34E+07	1.53E+07	8.93E+06	6.80E+05	6.87E+05	1.07E+06	2.03E+06	7.15E+06
GS13	1.53E+06	1.36E+06	6.00E+06	8.82E+06	2.55E+07	1.67E+07	9.47E+06	9.29E+05	0	0	1.08E+06	7.28E+06
GS12	0	0	6.73E+06	1.37E+07	3.01E+07	2.09E+07	1.16E+07	0	0	0	0	8.35E+06
GS11 (A-4 Discharges)	0	0	0	3.04E+06	2.05E+07	1.16E+07	6.31E+06	0	0	0	0	0

Please refer to table for details regarding available data

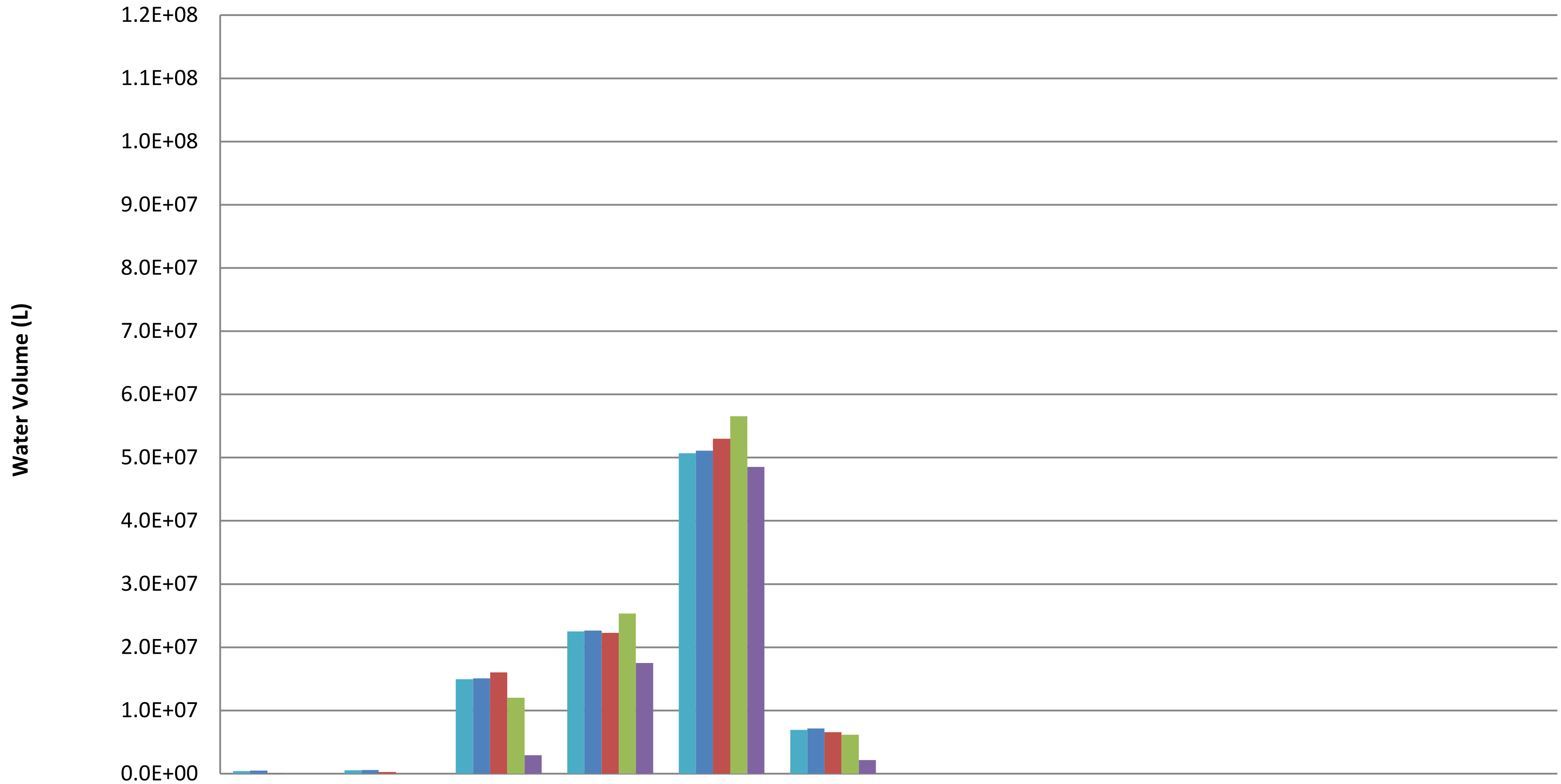
Figure F.12
Water Volume in North Walnut Creek
2020



	Jan-20	Feb-20	Mar-20	Apr-20	May-20	Jun-20	Jul-20	Aug-20	Sep-20	Oct-20	Nov-20	Dec-20
SW093	3.41E+06	6.97E+06	1.77E+07	1.99E+07	1.04E+07	1.59E+06	5.82E+05	3.00E+05	4.18E+05	5.30E+05	4.66E+05	4.25E+05
SW093 + SPOUT	3.56E+06	7.01E+06	1.80E+07	2.01E+07	1.06E+07	1.77E+06	7.34E+05	4.30E+05	5.30E+05	6.39E+05	5.66E+05	5.24E+05
GS13	3.71E+06	7.32E+06	1.96E+07	2.30E+07	1.07E+07	1.63E+06	7.70E+04	5.84E+01	1.89E+02	0	0	0
GS12	6.30E+06	1.01E+07	2.41E+07	2.61E+07	1.40E+07	9.50E+05	0	0	0	0	0	0
GS11 (A-4 Discharges)	1.79E+05	4.10E+06	1.50E+07	1.61E+07	4.58E+06	2.97E+05	0	0	0	0	0	0

Please refer to table for details regarding available data

Figure F.13
Water Volume in North Walnut Creek
2021

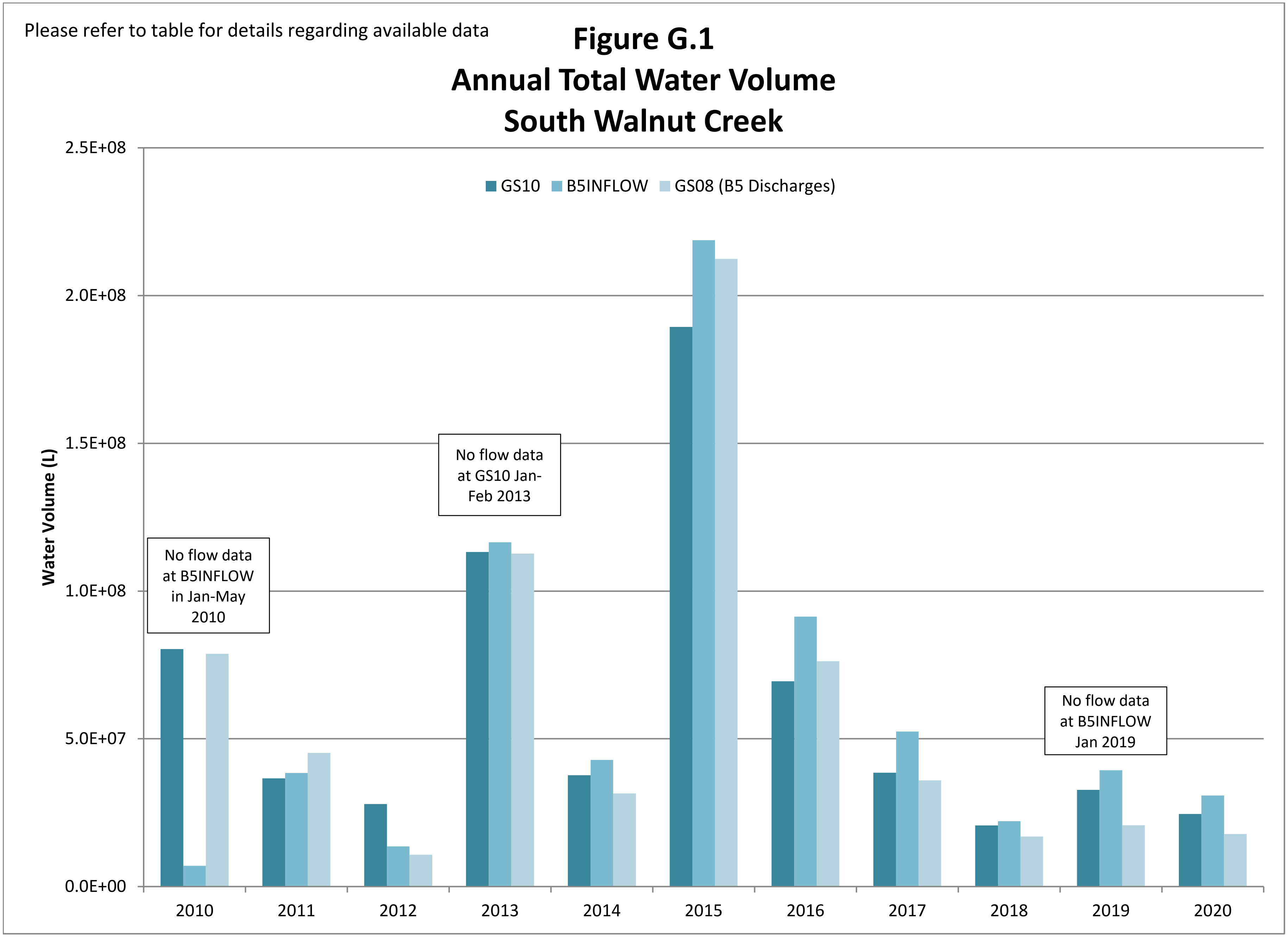


	Jan-21	Feb-21	Mar-21	Apr-21	May-21	Jun-21	Jul-21	Aug-21	Sep-21	Oct-21	Nov-21	Dec-21
SW093	3.89E+05	5.17E+05	1.50E+07	2.25E+07	5.07E+07	6.94E+06						
SW093 + SPOUT	4.81E+05	5.95E+05	1.51E+07	2.26E+07	5.11E+07	7.16E+06						
GS13	3.60E+04	2.67E+05	1.60E+07	2.23E+07	5.30E+07	6.57E+06						
GS12	0	0	1.20E+07	2.53E+07	5.65E+07	6.16E+06						
GS11 (A-4 Discharges)	0	0	2.92E+06	1.75E+07	4.85E+07	2.17E+06						

Table F.1

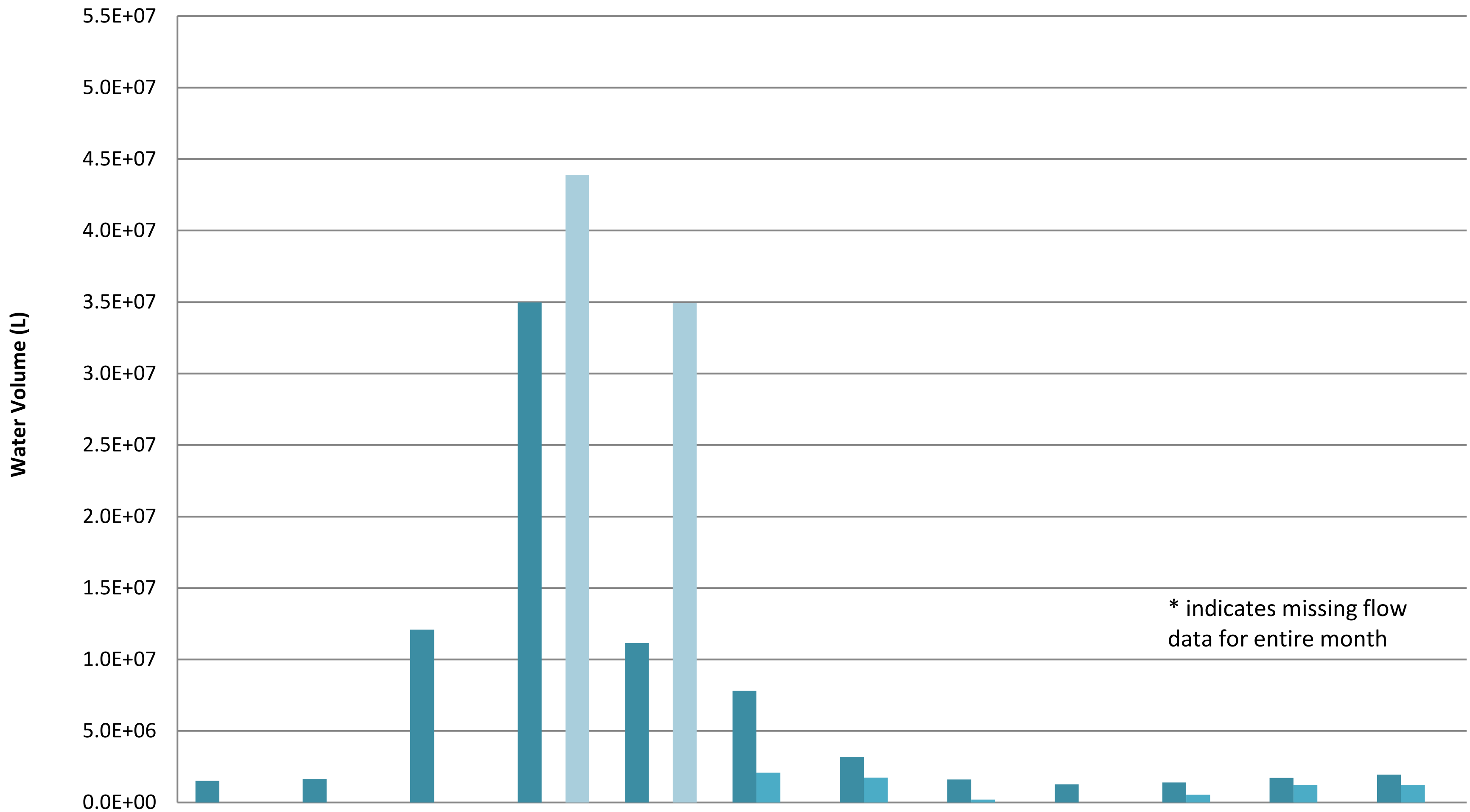
	Water Volume (L)								
Date	SW093	SPOUT	SW093 + SPOUT	+/-	GS13	+/-	GS12	+/-	GS11 (A-4 Discharges)
Jan-09	9.24E+05		9.24E+05	2.59E+06	3.51E+06	-3.51E+06	0	0	0
Feb-09	6.02E+05		6.02E+05	2.02E+06	2.62E+06	-2.62E+06	0	0	0
Mar-09	2.58E+06		2.58E+06	2.50E+06	5.07E+06	-5.07E+06	0	0	0
Apr-09	5.11E+07		5.11E+07	5.34E+06	5.65E+07	-8.52E+06	4.80E+07	-4.80E+07	0
May-09	1.19E+07		1.19E+07	3.52E+06	1.54E+07	-1.54E+07	0	2.52E+07	2.52E+07
Jun-09	1.61E+07		1.61E+07	3.34E+06	1.95E+07	1.75E+07	3.70E+07	-2.78E+07	9.20E+06
Jul-09	2.95E+06		2.95E+06	8.73E+05	3.82E+06	-3.82E+06	0	0	0
Aug-09	7.05E+05	1.58E+05	8.63E+05	3.61E+05	1.22E+06	-1.22E+06	0	0	0
Sep-09	5.10E+05	1.66E+05	6.77E+05	-6.76E+05	7.87E+02	-7.87E+02	0	0	0
Oct-09	3.85E+06	1.60E+05	4.01E+06	-5.07E+04	3.96E+06	-3.96E+06	0	0	0
Nov-09	6.83E+06	2.12E+05	7.04E+06	2.65E+06	9.69E+06	-1.40E+06	8.29E+06	-8.29E+06	0
Dec-09	3.15E+06	1.99E+05	3.34E+06	2.89E+06	6.23E+06	-6.23E+06	0	2.71E+07	2.71E+07
2009	**1.01E+08**	**8.95E+05**	**1.02E+08**	**2.53E+07**	**1.27E+08**	**-3.43E+07**	**9.32E+07**	**-3.16E+07**	**6.16E+07**
Jan-10	2.85E+06	1.81E+05	3.03E+06	3.75E+06	6.79E+06	-1.76E+06	5.02E+06	-5.02E+06	0
Feb-10	3.01E+06	1.88E+05	3.20E+06	3.00E+06	6.20E+06	-1.93E+05	6.01E+06	-6.01E+06	0
Mar-10	3.62E+07	2.25E+05	3.64E+07	8.27E+06	4.47E+07	-8.10E+06	3.66E+07	-3.66E+07	0
Apr-10	5.23E+07	2.11E+05	5.25E+07	1.03E+07	6.28E+07	-2.21E+07	4.07E+07	-4.07E+07	0
May-10	2.25E+07	2.93E+05	2.28E+07	5.19E+06	2.80E+07	2.30E+07	5.10E+07	7.18E+07	1.23E+08
Jun-10	1.73E+07	3.46E+05	1.76E+07	3.57E+06	2.12E+07	-1.77E+06	1.94E+07	-1.94E+07	0
Jul-10	4.91E+06	2.63E+05	5.18E+06	1.85E+06	7.03E+06	4.26E+06	1.13E+07	-1.13E+07	0
Aug-10	5.74E+05	2.30E+05	8.04E+05	-3.80E+05	4.24E+05	-3.37E+05	8.73E+04	-8.73E+04	0
Sep-10	8.10E+05	2.25E+05	1.04E+06	-1.04E+06	0	0	0	0	0
Oct-10	5.83E+05	2.39E+05	8.22E+05	-8.22E+05	3.82E+02	-3.82E+02	0	0	0
Nov-10	1.23E+06	1.97E+05	1.42E+06	8.24E+05	2.25E+06	-2.23E+06	1.95E+04	-1.95E+04	0
Dec-10	1.50E+06	1.94E+05	1.70E+06	1.91E+06	3.61E+06	-3.59E+06	2.34E+04	-2.34E+04	0
2010	**1.44E+08**	**2.79E+06**	**1.47E+08**	**3.64E+07**	**1.83E+08**	**-1.28E+07**	**1.70E+08**	**-4.74E+07**	**1.23E+08**
Jan-11	1.42E+06	1.60E+05	1.58E+06	2.60E+06	4.17E+06	-4.17E+06	0	0	0
Feb-11	3.26E+06	1.42E+05	3.40E+06	1.29E+06	4.69E+06	-4.69E+06	0	0	0
Mar-11	1.18E+06	1.33E+05	1.32E+06	1.79E+06	3.10E+06	-3.10E+06	0	1.26E+07	1.26E+07
Apr-11	2.00E+06	1.13E+05	2.12E+06	1.81E+06	3.93E+06	-2.54E+06	1.39E+06	-1.39E+06	0
May-11	2.08E+07	1.74E+05	2.10E+07	5.47E+06	2.64E+07	-5.09E+06	2.14E+07	-2.14E+07	0
Jun-11	3.31E+06	2.00E+05	3.51E+06	1.49E+06	4.99E+06	4.56E+06	9.55E+06	-9.55E+06	0
Jul-11	2.58E+07	1.79E+05	2.59E+07	2.60E+06	2.85E+07	1.20E+06	2.97E+07	-2.97E+07	0
Aug-11	1.30E+06	1.61E+05	1.46E+06	-1.39E+06	6.93E+04	1.03E+07	1.04E+07	-1.04E+07	0
Sep-11	3.08E+06	1.60E+05	3.24E+06	-1.73E+06	1.51E+06	-7.50E+05	7.56E+05	3.12E+07	3.19E+07
Oct-11	2.77E+06	1.26E+05	2.90E+06	-5.51E+05	2.35E+06	-2.17E+06	1.80E+05	4.16E+05	5.96E+05
Nov-11	3.85E+06	1.48E+05	4.00E+06	4.12E+05	4.41E+06	-3.24E+06	1.17E+06	1.83E+06	2.99E+06
Dec-11	8.74E+06	1.77E+05	8.92E+06	-6.70E+05	8.25E+06	-8.18E+06	7.47E+04	6.41E+06	6.48E+06
2011	**7.75E+07**	**1.87E+06**	**7.94E+07**	**1.31E+07**	**9.25E+07**	**-1.78E+07**	**7.46E+07**	**-2.00E+07**	**5.46E+07**
Jan-12	5.16E+06	1.88E+05	5.35E+06	8.13E+05	6.17E+06	-6.17E+06	1.51E+01	7.52E+06	7.52E+06
Feb-12	1.48E+07	1.93E+05	1.50E+07	3.32E+06	1.83E+07	-1.83E+07	0	1.27E+07	1.27E+07
Mar-12	7.42E+06	2.19E+05	7.64E+06	6.62E+05	8.30E+06	-7.88E+06	4.25E+05	5.31E+06	5.74E+06
Apr-12	4.90E+06	2.52E+05	5.15E+06	-4.04E+05	4.75E+06	2.74E+06	7.49E+06	-5.69E+06	1.79E+06
May-12	2.52E+06	1.95E+05	2.72E+06	-5.96E+05	2.12E+06	8.65E+05	2.99E+06	-2.95E+06	3.66E+04
Jun-12	7.01E+05	1.69E+05	8.70E+05	-8.23E+05	4.68E+04	-3.11E+04	1.58E+04	-1.58E+04	0
Jul-12	2.67E+06	1.42E+05	2.81E+06	-2.81E+06	0	0.00E+00	0	0.00E+00	0
Aug-12	1.10E+05	1.13E+05	2.23E+05	-2.23E+05	0	0.00E+00	0	0.00E+00	0
Sep-12	6.55E+05	9.86E+04	7.54E+05	-7.54E+05	0	0.00E+00	0	0.00E+00	0
Oct-12	7.49E+05	1.01E+05	8.50E+05	-8.50E+05	0	0.00E+00	0	0.00E+00	0
Nov-12	9.85E+05	9.45E+04	1.08E+06	-1.05E+06	2.54E+04	-2.54E+04	0	0.00E+00	0
Dec-12	7.79E+05	1.18E+05	8.97E+05	-1.45E+04	8.82E+05	-8.82E+05	0	0.00E+00	0
2012	**4.14E+07**	**1.88E+06**	**4.33E+07**	**-2.73E+06**	**4.06E+07**	**-2.97E+07**	**1.09E+07**	**1.69E+07**	**2.78E+07**
Jan-13	3.82E+05	9.62E+04	4.78E+05	6.71E+05	1.15E+06	-1.15E+06	0	0.00E+00	0
Feb-13	1.05E+06	8.71E+04	1.14E+06	-3.43E+05	7.96E+05	-7.96E+05	0	0.00E+00	0
Mar-13	5.36E+06	7.96E+04	5.44E+06	3.53E+05	5.80E+06	-2.36E+06	3.44E+06	-3.44E+06	0
Apr-13	2.66E+07	1.28E+05	2.68E+07	1.22E+06	2.80E+07	5.23E+06	3.32E+07	-1.54E+07	1.78E+07
May-13	2.39E+07	2.03E+05	2.41E+07	-7.08E+05	2.34E+07	3.77E+06	2.71E+07	-8.21E+06	1.89E+07
Jun-13	2.86E+06	1.81E+05	3.04E+06	-1.25E+06	1.79E+06	2.13E+05	2.01E+06	-1.33E+06	6.76E+05
Jul-13	3.47E+06	1.41E+05	3.61E+06	-1.32E+06	2.30E+06	-1.88E+06	4.12E+05	-4.12E+05	0
Aug-13	1.85E+06	1.67E+05	2.02E+06	-1.05E+06	9.74E+05	-9.74E+05	6.60E+01	-6.60E+01	0
Sep-13	1.91E+08	1.09E+05	1.92E+08	2.19E+07	2.13E+08	-1.05E+05	2.13E+08	4.32E+06	2.18E+08
Oct-13	1.07E+07	2.68E+05	1.10E+07	1.93E+06	1.29E+07	1.52E+06	1.44E+07	-5.71E+06	8.73E+06
Nov-13	5.98E+06	2.39E+05	6.22E+06	-8.18E+05	5.41E+06	2.14E+06	7.54E+06	-4.80E+06	2.75E+06
Dec-13	3.36E+06	1.84E+05	3.54E+06	2.99E+05	3.84E+06	1.89E+06	5.73E+06	-4.37E+06	1.36E+06
2013	**2.77E+08**	**1.88E+06**	**2.79E+08**	**2.09E+07**	**3.00E+08**	**7.49E+06**	**3.07E+08**	**-3.94E+07**	**2.68E+08**
Jan-14	3.90E+06	1.84E+05	4.09E+06	7.85E+05	4.87E+06	3.72E+06	8.60E+06	-6.10E+06	2.50E+06
Feb-14	4.94E+06	2.33E+05	5.17E+06	2.08E+05	5.38E+06	4.47E+06	9.85E+06	-5.86E+06	3.98E+06
Mar-14	9.29E+06	2.44E+05	9.53E+06	7.48E+05	1.03E+07	1.79E+06	1.21E+07	-5.03E+06	7.04E+06
Apr-14	8.35E+06	3.09E+05	8.66E+06	4.66E+05	9.13E+06	9.12E+05	1.00E+07	-4.72E+06	5.32E+06
May-14	1.91E+07	2.42E+05	1.93E+07	3.89E+06	2.32E+07	1.74E+05	2.34E+07	-6.97E+06	1.64E+07
Jun-14	2.89E+06	2.57E+05	3.15E+06	-6.87E+05	2.46E+06	4.60E+05	2.92E+06	-2.71E+06	2.15E+05
Jul-14	9.18E+06	1.97E+05	9.37E+06	-2.16E+05	9.16E+06	-2.68E+06	6.48E+06	-2.50E+06	3.98E+06
Aug-14	2.58E+06	1.53E+05	2.73E+06	-5.67E+05	2.16E+06	-3.50E+05	1.81E+06	-7.26E+05	1.08E+06
Sep-14	2.91E+06	1.13E+05	3.03E+06	-3.39E+05	2.69E+06	-1.67E+06	1.02E+06	-1.02E+06	0
Oct-14	3.52E+06	9.62E+04	3.62E+06	2.70E+05	3.89E+06	4.18E+05	4.30E+06	-4.30E+06	0
Nov-14	2.64E+06	1.02E+05	2.74E+06	5.86E+05	3.33E+06	3.89E+06	7.22E+06	-6.97E+06	2.50E+05
Dec-14	2.27E+06	1.10E+05	2.38E+06	8.29E+05	3.21E+06	4.56E+06	7.76E+06	-6.88E+06	8.88E+05
2014	**7.16E+07**	**2.24E+06**	**7.38E+07**	**5.97E+06**	**7.98E+07**	**1.57E+07**	**9.55E+07**	**-5.38E+07**	**4.17E+07**
Jan-15	4.13E+06	1.92E+05	4.32E+06	1.35E+06	5.67E+06	4.01E+06	9.68E+06	-6.64E+06	3.05E+06
Feb-15	1.04E+07	1.82E+05	1.06E+07	9.60E+05	1.15E+07	3.08E+06	1.46E+07	-6.71E+06	7.91E+06
Mar-15	2.78E+07	3.01E+05	2.81E+07	4.76E+06	3.29E+07	2.61E+06	3.55E+07	-8.31E+06	2.72E+07
Apr-15	3.67E+07	4.52E+05	3.71E+07	5.29E+06	4.24E+07	3.16E+06	4.56E+07	-8.01E+06	3.75E+07
May-15	1.34E+08	6.25E+05	1.34E+08	1.23E+07	1.47E+08	1.98E+07	1.66E+08	-7.14E+06	1.59E+08
Jun-15	6.05E+07	5.76E+05	6.11E+07	8.17E+06	6.92E+07	1.68E+07	8.60E+07	-1.53E+07	7.08E+07
Jul-15	8.35E+06	4.75E+05	8.82E+06	2.56E+06	1.14E+07	2.09E+06	1.35E+07	-5.03E+06	8.44E+06
Aug-15	7.70E+05	3.88E+05	1.16E+06	-7.49E+05	4.09E+05	-3.39E+05	7.00E+04	-7.00E+04	0
Sep-15	5.46E+05	2.26E+05	7.72E+05	-3.72E+05	4.00E+05	-4.00E+05	0	0.00E+00	0
Oct-15	2.37E+06	2.52E+05	2.62E+06	-1.03E+06	1.59E+06	-1.58E+06	1.03E+04	-1.03E+04	0
Nov-15	3.72E+06	2.31E+05	3.95E+06	-1.37E+04	3.94E+06	-1.95E+06	1.98E+06	-1.98E+06	0
Dec-15	5.68E+06	2.41E+05	5.92E+06	-1.60E+06	4.32E+06	2.17E+06	6.49E+06	-6.49E+06	0
2015	**2.95E+08**	**4.14E+06**	**2.99E+08**	**3.16E+07**	**3.30E+08**	**4.94E+07**	**3.80E+08**	**-6.56E+07**	**3.14E+08**
Jan-16	3.17E+06	2.13E+05	3.38E+06	6.86E+04	3.45E+06	3.51E+06	6.96E+06	-5.97E+06	9.82E+05
Feb-16	3.76E+06	1.78E+05	3.94E+06	5.73E+06	9.66E+06	6.37E+06	1.60E+07	-8.62E+06	7.42E+06
Mar-16	8.76E+06	2.16E+05	8.97E+06	2.30E+07	3.20E+07	3.61E+06	3.56E+07	-7.14E+06	2.85E+07
Apr-16	3.36E+07	1.43E+05	3.37E+07	2.55E+07	5.92E+07	3.75E+06	6.30E+07	-8.85E+06	5.41E+07
May-16	5.37E+07	4.18E+03	5.37E+07	-2.20E+07	3.17E+07	4.34E+06	3.61E+07	-8.67E+06	2.74E+07
Jun-16	2.29E+07	3.80E+03	2.29E+07	-1.87E+07	4.24E+06	1.98E+04	4.26E+06	-2.86E+06	1.39E+06
Jul-16	2.67E+06	2.68E+03	2.67E+06	-2.01E+06	6.61E+05	-6.61E+05	0	0.00E+00	0
Aug-16	4.93E+05	2.64E+05	7.57E+05	-7.55E+05	1.90E+03	-1.90E+03	0	0.00E+00	0
Sep-16	8.43E+05	1.78E+05	1.02E+06	-1.02E+06	0	0.00E+00	0	0.00E+00	0
Oct-16	8.17E+05	2.03E+05	1.02E+06	-1.02E+06	0	0.00E+00	0	0.00E+00	0
Nov-16	8.39E+05	1.71E+05	1.01E+06	-4.28E+05	5.82E+05	-5.82E+05	0	0.00E+00	0
Dec-16	1.32E+06	1.60E+05	1.48E+06	4.23E+05	1.90E+06	-1.90E+06	0	0.00E+00	0
2016	**1.33E+08**	**1.74E+06**	**1.35E+08**	**8.78E+06**	**1.43E+08**	**1.85E+07**	**1.62E+08**	**-4.21E+07**	**1.20E+08**
Jan-17	1.73E+06	1.55E+05	1.88E+06	1.07E+06	2.95E+06	-2.95E+06	0	0.00E+00	0
Feb-17	2.84E+06	1.32E+05	2.98E+06	-1.20E+06	1.78E+06	-1.78E+06	0	0.00E+00	0
Mar-17	1.35E+06	1.36E+05	1.48E+06	5.11E+05	1.99E+06	-8.39E+05	1.16E+06	-1.16E+06	0
Apr-17	3.33E+06	1.55E+05	3.48E+06	4.40E+06	7.88E+06	3.56E+06	1.14E+07	-1.14E+07	0
May-17	8.43E+06	2.34E+05	8.66E+06	4.85E+07	5.71E+07	2.89E+06	6.00E+07	-1.22E+07	4.79E+07
Jun-17	5.00E+07	2.27E+05	5.03E+07	-4.43E+07	6.01E+06	3.15E+06	9.16E+06	-6.53E+06	2.63E+06
Jul-17	4.18E+06	1.76E+05	4.35E+06	-4.02E+06	3.29E+05	-3.29E+05	0	0.00E+00	0
Aug-17	1.22E+06	1.65E+05	1.39E+06	-1.39E+06	0	0.00E+00	0	0.00E+00	0
Sep-17	9.96E+05	1.47E+05	1.14E+06	-1.14E+06	0	1.52E+04	1.52E+04	-1.52E+04	0
Oct-17	2.08E+06	2.08E+05	2.29E+06	2.86E+06	5.15E+06	-4.90E+06	2.45E+05	-2.45E+05	0
Nov-17	4.06E+06	1.59E+05	4.22E+06	-1.89E+06	2.33E+06	-1.15E+06	1.18E+06	-1.18E+06	0
Dec-17	1.94E+06	1.64E+05	2.10E+06	-7.19E+05	1.39E+06	-6.73E+04	1.32E+06	-1.32E+06	0
2017	**8.22E+07**	**2.06E+06**	**8.42E+07**	**2.70E+06**	**8.69E+07**	**-2.41E+06**	**8.45E+07**	**-3.40E+07**	**5.05E+07**
Jan-18	1.42E+06	1.46E+05	1.56E+06	3.67E+05	1.93E+06	1.36E+06	3.29E+06	-3.29E+06	0
Feb-18	1.57E+06	1.34E+05	1.70E+06	-1.14E+05	1.59E+06	1.30E+06	2.88E+06	-2.88E+06	0
Mar-18	1.97E+06	1.77E+05	2.15E+06	6.50E+06	8.65E+06	-5.41E+05	8.11E+06	-3.32E+06	4.79E+06
Apr-18	7.47E+06	1.86E+05	7.65E+06	-1.28E+06	6.37E+06	-4.37E+05	5.93E+06	-2.67E+06	3.26E+06
May-18	1.71E+07	2.86E+05	1.73E+07	1.02E+07	2.75E+07	-1.67E+06	2.58E+07	-3.78E+06	2.21E+07
Jun-18	1.19E+07	1.83E+05	1.21E+07	-1.17E+07	4.32E+05	-2.81E+04	4.04E+05	-3.47E+05	5.74E+04
Jul-18	4.96E+05	1.56E+05	6.52E+05	-6.50E+05	2.03E+03	-2.03E+03	0	0.00E+00	0
Aug-18	2.73E+05	1.42E+05	4.15E+05	-4.15E+05	0	0.00E+00	0	0.00E+00	0
Sep-18	2.92E+05	1.32E+05	4.24E+05	-4.24E+05	3.33E+02	9.14E+03	9.48E+03	-9.48E+03	0
Oct-18	3.95E+05	1.45E+05	5.39E+05	-5.39E+05	0	0.00E+00	0	0.00E+00	0
Nov-18	6.86E+05	8.02E+04	7.66E+05	-7.52E+05	1.36E+04	-1.36E+04	0	0.00E+00	0
Dec-18	6.41E+05	1.53E+05	7.94E+05	-5.18E+05	2.76E+05	-2.76E+05	0	0.00E+00	0
2018	**4.42E+07**	**1.92E+06**	**4.61E+07**	**6.53E+05**	**4.68E+07**	**-2.96E+05**	**4.65E+07**	**-1.63E+07**	**3.02E+07**
Jan-19	1.52E+06	1.15E+05	1.64E+06	-1.03E+05	1.53E+06	-1.53E+06	0	0.00E+00	0
Feb-19	1.41E+06	1.10E+05	1.52E+06	-1.52E+05	1.36E+06	-1.36E+06	0	0.00E+00	0
Mar-19	5.57E+06	1.31E+05	5.70E+06	2.95E+05	6.00E+06	7.31E+05	6.73E+06	-6.73E+06	0
Apr-19	7.53E+06	1.66E+05	7.70E+06	1.13E+06	8.82E+06	4.91E+06	1.37E+07	-1.07E+07	3.04E+06
May-19	2.32E+07	1.97E+05	2.34E+07	2.09E+06	2.55E+07	4.63E+06	3.01E+07	-9.63E+06	2.05E+07
Jun-19	1.51E+07	1.93E+05	1.53E+07	1.36E+06	1.67E+07	4.17E+06	2.09E+07	-9.26E+06	1.16E+07
Jul-19	8.76E+06	1.76E+05	8.93E+06	5.41E+05	9.47E+06	2.09E+06	1.16E+07	-5.25E+06	6.31E+06
Aug-19	5.54E+05	1.26E+05	6.80E+05	2.49E+05	9.29E+05	-9.29E+05	0	0.00E+00	0
Sep-19	5.50E+05	1.37E+05	6.87E+05	-6.87E+05	0	0.00E+00	0	0.00E+00	0
Oct-19	9.15E+05	1.53E+05	1.07E+06	-1.07E+06	0	0.00E+00	0	0.00E+00	0
Nov-19	1.88E+06	1.47E+05	2.03E+06	-9.44E+05	1.08E+06	-1.08E+06	0	0.00E+00	0
Dec-19	6.99E+06	1.61E+05	7.15E+06	1.30E+05	7.28E+06	1.07E+06	8.35E+06	-8.35E+06	0
2019	**7.40E+07**	**1.81E+06**	**7.58E+07**	**2.84E+06**	**7.87E+07**	**1.27E+07**	**9.14E+07**	**-4.99E+07**	**4.15E+07**
Jan-20	3.41E+06	1.45E+05	3.56E+06	1.55E+05	3.71E+06	2.58E+06	6.30E+06	-6.12E+06	1.79E+05
Feb-20	6.97E+06	3.74E+04	7.01E+06	3.13E+05	7.32E+06	2.77E+06	1.01E+07	-5.98E+06	4.10E+06
Mar-20	1.77E+07	2.61E+05	1.80E+07	1.68E+06	1.96E+07	4.51E+06	2.41E+07	-9.16E+06	1.50E+07
Apr-20	1.99E+07	2.56E+05	2.01E+07	2.92E+06	2.30E+07	3.05E+06	2.61E+07	-1.00E+07	1.61E+07
May-20	1.04E+07	2.10E+05	1.06E+07	1.32E+05	1.07E+07	3.32E+06	1.40E+07	-9.46E+06	4.58E+06
Jun-20	1.59E+06	1.79E+05	1.77E+06	-1.37E+05	1.63E+06	-6.78E+05	9.50E+05	-6.53E+05	2.97E+05
Jul-20	5.82E+05	1.52E+05	7.34E+05	-6.57E+05	7.70E+04	-7.70E+04	0	0.00E+00	0
Aug-20	3.00E+05	1.30E+05	4.30E+05	-4.30E+05	5.84E+01	-5.84E+01	0	0.00E+00	0
Sep-20	4.18E+05	1.12E+05	5.30E+05	-5.30E+05	1.89E+02	-1.89E+02	0	0.00E+00	0
Oct-20	5.30E+05	1.08E+05	6.39E+05	-6.39E+05	0	0.00E+00	0	0.00E+00	0
Nov-20	4.66E+05	1.00E+05	5.66E+05	-5.66E+05	0	0.00E+00	0	0.00E+00	0
Dec-20	4.25E+05	9.96E+04	5.24E+05	-5.24E+05	0	0.00E+00	0	0.00E+00	0
2020	**6.26E+07**	**1.79E+06**	**6.44E+07**	**1.71E+06**	**6.61E+07**	**1.55E+07**	**8.16E+07**	**-4.14E+07**	**4.02E+07**
Jan-21	3.89E+05	9.23E+04	4.81E+05	-4.45E+05	3.60E+04	-3.60E+04	0	0.00E+00	0
Feb-21	5.17E+05	7.83E+04	5.95E+05	-3.28E+05	2.67E+05	-2.67E+05	0	0.00E+00	0
Mar-21	1.50E+07	1.10E+05	1.51E+07	9.64E+05	1.60E+07	-4.03E+06	1.20E+07	-9.08E+06	2.92E+06
Apr-21	2.25E+07	1.38E+05	2.26E+07	-3.61E+05	2.23E+07	3.05E+06	2.53E+07	-7.85E+06	1.75E+07
May-21	5.07E+07	3.70E+05	5.11E+07	1.92E+06	5.30E+07	3.56E+06	5.65E+07	-8.04E+06	4.85E+07
Jun-21	6.94E+06	2.25E+05	7.16E+06	-5.90E+05	6.57E+06	-4.08E+05	6.16E+06	-4.00E+06	2.17E+06
Jul-21				0.00E+00		0.00E+00		0.00E+00	
Aug-21				0.00E+00		0.00E+00		0.00E+00	
Sep-21				0.00E+00		0.00E+00		0.00E+00	
Oct-21				0.00E+00		0.00E+00		0.00E+00	
Nov-21				0.00E+00		0.00E+00		0.00E+00	
Dec-21				0.00E+00		0.00E+00		0.00E+00	
2021	**9.60E+07**	**1.01E+06**	**9.70E+07**	**1.16E+06**	**9.82E+07**	**1.86E+06**	**1.00E+08**	**-2.90E+07**	**7.11E+07**

Notes:
0 means zero flow was recorded for that month.
NO FLOW DATA OR SOME FLOW DATA MISSING


Please refer to table for details regarding available data
Figure G.1
Annual Total Water Volume
South Walnut Creek
GS10
B5INFLOW
GS08 (B5 Discharges)
Water Volume (L)
2.5E+08
2.0E+08
1.5E+08
1.0E+08
5.0E+07
0.0E+00
No flow data at B5INFLOW in Jan-May 2010
No flow data at GS10 Jan-Feb 2013
No flow data at B5INFLOW Jan 2019
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020

Please refer to table for details regarding available data

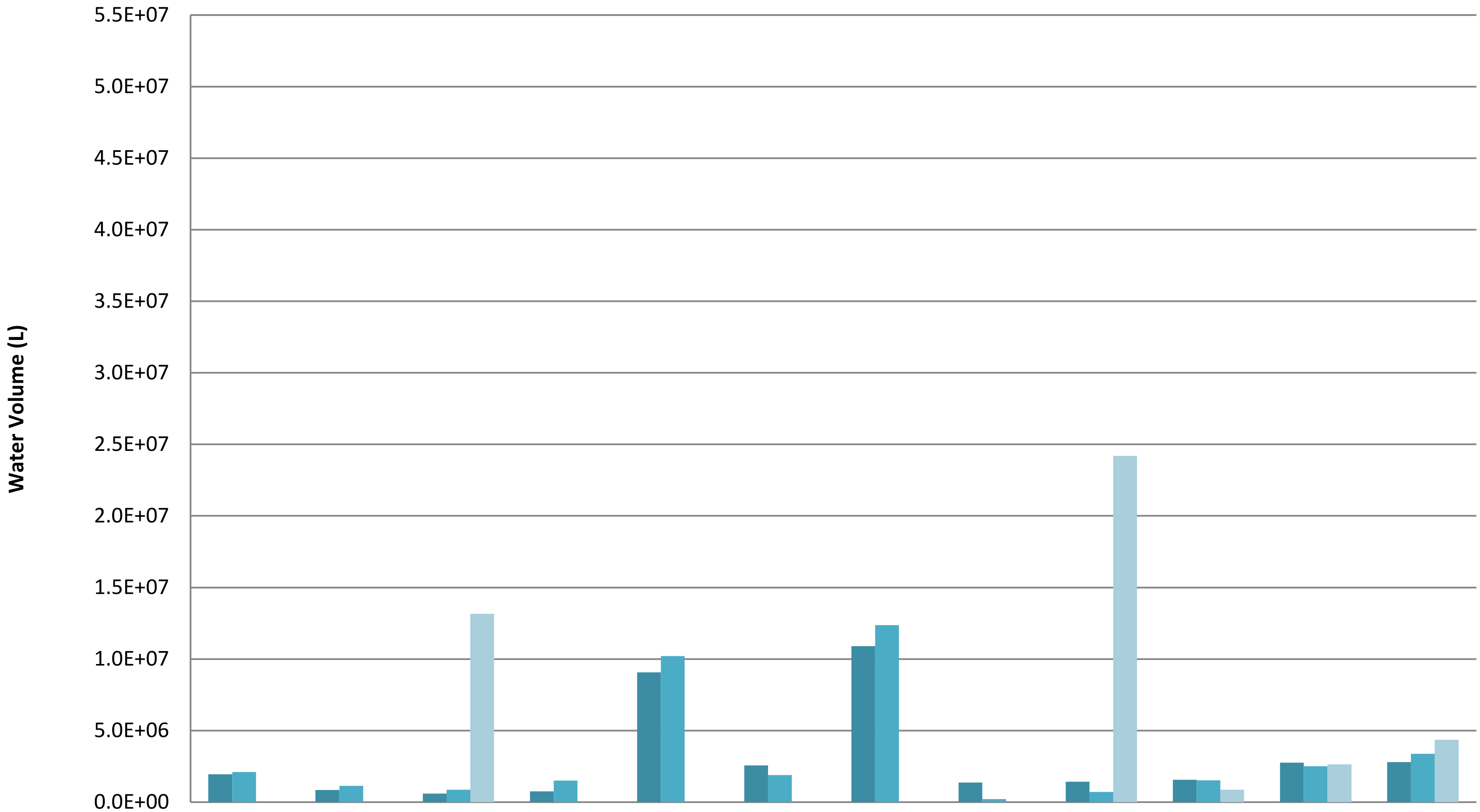
Figure G.2
Monthly Water Volume in South Walnut Creek
2010



	Jan-10	Feb-10	Mar-10	Apr-10	May-10	Jun-10	Jul-10	Aug-10	Sep-10	Oct-10	Nov-10	Dec-10
GS10	1.52E+06	1.66E+06	1.21E+07	3.50E+07	1.12E+07	7.81E+06	3.19E+06	1.62E+06	1.27E+06	1.40E+06	1.71E+06	1.96E+06
B5INFLOW	*	*	*	*	*	2.09E+06	1.73E+06	1.95E+05	0	5.54E+05	1.21E+06	1.22E+06
GS08 (B5 Discharges)	0	0	0	4.39E+07	3.49E+07	0	0	0	0	0	0	0

Please refer to table for details regarding available data

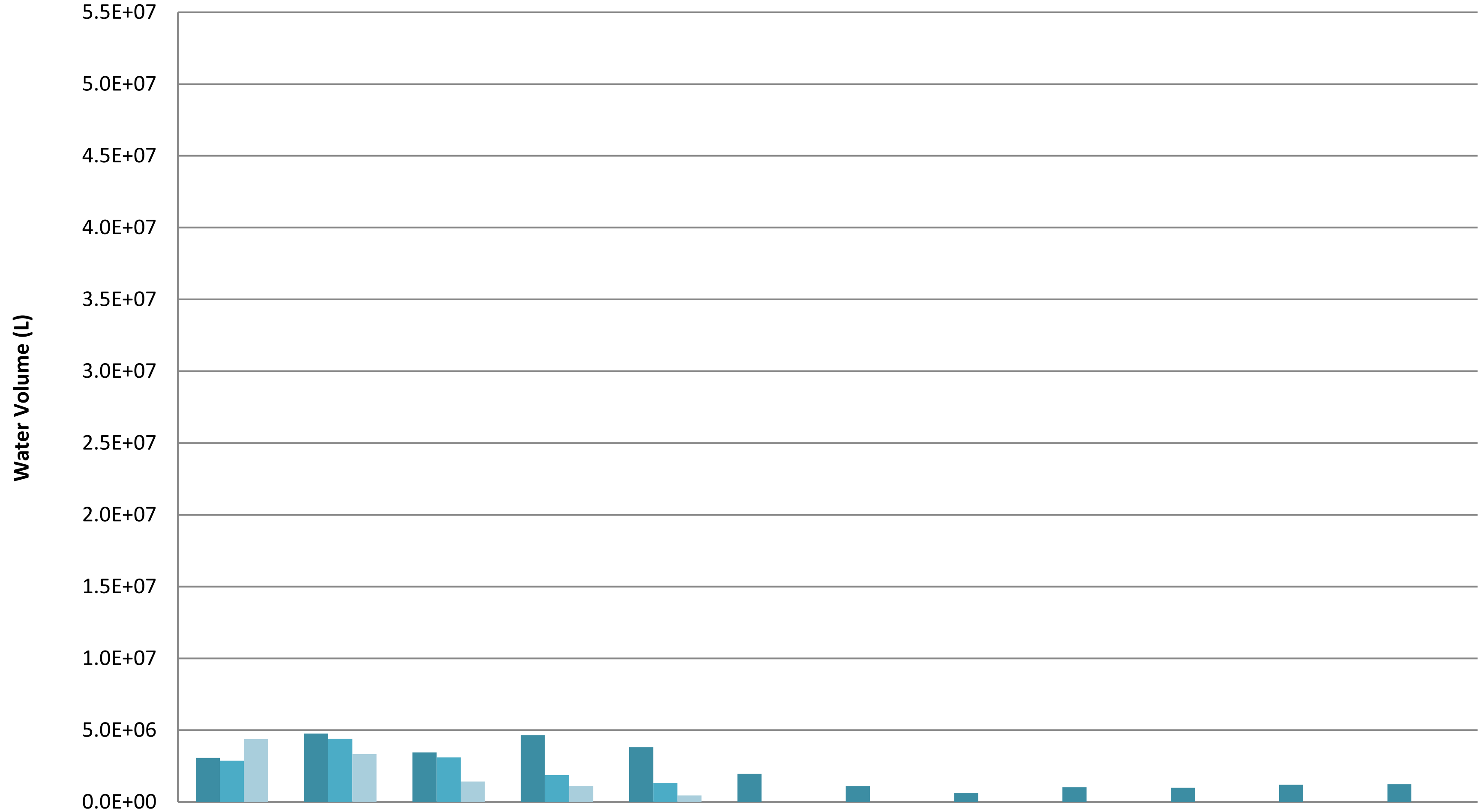
Figure G.3
Monthly Water Volume in South Walnut Creek
2011



	Jan-11	Feb-11	Mar-11	Apr-11	May-11	Jun-11	Jul-11	Aug-11	Sep-11	Oct-11	Nov-11	Dec-11
GS10	1.94E+06	8.50E+05	5.97E+05	7.57E+05	9.07E+06	2.57E+06	1.09E+07	1.37E+06	1.43E+06	1.56E+06	2.77E+06	2.80E+06
B5INFLOW	2.11E+06	1.14E+06	8.64E+05	1.50E+06	1.02E+07	1.89E+06	1.24E+07	2.21E+05	7.19E+05	1.52E+06	2.51E+06	3.37E+06
GS08 (B5 Discharges)	0	0	1.32E+07	0	0	0	0	0	2.42E+07	8.71E+05	2.65E+06	4.35E+06

Please refer to table for details regarding available data

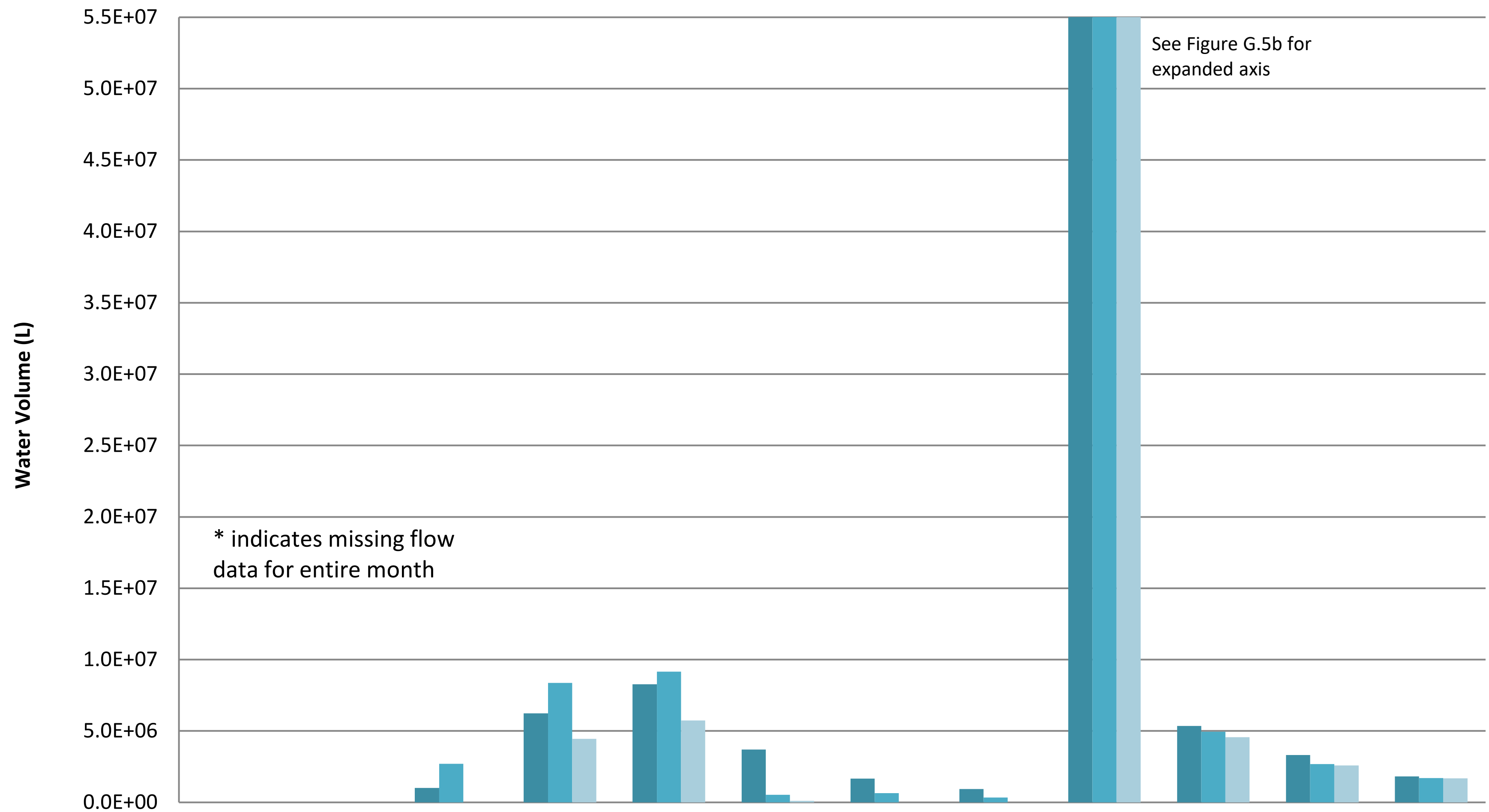
Figure G.4
Monthly Water Volume in South Walnut Creek
2012



	Jan-12	Feb-12	Mar-12	Apr-12	May-12	Jun-12	Jul-12	Aug-12	Sep-12	Oct-12	Nov-12	Dec-12
GS10	3.07E+06	4.77E+06	3.47E+06	4.67E+06	3.82E+06	1.96E+06	1.10E+06	6.45E+05	1.02E+06	9.86E+05	1.20E+06	1.25E+06
B5INFLOW	2.88E+06	4.42E+06	3.10E+06	1.87E+06	1.34E+06	0	0	0	0	0	0	0
GS08 (B5 Discharges)	4.39E+06	3.35E+06	1.43E+06	1.12E+06	4.67E+05	0	0	0	0	0	0	0

Please refer to table for details regarding available data

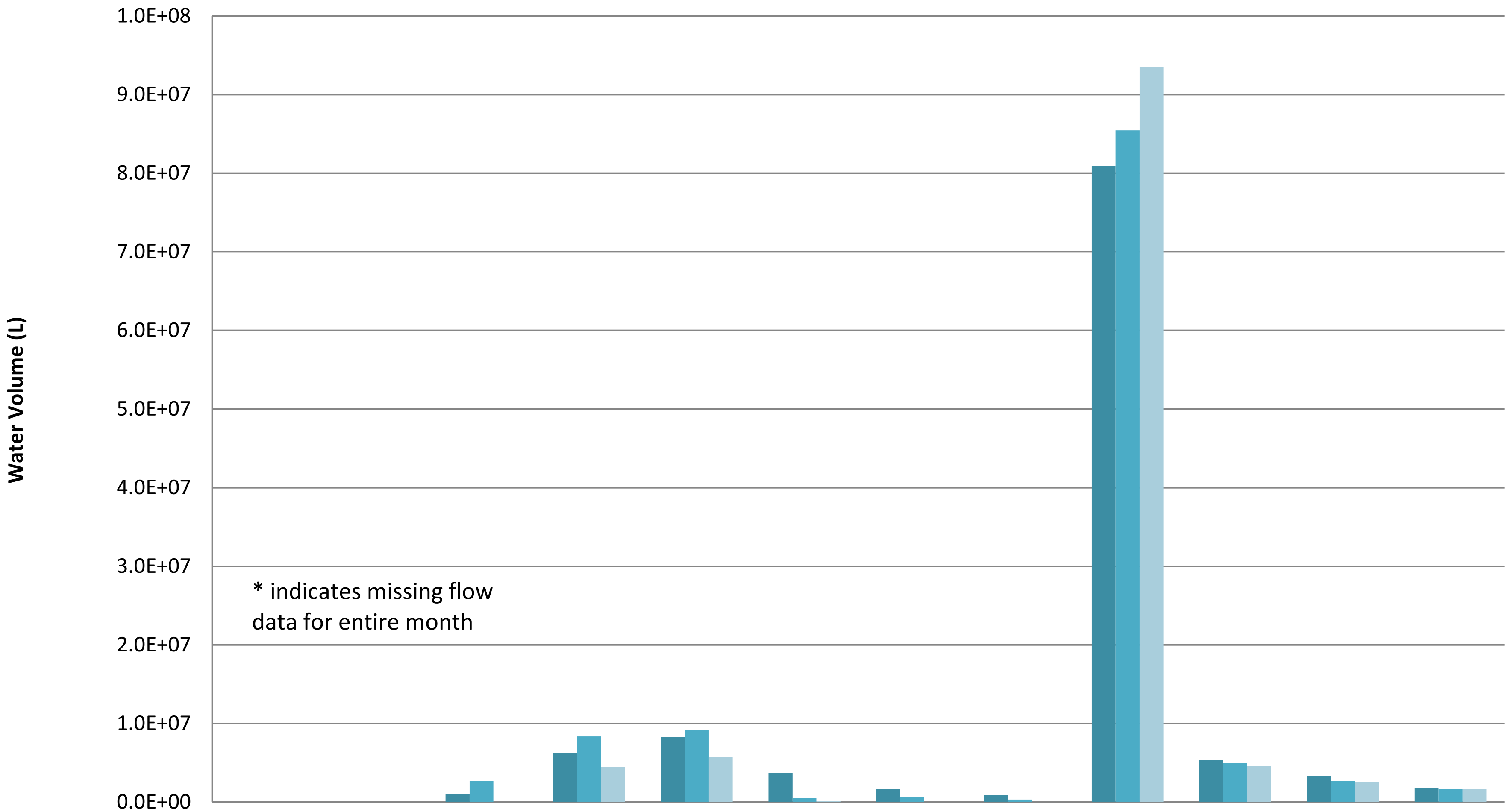
Figure G.5a
Monthly Water Volume in South Walnut Creek
2013



	Jan-13	Feb-13	Mar-13	Apr-13	May-13	Jun-13	Jul-13	Aug-13	Sep-13	Oct-13	Nov-13	Dec-13
GS10	*	*	1.01E+06	6.23E+06	8.27E+06	3.71E+06	1.67E+06	9.30E+05	8.09E+07	5.36E+06	3.31E+06	1.82E+06
B5INFLOW	0	0	2.70E+06	8.36E+06	9.15E+06	5.28E+05	6.48E+05	3.42E+05	8.55E+07	4.94E+06	2.69E+06	1.70E+06
GS08 (B5 Discharges)	0	0	0	4.46E+06	5.73E+06	1.09E+05	0	0	9.36E+07	4.56E+06	2.60E+06	1.69E+06

Please refer to table for details regarding available data

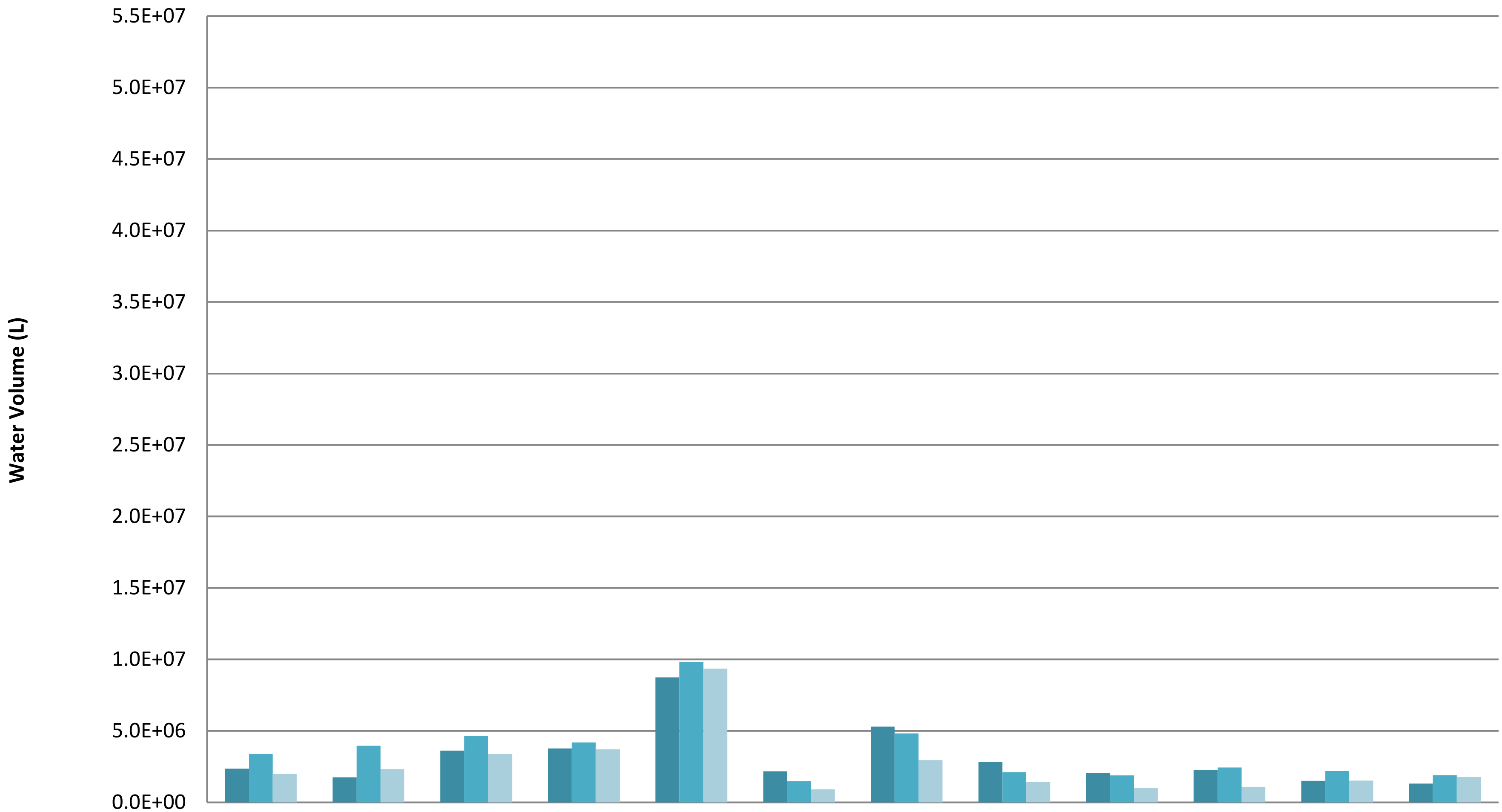
Figure G.5b
Monthly Water Volume in South Walnut Creek
2013



	Jan-13	Feb-13	Mar-13	Apr-13	May-13	Jun-13	Jul-13	Aug-13	Sep-13	Oct-13	Nov-13	Dec-13
GS10	*	*	1.01E+06	6.23E+06	8.27E+06	3.71E+06	1.67E+06	9.30E+05	8.09E+07	5.36E+06	3.31E+06	1.82E+06
B5INFLOW	0	0	2.70E+06	8.36E+06	9.15E+06	5.28E+05	6.48E+05	3.42E+05	8.55E+07	4.94E+06	2.69E+06	1.70E+06
GS08 (B5 Discharges)	0	0	0	4.46E+06	5.73E+06	1.09E+05	0	0	9.36E+07	4.56E+06	2.60E+06	1.69E+06

Please refer to table for details regarding available data

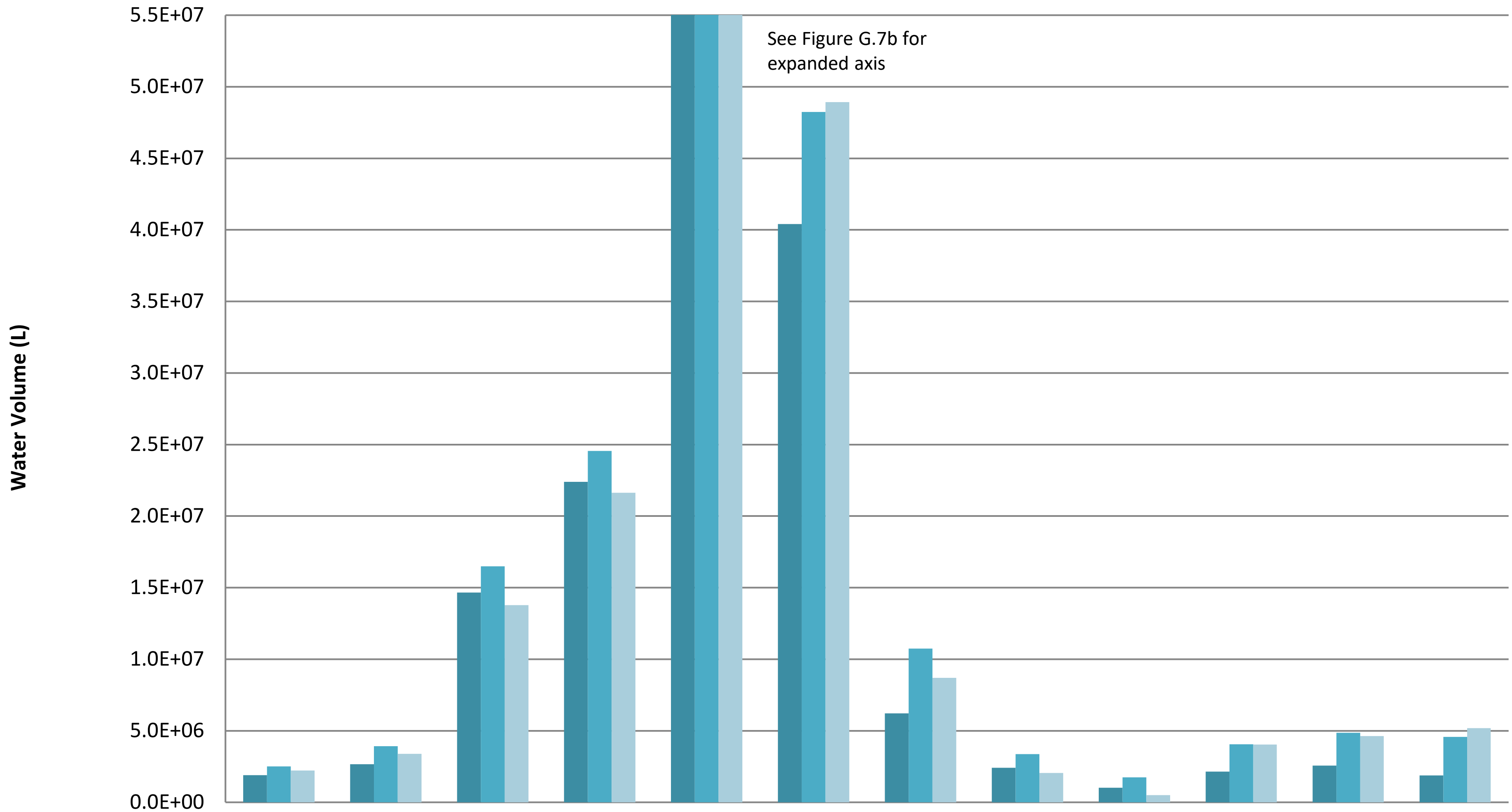
Figure G.6
Monthly Water Volume in South Walnut Creek
2014



	Jan-14	Feb-14	Mar-14	Apr-14	May-14	Jun-14	Jul-14	Aug-14	Sep-14	Oct-14	Nov-14	Dec-14
GS10	2.37E+06	1.76E+06	3.61E+06	3.78E+06	8.74E+06	2.17E+06	5.31E+06	2.83E+06	2.04E+06	2.25E+06	1.50E+06	1.32E+06
B5INFLOW	3.40E+06	3.96E+06	4.65E+06	4.19E+06	9.82E+06	1.49E+06	4.82E+06	2.11E+06	1.89E+06	2.43E+06	2.20E+06	1.90E+06
GS08 (B5 Discharges)	2.01E+06	2.33E+06	3.39E+06	3.72E+06	9.36E+06	9.24E+05	2.95E+06	1.43E+06	9.97E+05	1.08E+06	1.52E+06	1.77E+06

Please refer to table for details regarding available data

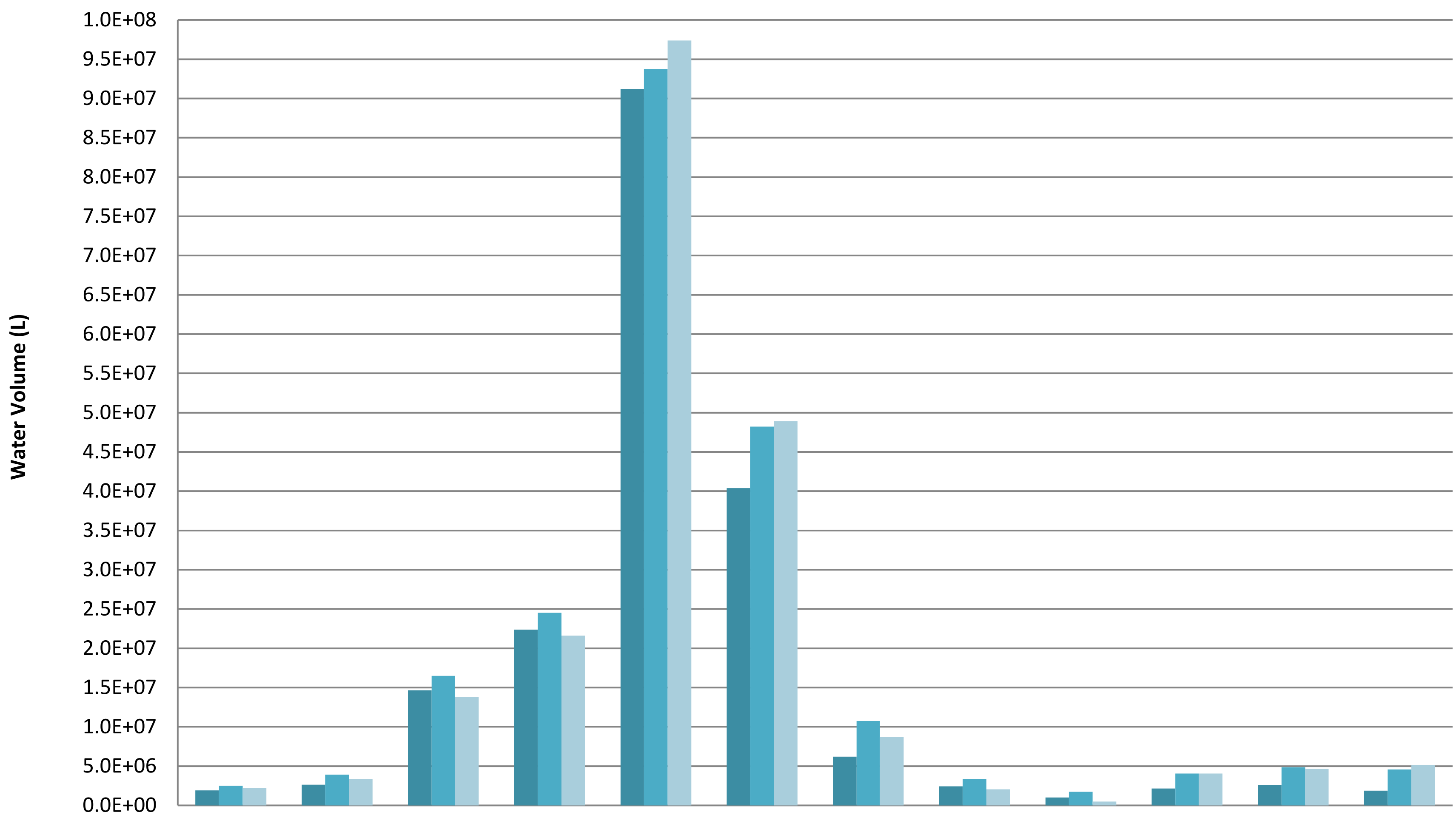
Figure G.7a
Monthly Water Volume in South Walnut Creek
2015



	Jan-15	Feb-15	Mar-15	Apr-15	May-15	Jun-15	Jul-15	Aug-15	Sep-15	Oct-15	Nov-15	Dec-15
GS10	1.91E+06	2.65E+06	1.47E+07	2.24E+07	9.12E+07	4.04E+07	6.22E+06	2.42E+06	1.01E+06	2.14E+06	2.57E+06	1.87E+06
B5INFLOW	2.50E+06	3.92E+06	1.65E+07	2.45E+07	9.37E+07	4.82E+07	1.07E+07	3.36E+06	1.74E+06	4.05E+06	4.85E+06	4.57E+06
GS08 (B5 Discharges)	2.23E+06	3.38E+06	1.38E+07	2.16E+07	9.74E+07	4.89E+07	8.69E+06	2.06E+06	4.95E+05	4.04E+06	4.63E+06	5.18E+06

Please refer to table for details regarding available data

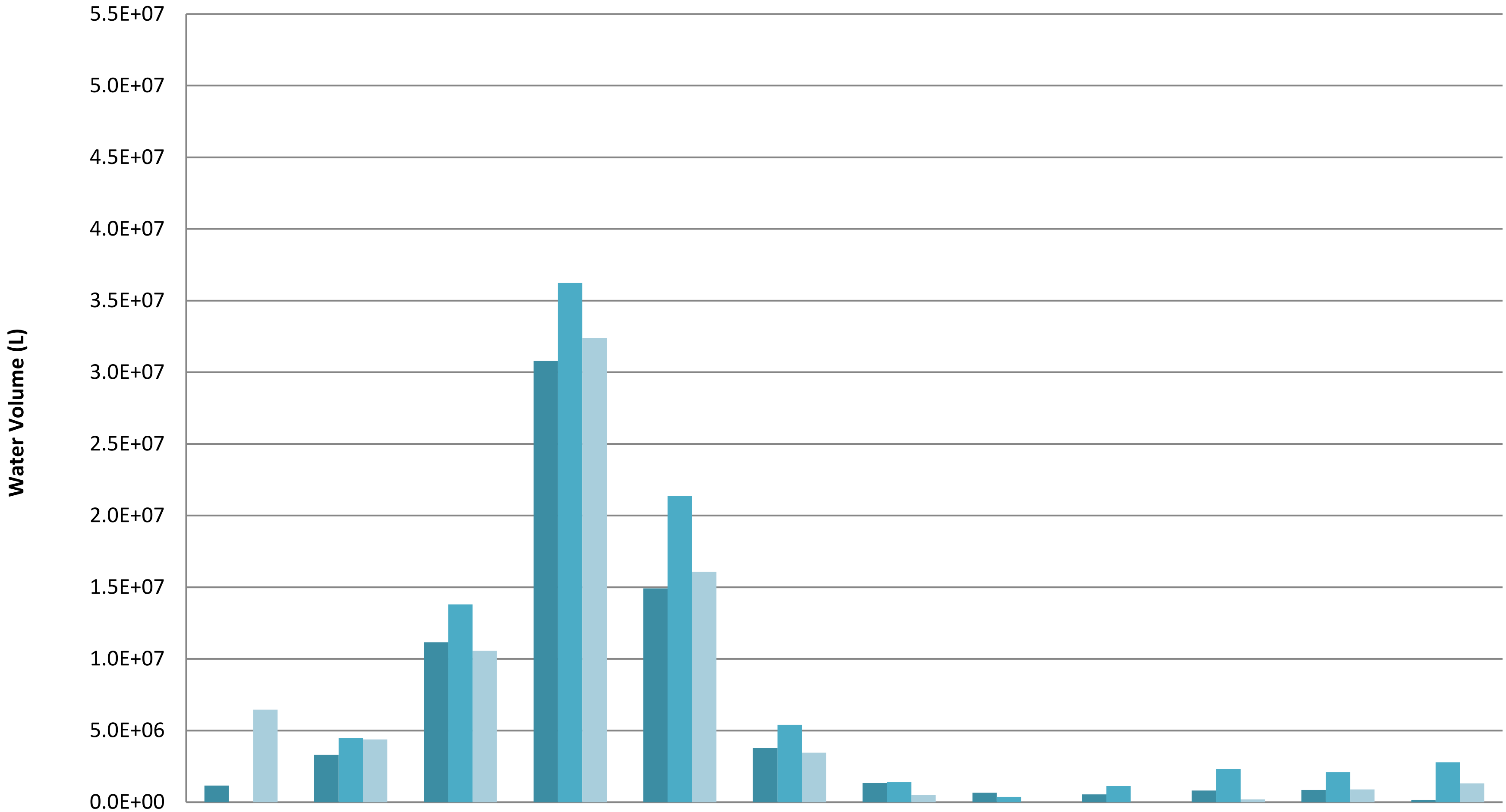
Figure G.7b
Monthly Water Volume in South Walnut Creek
2015



	Jan-15	Feb-15	Mar-15	Apr-15	May-15	Jun-15	Jul-15	Aug-15	Sep-15	Oct-15	Nov-15	Dec-15
GS10	1.91E+06	2.65E+06	1.47E+07	2.24E+07	9.12E+07	4.04E+07	6.22E+06	2.42E+06	1.01E+06	2.14E+06	2.57E+06	1.87E+06
B5INFLOW	2.50E+06	3.92E+06	1.65E+07	2.45E+07	9.37E+07	4.82E+07	1.07E+07	3.36E+06	1.74E+06	4.05E+06	4.85E+06	4.57E+06
GS08 (B5 Discharges)	2.23E+06	3.38E+06	1.38E+07	2.16E+07	9.74E+07	4.89E+07	8.69E+06	2.06E+06	4.95E+05	4.04E+06	4.63E+06	5.18E+06

Please refer to table for details regarding available data

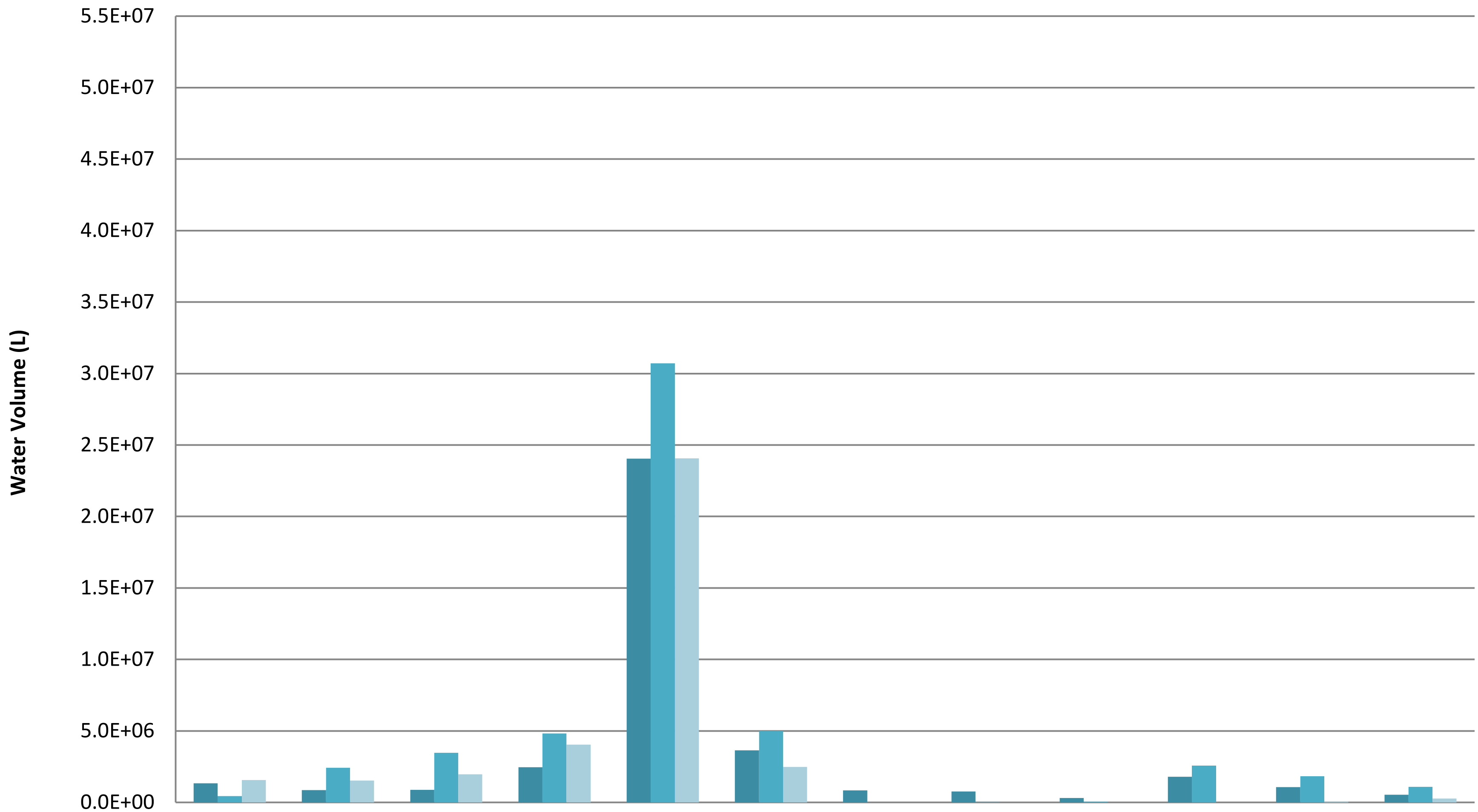
Figure G.8
Monthly Water Volume in South Walnut Creek
2016



	Jan-16	Feb-16	Mar-16	Apr-16	May-16	Jun-16	Jul-16	Aug-16	Sep-16	Oct-16	Nov-16	Dec-16
GS10	1.16E+06	3.30E+06	1.12E+07	3.08E+07	1.49E+07	3.79E+06	1.34E+06	6.67E+05	5.37E+05	8.07E+05	8.50E+05	1.54E+05
B5INFLOW	0	4.47E+06	1.38E+07	3.62E+07	2.13E+07	5.41E+06	1.38E+06	3.80E+05	1.12E+06	2.29E+06	2.10E+06	2.79E+06
GS08 (B5 Discharges)	6.46E+06	4.39E+06	1.06E+07	3.24E+07	1.61E+07	3.46E+06	5.08E+05	0	0	1.92E+05	8.98E+05	1.31E+06

Please refer to table for details regarding available data

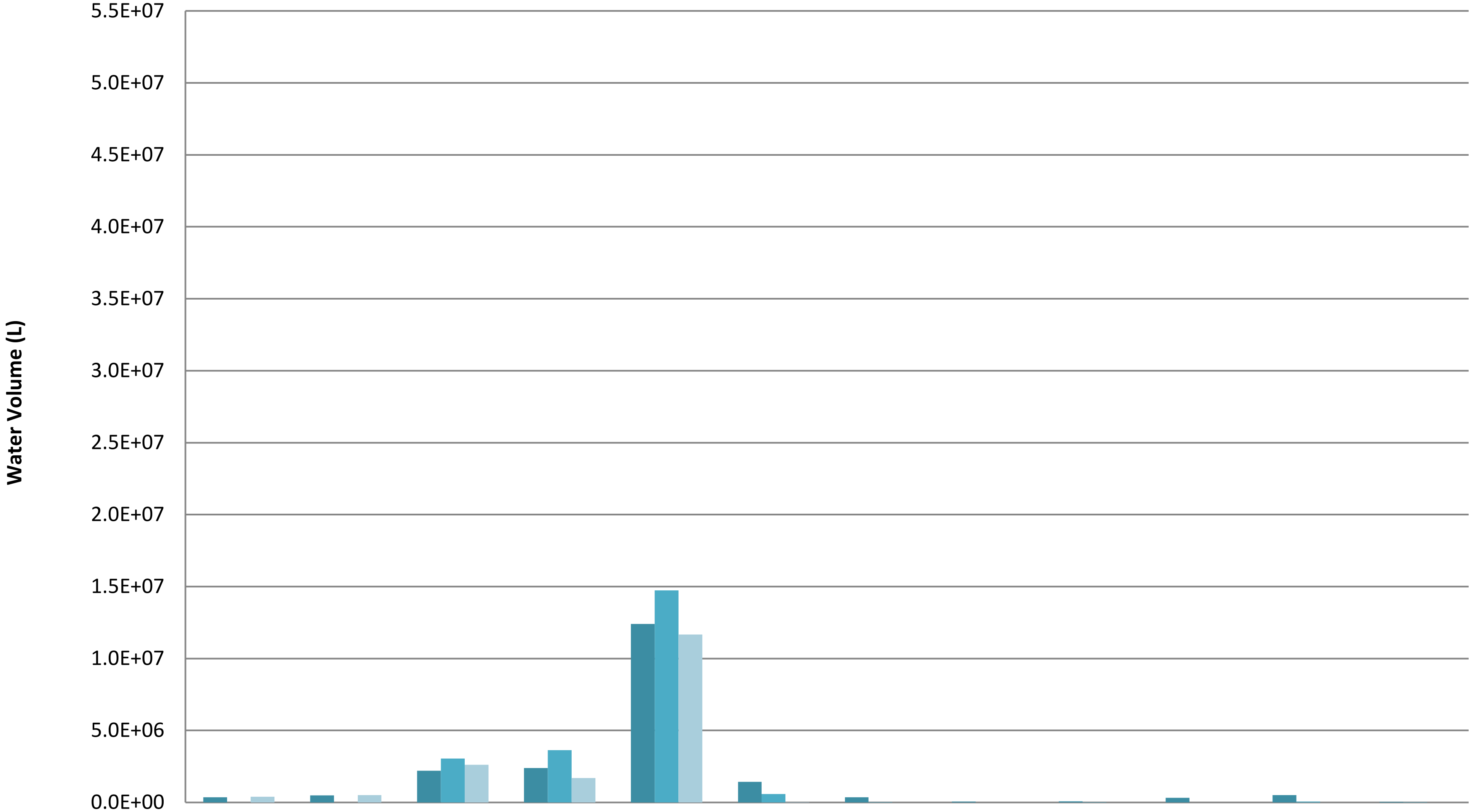
Figure G.9
Monthly Water Volume in South Walnut Creek
2017



	Jan-17	Feb-17	Mar-17	Apr-17	May-17	Jun-17	Jul-17	Aug-17	Sep-17	Oct-17	Nov-17	Dec-17
GS10	1.34E+06	8.57E+05	8.88E+05	2.47E+06	2.41E+07	3.64E+06	8.43E+05	7.57E+05	3.12E+05	1.79E+06	1.07E+06	5.33E+05
B5INFLOW	4.49E+05	2.43E+06	3.47E+06	4.82E+06	3.07E+07	5.00E+06	0	2.95E+04	3.38E+04	2.57E+06	1.84E+06	1.09E+06
GS08 (B5 Discharges)	1.56E+06	1.53E+06	1.96E+06	4.04E+06	2.41E+07	2.48E+06	0	0	0	0	3.59E+04	2.72E+05

Please refer to table for details regarding available data

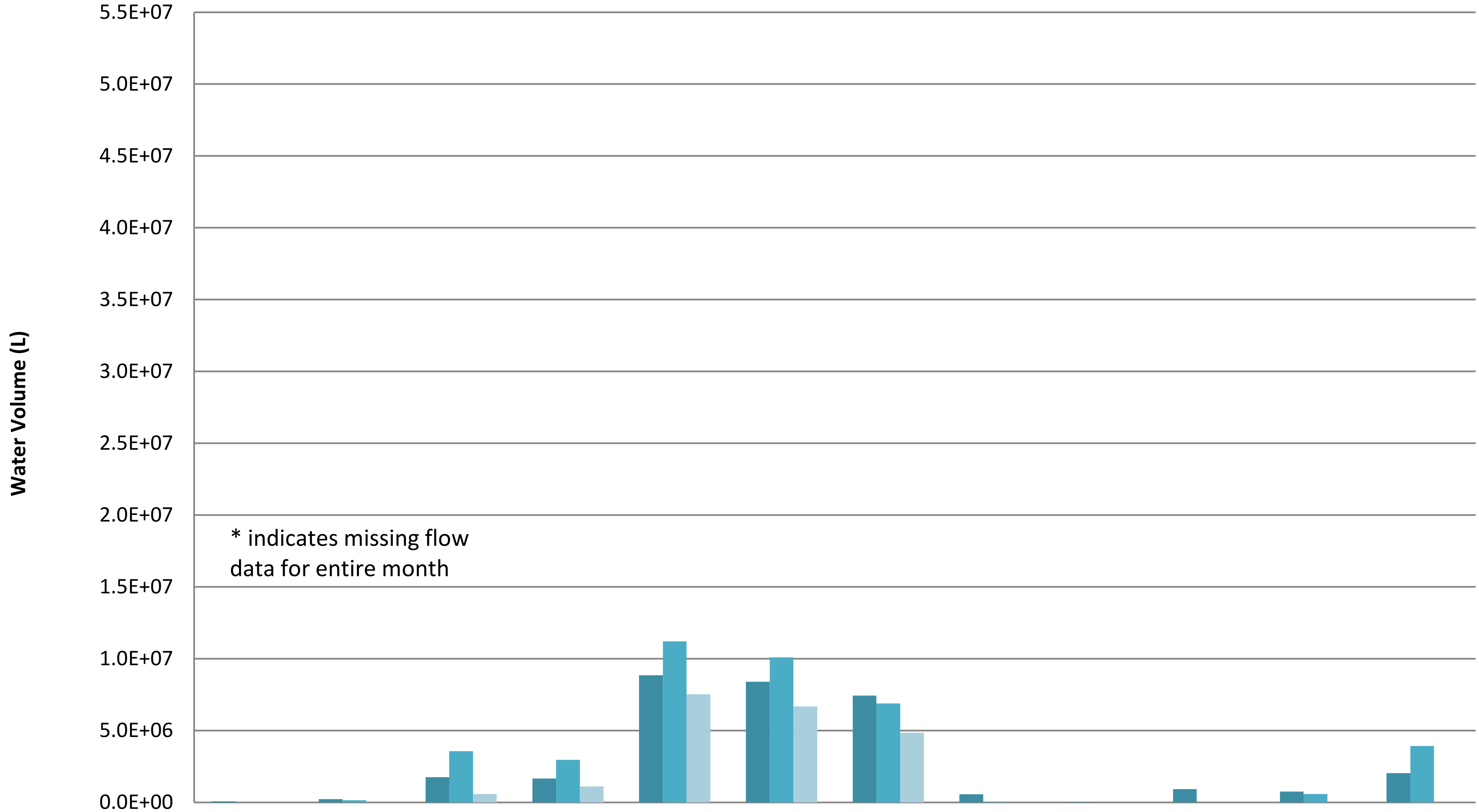
Figure G.10
Monthly Water Volume in South Walnut Creek
2018



	Jan-18	Feb-18	Mar-18	Apr-18	May-18	Jun-18	Jul-18	Aug-18	Sep-18	Oct-18	Nov-18	Dec-18
GS10	3.59E+05	4.99E+05	2.20E+06	2.39E+06	1.24E+07	1.44E+06	3.67E+05	5.27E+04	8.26E+04	3.31E+05	5.17E+05	4.08E+04
B5INFLOW	0	0	3.06E+06	3.64E+06	1.47E+07	5.86E+05	2.10E+04	0	7.11E+03	0	5.32E+04	1.99E+04
GS08 (B5 Discharges)	3.95E+05	5.15E+05	2.62E+06	1.71E+06	1.17E+07	1.43E+04	0	0	0	0	0	0

Please refer to table for details regarding available data

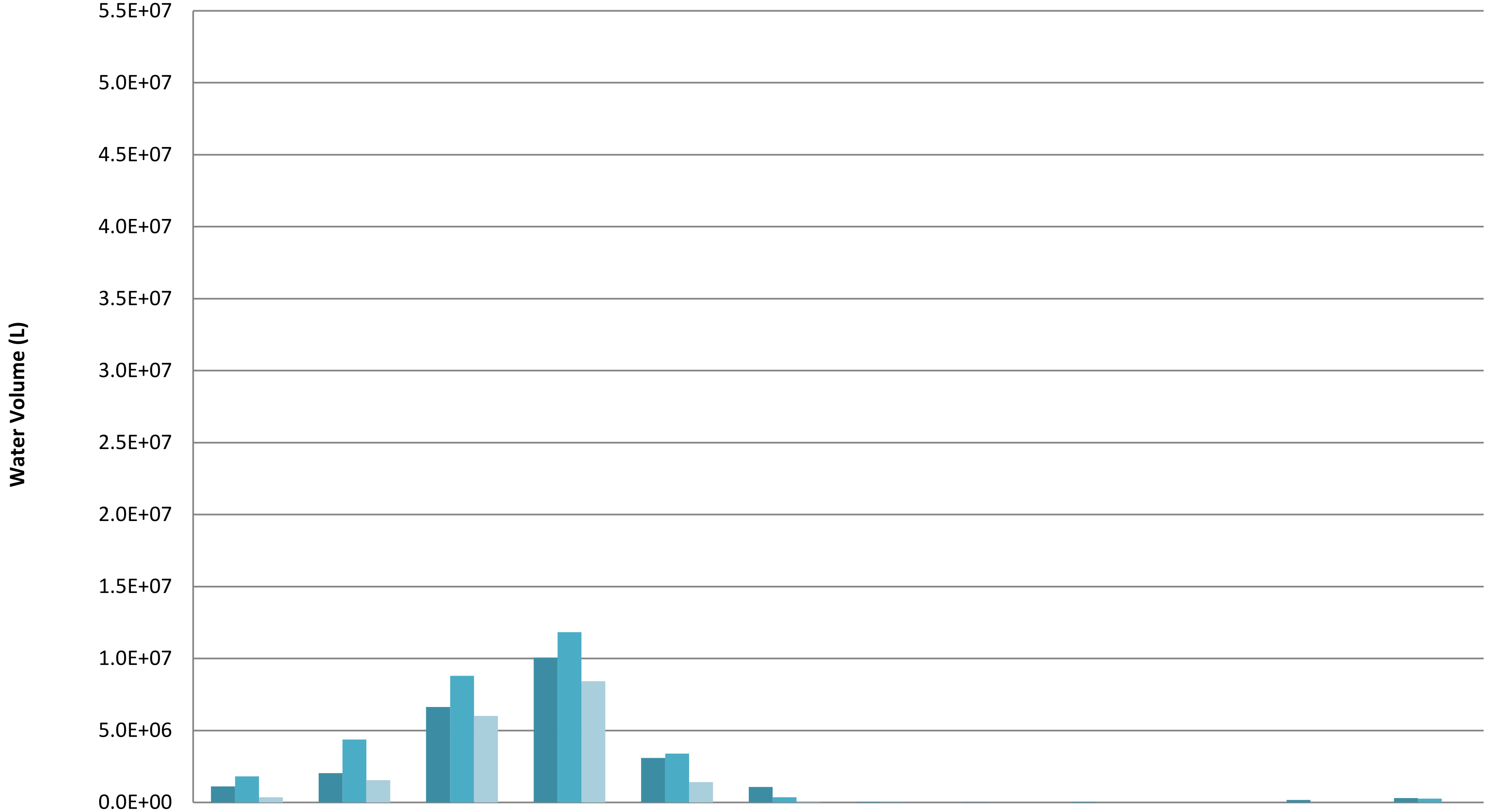
Figure G.11
Monthly Water Volume in South Walnut Creek
2019



	Jan-19	Feb-19	Mar-19	Apr-19	May-19	Jun-19	Jul-19	Aug-19	Sep-19	Oct-19	Nov-19	Dec-19
GS10	6.94E+04	2.34E+05	1.76E+06	1.66E+06	8.84E+06	8.40E+06	7.45E+06	5.66E+05	2.34E+04	9.23E+05	7.65E+05	2.03E+06
B5INFLOW	*	1.47E+05	3.57E+06	2.96E+06	1.12E+07	1.01E+07	6.89E+06	5.75E+01	0	0	5.84E+05	3.92E+06
GS08 (B5 Discharges)	0	0	5.88E+05	1.12E+06	7.54E+06	6.68E+06	4.84E+06	0	0	0	0	0

Please refer to table for details regarding available data

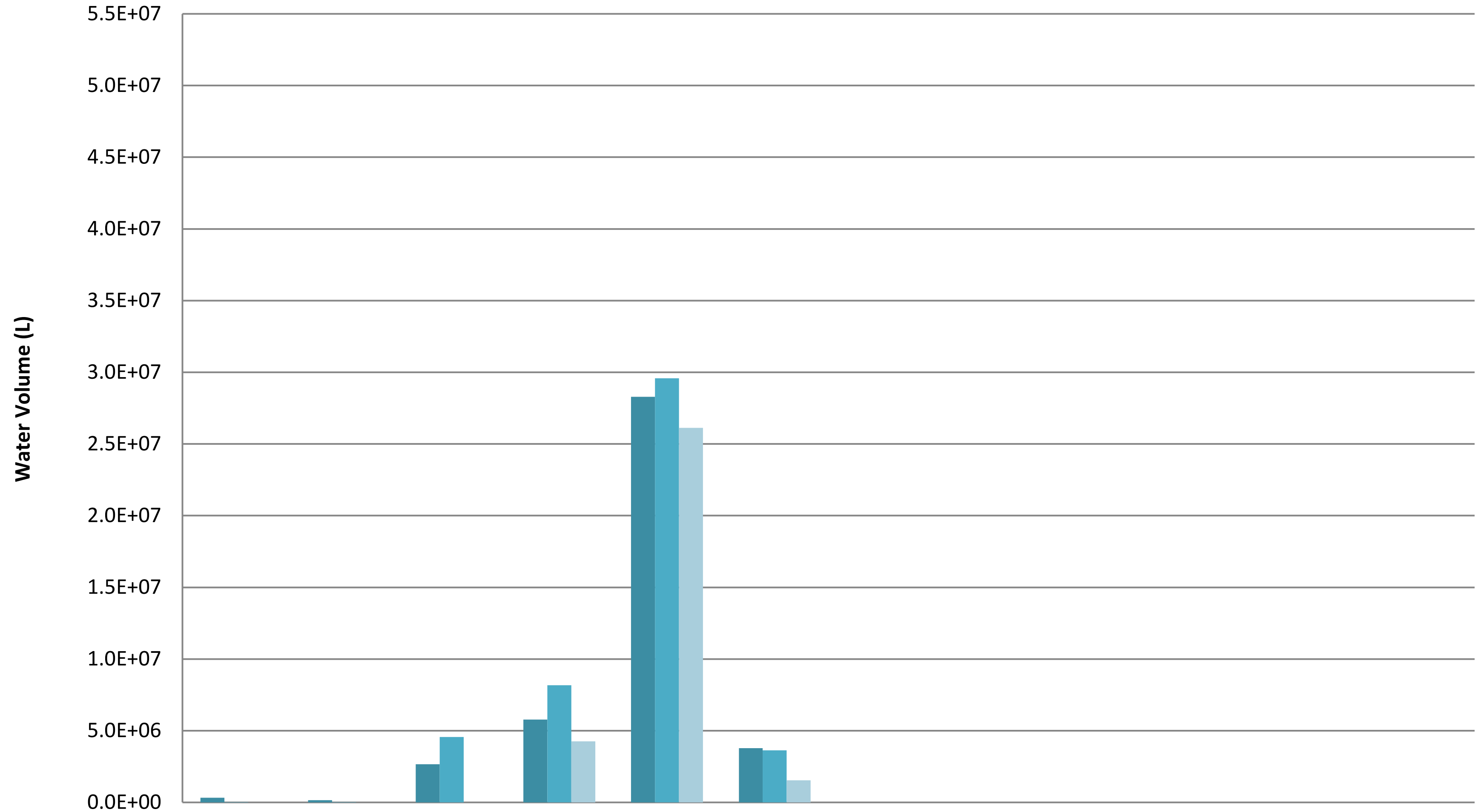
Figure G.12
Monthly Water Volume in South Walnut Creek
2020



	Jan-20	Feb-20	Mar-20	Apr-20	May-20	Jun-20	Jul-20	Aug-20	Sep-20	Oct-20	Nov-20	Dec-20
GS10	1.11E+06	2.04E+06	6.63E+06	1.01E+07	3.08E+06	1.07E+06	4.96E+04	1.94E+03	4.26E+04	0	1.80E+05	2.99E+05
B5INFLOW	1.81E+06	4.37E+06	8.80E+06	1.18E+07	3.38E+06	3.62E+05	1.99E+03	0	0	0	0	2.65E+05
GS08 (B5 Discharges)	3.64E+05	1.54E+06	6.00E+06	8.42E+06	1.42E+06	1.07E+04	0	0	0	0	0	0

Please refer to table for details regarding available data

Figure G.13
Monthly Water Volume in South Walnut Creek
2021



	Jan-21	Feb-21	Mar-21	Apr-21	May-21	Jun-21	Jul-21	Aug-21	Sep-21	Oct-21	Nov-21	Dec-21
GS10	3.18E+05	1.62E+05	2.66E+06	5.78E+06	2.83E+07	3.78E+06						
B5INFLOW	1.19E+04	6.21E+03	4.56E+06	8.17E+06	2.96E+07	3.63E+06						
GS08 (B5 Discharges)	0	0	0	4.26E+06	2.61E+07	1.55E+06						

Table G.1

	Water Volume (L)				
Date	**GS10**	+/-	**B5INFLOW**	+/-	**GS08 (B5 Discharges)**
Jan-09	7.70E+05	--		--	0
Feb-09	5.74E+05	--		--	0
Mar-09	1.02E+06	--		--	0
Apr-09	2.62E+07	--		--	0
May-09	7.90E+06	--		--	3.73E+07
Jun-09	8.58E+06	--		--	1.05E+07
Jul-09	2.86E+06	--		--	0
Aug-09	1.05E+06	--		--	0
Sep-09	9.93E+05	--		--	0
Oct-09	1.55E+06	--		--	0
Nov-09	3.62E+06	--		--	0
Dec-09	1.52E+06	--		--	0
2009	**5.66E+07**	***-5.66E+07***	**0.00E+00**	***4.78E+07***	**4.78E+07**
Jan-10	1.52E+06	--		--	0
Feb-10	1.66E+06	--		--	0
Mar-10	1.21E+07	--		--	0
Apr-10	3.50E+07	--		--	4.39E+07
May-10	1.12E+07	--		--	3.49E+07
Jun-10	7.81E+06	-5.72E+06	2.09E+06	-2.09E+06	0
Jul-10	3.19E+06	-1.46E+06	1.73E+06	-1.73E+06	0
Aug-10	1.62E+06	-1.42E+06	1.95E+05	-1.95E+05	0
Sep-10	1.27E+06	-1.27E+06	0	0.00E+00	0
Oct-10	1.40E+06	-8.50E+05	5.54E+05	-5.54E+05	0
Nov-10	1.71E+06	-4.99E+05	1.21E+06	-1.21E+06	0
Dec-10	1.96E+06	-7.33E+05	1.22E+06	-1.22E+06	0
2010	**8.04E+07**	***-7.34E+07***	**7.01E+06**	***7.18E+07***	**7.88E+07**
Jan-11	1.94E+06	1.66E+05	2.11E+06	-2.11E+06	0
Feb-11	8.50E+05	2.90E+05	1.14E+06	-1.14E+06	0
Mar-11	5.97E+05	2.67E+05	8.64E+05	1.23E+07	1.32E+07
Apr-11	7.57E+05	7.39E+05	1.50E+06	-1.50E+06	0
May-11	9.07E+06	1.15E+06	1.02E+07	-1.02E+07	0
Jun-11	2.57E+06	-6.81E+05	1.89E+06	-1.89E+06	0
Jul-11	1.09E+07	1.48E+06	1.24E+07	-1.24E+07	0
Aug-11	1.37E+06	-1.15E+06	2.21E+05	-2.21E+05	0
Sep-11	1.43E+06	-7.13E+05	7.19E+05	2.35E+07	2.42E+07
Oct-11	1.56E+06	-4.39E+04	1.52E+06	-6.47E+05	8.71E+05
Nov-11	2.77E+06	-2.54E+05	2.51E+06	1.34E+05	2.65E+06
Dec-11	2.80E+06	5.65E+05	3.37E+06	9.83E+05	4.35E+06
2011	**3.66E+07**	***1.81E+06***	**3.84E+07**	***6.79E+06***	**4.52E+07**
Jan-12	3.07E+06	-1.92E+05	2.88E+06	1.51E+06	4.39E+06
Feb-12	4.77E+06	-3.50E+05	4.42E+06	-1.07E+06	3.35E+06
Mar-12	3.47E+06	-3.62E+05	3.10E+06	-1.67E+06	1.43E+06
Apr-12	4.67E+06	-2.79E+06	1.87E+06	-7.49E+05	1.12E+06
May-12	3.82E+06	-2.47E+06	1.34E+06	-8.76E+05	4.67E+05
Jun-12	1.96E+06	-1.96E+06	0	0.00E+00	0
Jul-12	1.10E+06	-1.10E+06	0	0.00E+00	0
Aug-12	6.45E+05	-6.45E+05	0	0.00E+00	0
Sep-12	1.02E+06	-1.02E+06	0	0.00E+00	0
Oct-12	9.86E+05	-9.86E+05	0	0.00E+00	0
Nov-12	1.20E+06	-1.20E+06	0	0.00E+00	0
Dec-12	1.25E+06	-1.25E+06	0	0.00E+00	0
2012	**2.80E+07**	***-1.43E+07***	**1.36E+07**	***-2.86E+06***	**1.08E+07**
Jan-13		--	0	0.00E+00	0
Feb-13		--	0	0.00E+00	0
Mar-13	1.01E+06	1.69E+06	2.70E+06	-2.70E+06	0
Apr-13	6.23E+06	2.13E+06	8.36E+06	-3.91E+06	4.46E+06
May-13	8.27E+06	8.84E+05	9.15E+06	-3.42E+06	5.73E+06
Jun-13	3.71E+06	-3.18E+06	5.28E+05	-4.19E+05	1.09E+05
Jul-13	1.67E+06	-1.02E+06	6.48E+05	-6.48E+05	0
Aug-13	9.30E+05	-5.88E+05	3.42E+05	-3.42E+05	0
Sep-13	8.09E+07	4.52E+06	8.55E+07	8.09E+06	9.36E+07
Oct-13	5.36E+06	-4.19E+05	4.94E+06	-3.79E+05	4.56E+06
Nov-13	3.31E+06	-6.26E+05	2.69E+06	-9.13E+04	2.60E+06
Dec-13	1.82E+06	-1.25E+05	1.70E+06	-8.98E+03	1.69E+06
2013	**1.13E+08**	***3.26E+06***	**1.17E+08**	***-3.82E+06***	**1.13E+08**
Jan-14	2.37E+06	1.03E+06	3.40E+06	-1.39E+06	2.01E+06
Feb-14	1.76E+06	2.20E+06	3.96E+06	-1.63E+06	2.33E+06
Mar-14	3.61E+06	1.03E+06	4.65E+06	-1.26E+06	3.39E+06
Apr-14	3.78E+06	4.12E+05	4.19E+06	-4.68E+05	3.72E+06
May-14	8.74E+06	1.08E+06	9.82E+06	-4.51E+05	9.36E+06
Jun-14	2.17E+06	-6.79E+05	1.49E+06	-5.68E+05	9.24E+05
Jul-14	5.31E+06	-4.87E+05	4.82E+06	-1.86E+06	2.95E+06
Aug-14	2.83E+06	-7.23E+05	2.11E+06	-6.79E+05	1.43E+06
Sep-14	2.04E+06	-1.56E+05	1.89E+06	-8.90E+05	9.97E+05
Oct-14	2.25E+06	1.78E+05	2.43E+06	-1.35E+06	1.08E+06
Nov-14	1.50E+06	7.03E+05	2.20E+06	-6.85E+05	1.52E+06
Dec-14	1.32E+06	5.80E+05	1.90E+06	-1.35E+05	1.77E+06
2014	**3.77E+07**	***5.17E+06***	**4.29E+07**	***-1.14E+07***	**3.15E+07**
Jan-15	1.91E+06	5.93E+05	2.50E+06	-2.70E+05	2.23E+06
Feb-15	2.65E+06	1.27E+06	3.92E+06	-5.43E+05	3.38E+06
Mar-15	1.47E+07	1.83E+06	1.65E+07	-2.70E+06	1.38E+07
Apr-15	2.24E+07	2.16E+06	2.45E+07	-2.92E+06	2.16E+07
May-15	9.12E+07	2.55E+06	9.37E+07	3.65E+06	9.74E+07
Jun-15	4.04E+07	7.82E+06	4.82E+07	6.96E+05	4.89E+07
Jul-15	6.22E+06	4.52E+06	1.07E+07	-2.05E+06	8.69E+06
Aug-15	2.42E+06	9.43E+05	3.36E+06	-1.31E+06	2.06E+06
Sep-15	1.01E+06	7.26E+05	1.74E+06	-1.24E+06	4.95E+05
Oct-15	2.14E+06	1.91E+06	4.05E+06	-2.58E+03	4.04E+06
Nov-15	2.57E+06	2.28E+06	4.85E+06	-2.18E+05	4.63E+06
Dec-15	1.87E+06	2.70E+06	4.57E+06	6.07E+05	5.18E+06
2015	**1.89E+08**	***2.93E+07***	**2.19E+08**	***-6.30E+06***	**2.12E+08**
Jan-16	1.16E+06	-1.16E+06	0	6.46E+06	6.46E+06
Feb-16	3.30E+06	1.17E+06	4.47E+06	-8.38E+04	4.39E+06
Mar-16	1.12E+07	2.64E+06	1.38E+07	-3.22E+06	1.06E+07
Apr-16	3.08E+07	5.45E+06	3.62E+07	-3.84E+06	3.24E+07
May-16	1.49E+07	6.42E+06	2.13E+07	-5.27E+06	1.61E+07
Jun-16	3.79E+06	1.62E+06	5.41E+06	-1.95E+06	3.46E+06
Jul-16	1.34E+06	4.29E+04	1.38E+06	-8.76E+05	5.08E+05
Aug-16	6.67E+05	-2.87E+05	3.80E+05	-3.80E+05	0
Sep-16	5.37E+05	5.83E+05	1.12E+06	-1.12E+06	0
Oct-16	8.07E+05	1.49E+06	2.29E+06	-2.10E+06	1.92E+05
Nov-16	8.50E+05	1.25E+06	2.10E+06	-1.20E+06	8.98E+05
Dec-16	1.54E+05	2.63E+06	2.79E+06	-1.47E+06	1.31E+06
2016	**6.95E+07**	***2.18E+07***	**9.13E+07**	***-1.50E+07***	**7.63E+07**
Jan-17	1.34E+06	-8.95E+05	4.49E+05	1.11E+06	1.56E+06
Feb-17	8.57E+05	1.57E+06	2.43E+06	-8.92E+05	1.53E+06
Mar-17	8.88E+05	2.59E+06	3.47E+06	-1.51E+06	1.96E+06
Apr-17	2.47E+06	2.35E+06	4.82E+06	-7.71E+05	4.04E+06
May-17	2.41E+07	6.66E+06	3.07E+07	-6.65E+06	2.41E+07
Jun-17	3.64E+06	1.36E+06	5.00E+06	-2.52E+06	2.48E+06
Jul-17	8.43E+05	-8.43E+05	0	0.00E+00	0
Aug-17	7.57E+05	-7.28E+05	2.95E+04	-2.95E+04	0
Sep-17	3.12E+05	-2.79E+05	3.38E+04	-3.38E+04	0
Oct-17	1.79E+06	7.79E+05	2.57E+06	-2.57E+06	0
Nov-17	1.07E+06	7.71E+05	1.84E+06	-1.80E+06	3.59E+04
Dec-17	5.33E+05	5.57E+05	1.09E+06	-8.17E+05	2.72E+05
2017	**3.86E+07**	***1.39E+07***	**5.24E+07**	***-1.65E+07***	**3.59E+07**
Jan-18	3.59E+05	-3.59E+05	0	3.95E+05	3.95E+05
Feb-18	4.99E+05	-4.99E+05	0	5.15E+05	5.15E+05
Mar-18	2.20E+06	8.60E+05	3.06E+06	-4.39E+05	2.62E+06
Apr-18	2.39E+06	1.25E+06	3.64E+06	-1.93E+06	1.71E+06
May-18	1.24E+07	2.34E+06	1.47E+07	-3.07E+06	1.17E+07
Jun-18	1.44E+06	-8.50E+05	5.86E+05	-5.72E+05	1.43E+04
Jul-18	3.67E+05	-3.46E+05	2.10E+04	-2.10E+04	0
Aug-18	5.27E+04	-5.27E+04	0	0.00E+00	0
Sep-18	8.26E+04	-7.55E+04	7.11E+03	-7.11E+03	0
Oct-18	3.31E+05	-3.31E+05	0	0.00E+00	0
Nov-18	5.17E+05	-4.64E+05	5.32E+04	-5.32E+04	0
Dec-18	4.08E+04	-2.09E+04	1.99E+04	-1.99E+04	0
2018	**2.07E+07**	***1.45E+06***	**2.21E+07**	***-5.21E+06***	**1.69E+07**
Jan-19	6.94E+04	-6.94E+04		0.00E+00	0
Feb-19	2.34E+05	-8.62E+04	1.47E+05	-1.47E+05	0
Mar-19	1.76E+06	1.81E+06	3.57E+06	-2.98E+06	5.88E+05
Apr-19	1.66E+06	1.30E+06	2.96E+06	-1.84E+06	1.12E+06
May-19	8.84E+06	2.37E+06	1.12E+07	-3.67E+06	7.54E+06
Jun-19	8.40E+06	1.69E+06	1.01E+07	-3.41E+06	6.68E+06
Jul-19	7.45E+06	-5.56E+05	6.89E+06	-2.04E+06	4.84E+06
Aug-19	5.66E+05	-5.66E+05	5.75E+01	-5.75E+01	0
Sep-19	2.34E+04	-2.34E+04	0	0.00E+00	0
Oct-19	9.23E+05	-9.23E+05	0	0.00E+00	0
Nov-19	7.65E+05	-1.82E+05	5.84E+05	-5.84E+05	0
Dec-19	2.03E+06	1.89E+06	3.92E+06	-3.92E+06	0
2019	**3.27E+07**	***6.65E+06***	**3.94E+07**	***-1.86E+07***	**2.08E+07**
Jan-20	1.11E+06	6.98E+05	1.81E+06	-1.45E+06	3.64E+05
Feb-20	2.04E+06	2.33E+06	4.37E+06	-2.83E+06	1.54E+06
Mar-20	6.63E+06	2.17E+06	8.80E+06	-2.79E+06	6.00E+06
Apr-20	1.01E+07	1.76E+06	1.18E+07	-3.40E+06	8.42E+06
May-20	3.08E+06	3.00E+05	3.38E+06	-1.97E+06	1.42E+06
Jun-20	1.07E+06	-7.10E+05	3.62E+05	-3.52E+05	1.07E+04
Jul-20	4.96E+04	-4.76E+04	1.99E+03	-1.99E+03	0
Aug-20	1.94E+03	-1.94E+03	0	0.00E+00	0
Sep-20	4.26E+04	-4.26E+04	0	0.00E+00	0
Oct-20	0	0.00E+00	0	0.00E+00	0
Nov-20	1.80E+05	-1.80E+05	0	0.00E+00	0
Dec-20	2.99E+05	-3.42E+04	2.65E+05	-2.65E+05	0
2020	**2.46E+07**	***6.24E+06***	**3.08E+07**	***-1.31E+07***	**1.78E+07**
Jan-21	3.18E+05	-3.06E+05	1.19E+04	-1.19E+04	0
Feb-21	1.62E+05	-1.56E+05	6.21E+03	-6.21E+03	0
Mar-21	2.66E+06	1.90E+06	4.56E+06	-4.56E+06	0
Apr-21	5.78E+06	2.39E+06	8.17E+06	-3.92E+06	4.26E+06
May-21	2.83E+07	1.29E+06	2.96E+07	-3.45E+06	2.61E+07
Jun-21	3.78E+06	-1.53E+05	3.63E+06	-2.08E+06	1.55E+06
Jul-21		0.00E+00		0.00E+00	
Aug-21		0.00E+00		0.00E+00	
Sep-21		0.00E+00		0.00E+00	
Oct-21		0.00E+00		0.00E+00	
Nov-21		0.00E+00		0.00E+00	
Dec-21		0.00E+00		0.00E+00	
2021	**4.10E+07**	***4.97E+06***	**4.60E+07**	***-1.40E+07***	**3.19E+07**

Notes:
0 means zero flow was recorded for that month.
NO FLOW DATA OR SOME FLOW DATA MISSING

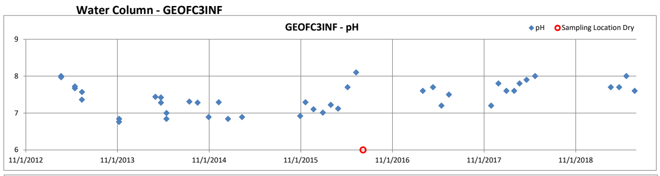
Figure H.1

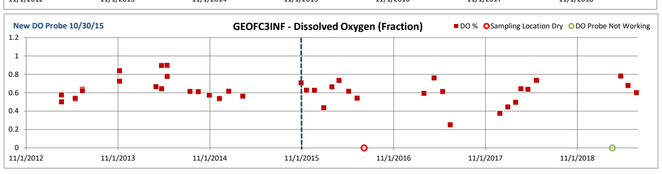
North Walnut Creek - GEOFC3INF - Water Quality and Sediment Data

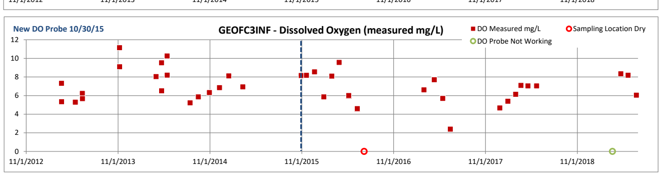
			Water Column												Sediment			
Location	DateTime Sampled	RIN-Tik	pH	DO [mg/L unless noted]	DO %	DO Measured mg/L	DO Saturated mg/L	Temp [C]	ORP [mV]	Fe [ug/L]	SO4 [mg/L]	H2S [mg/L]	NO3	NO2	ORP [mV] Top	ORP [mV] at Depth	ORP Depth [cm]	Uranium [mg/kg]
GEOFC3INF	11/8/12 10:30	12114959-611	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	1.3
GEOFC3INF	3/21/13 4:00		8	7.32	57.70%	7.32	12.7	5.2	-73.7	#N/A	#N/A	#N/A	4	0	-68.2	-58	2.5	#N/A
GEOFC3INF	3/21/13 12:20	13035202-738	7.97	5.34	50.08%	5.34	10.7	12.4	-77.1	#N/A	220	0.035	6	<2	-72.4	-67.3	2.5	#N/A
GEOFC3INF	5/15/13 4:15		7.67	5.34	52.91%	5.34	10.1	14.9	-58.2	#N/A	#N/A	#N/A	4	<2	-56	-52.4	2.5	#N/A
GEOFC3INF	5/15/13 10:15	13055330- 543	7.72	5.29	53.92%	5.29	9.8	16.2	-68.2	#N/A	50	0.14	<2	<2	-61.4	-60.7	2.5	#N/A
GEOFC3INF	6/12/13 2:50		7.36	6.23	63.90%	6.23	9.8	16.5	-46	#N/A	#N/A	#N/A	<2	<2	-47.7	-28.9	3	#N/A
GEOFC3INF	6/12/13 10:00	13065414-975	7.57	5.67	62.25%	5.67	9.1	19.8	-60.9	#N/A	40	0.14	3	<2	-57.2	-56.1	3	#N/A
GEOFC3INF	11/7/13 4:30		6.76	11.14	84.00%	11.14	13.3	3.5	121.4	#N/A	#N/A	#N/A	low	0	121.3	121.5	1	#N/A
GEOFC3INF	11/7/13 11:15	13115739-260	6.84	9.09	72.60%	9.09	12.5	5.7	117.8	68	56	0.007	55	0	116	115.1	1	#N/A
GEOFC3INF	4/1/14 3:45		7.44	8.04	66.66%	8.04	12.1	7.2	83.1	#N/A	#N/A	#N/A	low	0	83.1	83.5	2	#N/A
GEOFC3INF	4/23/14 4:30		7.28	9.52	89.70%	9.52	10.6	12.6	90.6	#N/A	#N/A	#N/A	5	0	93.4	90.3	3	#N/A
GEOFC3INF	4/23/14 11:00	14046106-062	7.42	6.51	64.40%	6.51	10.1	14.8	86.4	260	68	0.007	low	0	90	91.4	1	#N/A
GEOFC3INF	5/15/14 3:45		6.84	10.26	89.92%	10.26	11.4	9.5	120.4	#N/A	#N/A	#N/A	#N/A	0	117.2	118	1	#N/A
GEOFC3INF	5/15/14 10:03	sampling team returned to measure NO3, etc.	#N/A	#N/A	#N/A	#N/A	11.1	10.7	106.8	#N/A	#N/A	#N/A	10	#N/A	#N/A	#N/A	#N/A	#N/A
GEOFC3INF	5/15/14 13:16		7	8.2	77.77%	8.2	10.5	12.90	112	890	35	0.007	5	0	111.7	111.9	1	#N/A
GEOFC3INF	8/14/14 14:09		7.31	5.22	61.44%	5.22	8.5	23.4	101.2	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
GEOFC3INF	9/16/14 10:35		7.28	5.86	61.23%	5.86	9.6	17.4	86.6	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
GEOFC3INF	10/30/14 12:10		6.89	6.33	57.36%	6.33	11.0	10.9	110.2	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
GEOFC3INF	12/9/14 13:15		7.29	6.85	53.73%	6.85	12.8	5.0	101.4	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
GEOFC3INF	1/15/15 13:20		6.84	8.12	61.70%	8.12	13.2	3.8	124.9	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
GEOFC3INF	3/12/15 11:00		6.89	6.94	56.40%	6.94	12.3	6.4	122.8	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
GEOFC3INF	10/30/15 12:07	15107471-355	6.92	8.16	70.82%	8.16	11.5	9.1	188	#N/A	#N/A	#N/A	0	0	178	245	1	#N/A
GEOFC3INF	11/20/15 11:56	15117518-469	7.29	8.18	62.82%	8.18	13.0	4.2	245	730	170	0.007	0	0	243	240	1	#N/A
GEOFC3INF	12/22/15 12:00	15127565-095	7.10	8.55	62.75%	8.55	13.6	2.5	201	1000	120	0.007	0	0	200	198	<1	#N/A
GEOFC3INF	1/28/16 12:00	16017617-075	7.01	5.86	43.72%	5.86	13.4	3.1	201	44	98	0.007	0	0	198	195	1	#N/A
GEOFC3INF	2/29/16 11:50		7.22	8.10	66.49%	8.10	12.2	6.8	198	82	170	0.007	0	0	197	243	1	#N/A
GEOFC3INF	3/29/16 10:40	16037714-925	7.12	9.56	73.41%	9.56	13.0	4.2	226	790	30	0.007	#N/A	#N/A	223	223	1	#N/A
GEOFC3INF	5/6/16 11:10	16047775-689	7.7	6.01	61.64%	6.01	9.8	16.5	225	180	50	0.007	0	0	223	221	1	#N/A
GEOFC3INF	6/9/16 11:42	16067860-492	8.1	4.60	54.14%	4.60	8.5	23.4	152	760	54	0.007	10	0	151	-14	1	#N/A
GEOFC3INF	7/7/16 0:00	Dry	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
GEOFC3INF	3/2/17 0:00	17028281-226	7.6	6.62	59.43%	6.62	11.1	10.5	198	150	260	0.007	0	0	176	210	1	#N/A
GEOFC3INF	4/11/17 12:29	17048405-233	7.7	7.70	76.13%	7.70	10.1	14.8	172	150	170	0.007	0	0	176	73	2	#N/A
GEOFC3INF	5/15/17 12:14	17048461-640	7.2	5.70	61.30%	5.70	9.3	18.8	18	110	73	0.007	0	0	16	92	2	#N/A
GEOFC3INF	6/14/17 8:43	17068579-098	7.5	2.40	25.18%	2.40	9.5	17.6	116	280	35	0.007	0	0	107	102	2	#N/A
GEOFC3INF	11/29/17 11:12	17118797-142	7.2	#N/A	#N/A	#N/A	12.5	5.8	115	310	130	0.007	0	0	119	221	1	#N/A
GEOFC3INF	12/28/17 9:48	17128825-005	7.8	4.67	37.66%	4.67	12.4	6.1	230	630	130	0.014	0.5	0	227	122	1	#N/A
GEOFC3INF	1/29/18 10:40	RFS01-12.1801001-002	7.6	5.39	44.58%	5.39	12.1	7.1	201	72	130	0.007	0	0	200	32	2	#N/A
GEOFC3INF	3/1/18 9:45	RFS01-12.1803002-002	7.6	6.14	49.64%	6.14	12.4	6.2	225	80	110	0.007	0	0	221	234	1	#N/A
GEOFC3INF	3/22/18 12:26	RFS01-12.1803003-002	7.8	7.09	64.40%	7.09	11.0	11.0	183	69	84	0.007	0	0	160	99	1	#N/A
GEOFC3INF	4/19/18 10:26	RFS01-13.1804004-002	7.9	7.04	63.79%	7.04	11.0	10.9	146	110	84	0.007	0	0	148	179	1	#N/A
GEOFC3INF	5/23/18 12:45	RFS01-12.1805005-002	8	7.04	73.56%	7.04	9.6	17.4	66	170	42	0.007	0	0	70	-20	1	#N/A
GEOFC3INF	3/21/19 10:50	RFS01-12.1903007-002	7.7	#N/A	#N/A	#N/A	10.3	13.9	188	730	96	0.077	0	0	181	169	1	#N/A
GEOFC3INF	4/23/19 12:35	RFS01-12.1904008-002	7.7	8.34	78.21%	8.34	10.7	12.4	149	66	63	0.042	0	0	135	138	2	#N/A
GEOFC3INF	5/22/19 11:10	RFS01-12.1905009-002	8	8.19	67.90%	8.19	12.1	7.2	99	450	28	0.022	0	0	97	42	2	#N/A
GEOFC3INF	6/24/19 11:00	RFS01-12.1906010-002	7.6	6.05	60.21%	6.05	10.0	15.1	144	370	20	0.022	0	0	32	-28	2	#N/A

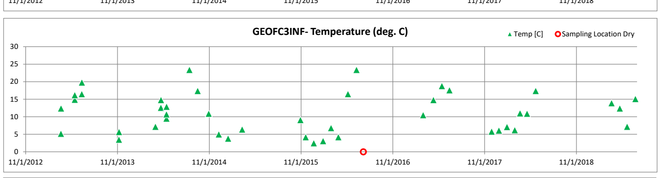
*** Dissolved Oxygen calculations were performed using Table 3.4 of Applications of Environmental Aquatic Chemistry, 3rd Edition by Eugene Weiner (linear interpolation used for 2021 report)*

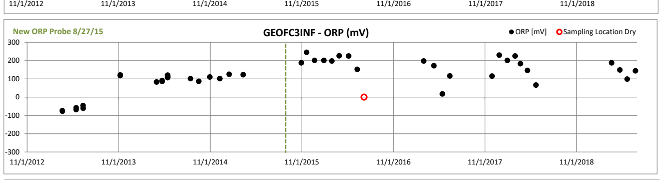
Water Column - GEOFC3INF

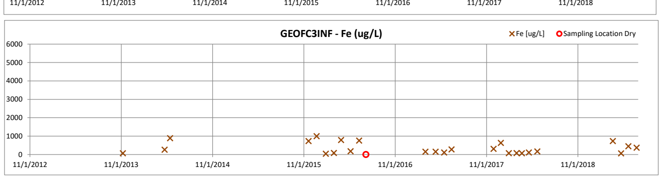


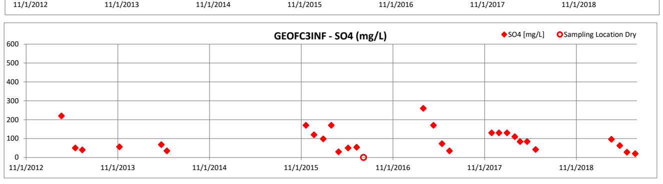


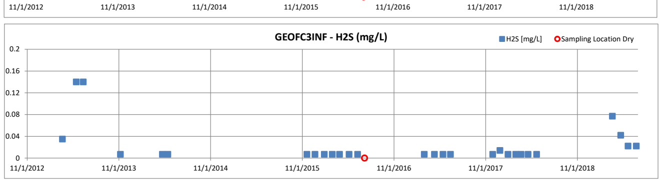


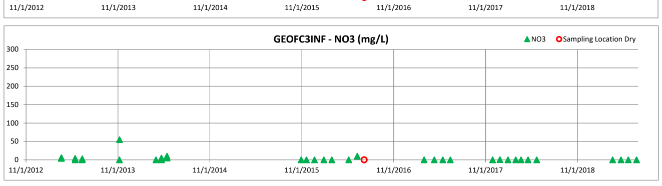


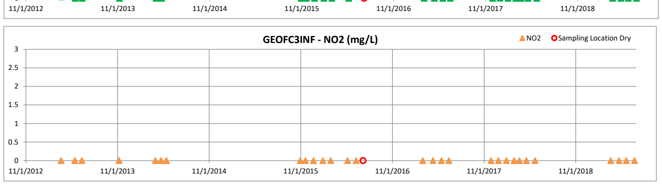




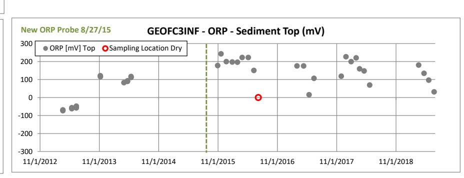








Sediment - GEOFC3INF



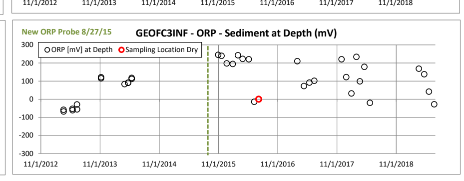


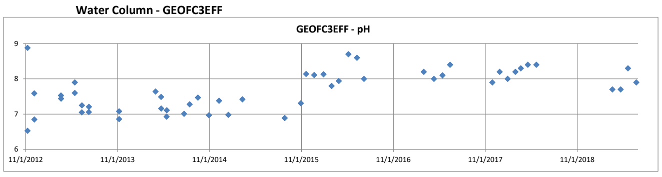
Figure H.2

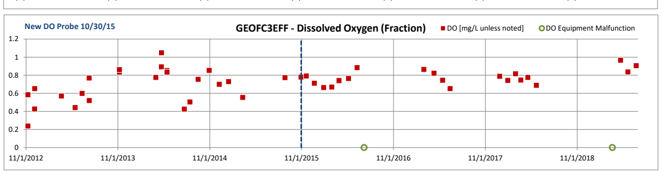
North Walnut Creek - GEOFC3EFF - Water Quality and Sediment Data

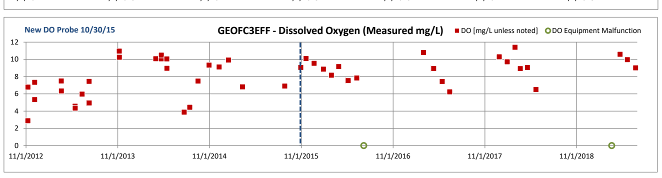
			Water Column												Sediment			
Location	DateTime Sampled	RIN-Tik	pH	DO [mg/L unless noted]	DO %	DO Measured mg/L	DO Saturated mg/L	Temp [C]	ORP [mV]	Fe [ug/L]	SO4 [mg/L]	H2S [mg/L]	NO3	NO2	ORP [mV] Top	ORP [mV] at Depth	ORP Depth [cm]	Uranium [mg/kg]
GEOFC3EFF	11/8/12 5:20		6.53	2.88	23.82%	2.88	12.1	7.1	-21.7	#N/A	#N/A	#N/A	7	0	-17.4	-27.6	4	#N/A
GEOFC3EFF	11/8/12 10:45	12114959-604	8.88	6.78	58.42%	6.78	11.6	8.8	-67.5	820	160	0.021	<2	0	-87.2	-87.2	4	2.8
GEOFC3EFF	12/5/12 5:40		7.59	5.34	42.63%	5.34	12.5	5.7	-31.6	#N/A	#N/A	#N/A	4	0	-31.2	-26	6	#N/A
GEOFC3EFF	12/5/12 11:15	12125014-216	6.85	7.34	65.28%	7.34	11.2	10.1	-29.3	4850	175	0.007	6	0	-26.7	-25	6	#N/A
GEOFC3EFF	3/21/13 4:20		7.53	7.49	57.22%	7.49	13.1	4.0	-46	#N/A	#N/A	#N/A	3	0	-46.1	-37.3	4	#N/A
GEOFC3EFF	3/21/13 12:15	13035202-739	7.44	6.34	57.05%	6.34	11.1	10.6	-59.7	#N/A	150	0.035	5	<2	-46.2	-37.3	6	#N/A
GEOFC3EFF	5/15/13 4:25		7.60	4.57	44.60%	4.57	10.2	14.2	-62.2	#N/A	#N/A	#N/A	13	<2	-64.8	-66.8	6	#N/A
GEOFC3EFF	5/15/13 10:25	13055330- 544	7.90	4.34	44.33%	4.34	9.8	16.3	-77.5	#N/A	56	0.140	<2	<2	-75.1	-72.4	6	#N/A
GEOFC3EFF	6/12/13 3:10		7.05	5.97	59.94%	5.97	10.0	15.5	-29.3	#N/A	#N/A	#N/A	<2	0	-32.3	-33.1	4	#N/A
GEOFC3EFF	6/12/13 10:20	13065414-976	7.25	#N/A	#N/A	#N/A	9.5	17.8	-40.1	#N/A	69	0.140	<2	<2	-37.7	-35.4	4	#N/A
GEOFC3EFF	7/10/13 4:10		7.06	7.45	77.00%	7.45	9.7	16.9	-26.6	#N/A	#N/A	#N/A	#N/A	#N/A	-28.3	-26.8	2	#N/A
GEOFC3EFF	7/10/13 10:30	13075490-837	7.21	4.95	52.00%	4.95	9.5	17.7	-37.8	#N/A	150	0.007	4	<2	-32.7	-28.7	2	#N/A
GEOFC3EFF	11/7/13 4:20		6.86	10.96	83.5%	10.96	13.1	3.9	118.4	#N/A	#N/A	#N/A	69	0	118.7	119.5	4	#N/A
GEOFC3EFF	11/7/13 11:40	13115739-261	7.08	10.25	86.2%	10.25	11.9	7.8	105.6	1500	65	0.007	0	0	107.2	110.1	4	#N/A
GEOFC3EFF	4/1/14 4:00		7.64	10.08	77.6%	10.08	13.0	4.3	76.5	#N/A	#N/A	#N/A	low	0	77.1	77.9	4	#N/A
GEOFC3EFF	4/23/14 4:20		7.49	10.06	89.3%	10.06	11.3	10.0	84.4	#N/A	#N/A	#N/A	11	0	84.8	85.5	3	#N/A
GEOFC3EFF	4/23/14 11:30	14046106-063	7.16	10.49	104.9%	10.49	10.0	15.3	76.4	290	68	0.007	14	2	83.8	89.9	2	#N/A
GEOFC3EFF	5/15/14 3:50		6.93	10.06	85.24%	10.06	11.8	8.1	116.5	#N/A	#N/A	#N/A	#N/A	0	116.8	117.5	4	#N/A
GEOFC3EFF	5/15/14 10:30		#N/A	#N/A	#N/A	#N/A	11.1	10.7	111.5	#N/A	#N/A	#N/A	28	#N/A	#N/A	#N/A	#N/A	#N/A
GEOFC3EFF	5/15/14 13:35		7.11	8.96	83.46%	8.96	10.7	12.1	105.5	#N/A	#N/A	#N/A	30	0	105.5	104	2	#N/A
GEOFC3EFF	7/23/14 10:03		7.01	3.88	42.60%	3.88	9.1	19.8	116.6	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
GEOFC3EFF	8/14/14 14:21		7.28	4.44	50.50%	4.44	8.8	21.6	101.6	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
GEOFC3EFF	9/16/14 10:45		7.47	7.48	75.43%	7.48	9.9	15.7	78.9	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
GEOFC3EFF	10/30/14 12:30		6.97	9.33	85.32%	9.33	10.9	11.3	105.7	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
GEOFC3EFF	12/9/14 13:25		7.38	9.12	70.04%	9.12	13.0	4.2	96.0	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
GEOFC3EFF	1/15/15 13:30		6.98	9.92	73.01%	9.92	13.6	2.6	116.4	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
GEOFC3EFF	3/12/15 11:20		7.42	6.82	55.42%	6.82	12.3	6.4	93.8	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
GEOFC3EFF	8/27/15 11:18	15087301-327	6.89	6.90	77.38%	6.90	8.9	20.9	62	15000	140	0.015	16	0.049	63	79	3	#N/A
GEOFC3EFF	10/30/15 12:30	15107471-352	7.31	9.06	78.06%	9.06	11.6	8.8	-14	1900	150	0.007	5	0	-11	#N/A	#N/A	#N/A
GEOFC3EFF	11/20/15 12:15	15117518-467	8.14	10.10	79.22%	10.10	12.8	5.0	18	1500	130	0.007	10	0	47	112	3	#N/A
GEOFC3EFF	12/22/15 12:24	15127565-093	8.11	9.54	71.17%	9.54	13.4	3.1	-20	1400	100	0.007	10	0	55	-57	3	#N/A
GEOFC3EFF	1/28/16 12:20	16017617-073	8.13	8.86	66.44%	8.86	13.3	3.3	-7	680	160	0.007	5	0	-18	32	2	#N/A
GEOFC3EFF	2/29/16 12:05		7.80	8.16	66.98%	8.16	12.2	6.8	6	#N/A	#N/A	#N/A	25	0	24	41	2	#N/A
GEOFC3EFF	3/29/16 10:55	16037714-923	7.94	9.17	74.14%	9.17	12.4	6.2	83	590	36	0.007	#N/A	#N/A	89	96	1	#N/A
GEOFC3EFF	5/6/16 11:45	16047775-687	8.70	7.54	76.38%	7.54	9.9	15.9	-39	240	56	0.007	100	0	-20	59	1	#N/A
GEOFC3EFF	6/9/16 11:25	16067860-493	8.60	7.84	88.45%	7.84	8.9	21.2	66	6800	79	0.007	250	0	9	62	1	#N/A
GEOFC3EFF	7/7/16 10:13	16077930-272	8.00	#N/A	#N/A	#N/A	8.9	21.2	-70	3700	110	0.2	250	3	-16	26	1	#N/A
GEOFC3EFF	3/2/17 0:00	17028281-227	8.20	10.80	86.44%	10.80	12.5	5.8	-29	350	250	0.007	0	0	-26	#N/A	rip rap grout	#N/A
GEOFC3EFF	4/11/17 10:45	17048405-234	8.00	8.94	82.32%	8.94	10.9	11.6	-71	180	130	0.007	0-10	0	-75	concrete	#N/A	#N/A
GEOFC3EFF	5/15/17 12:52	17048461-641	8.10	7.44	74.53%	7.44	10.0	15.4	46	200	64	0.007	0	0	no sediment	#N/A	#N/A	#N/A
GEOFC3EFF	6/14/17 9:11	17068579-099	8.40	6.24	65.20%	6.24	9.6	17.4	-13	250	45	0.007	0	0	-20	concrete	#N/A	#N/A
GEOFC3EFF	11/29/17 11:39	17118797-143	7.90	#N/A	#N/A	#N/A	12.2	6.6	-58	470	140	0.007	0	0	-79	-65	2	#N/A
GEOFC3EFF	12/28/17 10:17	17128825-006	8.20	10.30	78.89%	10.30	13.1	4.1	-24	57	140	0.0093	0	0	-43	-207	2	#N/A
GEOFC3EFF	1/29/18 11:00	RFS01-12.1801001-001	8.00	9.72	74.26%	9.72	13.1	4.0	-28	760	140	0.007	0	0	45	-140	1	#N/A
GEOFC3EFF	3/1/18 10:05	RFS01-12.1803002-001	8.20	11.40	81.65%	11.40	14.0	1.6	#N/A	26	140	0.007	0	0	#N/A	#N/A	NA	#N/A
GEOFC3EFF	3/22/18 10:45	RFS01-12.1803003-001	8.30	8.93	74.75%	8.93	11.9	7.6	136	27	75	0.007	0	0	145	#N/A	NA	#N/A
GEOFC3EFF	4/19/18 10:41	RFS01-13.1804004-001	8.40	9.05	77.60%	9.05	11.7	8.6	28	160	83	0.007	0	0	37	#N/A	NA	#N/A
GEOFC3EFF	5/23/18 13:44	RFS01-12.1805005-001	8.40	6.50	68.92%	6.50	9.4	18.1	117	120	34	0.007	25	0	111	#N/A	NA	#N/A
GEOFC3EFF	3/21/19 11:25	RFS01-12.1903007-001	7.7	#N/A	#N/A	#N/A	10.3	13.9	14	22	78	0.049	0	0	15	117	1	#N/A
GEOFC3EFF	4/23/19 10:40	RFS01-12.1904008-001	7.7	10.59	96.62%	10.59	11.0	11.2	114	99	67	0.042	0	0	143	-41	2	#N/A
GEOFC3EFF	5/22/19 11:35	RFS01-12.1905009-001	8.3	9.97	83.66%	9.97	11.9	7.7	82	140	29	0.002	0	0	61	-15	2	#N/A
GEOFC3EFF	6/24/19 11:40	RFS01-12.1906010	7.9	9.02	90.56%	9.02	10.0	15.5	64	29	22	0.022	0	0	48	45	1	#N/A

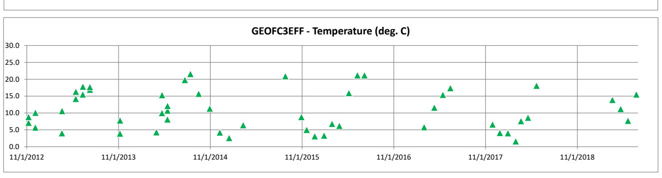
*** Dissolved Oxygen calculations were performed using Table 3.4 of Applications of Environmental Aquatic Chemistry, 3rd Edition by Eugene Weiner (linear interpolation used for 2021 report)*

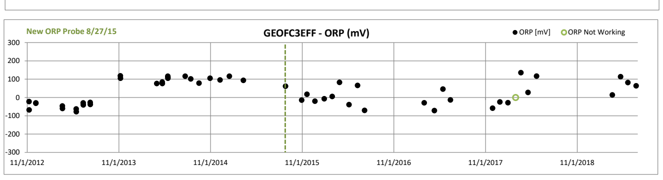
Water Column - GEOFC3EFF

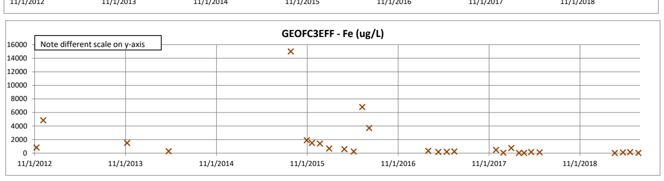


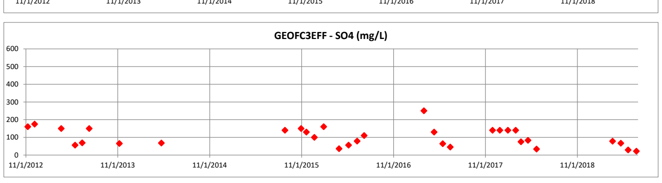


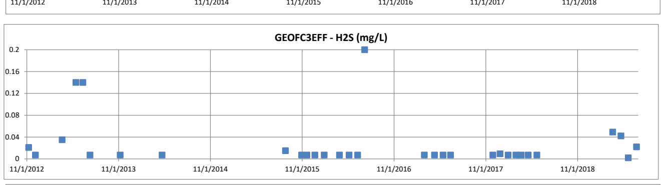


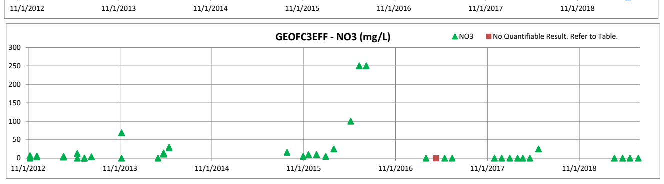


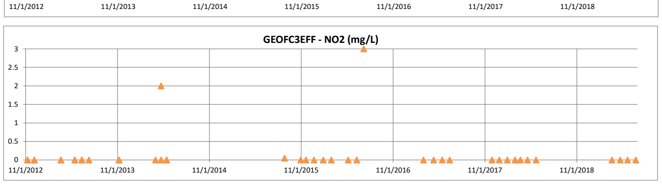




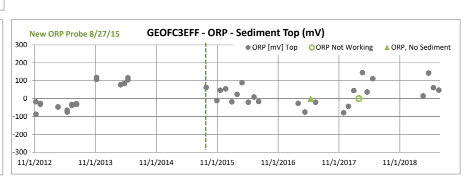








Sediment - GEOFC3EFF



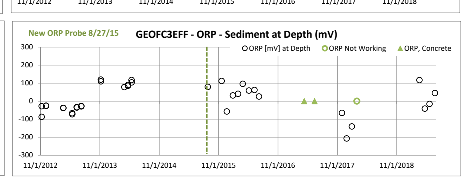


Figure H.3

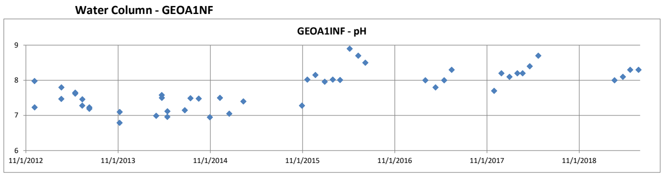
North Walnut Creek - GEOA1INF - Water Quality and Sediment Data

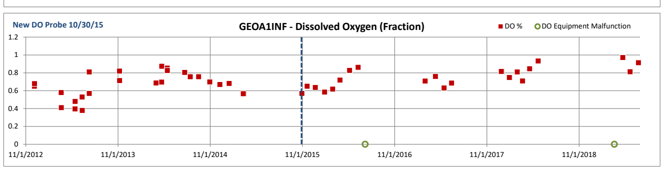
			Water Column													Sediment			
Location	DateTime Sampled	RIN-Tik	pH	DO [mg/L unless noted]	DO %	DO Measured mg/L	DO Saturated mg/L	Temp [C]	ORP [mV]	Fe [ug/L]	SO4 [mg/L]	H2S [mg/L]	NO3	NO2	ORP [mV] Top	ORP [mV] at Depth	ORP Depth [cm]	Uranium [mg/kg]
GEOA1INF	11/8/12 9:50	12114959-614	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	2.35
GEOA1INF	12/5/12 5:50		7.98	7.94	65.01%	7.94	12.2	6.7	-38.6	#N/A	#N/A	#N/A	High	<2	-39.8	-37.6	6	#N/A
GEOA1INF	12/5/12 11:30	12125014-228	7.23	8.15	67.89%	8.15	12.0	7.4	-35.5	25	300	0.007	High	0	-35	-34.4	6	#N/A
GEOA1INF	3/21/13 4:35		7.47	7.72	57.89%	7.72	13.3	3.3	-53.9	#N/A	#N/A	#N/A	49	<2	-53	-54.8	6	#N/A
GEOA1INF	3/21/13 12:40	13035202-740	7.80	4.96	41.02%	4.96	12.1	7.1	-62.4	#N/A	180	0.035	High	<2	-59.2	-53.7	6	#N/A
GEOA1INF	5/15/13 4:40		7.62	4.21	39.66%	4.21	10.6	12.6	-60.3	#N/A	#N/A	#N/A	32	<2	-58.7	-46.7	7	#N/A
GEOA1INF	5/15/13 10:40	13055330- 545	7.65	4.87	48.05%	4.87	10.1	14.7	-62.4	#N/A	58	0.007	30	<2	-57.4	-59.4	6	#N/A
GEOA1INF	6/12/13 3:15		7.28	5.35	53.01%	5.35	10.1	14.9	-40.7	#N/A	#N/A	#N/A	34	2	-30.9	-33	6	#N/A
GEOA1INF	6/12/13 10:40	13065414-977	7.46	3.79	37.97%	3.79	10.0	15.4	-51.9	#N/A	68	0.14	30	<2	-47	-45.7	3	#N/A
GEOA1INF	7/10/13 4:20		7.23	7.6707	81.00%	7.6707	9.5	17.9	-32.6	#N/A	#N/A	#N/A	15	2	-27.2	-23.1	6	#N/A
GEOA1INF	7/10/13 10:45	13075490-838	7.19	5.26737	57.00%	5.26737	9.2	19.1	-36.4	#N/A	91	0.007	18	2	-32.2	-30.2	4	#N/A
GEOA1INF	11/7/13 3:30		6.79	10.99	82.00%	10.99	13.4	3.1	119.8	#N/A	#N/A	#N/A	High	0	119.6	119.4	3	#N/A
GEOA1INF	11/7/13 12:00	13115739-267	7.10	8.84	71.30%	8.84	12.4	6.1	104.4	22	75	0.007	High	0	106.5	107.7	3	#N/A
GEOA1INF	4/1/14 4:15		6.99	9.21	68.71%	9.21	13.4	3.1	102.9	#N/A	#N/A	#N/A	82	0	100.4	96.1	6	#N/A
GEOA1INF	4/23/14 3:40		7.58	8.25	69.60%	8.25	11.9	7.9	79.3	#N/A	#N/A	#N/A	High	0	81.7	82.9	8	#N/A
GEOA1INF	4/23/14 11:50	14046106-069	7.50	8.96	87.40%	8.96	10.2	14.2	82.4	44	81	0.007	76	0	84.9	85.3	2	#N/A
GEOA1INF	5/15/14 3:55		6.96	10.37	85.34%	10.37	12.2	6.9	114.1	#N/A	#N/A	#N/A	not working	0	117.5	116.9	6	#N/A
GEOA1INF	5/15/14 10:53		#N/A	#N/A	#N/A	#N/A	10.9	11.6	107.3	#N/A	#N/A	#N/A	40	#N/A	#N/A	#N/A	#N/A	#N/A
GEOA1INF	5/15/14 13:47		7.12	8.4	82.69%	8.4	10.2	14.6	104.8	#N/A	#N/A	#N/A	51	0	105.2	104.7	4	#N/A
GEOA1INF	7/23/14 10:08		7.15	7.41	80.52%	7.41	9.2	19.3	109.4	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
GEOA1INF	8/14/14 14:29		7.49	7.02	75.65%	7.02	9.3	18.9	90	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
GEOA1INF	9/16/14 10:51		7.48	7.50	75.64%	7.50	9.9	15.7	76.2	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
GEOA1INF	10/30/14 12:40		6.95	7.97	69.85%	7.97	11.4	9.5	106.7	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
GEOA1INF	12/9/14 13:35		7.50	8.84	67.00%	8.84	13.2	3.7	91.9	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
GEOA1INF	1/15/15 13:40		7.05	9.31	68.15%	9.31	13.7	2.4	114.2	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
GEOA1INF	3/12/15 11:30		7.40	6.88	56.62%	6.88	12.2	6.9	96.1	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
GEOA1INF	10/30/15 12:55	15107471-356	7.28	6.54	56.90%	6.54	11.5	9.2	138	87	190	0.007	250	0	141	148	1	#N/A
GEOA1INF	11/20/15 12:35	15117518-470	8.02	8.31	65.00%	8.31	12.8	4.9	146	83	150	0.007	20	0	144	156	2	#N/A
GEOA1INF	12/22/15 12:41	15127565-096	8.15	8.71	63.58%	8.71	13.7	2.3	150	22	130	0.007	100	0	154	160	1	#N/A
GEOA1INF	1/28/16 12:30	16017617-076	7.96	8.20	58.41%	8.20	14.0	1.4	196	36	170	0.007	250	0	185	183	1	#N/A
GEOA1INF	2/29/16 12:20		8.02	7.43	61.75%	7.43	12.0	7.3	140	#N/A	#N/A	#N/A	100	0	140	175	3	#N/A
GEOA1INF	3/29/16 11:15	16037714-926	8.01	9.05	71.88%	9.05	12.6	5.5	150	550	40	0.007	#N/A	#N/A	149	157	3	#N/A
GEOA1INF	5/6/16 12:40	16047775-690	8.90	8.12	82.77%	8.12	9.8	16.2	136	150	63	0.007	175	0	135	150	1	#N/A
GEOA1INF	6/9/16 11:10	16067860-496	8.70	7.79	86.21%	7.79	9.0	20.2	191	65	96	0.007	250	0	190	185	1	#N/A
GEOA1INF	7/7/16 10:30	16077930-275	8.50	#N/A	#N/A	#N/A	7.9	27.7	103	4300	130	0.007	250	0	107	105	2	#N/A
GEOA1INF	3/2/17 0:00	17028281-230	8.00	8.67	70.81%	8.67	12.2	6.6	101	50	250	0.007	50	0	107	201	1	#N/A
GEOA1INF	4/11/17 11:01	17048405-237	7.80	8.43	76.03%	8.43	11.1	10.7	191	110	160	0.007	50-100	0	186	218	1	#N/A
GEOA1INF	5/15/17 14:00	17048461-643	8.00	6.19	63.09%	6.19	9.8	16.2	55	94	77	0.007	10-25	0	63	72	2	#N/A
GEOA1INF	6/14/17 10:00	17068579-102	8.30	6.63	68.56%	6.63	9.7	16.9	111	52	59	0.007	2.3-5.6	0-2	108	145	2--3	#N/A
GEOA1INF	11/29/17 12:12	17118797-146	7.70	#N/A	#N/A	#N/A	12.3	6.3	141	84	140	0.007	50	0	143	190	2	#N/A
GEOA1INF	12/28/17 10:40	17128825-009	8.20	10.90	81.53%	10.90	13.4	3.2	76	250	150	0.007	10	0	78	122	1	#N/A
GEOA1INF	1/29/18 11:17	RFS01-12.1801001-003	8.10	10.00	74.79%	10.00	13.4	3.2	100	140	160	0.007	5--10	0	102	104	2	#N/A
GEOA1INF	3/1/18 10:27	RFS01-12.1803002-003	8.20	10.80	80.99%	10.80	13.3	3.3	209	22	160	0.007	0	0	207	101	2	#N/A
GEOA1INF	3/22/18 11:05	RFS01-12.1803003-003	8.20	8.45	70.91%	8.45	11.9	7.7	158	38	110	0.007	0	0	160	176	0.5	#N/A
GEOA1INF	4/19/18 11:01	RFS01-13.1804004-003	8.40	9.94	84.62%	9.94	11.7	8.3	112	290	100	0.007	25	0	135	142	1	#N/A
GEOA1INF	5/23/18 14:00	RFS01-12.1805005-003	8.70	8.67	93.25%	8.67	9.3	18.8	130	181	43	0.007	25	0	131	156	3	#N/A
GEOA1INF	3/21/19 11:50	RFS01-12.1903007-003	8	#N/A	#N/A	#N/A	10.5	13.3	142	190	110	0.045	0	0	141	153	1	#N/A
GEOA1INF	4/23/19 11:10	RFS01-12.1904008-003	8.1	10.18	97.19%	10.18	10.5	13.2	128	65	50	0.046	0	0	110	204	2	#N/A
GEOA1INF	5/22/19 11:45	RFS01-12.1905009-003	8.3	9.43	81.25%	9.43	11.6	8.8	107	210	38	0.022	0	0	101	110	2	#N/A
GEOA1INF	6/24/19 11:55	RFS01-12.1906010	8.3	8.69	91.38%	8.69	9.5	17.7	-22	120	31	0.022	0	0	74	-22	2	#N/A

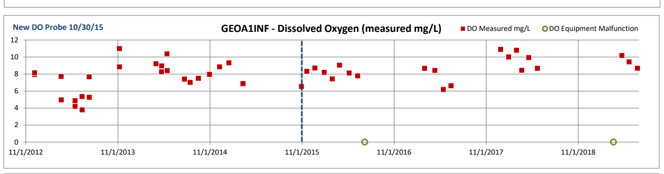
*** Dissolved Oxygen calculations were performed using Table 3.4 of Applications of Environmental Aquatic Chemistry, 3rd Edition by Eugene Weiner (linear interpolation used for 2021 report)*

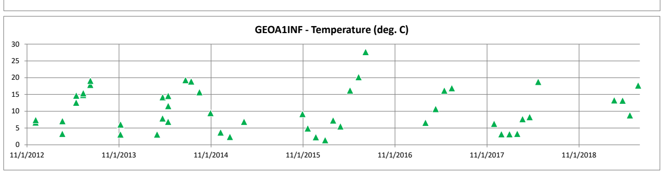
Water Column - GEOA1INF

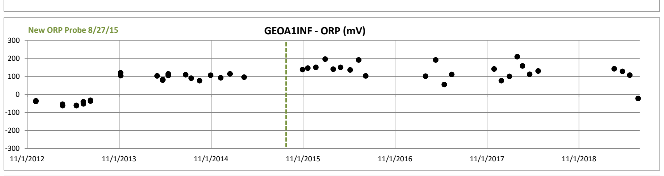
Sediment - GEOA1INF

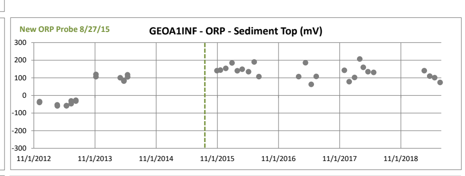


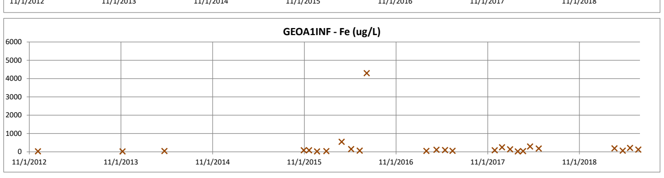


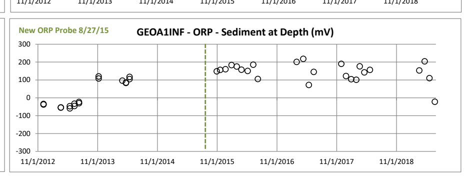


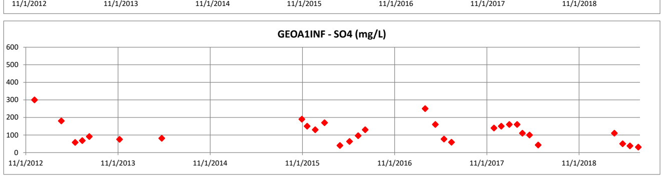


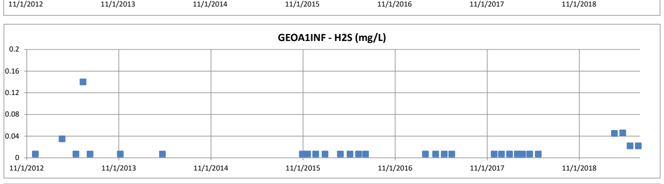


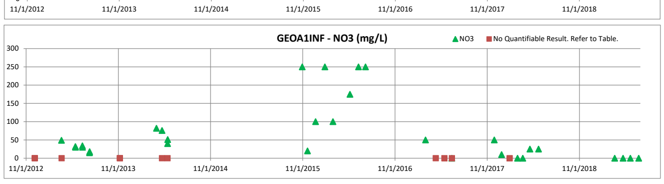












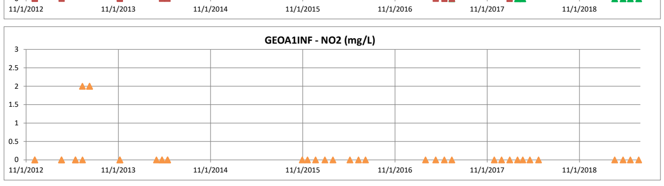


Figure H.4

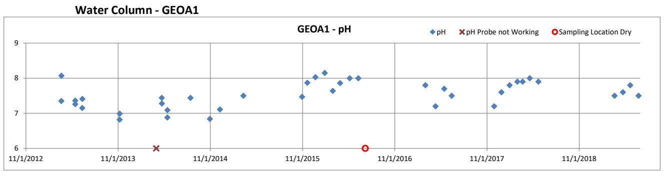
North Walnut Creek - GEOA1 - Water Quality and Sediment Data

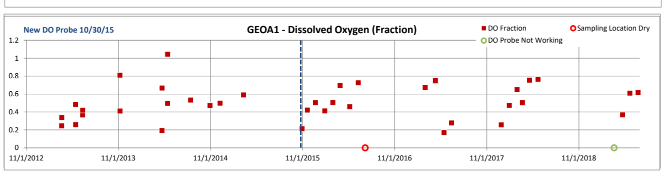
			Water Column												Sediment			
Location	DateTime Sampled	RIN-Tik	pH	DO [mg/L unless noted]	DO %	DO Measured mg/L	DO Saturated mg/L	Temp [C]	ORP [mV]	Fe [ug/L]	SO4 [mg/L]	H2S [mg/L]	NO3	NO2	ORP [mV] Top	ORP [mV] at Depth	ORP Depth [cm]	Uranium [mg/kg]
GEOA1	11/8/12 9:45	12114959-613	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	6.5
GEOA1	3/21/13 4:45		7.35	3.42	24.56%	3.42	13.924	1.7	-41.2	#N/A	#N/A	#N/A	32	<2	-39.7	-43.5	4	#N/A
GEOA1	3/21/13 12:35	13035202-741	8.07	3.78	33.85%	3.78	11.166	10.4	-85.6	#N/A	240	0.035	32	27	-67.9	-59.2	4	#N/A
GEOA1	5/15/13 4:55		7.36	5.32	48.54%	5.32	10.960	11.2	-38.7	#N/A	#N/A	#N/A	20	<2	-44.9	-39.2	5	#N/A
GEOA1	5/15/13 10:55	13055330- 546	7.26	2.77	25.92%	2.77	10.688	12.3	-48.7	#N/A	60	0.14	17	<2	-36.9	-33.8	2.5	#N/A
GEOA1	6/12/13 3:34		7.15	3.78	36.65%	3.78	10.313	13.9	-29.6	#N/A	#N/A	#N/A	<2	<2	-30.2	-20.3	4	#N/A
GEOA1	6/12/13 10:50	13065414-978	7.41	4.21	41.99%	4.21	10.026	15.2	-51.5	#N/A	64	0.14	6	<2	-41.4	-39.1	3	#N/A
GEOA1	11/7/13 3:20		6.82	11.71	81.10%	11.71	14.436	0.4	121.5	#N/A	#N/A	#N/A	55	0	122.1	123.4	2	#N/A
GEOA1	11/7/13 12:10	13115739-263	6.99	5.47	41.10%	5.47	13.300	3.4	112.3	5300	74	0.007	70	0	114.3	111.2	2	#N/A
GEOA1	4/1/14 4:30	pH probe not working after initial samples	#N/A	#N/A	#N/A	#N/A	13.886	1.8	#N/A	#N/A	#N/A	#N/A	56	0	#N/A	#N/A	#N/A	#N/A
GEOA1	4/23/14 3:30		7.44	2.38	19.40%	2.38	12.244	6.6	89.2	#N/A	#N/A	#N/A	79	0	89.1	91.1	2	#N/A
GEOA1	4/23/14 12:00	14046106-065	7.28	6.69	66.70%	6.69	10.026	15.2	95.5	120	92	0.007	High	0	96.5	97.6	2	#N/A
GEOA1	5/15/14 4:05		6.88	6.41	49.74%	6.41	12.886	4.6	120.6	#N/A	#N/A	#N/A	instrument not working	0	118.8	119.1	3	#N/A
GEOA1	5/15/14 11:07		#N/A	#N/A	#N/A	#N/A	10.640	12.5	112	#N/A	#N/A	#N/A	28	#N/A	#N/A	#N/A	#N/A	#N/A
GEOA1	5/15/14 14:00		7.09	10.04	104.47%	10.04	9.610	17.2	106.8	#N/A	#N/A	#N/A	50	0	106.4	108.8	4	#N/A
GEOA1	8/14/14 14:35		7.44	4.74	53.37%	4.74	8.882	21.1	92.7	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
GEOA1	10/30/14 12:45		6.84	5.46	47.27%	5.46	11.550	9.0	113.7	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
GEOA1	12/9/14 13:40		7.11	7.02	49.87%	7.02	14.076	1.3	113.4	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
GEOA1	3/12/15 11:38		7.50	7.12	59.03%	7.12	12.062	7.2	89.1	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
GEOA1	10/30/15 13:04	15107471-357	7.47	2.58	21.34%	2.58	12.091	7.1	171	33	200	0.007	100	2	173	173	<1	#N/A
GEOA1	11/20/15 12:50	15117518-471	7.87	5.59	42.14%	5.59	13.265	3.5	199	130	140	0.14	100	0	194	204	<1	#N/A
GEOA1	12/22/15 12:53	15127565-097	8.03	6.93	50.32%	6.93	13.773	2.1	172	22	140	0.007	100	0	171	155	<1	#N/A
GEOA1	1/28/16 13:10	16017617-077	8.15	5.76	41.14%	5.76	14.000	1.5	220	22	170	0.007	100	0	218	#N/A	<1	#N/A
GEOA1	2/29/16 12:30		7.64	6.23	50.75%	6.23	12.275	6.5	202	#N/A	#N/A	#N/A	100	0	195	197	<1	#N/A
GEOA1	3/29/16 11:25	16037714-927	7.86	8.91	69.70%	8.91	12.784	4.9	174	1000	40	0.007	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
GEOA1	5/6/16 12:26	16047775-691	8.00	4.89	45.75%	4.89	10.688	12.3	193	74	63	0.007	100	0	128	119	1	#N/A
GEOA1	6/9/16 11:00	16067860-497	8.00	6.58	72.55%	6.58	9.070	20.0	215	190	90	0.007	250	0	215	#N/A	riprap	#N/A
GEOA1	7/7/16 0:00	Dry	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
GEOA1	3/2/17 0:00	17028281-231	7.80	8.33	67.18%	8.33	12.399	6.1	206	60	90	0.007	50	0	201	#N/A	lots of algae	#N/A
GEOA1	4/11/17 11:16	17048405-238	7.20	8.43	75.15%	8.43	11.218	10.2	208	80	140	0.007	50	0	195	rocks	#N/A	#N/A
GEOA1	5/15/17 14:10	17048461-644	7.70	1.79	17.17%	1.79	10.428	13.4	129	89	74	0.007	0-10	0	115	105	2	#N/A
GEOA1	6/14/17 10:17	17068579-103	7.50	2.65	27.81%	2.65	9.530	17.6	162	230	54	0.007	0	0	159	137	0.5	#N/A
GEOA1	11/29/17 12:33	17118797-147	7.20	#N/A	#N/A	#N/A	12.182	6.8	199	35	130	0.007	25	0	202	#N/A	N/A	#N/A
GEOA1	12/28/17 11:00	17128825-010	7.60	3.52	25.63%	3.52	13.736	2.2	150	64	150	0.017	2--5	0	144	#N/A	N/A	#N/A
GEOA1	1/29/18 13:30	RFS01-12.1801001-004	7.80	6.26	47.57%	6.26	13.160	3.8	151	38	140	0.007	10	0	154	#N/A	N/A	#N/A
GEOA1	3/1/18 10:49	RFS01-12.1803002-004	7.90	8.90	64.79%	8.90	13.736	2.2	164	28	160	0.007	0	0	167	#N/A	NA	#N/A
GEOA1	3/22/18 12:08	RFS01-12.1803003-004	7.90	5.98	50.43%	5.98	11.859	7.9	202	68	100	0.007	0	0	198	#N/A	NA	#N/A
GEOA1	4/19/18 11:17	RFS01-13.1804004-004	8.00	8.96	75.55%	8.96	11.859	7.9	217	170	99	0.007	10	0	121	#N/A	NA	#N/A
GEOA1	5/23/18 14:26	RFS01-12.1805005-004	7.90	7.04	76.66%	7.04	9.184	19.4	136	110	39	0.007	10	0	139	#N/A	NA	#N/A
GEOA1	3/21/19 12:05	RFS01-12.1903007-004	7.5	#N/A	#N/A	#N/A	11.298	9.9	126	31	99	0.045	0	0	134	141	2	#N/A
GEOA1	4/23/19 11:40	RFS01-12.1904008-004	7.6	4.16	36.73%	4.16	11.326	9.8	178	150	79	0.042	0	0	182	161	1	#N/A
GEOA1	5/22/19 12:05	RFS01-12.1905009-004	7.8	7.43	60.99%	7.43	12.182	6.8	101	150	41	0.022	0	0	107	104	1	#N/A
GEOA1	6/24/19 11:15	RFS01-12.1906010	7.5	6.23	61.46%	6.23	10.136	14.7	140	130	28	0.022	0	0	120	117	1	#N/A

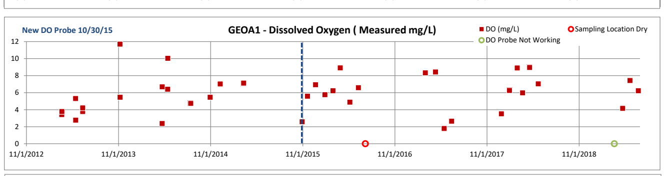
*** Dissolved Oxygen calculations were performed using Table 3.4 of Applications of Environmental Aquatic Chemistry, 3rd Edition by Eugene Weiner (linear interpolation used for 2021 report)*

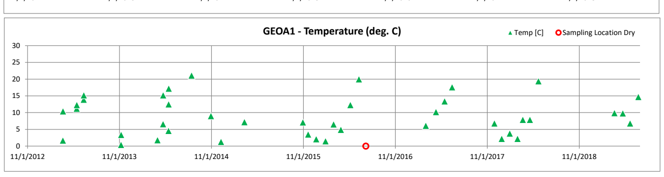
Water Column - GEOA1

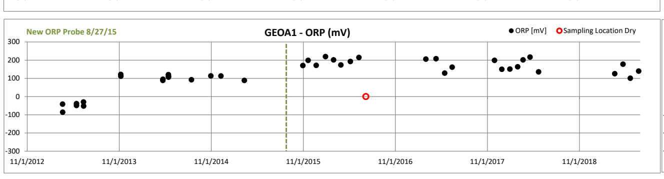
Sediment - GEOA1

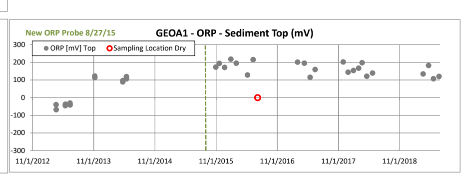


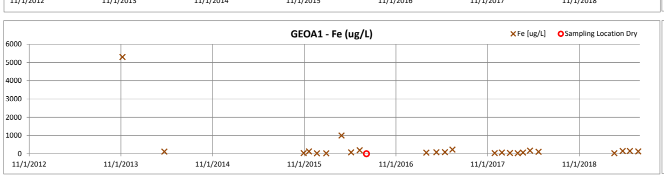


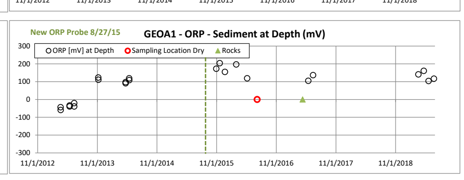


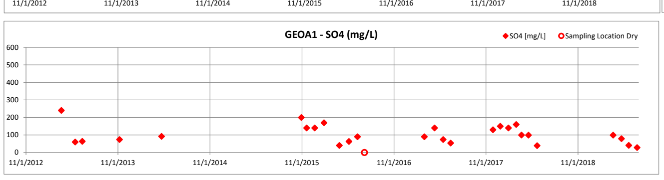


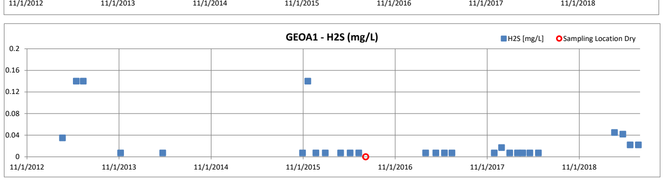


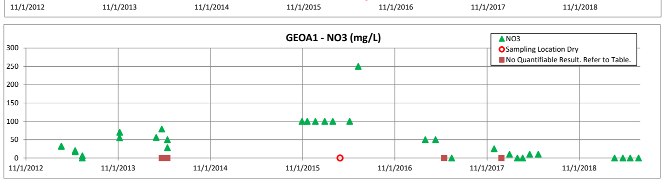












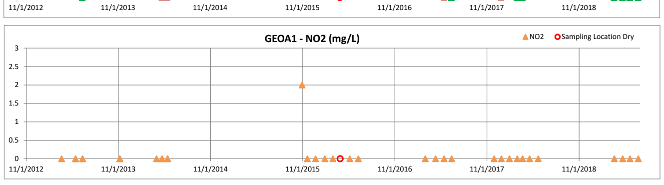


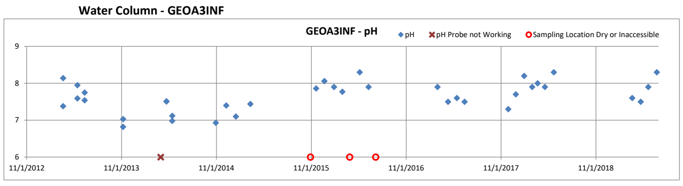
Figure H.5

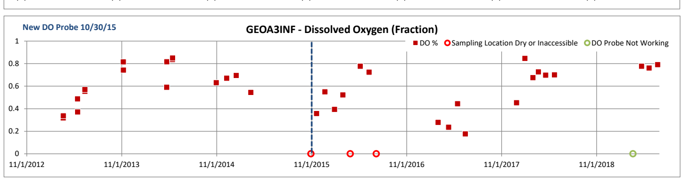
North Walnut Creek - GEOA3INF - Water Quality and Sediment Data

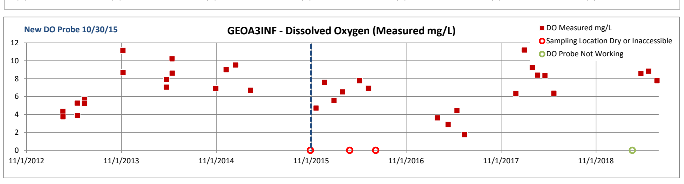
			Water Column												Sediment			
Location	DateTime Sampled	RIN-Tik	pH	DO [mg/L unless noted]	DO %	DO Measured mg/L	DO Saturated mg/L	Temp [C]	ORP [mV]	Fe [ug/L]	SO4 [mg/L]	H2S [mg/L]	NO3	NO2	ORP [mV] Top	ORP [mV] at Depth	ORP Depth [cm]	Uranium [mg/kg]
GEOA3INF	11/8/12 9:35	12114959-609	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	3
GEOA3INF	3/21/13 5:05		7.38	4.33	31.87%	4.33	13.6	2.6	-45.4	#N/A	#N/A	#N/A	15	<2	-44.3	-44.6	3	#N/A
GEOA3INF	3/21/13 12:40	13035202-742	8.14	3.74	33.73%	3.74	11.1	10.7	-88.8	#N/A	350	0.035	12	<2	-89.3	-90.2	5	#N/A
GEOA3INF	5/15/13 5:10		7.59	5.27	48.75%	5.27	10.8	11.8	-58.9	#N/A	#N/A	#N/A	31	<2	-58.8	-58.1	5	#N/A
GEOA3INF	5/15/13 11:05	13055330- 547	7.95	3.87	37.11%	3.87	10.4	13.4	-80.1	#N/A	70	0.007	31	<2	-79.2	-74.7	4	#N/A
GEOA3INF	6/12/13 3:55		7.54	5.67	55.46%	5.67	10.2	14.3	-53.6	#N/A	#N/A	#N/A	<2	0	-60.6	-58	3.5	#N/A
GEOA3INF	6/12/13 11:00	13065414-979	7.75	5.21	57.08%	5.21	9.1	19.7	-69.4	#N/A	110	0.14	4	<2	-65.6	-60.7	2	#N/A
GEOA3INF	11/7/13 3:45		6.82	11.15	81.60%	11.15	13.7	2.4	119.4	#N/A	#N/A	#N/A	50	0	119.4	117.9	3	#N/A
GEOA3INF	11/7/13 12:20	13115739-264	7.03	8.71	74.30%	8.71	11.7	8.4	107.9	1100	80	0.007	#N/A	0	111	112.7	3	#N/A
GEOA3INF	4/1/14 4:45	pH Probe not Working	#N/A	#N/A	#N/A	#N/A	13.3	3.4	#N/A	#N/A	#N/A	#N/A	20	0	#N/A	#N/A	#N/A	#N/A
GEOA3INF	4/23/14 3:55		7.51	7.06	59.10%	7.06	11.9	7.6	84.1	#N/A	#N/A	#N/A	17	0	84.7	86.2	3	#N/A
GEOA3INF	4/23/14 12:15	14046106-066	7.51	7.88	81.70%	7.88	9.7	17	78.7	3100	90	0.007	88	1	79.2	83.3	5	#N/A
GEOA3INF	5/15/14 4:10		6.98	10.21	83.60%	10.21	12.2	6.7	115	#N/A	#N/A	#N/A	#N/A	0	114.6	115.7	4	#N/A
GEOA3INF	5/15/14 11:12		#N/A	#N/A	#N/A	#N/A	10.7	12.4	112	#N/A	#N/A	#N/A	35	#N/A	#N/A	#N/A	#N/A	#N/A
GEOA3INF	5/15/14 14:10		7.12	8.62	85.04%	8.62	10.1	14.7	105	#N/A	#N/A	#N/A	50	0	107.4	108.8	6	#N/A
GEOA3INF	10/30/14 12:55		6.93	6.92	63.14%	6.92	11.0	11.2	108.1	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
GEOA3INF	12/9/14 13:50		7.40	8.99	67.06%	8.99	13.4	3.1	94.9	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
GEOA3INF	1/15/15 14:00		7.10	9.53	69.57%	9.53	13.7	2.3	111.6	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
GEOA3INF	3/12/15 11:46		7.44	6.71	54.53%	6.71	12.3	6.4	95.9	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
GEOA3INF	10/30/15 0:00	dry	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
GEOA3INF	11/20/15 13:00	15117518-472	7.86	4.72	35.77%	4.72	13.2	3.7	219	400	180	0.007	50	0	220	219	1	#N/A
GEOA3INF	12/22/15 13:08	15127565-098	8.06	7.60	55.03%	7.60	13.8	2.0	184	69	160	0.007	100	0	181	185	<1	#N/A
GEOA3INF	1/28/16 13:25	16017617-072	7.90	5.58	39.43%	5.58	14.2	1.1	202	45	180	0.007	250	0	197	#N/A	<1	#N/A
GEOA3INF	2/29/16 12:40		7.77	6.52	52.32%	6.52	12.5	5.9	173	#N/A	#N/A	#N/A	250	0	170	154	1	#N/A
GEOA3INF	3/29/16 0:00	Could Not Access; too snowy and steep	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
GEOA3INF	5/6/16 12:15	16047775-686	8.30	7.76	77.74%	7.76	10.0	15.4	175	44	64	0.007	100	0	174	#N/A	0	#N/A
GEOA3INF	6/9/16 10:50	16067860-495	7.90	6.93	72.41%	6.93	9.6	17.4	212	52	100	0.007	100	0	201	#N/A	riprap	#N/A
GEOA3INF	7/7/16 0:00	Dry	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
GEOA3INF	3/2/17 0:00	17028281-229	7.90	3.62	27.87%	3.62	13.0	4.3	88	30	230	0.007	25	0	94	#N/A	#N/A	#N/A
GEOA3INF	4/11/17 11:30	17048405-236	7.50	2.88	23.63%	2.88	12.2	6.8	160	22	160	0.007	25-50	0	162	concrete	#N/A	#N/A
GEOA3INF	5/15/17 14:19	17048461-642	7.60	4.46	44.48%	4.46	10.0	15.2	133	71	84	0.007	0	0	133	112	2	#N/A
GEOA3INF	6/14/17 10:34	17068579-101	7.50	1.74	17.70%	1.74	9.8	16.1	91	240	69	0.007	0	0	88	58	1--2	#N/A
GEOA3INF	11/29/17 12:50	17118797-145	7.30	#N/A	#N/A	#N/A	12.6	5.6	194	190	140	0.007	0	0	191	102	3	#N/A
GEOA3INF	12/28/17 12:04	17128825-008	7.70	6.35	45.36%	6.35	14.0	1.5	167	420	160	0.007	5	0	158	127	0.5	#N/A
GEOA3INF	1/29/18 13:38	RFS01-12.1801001-006	8.20	11.20	84.66%	11.20	13.2	3.6	163	62	170	0.007	5	0	152	95	1.5	#N/A
GEOA3INF	3/1/18 11:02	RFS01-12.1803002-006	7.90	9.26	67.60%	9.26	13.7	2.3	176	39	170	0.007	0	0	177	#N/A	#N/A	#N/A
GEOA3INF	3/22/18 11:55	RFS01-12.1803003-006	8.00	8.40	72.73%	8.40	11.6	9.0	155	190	130	0.007	0	0	160	172	0.5	#N/A
GEOA3INF	4/19/18 11:32	RFS01-13.1804004-006	7.90	8.38	69.81%	8.38	12.0	7.4	195	190	130	0.007	0	0	198	#N/A	#N/A	#N/A
GEOA3INF	5/23/18 14:19	RFS01-12.1805005-006	8.30	6.38	70.05%	6.38	9.1	19.8	133	220	46	0.007	0	0	137	#N/A	#N/A	#N/A
GEOA3INF	3/21/19 12:25	RFS01-12.1903007-006	7.6	#N/A	#N/A	#N/A	10.7	12.4	143	26	120	0.041	0	0	146	#N/A	#N/A	#N/A
GEOA3INF	4/23/19 11:50	RFS01-12.1904008-006	7.5	8.56	77.75%	8.56	11.0	11.0	142	90	92	0.042	0	0	135	77	1	#N/A
GEOA3INF	5/22/19 12:15	RFS01-12.1905009-006	7.9	8.84	76.17%	8.84	11.6	8.8	112	200	48	0.022	0	0	107	104	1	#N/A
GEOA3INF	6/24/19 11:30	RFS01-12.1906010	8.3	7.76	79.10%	7.76	9.8	16.2	114	290	35	0.022	0	0	20	-32	1	#N/A

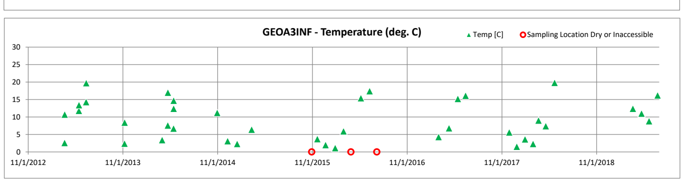
*** Dissolved Oxygen calculations were performed using Table 3.4 of Applications of Environmental Aquatic Chemistry, 3rd Edition by Eugene Weiner (linear interpolation used for 2021 report)*

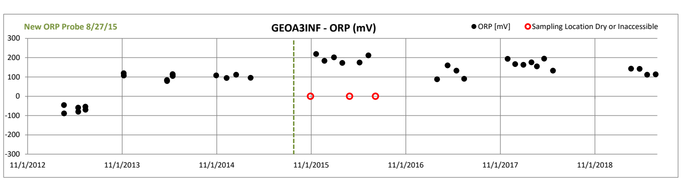
Water Column - GEOA3INF

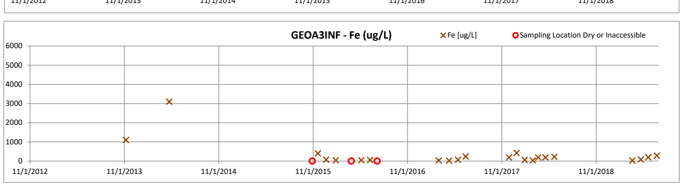


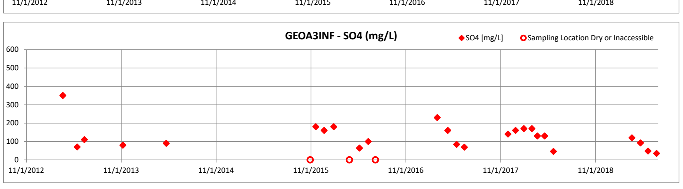


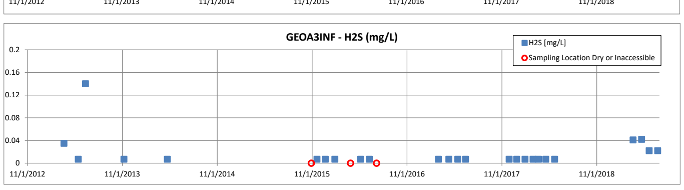


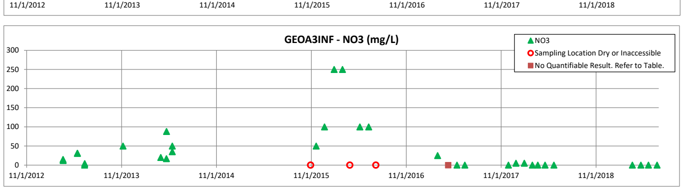


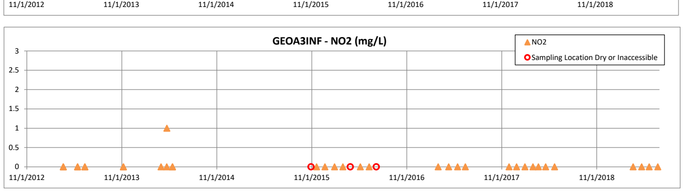




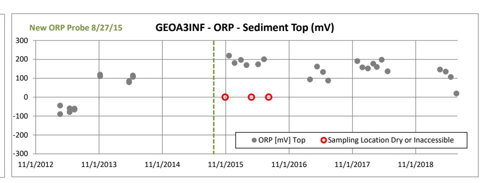


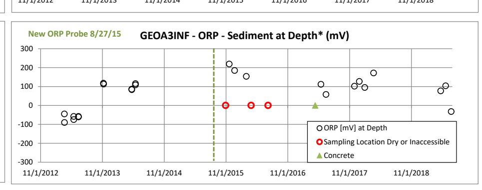






Sediment - GEOA3INF





*Water level too high to take ORP at depth 3/21/19

Figure H.6

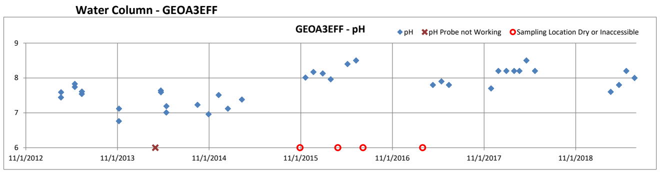
North Walnut Creek - GEOA3EFF - Water Quality and Sediment Data

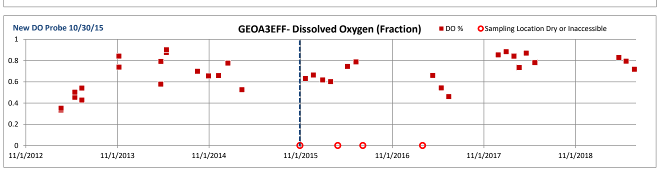
			Water Column												Sediment			
Location	DateTime Sampled	RIN-Tik	pH	DO [mg/L unless noted]	DO %	DO Measured mg/L	DO Saturated mg/L	Temp [C]	ORP [mV]	Fe [ug/L]	SO4 [mg/L]	H2S [mg/L]	NO3	NO2	ORP [mV] Top	ORP [mV] at Depth	ORP Depth [cm]	Uranium [mg/kg]
GEOA3EFF	11/8/12 9:20	12114959-610	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	7
GEOA3EFF	3/21/13 5:15		7.44	4.42	33.41%	4.42	13.2	3.6	-50	#N/A	#N/A	#N/A	11	<2	-48.4	-46.8	3	#N/A
GEOA3EFF	3/21/13 12:50	13035202-743	7.59	4.21	35.16%	4.21	12.0	7.5	-59.8	#N/A	540	0.035	<2	<2	-60.4	-63.2	3	#N/A
GEOA3EFF	5/15/13 5:00		7.74	4.79	45.43%	4.79	10.5	12.9	-67.6	#N/A	#N/A	#N/A	40	<2	-66.7	-63.7	3	#N/A
GEOA3EFF	5/15/13 11:15	13055330- 548	7.83	5.19	50.21%	5.19	10.3	13.8	-73.4	#N/A	85	0.007	27	<2	-69.7	-65.4	4	#N/A
GEOA3EFF	6/12/13 3:45		7.54	5.43	54.16%	5.43	10.0	15.2	-34	#N/A	#N/A	#N/A	6	0	-36.8	-56.3	2.5	#N/A
GEOA3EFF	6/12/13 11:20	13065414-980	7.61	3.84	42.82%	3.84	9.0	20.6	-62.7	#N/A	140	0.14	6	<2	-51.2	-49.4		#N/A
GEOA3EFF	11/7/13 3:40		6.76	11.82	84.2%	11.82	14.0	1.4	118	#N/A	#N/A	#N/A	#N/A	0	117.6	118.1	5	#N/A
GEOA3EFF	11/7/13 12:30	13115739-265	7.12	9.15	73.8%	9.15	12.4	6.1	103.4	37	93	0.007	70	0	104.5	106.8	5	#N/A
GEOA3EFF	4/1/14 5:00		#N/A	#N/A	#N/A	#N/A	12.6	5.6	#N/A	#N/A	#N/A	#N/A	57	0	#N/A	#N/A	#N/A	#N/A
GEOA3EFF	4/23/14 3:45		7.64	6.36	57.80%	6.36	11.0	11	75.3	#N/A	#N/A	#N/A	61	0	75.8	81.7	3	#N/A
GEOA3EFF	4/23/14 12:30	14046106-067	7.59	7.80	79.30%	7.80	9.8	16.1	75.3	69	110	0.007	79	0	75.1	84.9	1	#N/A
GEOA3EFF	5/15/14 4:20		7.01	10.45	87.69%	10.45	11.9	7.7	112.8	#N/A	#N/A	#N/A	#N/A	0	112.4	116.5	4	#N/A
GEOA3EFF	5/15/14 11:18		#N/A	#N/A	#N/A	#N/A	10.5	13	105.2	#N/A	#N/A	#N/A	28	#N/A	#N/A	#N/A	#N/A	#N/A
GEOA3EFF	5/15/14 14:20		7.19	8.65	90.20%	8.65	9.6	17.3	100.5	#N/A	#N/A	#N/A	10	0	103.3	105.9	2	#N/A
GEOA3EFF	9/16/14 11:10		7.23	6.58	69.91%	6.58	9.4	18.2	82.5	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
GEOA3EFF	10/30/14 13:05		6.96	7.39	65.57%	7.39	11.3	10.0	106.1	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
GEOA3EFF	12/9/14 13:55		7.51	8.53	65.85%	8.53	13.0	4.4	88.9	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
GEOA3EFF	1/15/15 14:05		7.12	10.49	77.62%	10.49	13.5	2.8	109.8	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
GEOA3EFF	3/12/15 11:58		7.38	6.34	52.56%	6.34	12.1	7.2	95.4	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
GEOA3EFF	10/30/15 0:00	Dry	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
GEOA3EFF	11/20/15 13:30	15117518-473	8.01	8.38	63.17%	8.38	13.3	3.5	222	72	320	0.007	100	0	223	223	1	#N/A
GEOA3EFF	12/22/15 13:22	15127565-099	8.17	9.13	66.47%	9.13	13.7	2.2	175	24	200	0.007	100	0	174	174	<1	#N/A
GEOA3EFF	1/28/16 13:40	16017617-074	8.13	8.72	61.78%	8.72	14.1	1.2	200	22	210	0.007	250	0	198	192	1	#N/A
GEOA3EFF	2/29/16 12:52		7.96	7.33	60.17%	7.33	12.2	6.8	176	#N/A	#N/A	#N/A	50	0	174	183	2	#N/A
GEOA3EFF	3/29/16 0:00	Could Not Access; too snowy and steep	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
GEOA3EFF	5/6/16 12:02	16047775-688	8.40	7.06	74.55%	7.06	9.5	17.9	124	84	71	0.007	75	0	127	141	2	#N/A
GEOA3EFF	6/9/16 10:38	16067860-494	8.50	6.85	78.84%	6.85	8.7	22.2	152	70	110	0.007	50	0	155	184	2	#N/A
GEOA3EFF	7/7/16 0:00	Dry	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
GEOA3EFF	3/2/17 0:00	Dry	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
GEOA3EFF	4/11/17 11:48	17048405-235	7.80	7.24	66.06%	7.24	11.0	11.2	178	22	210	0.007	0-10	0	178	181	2	#N/A
GEOA3EFF	5/15/17 14:31	17048461-647	7.90	5.24	54.30%	5.24	9.7	17.0	145	47	94	0.007	0	0	144	138	2	#N/A
GEOA3EFF	6/14/17 10:52	17068579-100	7.80	4.16	46.04%	4.16	9.0	20.2	127	81	75	0.007	0	0	125	186	2--3	#N/A
GEOA3EFF	11/29/17 13:16	17118797-144	7.70	#N/A	#N/A	#N/A	11.7	8.4	207	380	200	0.007	0	0	211	219	1	#N/A
GEOA3EFF	12/28/17 11:45	17128825-007	8.20	11.70	85.41%	11.70	13.7	2.3	193	480	200	0.007	0	0	195	205	1	#N/A
GEOA3EFF	1/29/18 12:51	RFS01-12.1801001-005	8.20	11.10	88.39%	11.10	12.6	5.6	154	890	160	0.007	0.5	0	130	161	1	#N/A
GEOA3EFF	3/1/18 11:20	RFS01-12.1803002-005	8.20	11.10	84.12%	11.10	13.2	3.7	170	22	180	0.007	0	0	172	191	4	#N/A
GEOA3EFF	3/22/18 9:59	RFS01-12.1803003-005	8.20	8.22	73.45%	8.22	11.2	10.3	185	25	140	0.007	0	0	181	114	3	#N/A
GEOA3EFF	4/19/18 11:58	RFS01-13.1804004-005	8.50	9.61	87.08%	9.61	11.0	10.9	154	63	130	0.007	0	0	68	-24	2	#N/A
GEOA3EFF	5/23/18 13:08	RFS01-12.1805005-005	8.20	7.04	78.06%	7.04	9.0	20.3	130	94	50	0.007	0	0	132	-70	1	#N/A
GEOA3EFF	3/21/19 12:40	RFS01-12.1903007-005	7.6	#N/A	#N/A	#N/A	10.3	14.0	157	22	160	0.045	0	0	155	158	1	#N/A
GEOA3EFF	4/23/19 12:05	RFS01-12.1904008-005	7.8	8.79	82.99%	8.79	10.6	12.7	141	40	110	0.038	0	0	143	158	2	#N/A
GEOA3EFF	5/22/19 12:35	RFS01-12.1905009-005	8.2	9.26	79.40%	9.26	11.7	8.6	105	340	63	0.022	25	0	107	115	2	#N/A
GEOA3EFF	6/24/19 10:35	RFS01-12.1906010	8	6.95	71.87%	6.95	9.7	16.9	194	93	38	0.022	0	0	135	-42	2	#N/A

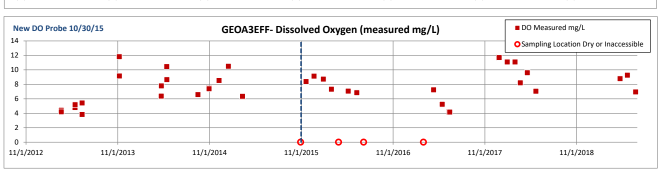
*** Dissolved Oxygen calculations were performed using Table 3.4 of Applications of Environmental Aquatic Chemistry, 3rd Edition by Eugene Weiner (linear interpolation used for 2021 report)*

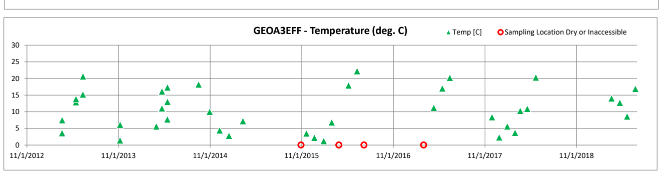
Water Column - GEOA3EFF

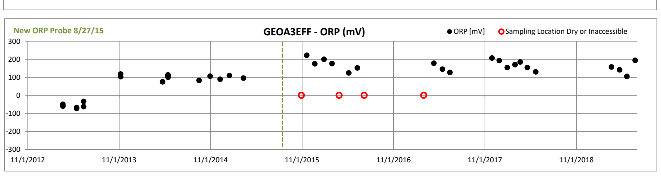
Sediment - GEOA3EFF

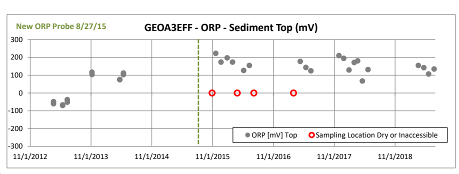


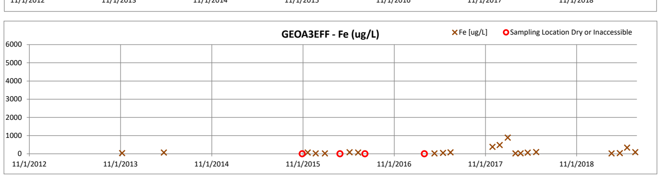


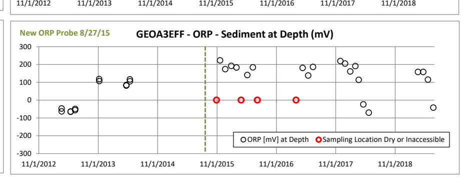


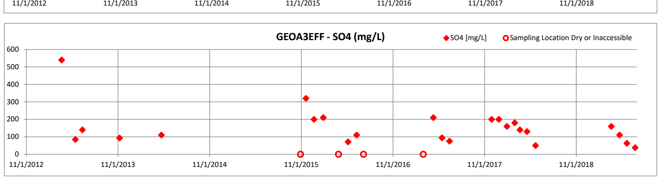


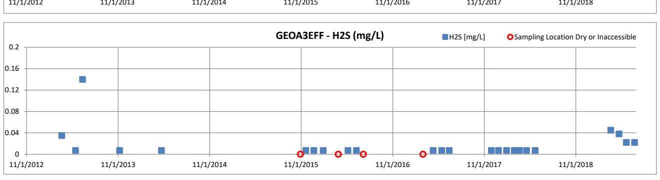


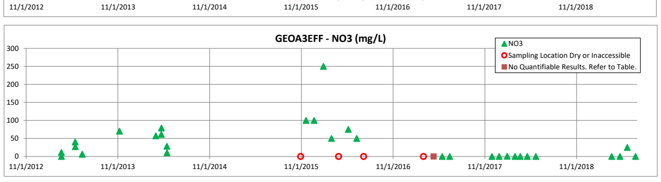












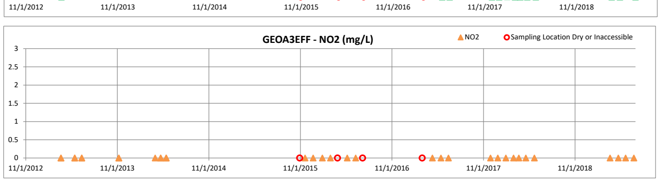


TABLE H.1
NORTH WALNUT CREEK – GEOFC3INF
GEOCHEMICAL DATA ANALYSIS SUMMARY

SUMMARY COMMENT:
No trends were determined for the GEOFC3INF sampling location.

GEOFCINF was dry on the 07/07/16 sampling event.

Parameter	Date Interval	Comments	
pH	03/21/13 – 06/24/19	av.: 7.42; max.: 8.10; min.: 6.76; No trend.	
DO (% sat) Values considered high or low depend on temp.	03/21/13 – 06/24/19	av.: 62.4%; max.: 89.9%; min.: 25.2%; No trend.	
SO_4 (mg/L)	03/21/13 – 06/24/19	av.: 93.4; max.: 260; min.: 20; No trend. There was no data collected between 08/14/14 – 10/30/15.	
NO_3 (mg/L)	03/21/13 – 06/24/19	max.: 55; min.: non-detect (0)	Only 1 high value (55) occurring on 11/7/13. Then all low values, unlike other sampling points.

Table H.2
NORTH WALNUT CREEK – GEOFC3 EFF
GEOCHEMICAL DATA ANALYSIS SUMMARY

SUMMARY COMMENT:

On/Before 07/10/13:

- Minimal diurnal changes ⇨ Little wetland activity
- Low DO saturation ⇨ reducing conditions

On/After 11/07/13:

- Higher DO saturation ⇨ oxidizing conditions.

Consistent with an upgradient oxidation source and/or loss of reducing conditions (e.g., increased DO in base flow, high flow-initiated streambed sediment movement, streambed scouring of decaying vegetation, increased NO3 from solar ponds, etc.), potentially with increased U mobility sometime after 07/10/13. Some support for this from SO4 and NO3 data.

Parameter	Date Interval	Comments	
pH	11/08/12 – 06/24/19	av.: 7.67; max.: 8.88; min.: 6.53; No trend.	
DO (% sat) Values considered high or low depend on Temp.	11/08/12 – 07/10/13	av.: 52.9%; max.: 77.0%; min.: 23.8% Early morn & afternoon both low; indicates low DO with no significant wetland activity.	
	11/07/13 – 06/24/19	av.: 77.1%; max.: 104.9%; min.: 42.6% Early morn & afternoon both high; indicates oxidizing conditions from a new upgradient oxidation source. Increased U mobility. There was 1 instance where the % sat was greater than 100 % (04/23/14). It is likely that the measured super saturated value may be unreliable. DO equipment malfunction on 7/7/16.	
SO_4 (mg/L)	11/08/12 – 06/24/19	av.: 102.8; max.: 250; min.: 22; No trend. There was no data collected between 05/14/14 – 03/12/15.	
NO_3 (mg/L)	11/08/12 – 06/24/19	max.: 250; min.: non-detect (0)	No conclusions. The data is highly variable.

TABLE H.3
NORTH WALNUT CREEK - GEOA1INF
GEOCHEMICAL DATA ANALYSIS SUMMARY

SUMMARY COMMENT:
On/Before 07/10/13:

- Minimal diurnal changes ⇨ Little wetland activity
- Low DO saturation ⇨ reducing conditions

On/After 11/07/13:

- Higher DO saturation ⇨ oxidizing conditions

Consistent with an upgradient oxidation source and/or loss of reducing conditions (e.g., increased DO in base flow, high flow-initiated streambed sediment movement, streambed scouring of decaying vegetation, increased NO3 from solar ponds, etc.), potentially with increased U mobility sometime after 07/10/13. Some support for this from SO4 and NO3 data.

Parameter	Date Interval	Comments
pH	12/05/12 – 06/24/19	av.: 7.75; max.: 8.90; min.: 6.79; No trend.
DO (% sat) Values considered high or low depend on Temp.	12/05/12 – 07/10/13	av.: 54.9%; max.: 81%; min.: 38.0% Early morn & afternoon both low to fairly low; indicates low ORP & little wetland activity.
	11/07/13 – 06/24/19	av.: 74.9%; max.: 97.2%; min.: 56.6% Early morn & afternoon both high; indicates an upgradient oxidation source. Increased U mobility. DO equipment malfunction 7/7/16.
SO4 (mg/L)	12/05/12 – 06/24/19	av.: 115; max.: 300; min.: 31; No trend. There was no data collected between 05/14/14 – 03/12/15.
NO3 (mg/L)	12/05/12 – 06/24/19	max.: 250*; min.: non-detect (0) *"High" result recorded on 12/5/12, 3/21/13, 11/7/13, and 4/23/14. No observable trends – the data is highly variable. There was no data collected from 07/23/14-03/12/15.

Table H.4
NORTH WALNUT CREEK – GEOA1
GEOCHEMICAL DATA ANALYSIS SUMMARY

SUMMARY COMMENT:
No trends were determined for the GEOA1 sampling location.

GEOA1 was dry on 07/07/16 sampling event.

Parameter	Date Interval	Comments
pH	03/21/13 – 06/24/19	av.: 7.54; max.: 8.15; min.: 6.82; No trend.
DO (% sat) Values considered high or low depend on temp.	03/21/13 – 06/24/19	av.: 50.4%; max.: 104.5%; min.:17.2%; No trend. The DO (% sat) records at this location are highly variable. There was 1 instance where the % sat was greater than 100 % (05/15/14). It is likely that the measured super saturated value may be unreliable. pH probe not working 4/1/14.
SO_4 (mg/L)	03/21/13 – 06/24/19	av.: 104; max.: 240; min.: 28; No trend. There was no data collected between 05/14/14 – 03/12/15.
NO_3 (mg/L)	03/21/13 – 06/24/19	max.: 250*; min.: non-detect (0) *"High" recorded on 4/23/14. No observable trends – the data is highly variable. There was no data collected from 08/14/14-03/12/15.

Table H.5
NORTH WALNUT CREEK – GEOA3INF
GEOCHEMICAL DATA ANALYSIS SUMMARY

SUMMARY COMMENT:
No trends were determined for the GEOA3INF sampling location.

GEOA3INF could not be accessed on the 3/29/16 sampling event and it was dry on 10/30/15 and 07/07/16.

Parameter	Date Interval	Comments
pH	03/21/13 – 06/24/19	av.: 7.65; max.: 8.30; min.: 6.82; No trend. pH probe not working 4/1/14.
DO (% sat) Values considered high or low depend on Temp.	03/21/13 – 06/24/19	av.: 59.2%; max.: 85.0%; min.:17.7%; No trend. The DO (% sat) records at this location are highly variable.
SO_4 (mg/L)	03/21/13 – 06/24/19	av.: 127; max.: 350; min.: 35; If 350 is an accurate measurement, it indicates loss of SO_4 sometime after 3/21/13, possibly by reduction to SO_2 or by complexation with metals, including U, mobilizing them. However, the data is highly variable and there are other elevated values. There was no data collected between 05/15/14 – 03/12/15.
NO_3 (mg/L)	03/21/13 – 06/24/19	max.: 250; min.: non-detect (0) No observable trends – the data is highly variable. There was no data collected from 10/30/14-03/12/15.

Table H.6
NORTH WALNUT CREEK – GEOA3EFF
GEOCHEMICAL DATA ANALYSIS SUMMARY

SUMMARY COMMENT: No trends were determined for the GEOA3EFF sampling location. GEOA3EFF could not be accessed on the 3/29/16 sampling event and it was dry on 10/30/15, 07/07/16 and 03/02/17.		
Parameter	**Date Interval**	**Comments**
pH	03/21/13 – 06/24/19	av.: 7.75; max.: 8.50; min.: 6.76; No trend. pH probe not working 4/1/14.
DO (% sat) Values considered high or low depend on Temp.	03/21/13 – 06/24/19	av.: 67.7%; max.: 90.2%; min.: 33.4%; No trend.
SO_4 (mg/L)	03/21/13 – 06/24/19	av.: 154; max.: 540; min.: 38; If 540 is an accurate measurement, it indicates loss of SO_4 sometime after 3/21/13, possibly by reduction to SO_2 or by complexation with metals, including U, mobilizing them. However, the data is highly variable and there are other elevated values. There was no data collected between 05/15/14 – 03/12/15.
NO_3 (mg/L)	03/21/13 – 06/24/19	max.: 250; min.: non-detect (0) No observable trends – the data is highly variable. There was no data collected from 09/16/14-03/12/15.

Figure I.1

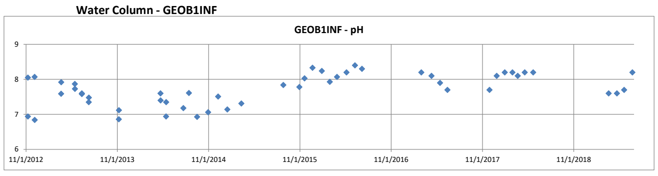
South Walnut Creek - GEOB1INF - Water Quality and Sediment Data

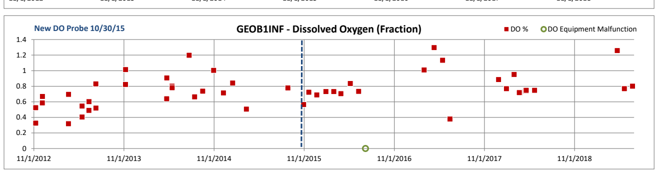
			Water Column												Sediment			
Location	DateTime Sampled	RIN-Tik	pH	DO [mg/L unless noted]	DO %	DO Measured mg/L	DO Saturated mg/L	Temp [C]	ORP [mV]	Fe [ug/L]	SO4 [mg/L]	H2S [mg/L]	NO3	NO2	ORP [mV] Top Sed	ORP [mV] in Sed	Depth [cm]	Uranium [mg/kg]
GEOB1INF	11/8/12 5:45		8.05	3.99	32.59%	3.99	12.244	6.6	-56.6	#N/A	#N/A	#N/A	<2	0	-42	-34.1	4	#N/A
GEOB1INF	11/8/12 11:15	12114959-605	6.94	6.14	52.52%	6.14	11.690	8.5	-51.7	1100	61	0.007	<2	0	-62.1	-42.2	4	14
GEOB1INF	12/5/12 5:15		8.07	7.32	58.59%	7.32	12.494	5.8	-57.6	#N/A	#N/A	#N/A	<2	2	-58.3	-52.4	4.5	#N/A
GEOB1INF	12/5/12 11:50	12125014-217	6.84	7.88	66.93%	7.88	11.774	8.2	-52.8	17000	58	0.049	<2	0	-51.8	-59.6	4.5	#N/A
GEOB1INF	3/21/13 5:50		7.59	4.27	31.94%	4.27	13.370	3.2	-56.7	#N/A	#N/A	#N/A	<10	<2	-44.3	-46.1	4	#N/A
GEOB1INF	3/21/13 13:20	13035202-745	7.92	8.52	69.59%	8.52	12.244	6.6	-72.3	#N/A	100	0.035	<2	0	-74.6	-82.6	4	#N/A
GEOB1INF	5/15/13 5:40		7.87	5.84	54.52%	5.84	10.712	12.2	-69	#N/A	#N/A	#N/A	11	<2	-66.2	-66.8	5	#N/A
GEOB1INF	5/15/13 12:00	13055330- 550	7.73	4.23	40.56%	4.23	10.428	13.4	-66.9	#N/A	73	0.007	4	<2	-62.4	-63.2	5	#N/A
GEOB1INF	6/12/13 4:25		7.58	4.98	49.03%	4.98	10.158	14.6	-57.2	#N/A	#N/A	#N/A	0	0	-54.8	-44.5	4	#N/A
GEOB1INF	6/12/13 11:45	13065414-982	7.6	5.86	60.23%	5.86	9.730	16.6	-67.4	#N/A	72	0.14	<4	<2	-58.4	-55.2	4	#N/A
GEOB1INF	7/10/13 3:50		7.35	7.99	83.00%	7.99	9.630	17.1	-40.3	#N/A	#N/A	#N/A	0	0	-39.4	-37.6	4	#N/A
GEOB1INF	7/10/13 13:15	13075490-839	7.48	4.84	52.00%	4.84	9.317	18.7	-51.9	#N/A	62	0.007	<2	<2	-42.3	-39.4	#N/A	#N/A
GEOB1INF	11/7/13 4:45		6.86	11.15	82.30%	11.15	13.551	2.7	118	#N/A	#N/A	#N/A	low	0	120.5	120.6	6	#N/A
GEOB1INF	11/7/13 13:10	13115739-262	7.12	12.03	101.40%	12.03	11.859	7.9	101.9	390	70	0.007	#N/A	0	105	104.9	6	#N/A
GEOB1INF	4/1/14 5:30		#N/A	#N/A	#N/A	#N/A	12.818	4.8	#N/A	#N/A	#N/A	#N/A	low	0	#N/A	#N/A	#N/A	#N/A
GEOB1INF	4/23/14 4:00		7.6	7.37	64.00%	7.37	11.522	9.1	78.2	#N/A	#N/A	#N/A	low	0	80.2	91.5	2	#N/A
GEOB1INF	4/23/14 13:00	14046106-064	7.4	9.80	90.70%	9.80	10.810	11.8	86.6	27	71	0.007	low	0	81.4	85.6	5	#N/A
GEOB1INF	5/15/14 5:00		6.94	9.88	80.08%	9.88	12.337	6.3	113.5	#N/A	#N/A	#N/A	#N/A	0	116.1	117.4	8	#N/A
GEOB1INF	5/15/14 11:40		#N/A	#N/A	#N/A	#N/A	11.522	9.1	109.1	#N/A	#N/A	#N/A	10	#N/A	#N/A	#N/A	#N/A	#N/A
GEOB1INF	5/15/14 14:45		7.35	8.74	78.09%	8.74	11.192	10.3	92	54	49	0.007	0	0	94.4	93.4	3	#N/A
GEOB1INF	7/23/14 10:47		7.18	10.26	119.86%	10.26	8.560	23	106.3	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
GEOB1INF	8/14/14 15:27		7.61	6.10	66.42%	6.10	9.184	19.4	82.8	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
GEOB1INF	9/16/14 11:45		6.93	6.92	73.67%	6.92	9.393	18.3	89.8	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
GEOB1INF	10/30/14 13:35		7.06	10.71	100.43%	10.71	10.664	12.4	100.9	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
GEOB1INF	12/9/14 12:45		7.51	9.46	71.50%	9.46	13.230	3.6	88.5	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
GEOB1INF	1/15/15 14:25		7.14	11.25	84.14%	11.25	13.370	3.2	108.5	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
GEOB1INF	3/12/15 12:39		7.31	6.45	50.59%	6.45	12.750	5.0	102.1	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
GEOB1INF	8/27/15 12:35	15087301-326	7.84	7.02	77.84%	7.02	9.019	20.3	130	22	48	0.007	0.29	0.049	143	155	2	#N/A
GEOB1INF	10/30/15 13:51	15107471-351	7.78	6.43	56.49%	6.43	11.382	9.6	98	830	68	0.007	0	0	107	114	2	#N/A
GEOB1INF	11/20/15 13:55	15117518-466	8.03	9.29	72.28%	9.29	12.852	4.7	265	440	81	0.0077	0	0	236	65	2	#N/A
GEOB1INF	12/22/15 14:12	15127565-092	8.33	9.09	68.89%	9.09	13.195	3.7	209	560	78	0.007	0	0	210	211	1	#N/A
GEOB1INF	1/28/16 14:25	16017617-080	8.24	10.06	73.24%	10.06	13.736	2.2	202	180	88	0.007	0	0	198	198	<1	#N/A
GEOB1INF	2/29/16 13:35		7.93	8.78	73.14%	8.78	12.004	7.4	188	320	84	0.007	0	0	187	194	3	#N/A
GEOB1INF	3/29/16 12:25	16037714-929	8.07	9.23	70.51%	9.23	13.090	4.0	139	200	28	0.007	#N/A	#N/A	139	130	1	#N/A
GEOB1INF	5/6/16 13:09	16047775-693	8.20	8.66	83.60%	8.66	10.359	13.7	126	530	57	0.007	5	0	127	130	1-2	#N/A
GEOB1INF	6/9/16 10:00	16067860-499	8.40	6.94	73.44%	6.94	9.450	18.0	114	34	60	0.007	5	0	84	71	1	#N/A
GEOB1INF	7/7/16 11:20	16077930-278	8.30	#N/A	#N/A	#N/A	9.146	19.6	18	370	54	0.007	0	0	-13	-90	10	#N/A
GEOB1INF	3/2/17 0:00	17028281-233	8.20	12.30	100.97%	12.30	12.182	6.8	215	73	270	0.007	0	0	216	218	4	#N/A
GEOB1INF	4/11/17 12:52	17048405-240	8.10	13.70	129.64%	13.70	10.568	12.8	137	2300	100	0.007	0	0	117	-53	3	#N/A
GEOB1INF	5/15/17 15:13	17048461-646	7.90	11.40	113.46%	11.40	10.048	15.1	124	110	64	0.007	0	0	90	73	2	#N/A
GEOB1INF	6/14/17 12:12	17068579-105	7.70	3.44	37.93%	3.44	9.070	20.0	127	71	50	0.007	0	0	131	116	2	#N/A
GEOB1INF	11/29/17 14:26	17118797-149	7.70	#N/A	#N/A	#N/A	11.774	8.2	177	69	92	0.007	0	0	-181	-300	2	#N/A
GEOB1INF	12/28/17 12:55	17128825-012	8.10	12.20	88.58%	12.20	13.773	2.1	94	910	99	0.014	0	0	114	151	2	#N/A
GEOB1INF	1/29/18 14:24	RFS01-12.1801001-009	8.20	10.20	76.89%	10.20	13.265	3.5	178	400	99	0.007	0	0	180	155	1	#N/A
GEOB1INF	3/1/18 12:10	RFS01-12.1803002-009	8.20	12.20	95.18%	12.20	12.818	4.8	171	62	100	0.007	0	0	174	56	4	#N/A
GEOB1INF	3/22/18 13:00	RFS01-12.1803003-009	8.10	8.50	71.85%	8.50	11.830	8.0	177	22	79	0.007	0	0	170	-10	1	#N/A
GEOB1INF	4/19/18 12:58	RFS01-13.1804004-009	8.20	7.92	74.77%	7.92	10.592	12.7	107	39	83	0.007	0	0	44	-195	2	#N/A
GEOB1INF	5/23/18 12:33	RFS01-12.1805005-009	8.20	7.04	74.80%	7.04	9.412	18.2	86	140	47	0.007	0	0	-18	-155	3	#N/A
GEOB1INF	3/21/19 13:35	RFS01-12.1903007-009	7.6	#N/A	#N/A	#N/A	9.317	18.7	159	61	76	0.049	0	0	109	101	1	#N/A
GEOB1INF	4/23/19 13:10	RFS01-12.1904008-009	7.6	12.40	125.89%	12.40	9.850	16.0	34	63	71	0.081	0	0	-42	-75	2	#N/A
GEOB1INF	5/22/19 10:25	RFS01-12.1905009-009	7.7	9.25	76.87%	9.25	12.033	7.3	181	0.052	57	0.022	0	0	170	161	2	#N/A
GEOB1INF	6/24/19 12:30	RFS01-12.1906010	8.2	7.76	80.08%	7.76	9.690	16.8	124	220	46	0.022	0	0	86	39	2	#N/A

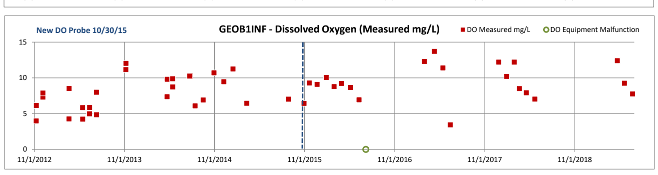
*** Dissolved Oxygen calculations were performed using Table 3.4 of Applications of Environmental Aquatic Chemistry, 3rd Edition by Eugene Weiner (linear interpolation used for 2021 report)*

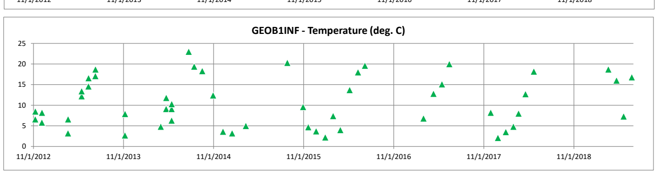
Water Column - GEOB1INF

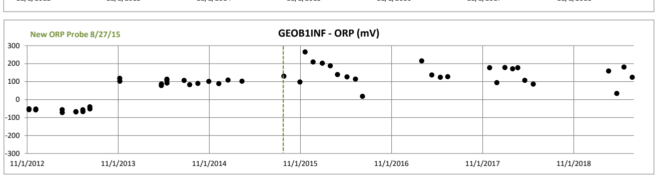
Sediment - GEOB1INF

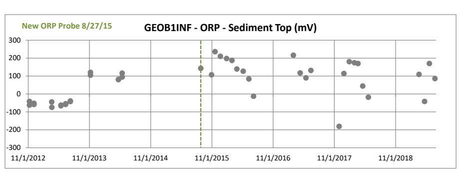


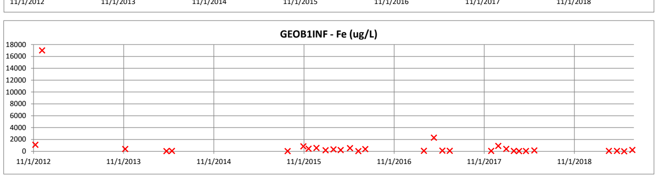


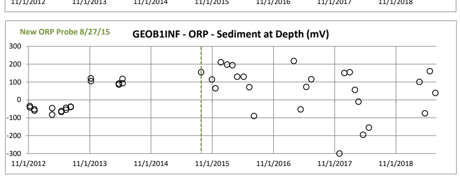


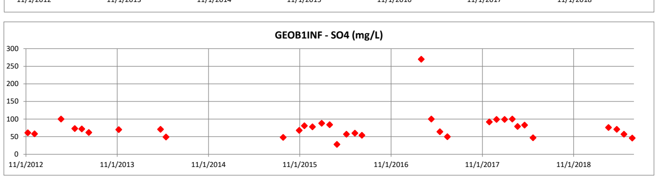


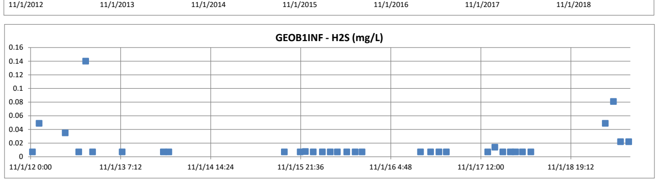


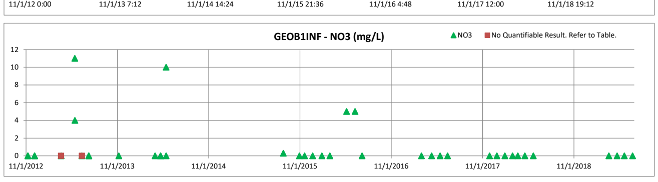












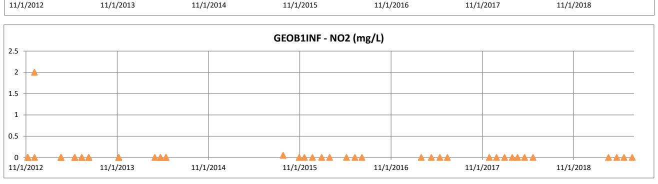


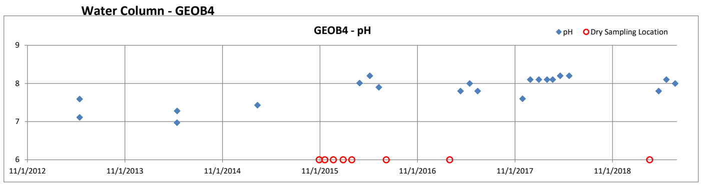
Figure I.2

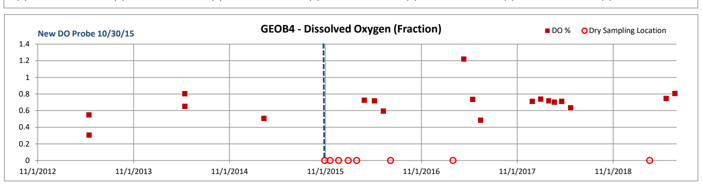
South Walnut Creek - GEOB4 - Water Quality and Sediment Data

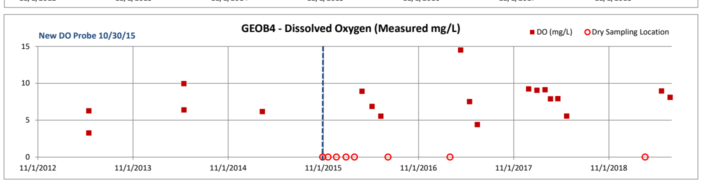
			Water Column												Sediment			
Location	DateTime Sampled	RIN-Tik	pH	DO [mg/L unless noted]	DO %	DO Measured mg/L	DO Saturated mg/L	Temp [C]	ORP [mV]	Fe [ug/L]	SO4 [mg/L]	H2S [mg/L]	NO3	NO2	ORP [mV] Top Sed	ORP [mV] in Sed	Depth [cm]	Uranium [mg/kg]
GEOB4	11/8/12 9:30	12114959-608	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	1.4
GEOB4	5/15/13 5:30		7.59	6.27	54.82%	6.27	11.438	9.4	-47.7	#N/A	#N/A	#N/A	4	<2	-53	54.3	2.5	#N/A
GEOB4	5/15/13 11:45	13055330- 551	7.11	3.27	30.66%	3.27	10.664	12.4	-34.7	#N/A	45	0.14	4	<2	-27.1	-25.7	2.5	#N/A
GEOB4	5/15/14 4:50		6.97	9.96	80.33%	9.96	12.399	6.1	115.7	#N/A	#N/A	#N/A	#N/A	0	116.1	117.4	6	#N/A
GEOB4	5/15/14 11:34		#N/A	#N/A	#N/A	#N/A	10.451	13.3	108.2	#N/A	#N/A	#N/A	10	#N/A	#N/A	#N/A	#N/A	#N/A
GEOB4	5/15/14 14:44	14056186-046	7.28	6.39	65.14%	6.39	9.810	16.2	94.9	12000	20	0.007	5	0	95.2	93.9	4	#N/A
GEOB4	3/12/15 12:28		7.43	6.17	50.65%	6.17	12.182	6.8	98.1	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
GEOB4	10/30/15 0:00	Dry	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
GEOB4	11/20/15 0:00	Dry	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
GEOB4	12/22/15 0:00	Dry	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
GEOB4	1/28/16 0:00	Dry	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
GEOB4	2/29/16 0:00	Dry	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
GEOB4	3/29/16 0:00	16037714-930	8.01	8.92	72.48%	8.92	12.306	6.4	199	960	29	0.007	#N/A	#N/A	NA - sediments too deep	#N/A	#N/A	#N/A
GEOB4	5/6/16 12:58	16047775-694	8.20	6.87	71.79%	6.87	9.570	17.4	125	250	57	0.007	0	0	126	133	3	#N/A
GEOB4	6/9/16 9:32	16067860-500	7.90	5.55	59.45%	5.55	9.336	18.6	117	3800	51	0.007	10	0	-80	-154	3	#N/A
GEOB4	7/7/16 0:00	Dry	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
GEOB4	3/2/17 0:00	Dry	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
GEOB4	4/11/17 13:08	17048405-241	7.80	14.50	122.06%	14.50	11.879	7.8	76	22000	100	0.007	0	0	80	29	2	#N/A
GEOB4	5/15/17 15:04	17048461-648	8.00	7.51	73.45%	7.51	10.224	14.3	99	2600	50	0.007	10-25	0	98	103	2	#N/A
GEOB4	6/14/17 11:50	17068579-106	7.80	4.41	48.52%	4.41	9.089	19.9	113	7400	54	0.007	5.6-11	0	107	46	2--3	#N/A
GEOB4	11/29/17 14:04	17118797-150	7.60	#N/A	#N/A	#N/A	11.244	10.1	189	19000	50	0.07	25	0	211	86	2	#N/A
GEOB4	12/28/17 12:38	17128825-013	8.10	9.24	71.14%	9.24	12.988	4.3	188	66000	45	0.007	2	0	182	146	3	#N/A
GEOB4	1/29/18 14:01	RFS01-12.1801001-008	8.10	9.06	73.81%	9.06	12.275	6.5	164	9300	42	0.007	5--10	0	184	160	3	#N/A
GEOB4	3/1/18 11:58	RFS01-12.1803002-008	8.10	9.12	71.71%	9.12	12.718	5.1	161	190	51	0.007	0	0	134	14	4	#N/A
GEOB4	3/22/18 12:45	RFS01-12.1803003-008	8.10	7.89	70.17%	7.89	11.244	10.1	168	150	47	0.007	0	0	172	144	3	#N/A
GEOB4	4/19/18 12:44	RFS01-13.1804004-008	8.20	7.92	71.10%	7.92	11.140	10.5	83	1800	54	0.007	25	0	84	34	3	#N/A
GEOB4	5/23/18 12:10	RFS01-12.1805005-008	8.20	5.56	63.37%	5.56	8.774	21.7	16	1200	55	0.007	25	0	-40	-85	3	#N/A
GEOB4	3/21/19 0:00	dry	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
GEOB4	4/23/19 13:30	RFS01-12.1904008-008	7.8	#N/A	#N/A	#N/A	10.985	11.1	120	910	81	0.03	0	0	102	108	2	#N/A
GEOB4	5/22/19 10:45	RFS01-12.1905009-008	8.1	8.96	74.64%	8.96	12.004	7.4	51	26000	54	0.022	0	0	46	-10	2	#N/A
GEOB4	6/24/19 13:10	RFS01-12.1906010	8	8.10	80.61%	8.10	10.048	15.1	76	18000	59	0.022	25	0	96	104	2	#N/A

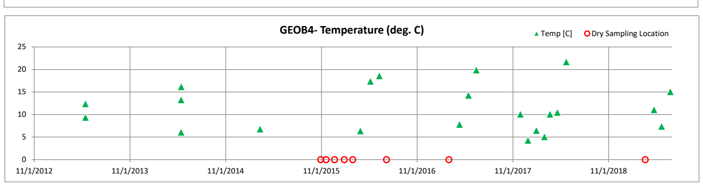
*** Dissolved Oxygen calculations were performed using Table 3.4 of Applications of Environmental Aquatic Chemistry, 3rd Edition by Eugene Weiner (linear interpolation used for 2021 report)*

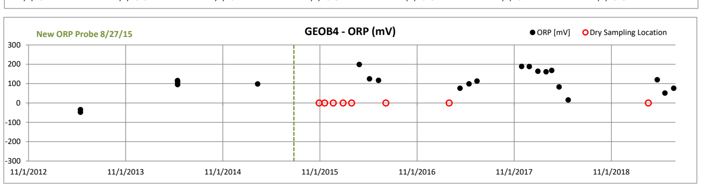
Water Column - GEOB4

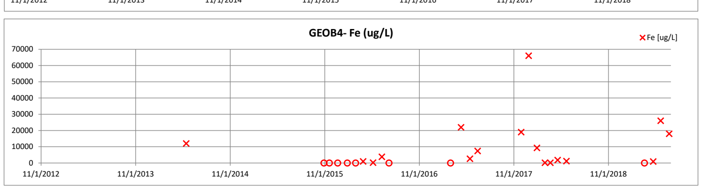


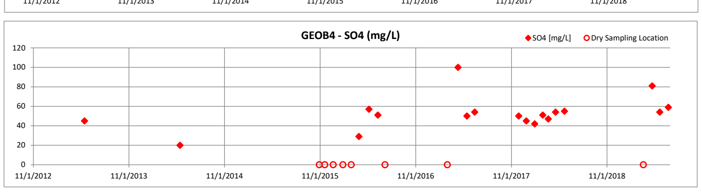


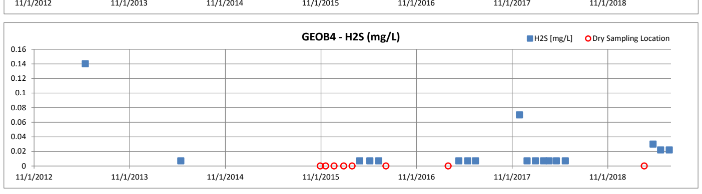


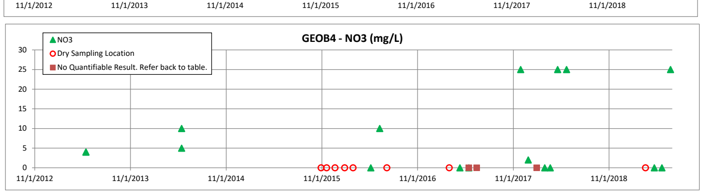


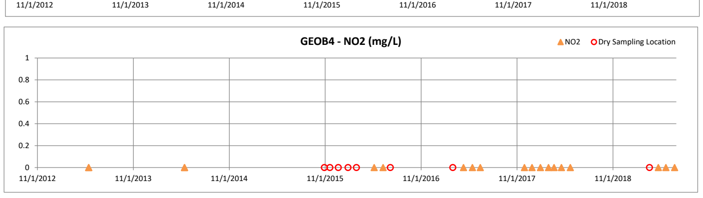




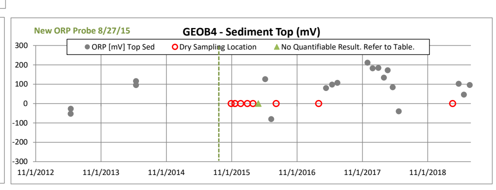








Sediment - GEOB4



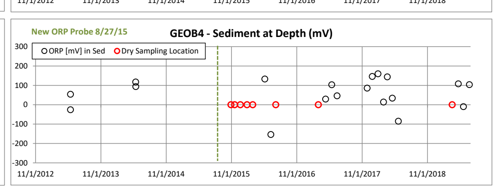


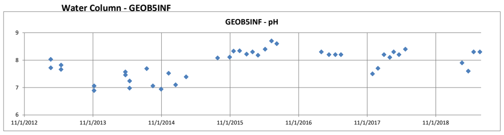
Figure I.3

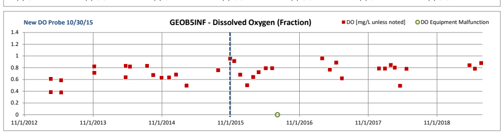
South Walnut Creek - GEOB5INF - Water Quality and Sediment Data

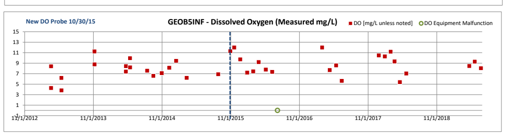
			Water Column												Sediment			
Location	DateTime Sampled	RIN-Tik	pH	DO [mg/L unless noted]	DO %	DO Measured mg/L	DO Saturated mg/L	Temp [C]	ORP [mV]	Fe [ug/L]	SO4 [mg/L]	H2S [mg/L]	NO3	NO2	ORP [mV] Top Sed	ORP [mV] in Sed	Depth [cm]	Uranium [mg/kg]
GEOB5INF	11/8/12 10:00	12114959-606	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	2.5
GEOB5INF	3/21/13 5:30		8.03	8.42	61.13%	8.42	13.773	2.1	-82	#N/A	#N/A	#N/A	<10	<2	-60.1	-52.7	3	#N/A
GEOB5INF	3/21/13 13:00	13035202-744	7.72	4.27	38.51%	4.27	11.088	10.7	-57.6	#N/A	210	0.007	<2	<2	-62.4	-64.7	4	#N/A
GEOB5INF	5/15/13 5:15		7.66	6.2	58.67%	6.20	10.568	12.8	-64.1	#N/A	#N/A	#N/A	0	<2	-67.2	-74.8	3	#N/A
GEOB5INF	5/15/13 11:30	13055330- 549	7.82	3.82	38.02%	3.82	10.048	15.1	-72.7	#N/A	83	0.007	<2	<2	-68.5	-64.4	3	#N/A
GEOB5INF	11/7/13 4:10		6.89	11.24	82.30%	11.24	13.662	2.4	116.2	#N/A	#N/A	#N/A	12	0	115.9	115.7	6	#N/A
GEOB5INF	11/7/13 12:40	13115739-266	7.06	8.77	71.30%	8.77	12.306	6.4	106.9	630	66	0.007	#N/A	0	108.7	108.9	6	#N/A
GEOB5INF	4/1/14 5:15		#N/A	#N/A	#N/A	#N/A	13.195	3.7	#N/A	#N/A	#N/A	#N/A	9	0	#N/A	#N/A	#N/A	#N/A
GEOB5INF	4/23/14 4:10		7.57	7.40	63.80%	7.40	11.606	8.8	79.7	#N/A	#N/A	#N/A	low	0	80	80	6	#N/A
GEOB5INF	4/23/14 12:40	14046106-068	7.46	8.44	83.10%	8.44	10.158	14.6	79.6	1900	71	0.007	low	0	79.5	79.5	4	#N/A
GEOB5INF	5/15/14 4:35		6.98	9.96	81.76%	9.96	12.182	6.8	112.8	#N/A	#N/A	#N/A	#N/A	0	114.8	113.6	6	#N/A
GEOB5INF	5/15/14 11:27		#N/A	#N/A	#N/A	#N/A	10.544	12.9	106	#N/A	#N/A	#N/A	10	#N/A	#N/A	#N/A	#N/A	#N/A
GEOB5INF	5/15/14 14:32	14056186-045	7.24	8.2	82.15%	8.2	9.982	15.4	97.5	230	49	0.007	0	0	98.7	97.7	3	#N/A
GEOB5INF	8/14/14 15:09		7.69	7.57	83.11%	7.57	9.108	19.8	77.2	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
GEOB5INF	9/16/14 11:20		7.06	6.59	67.59%	6.59	9.750	16.5	91.1	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
GEOB5INF	10/30/14 13:15		6.94	7.11	62.93%	7.11	11.298	9.9	107.1	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
GEOB5INF	12/9/14 14:10		7.52	8.14	63.34%	8.14	12.852	4.7	90.1	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
GEOB5INF	1/15/15 14:15		7.10	9.46	68.31%	9.46	13.848	1.9	111.3	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
GEOB5INF	3/12/15 12:14		7.39	6.21	49.70%	6.21	12.494	5.8	98.1	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
GEOB5INF	8/27/15 12:01	15087301-330	8.08	6.90	75.92%	6.90	9.089	19.9	172	1200	53	0.023	0.066	0.049	178	116	2	#N/A
GEOB5INF	10/30/15 13:25	15107471-353	8.11	11.31	95.60%	11.31	11.830	8.0	181	270	65	0.007	0	0	179	179	1	#N/A
GEOB5INF	11/20/15 13:15	15117518-468	8.33	11.99	91.35%	11.99	13.125	3.9	220	570	77	0.007	0	0	220	225	1	#N/A
GEOB5INF	12/22/15 13:43	15127565-094	8.34	9.73	68.18%	9.73	14.272	0.8	178	99	72	0.007	0	0	178	186	1	#N/A
GEOB5INF	1/28/16 14:00	16017617-078	8.22	7.21	50.23%	7.21	14.354	0.6	224	75	86	0.007	10	0	220	218	1	#N/A
GEOB5INF	2/29/16 13:25	16027659-077	8.30	7.44	64.26%	7.44	11.578	8.9	184	80	82	0.007	0	0	183	180	1	#N/A
GEOB5INF	3/29/16 11:50	16037714-928	8.18	9.22	72.50%	9.22	12.718	5.1	188	370	34	0.007	#N/A	#N/A	187	185	2	#N/A
GEOB5INF	5/6/16 11:30	16047775-692	8.40	7.79	79.25%	7.79	9.830	16.1	195	240	60	0.007	5	0	194	194	<1	#N/A
GEOB5INF	6/9/16 10:22	16067860-498	8.70	7.35	79.21%	7.35	9.279	18.9	134	570	47	0.007	0	0	131	70	<1	#N/A
GEOB5INF	7/7/16 11:00	16077930-277	8.60	#N/A	#N/A	#N/A	9.570	17.4	131	850	45	0.007	0	0	61	-96	2	#N/A
GEOB5INF	3/2/17 0:00	17028281-232	8.30	12.00	96.05%	12.00	12.494	5.8	110	69	120	0.007	0	0	118	137	2	#N/A
GEOB5INF	4/11/17 12:08	17048405-239	8.20	7.70	76.80%	7.70	10.026	15.2	119	86	93	0.007	0	0	121	136	1	#N/A
GEOB5INF	5/15/17 14:44	17048461-645	8.20	8.58	88.73%	8.58	9.670	16.9	146	260	53	0.007	0	0	143	143	2	#N/A
GEOB5INF	6/14/17 11:27	17068579-104	8.20	5.63	61.94%	5.63	9.089	19.9	136	490	32	0.007	0	0	132	-85	4	#N/A
GEOB5INF	11/29/17 13:40	17118797-148	7.50	#N/A	#N/A	#N/A	11.975	7.5	197	46	98	0.007	0	0	201	227	2	#N/A
GEOB5INF	12/28/17 11:20	17128825-011	7.70	10.50	78.74%	10.50	13.335	3.3	144	1700	110	0.063	0	0	145	215	2	#N/A
GEOB5INF	1/29/18 13:10	RFS01-12.1801001-007	8.20	10.30	78.69%	10.30	13.090	4.0	200	42	100	0.007	0.5	0	209	35	2	#N/A
GEOB5INF	3/1/18 11:37	RFS01-12.1803002-007	8.10	11.20	84.66%	11.20	13.230	3.6	187	22	100	0.007	0	0	189	198	1	#N/A
GEOB5INF	3/22/18 10:20	RFS01-12.1803003-007	8.30	9.33	80.20%	9.33	11.634	8.7	166	99	83	0.007	0	0	164	89	1	#N/A
GEOB5INF	4/19/18 12:23	RFS01-13.1804004-007	8.20	5.40	49.27%	5.40	10.960	11.2	156	30	93	0.007	0	0	-45	-110	1	#N/A
GEOB5INF	5/23/18 13:29	RFS01-12.1805005-007	8.40	7.04	78.20%	7.04	9.002	20.4	96	790	47	0.007	0	0	105	57	3	#N/A
GEOB5INF	3/21/19 13:00	RFS01-12.1903007-007	7.9	#N/A	#N/A	#N/A	9.530	17.6	140	41	91	0.053	0	0	185	176	2	#N/A
GEOB5INF	4/23/19 13:50	RFS01-12.1904008-007	7.6	8.47	84.30%	8.47	10.048	15.1	94	27	83	0.022	0	0	118	155	2	#N/A
GEOB5INF	5/22/19 12:50	RFS01-12.1905009-007	8.3	9.30	78.42%	9.30	11.859	7.9	143	210	57	0.022	0	0	141	118	2	#N/A
GEOB5INF	6/24/19 13:40	RFS01-12.1906010	8.3	8.05	88.02%	8.05	9.146	19.6	114	110	33	0.022	0	0	134	131	2	#N/A

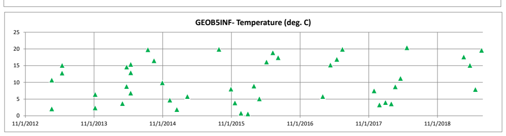
*** Dissolved Oxygen calculations were performed using Table 3.4 of Applications of Environmental Aquatic Chemistry, 3rd Edition by Eugene Weiner (linear interpolation used for 2021 report)*

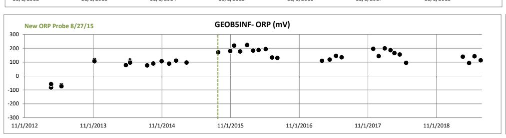
Water Column - GEOB5INF

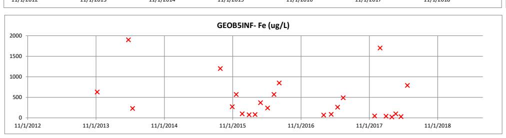


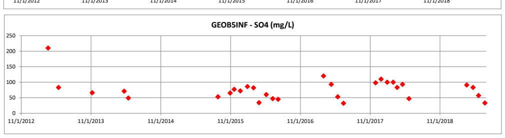


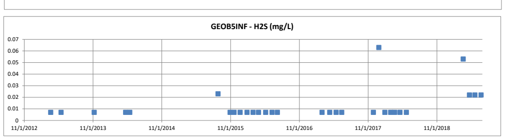


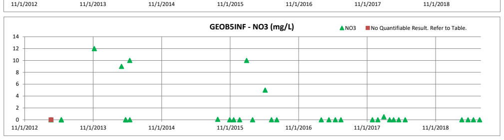


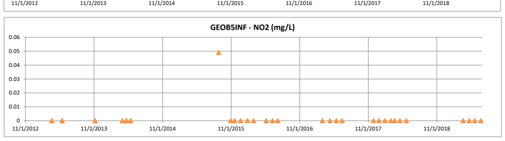




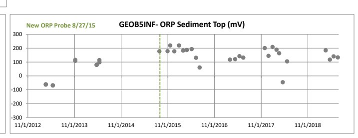








Sediment - GEOB5INF



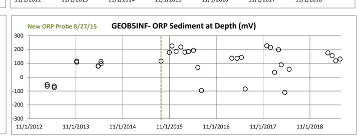


TABLE I.1
SOUTH WALNUT CREEK – GEOB1INF
GEOCHEMICAL DATA ANALYSIS SUMMARY

SUMMARY COMMENT:

Before 07/10/13:

- Minimal diurnal change ⇨ Little wetland activity.
- Low DO saturation with no diurnal change ⇨ reducing conditions with no photosynthesis effect.

After 07/10/13:

- Higher DO saturation with little diurnal change ⇨ oxidizing conditions in water and sediments with limited photosynthesis effect.

The changes in %DO are consistent with data collected from North Walnut Creek that show a change from anoxic to oxidizing conditions during the same time periods. This could indicate a new upgradient oxidation source and/or loss of reducing conditions (e.g., increased DO in base flow, high flow-initiated streambed sediment movement, streambed scouring of decaying vegetation, etc.), potentially with increased U mobility sometime after 07/10/13. Other data are inconclusive.

Parameter	Date Interval	Comments
pH	11/08/12 – 06/24/19	av.: 7.72; max.: 8.40; min.: 6.84; No trend.
DO (% sat) Values considered high or low depend on temp.	11/08/12 – 07/10/13	av.: 42.4%; max.: 59.9%; min.:5.5% Early morn & afternoon both low; indicates low DO with no significant wetland activity.
	11/07/13 – 06/24/19	av.: 81.7%; max.: 129.6%; min.: 37.9% Early morn & afternoon both high; indicates oxidizing conditions from a new upgradient oxidation source. Increased U mobility. There were 7 instances where the % sat was greater than 100 % (11/07/13, 7/23/14, 10/30/14, 03/02/17, 04/11/17, 05/15/17, 4/23/19). It is likely that the measured super saturated values may be unreliable. DO equipment malfunction on 7/7/16.
SO_4 (mg/L)	11/08/12 – 06/24/19	av.: 76; max.: 270; min.: 28; No trend. There was no data collected between 05/14/14 – 03/12/15. The sample collected on 03/02/17 with a value of 270 appears to be an outlier.
NO_3 (mg/L)	11/08/12 – 06/24/19	max.: 11.0; min.: <2.0 Generally undetectable throughout. Only 6 detects (11, 4, 10, 0.29, 5, 5) but some signs that data may be unreliable.

Table I.2
SOUTH WALNUT CREEK – GEOB4
GEOCHEMICAL DATA ANALYSIS SUMMARY

SUMMARY COMMENT:
GEOB4 was dry during multiple sampling events (10/30/15-02/29/16; 07/07/16; 03/02/17; 03/21/19).

Parameter	Date Interval	Comments	
pH	05/15/13 – 06/24/19	av.: 7.83; max.: 8.20; min.: 6.97; No trend.	
DO (% sat) Values considered high or low depend on temp.	05/15/13	54.8% (5:30), 30.7% (11:45) Just 1 day but low DO% consistent with North Walnut Creek during time period.	
	05/15/13 – 05/15/14	No data	
	05/15/14	80.3% (4:50), 65.1% (14:44) Just 1 day but high DO% consistent with North Walnut Creek during time period.	
	03/12/15	50.7 %	
	10/30/15-02/29/16	No data – Location Dry.	
	03/29/16-06/24/19	av.: 73.2%; max.: 122.1%; min.: 48.5%; No trend. There was 1 instance where the % sat was greater than 100 % (04/11/17). It is likely that the measured super saturated value may be unreliable.	
SO_4 (mg/L)	05/15/13 – 06/24/19	av.: 52.4; max.: 100; min.: 20; No trend. There was no data collected between 05/14/14 – 02/29/16.	
NO_3 (mg/L)	05/15/13	4 (5:30), 4 (11:45)	
	05/15/14	10 (11:34), 5 (14:44)	
	03/12/15-03/29/16	No data. 10/30/15-02/29/16 Location was dry.	
	05/06/16-06/24/19	max.: 25; min.: non-detect (0)	No conclusions.

Table I.3
SOUTH WALNUT CREEK – GEOB5INF
GEOCHEMICAL DATA ANALYSIS SUMMARY

SUMMARY COMMENT:
No trends were determined for the GEOB5INF sampling location.

Parameter	Date Interval	Comments	
pH	03/21/13 – 06/24/19	av.: 7.87; max.: 8.70; min.: 6.89; No trend.	
DO (% sat) Values considered high or low depend on Temp.	03/21/13 – 06/24/19	av.: 72.5%; max.: 96.1%; min.: 38.0%; No trend.	
SO_4 (mg/L)	03/21/13 – 06/24/2019	av.: 76.4; max.: 210; min.: 32 If 210 is an accurate measurement, it indicates loss of SO_4 sometime after 3/21/13, possibly by reduction to SO_2 or by complexation with metals, including U, mobilizing them. However, the data is highly variable and there are other elevated values. There was no data collected between 05/15/14 – 03/12/15.	
NO_3 (mg/L)	03/21/13 – 06/24/19	max.: 12.0; min.: <2.0	Only 7 detects (12, 9, 10, .066, 10, 5, 0.5) but some signs that data may be unreliable.

Figure J.1

Total Uranium Concentration by Location

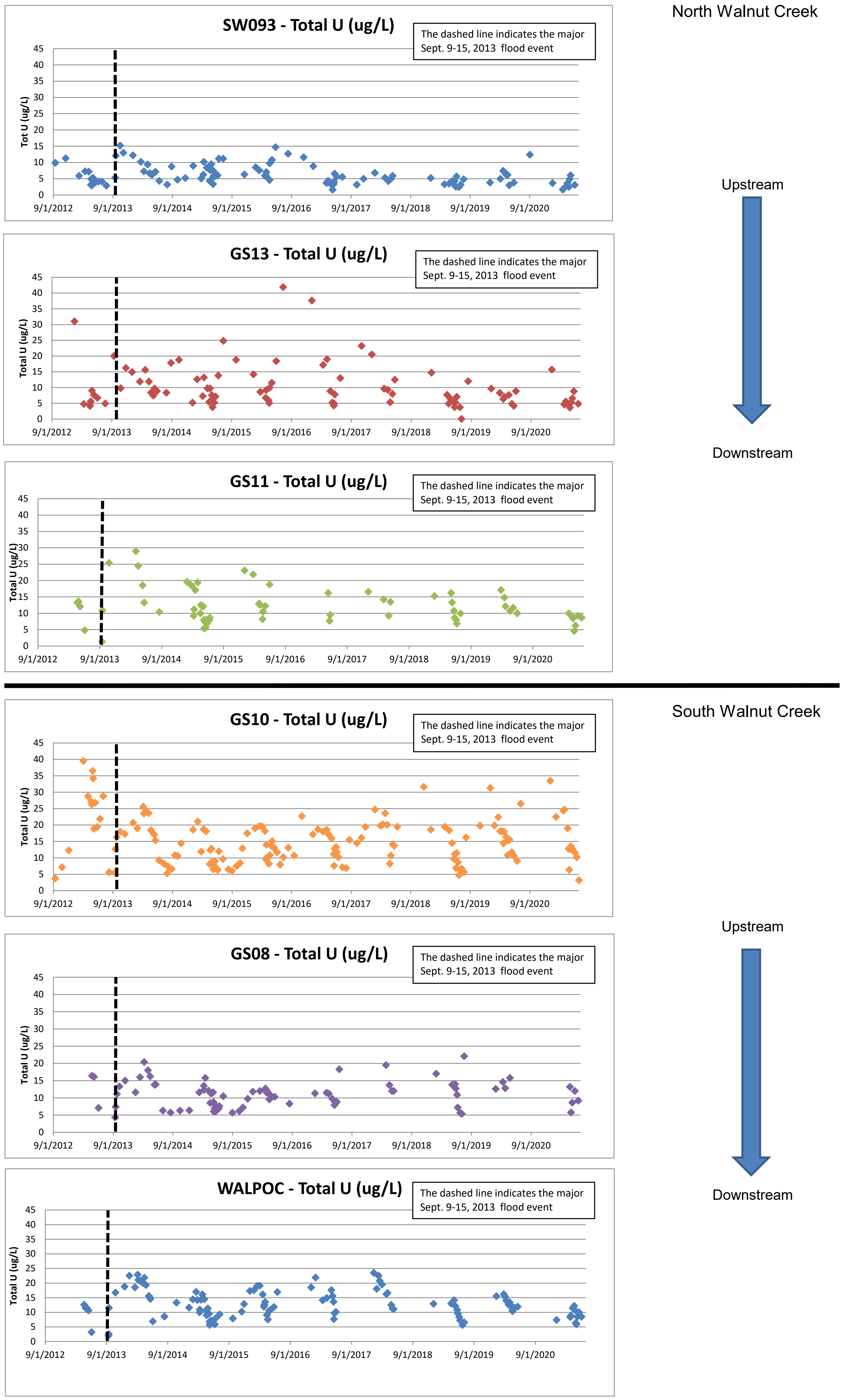
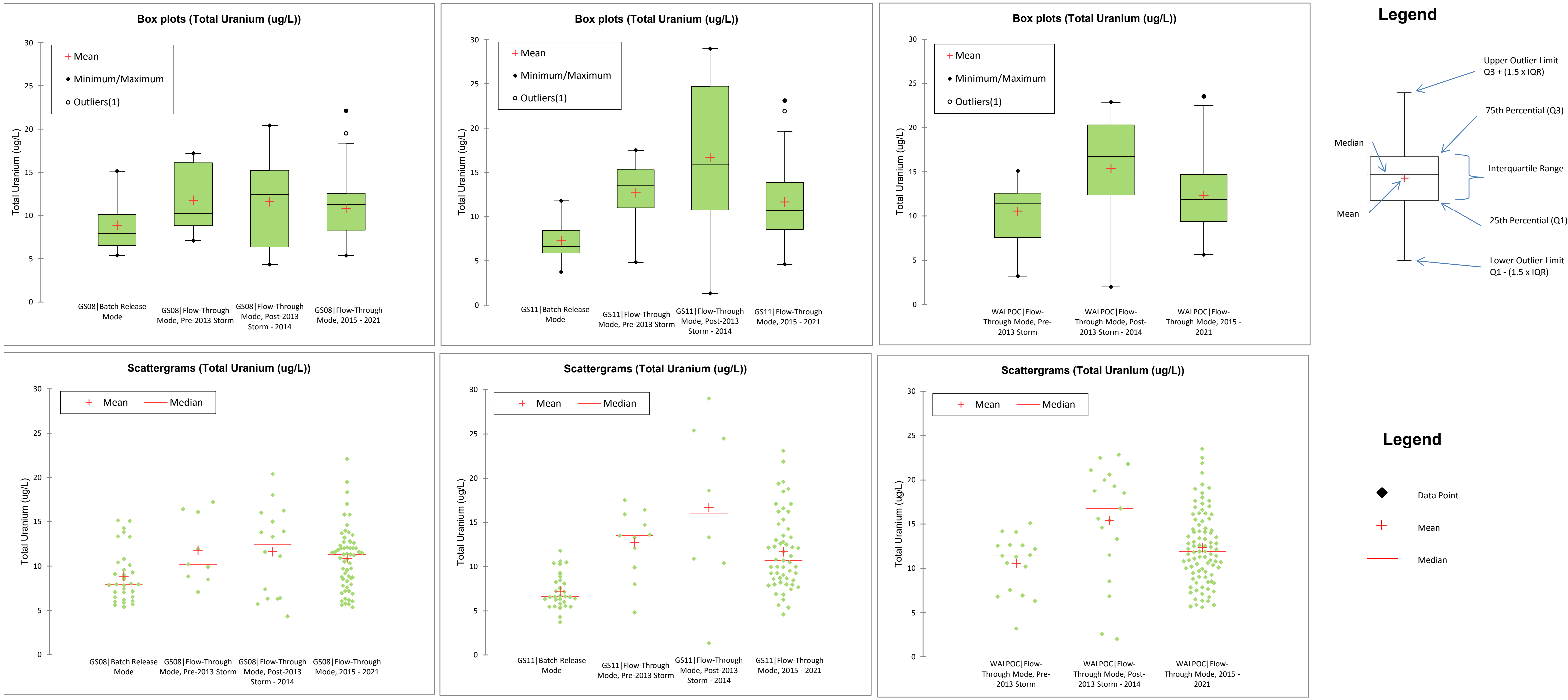


Figure J.2



Box plots (Total Uranium (ug/L))
Mean
Minimum/Maximum
Outliers(1)
Total Uranium (ug/L)
GS08|Batch Release Mode
GS08|Flow-Through Mode, Pre-2013 Storm
GS08|Flow-Through Mode, Post-2013 Storm - 2014
GS08|Flow-Through Mode, 2015 - 2021
GS11|Batch Release Mode
GS11|Flow-Through Mode, Pre-2013 Storm
GS11|Flow-Through Mode, Post-2013 Storm - 2014
GS11|Flow-Through Mode, 2015 - 2021
WALPOC|Flow-Through Mode, Pre-2013 Storm
WALPOC|Flow-Through Mode, Post-2013 Storm - 2014
WALPOC|Flow-Through Mode, 2015 - 2021
Scattergrams (Total Uranium (ug/L))
Median
Legend
Upper Outlier Limit Q3 + (1.5 x IQR)
75th Percential (Q3)
Median
Interquartile Range
Mean
25th Percential (Q1)
Lower Outlier Limit Q1 - (1.5 x IQR)
Legend
Data Point
Mean
Median

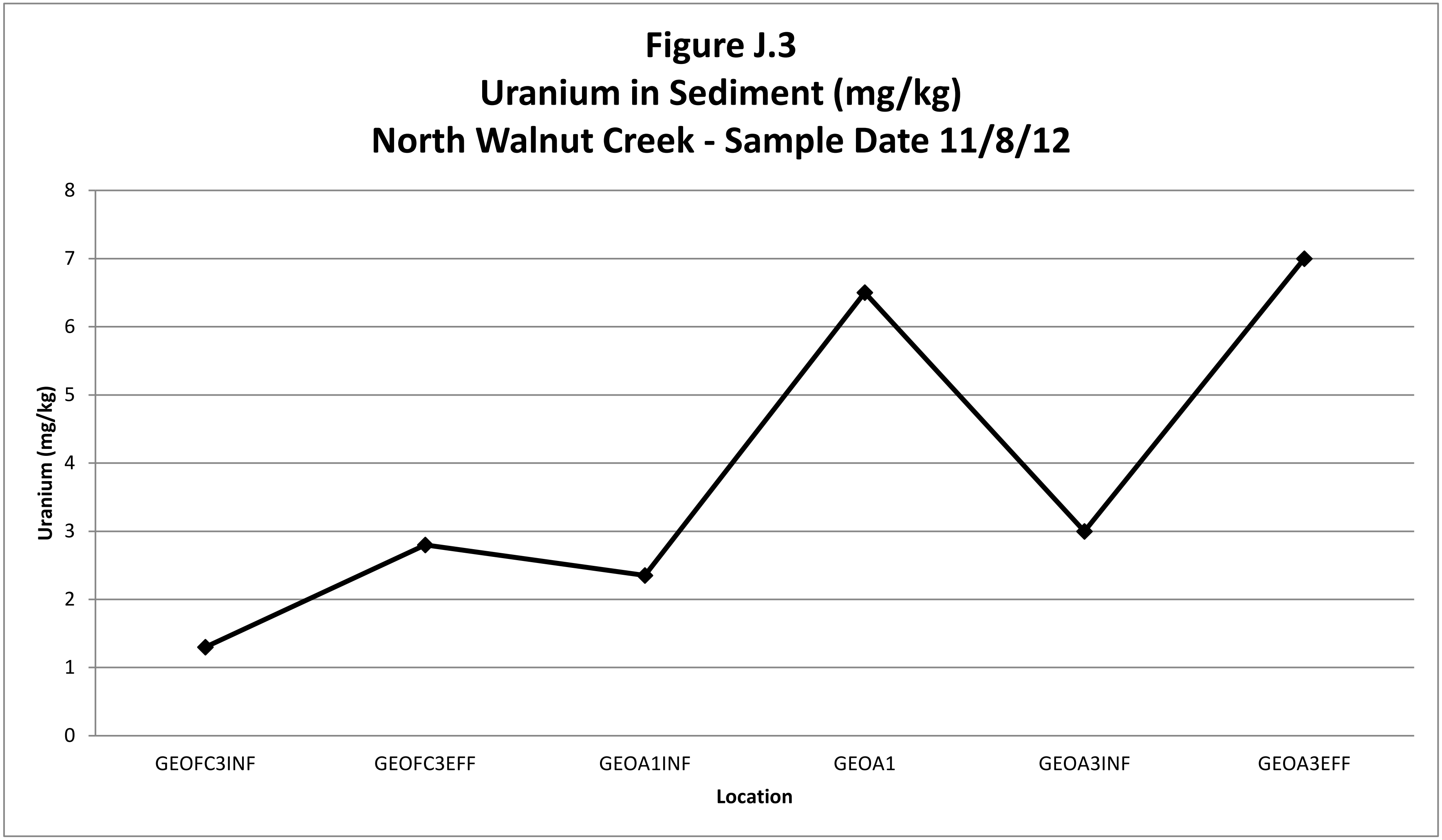


Figure J.3
Uranium in Sediment (mg/kg)
North Walnut Creek - Sample Date 11/8/12
8
7
6
5
4
3
2
1
0
Uranium (mg/kg)
GEOFC3INF
GEOFC3EFF
GEOA1INF
GEOA1
GEOA3INF
GEOA3EFF
Location

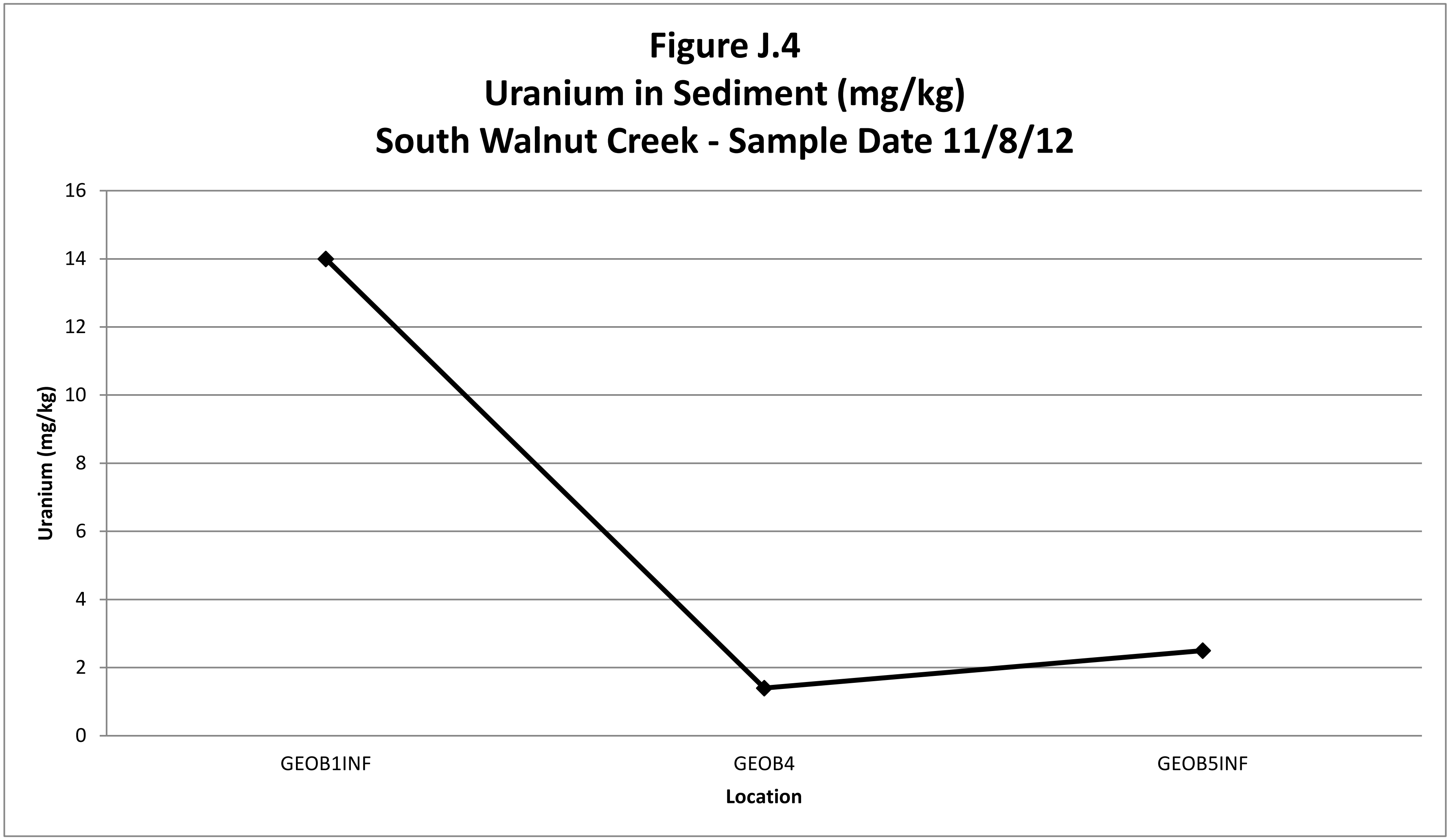


Figure J.4
Uranium in Sediment (mg/kg)
South Walnut Creek - Sample Date 11/8/12
16
14
12
10
8
6
4
2
0
Uranium (mg/kg)
GEOB1INF
GEOB4
GEOB5INF
Location

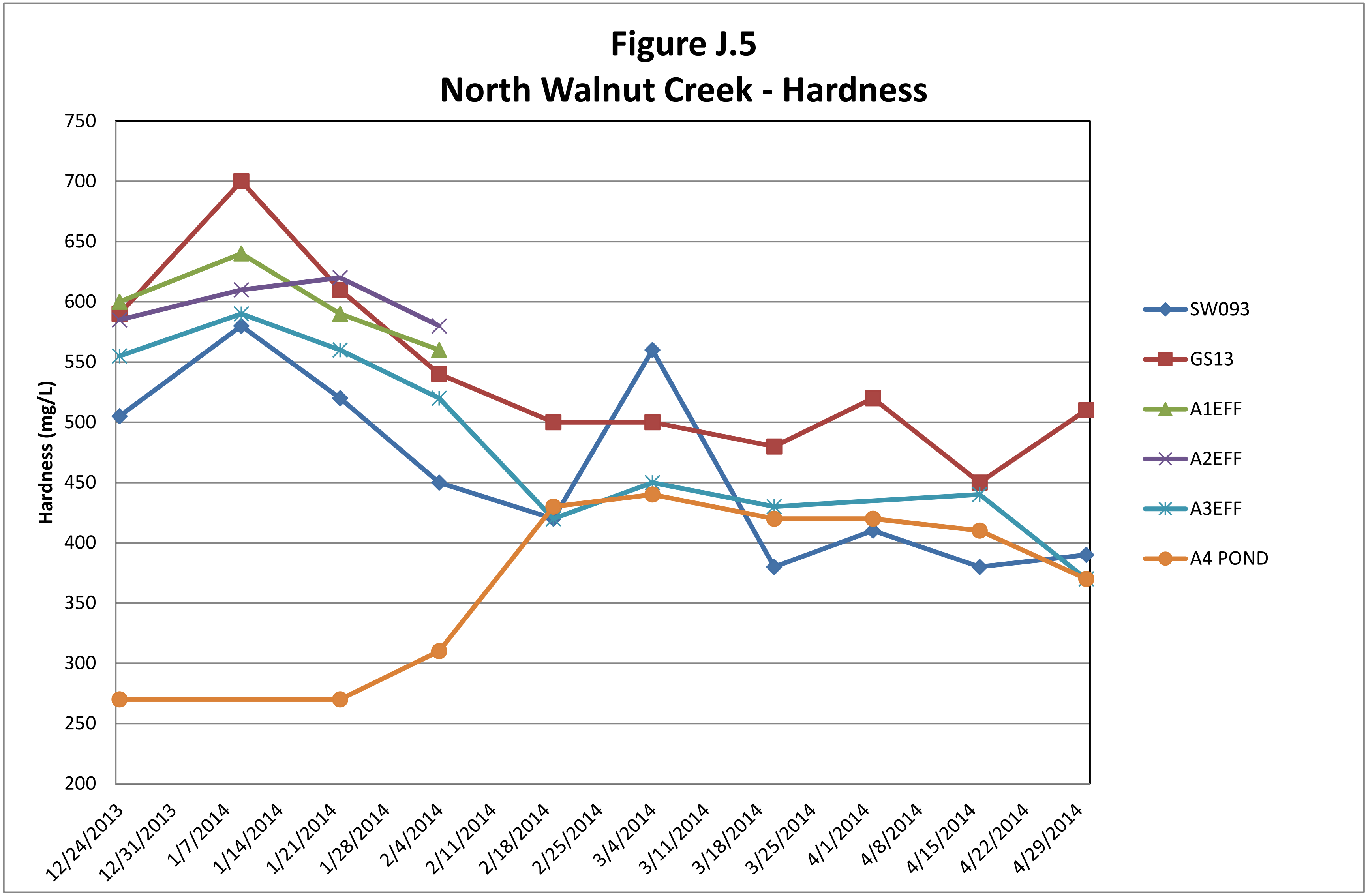


Figure J.5
North Walnut Creek - Hardness
Hardness (mg/L)
750
700
650
600
550
500
450
400
350
300
250
200
12/24/2013
12/31/2013
1/7/2014
1/14/2014
1/21/2014
1/28/2014
2/4/2014
2/11/2014
2/18/2014
2/25/2014
3/4/2014
3/11/2014
3/18/2014
3/25/2014
4/1/2014
4/8/2014
4/15/2014
4/22/2014
4/29/2014
SW093
GS13
A1EFF
A2EFF
A3EFF
A4 POND

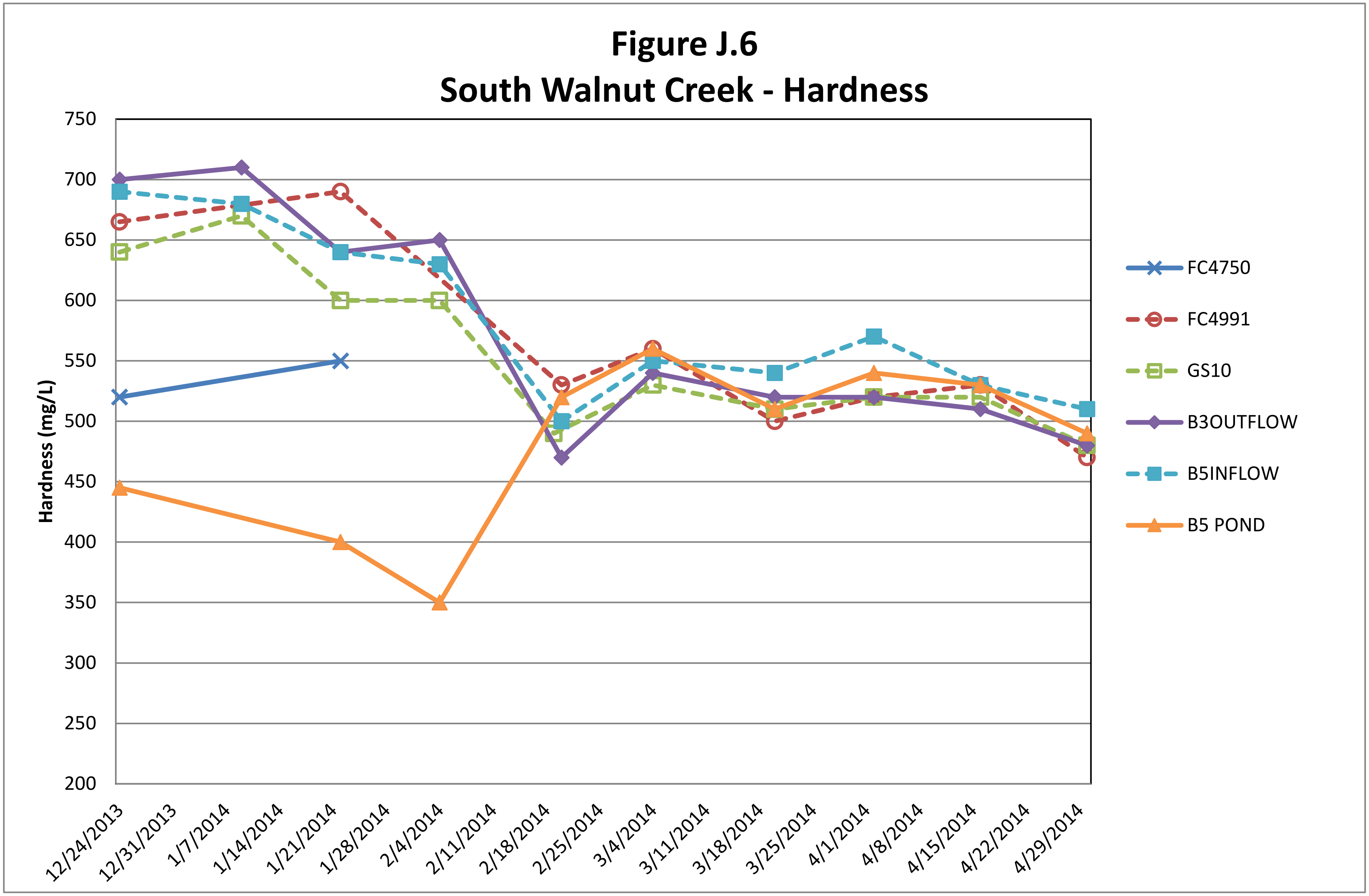


Figure J.6
South Walnut Creek - Hardness
Hardness (mg/L)
750
700
650
600
550
500
450
400
350
300
250
200
12/24/2013
12/31/2013
1/7/2014
1/14/2014
1/21/2014
1/28/2014
2/4/2014
2/11/2014
2/18/2014
2/25/2014
3/4/2014
3/11/2014
3/18/2014
3/25/2014
4/1/2014
4/8/2014
4/15/2014
4/22/2014
4/29/2014
FC4750
FC4991
GS10
B3OUTFLOW
B5INFLOW
B5 POND

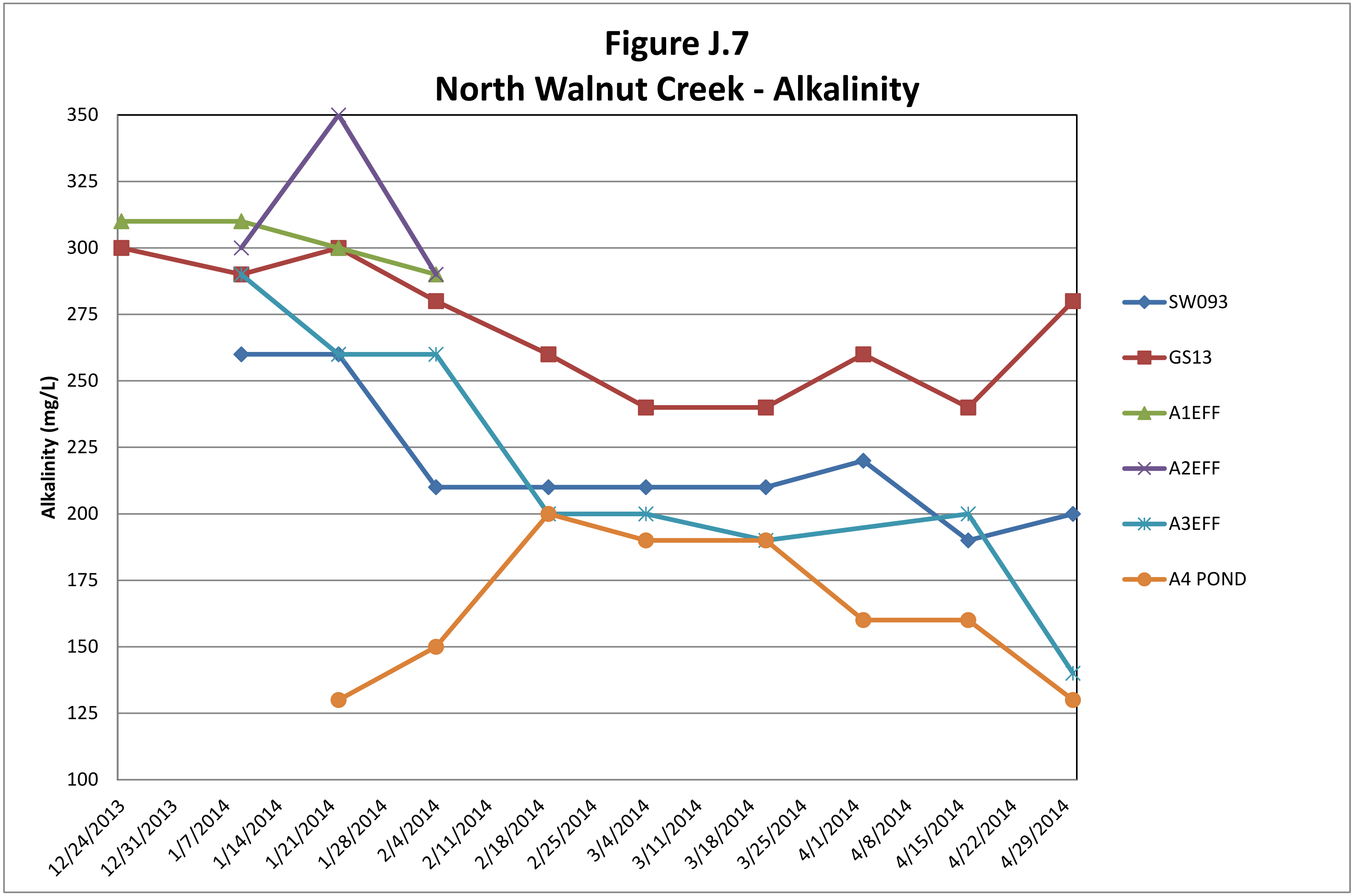


Figure J.7
North Walnut Creek - Alkalinity
Alkalinity (mg/L)
350
325
300
275
250
225
200
175
150
125
100
12/24/2013
12/31/2013
1/7/2014
1/14/2014
1/21/2014
1/28/2014
2/4/2014
2/11/2014
2/18/2014
2/25/2014
3/4/2014
3/11/2014
3/18/2014
3/25/2014
4/1/2014
4/8/2014
4/15/2014
4/22/2014
4/29/2014
SW093
GS13
A1EFF
A2EFF
A3EFF
A4 POND

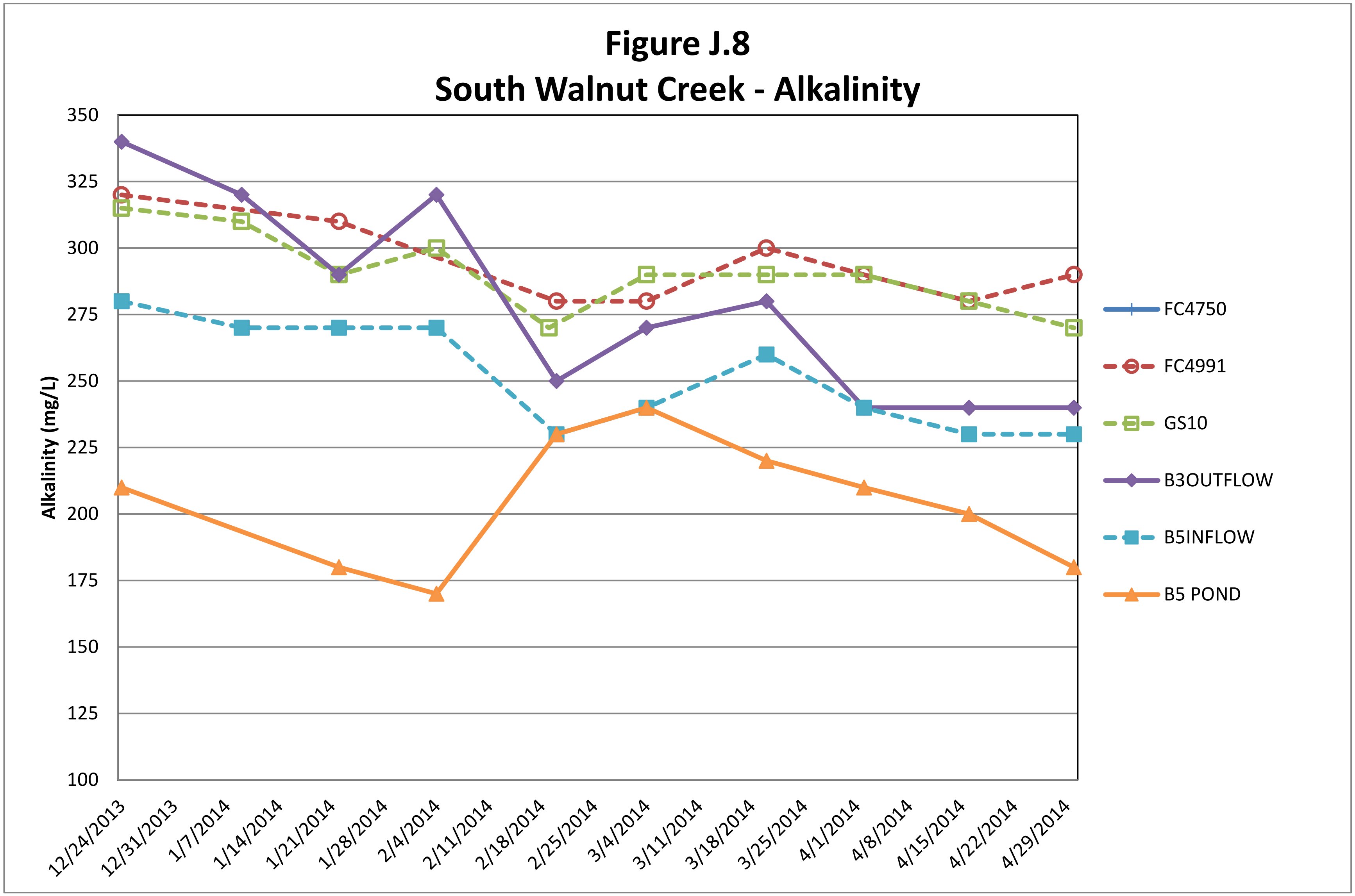


Figure J.8
South Walnut Creek - Alkalinity
Alkalinity (mg/L)
350
325
300
275
250
225
200
175
150
125
100
12/24/2013
12/31/2013
1/7/2014
1/14/2014
1/21/2014
1/28/2014
2/4/2014
2/11/2014
2/18/2014
2/25/2014
3/4/2014
3/11/2014
3/18/2014
3/25/2014
4/1/2014
4/8/2014
4/15/2014
4/22/2014
4/29/2014
FC4750
FC4991
GS10
B3OUTFLOW
B5INFLOW
B5 POND

Figure J.9

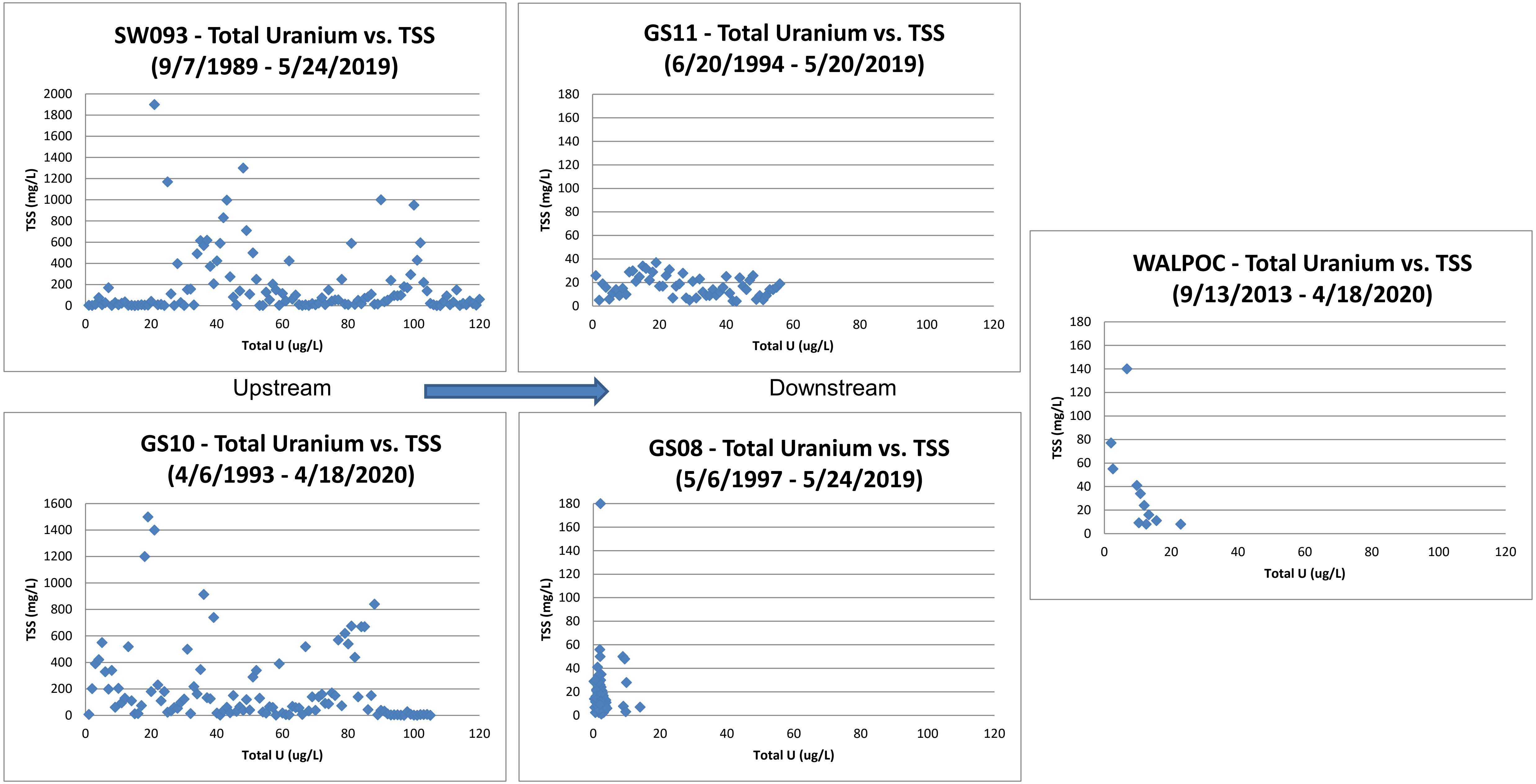
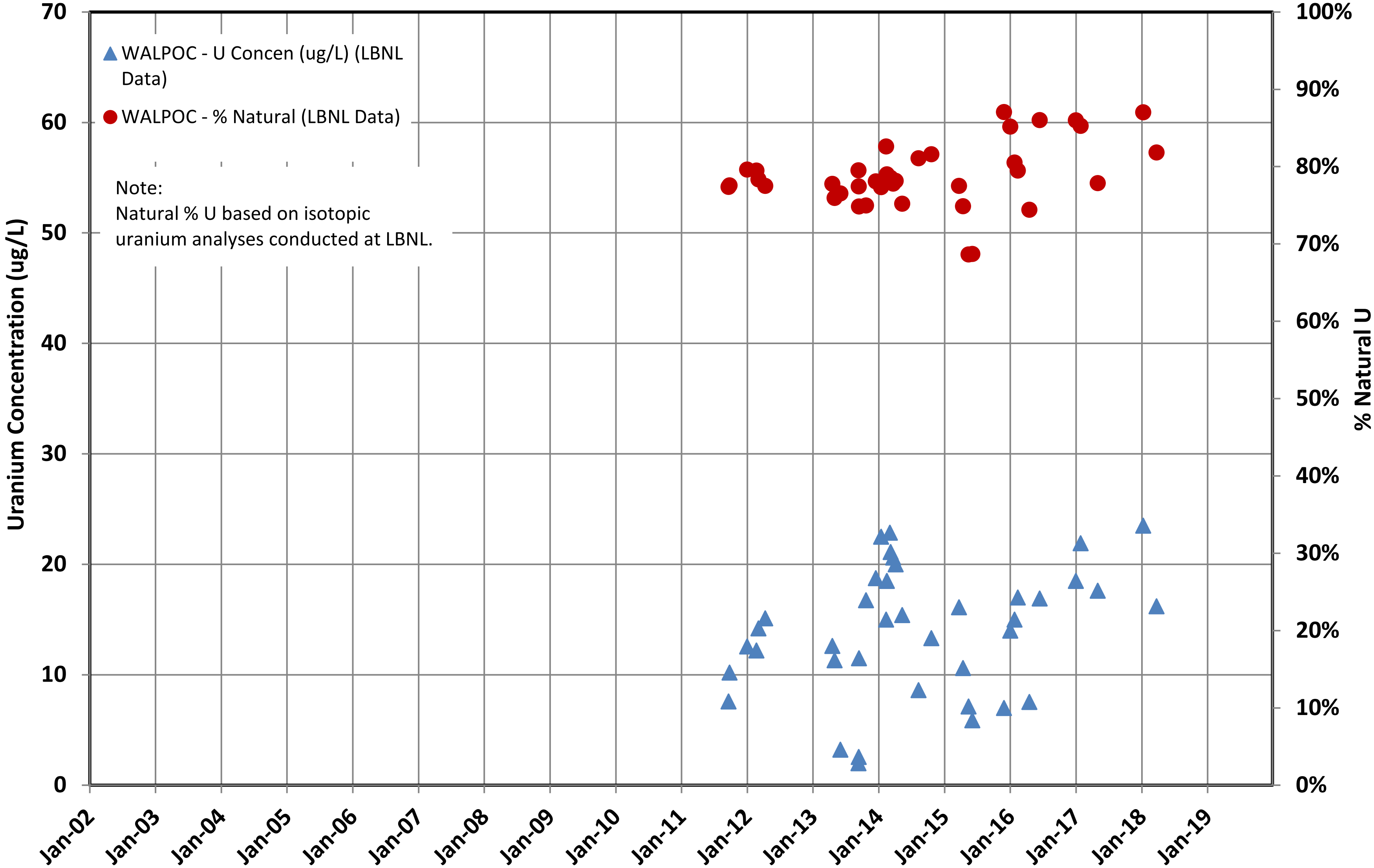

SW093 - Total Uranium vs. TSS
(9/7/1989 - 5/24/2019)
TSS (mg/L)
0
200
400
600
800
1000
1200
1400
1600
1800
2000
Total U (ug/L)
0
20
40
60
80
100
120
GS11 - Total Uranium vs. TSS
(6/20/1994 - 5/20/2019)
TSS (mg/L)
0
20
40
60
80
100
120
140
160
180
Total U (ug/L)
0
20
40
60
80
100
120
WALPOC - Total Uranium vs. TSS
(9/13/2013 - 4/18/2020)
TSS (mg/L)
0
20
40
60
80
100
120
140
160
180
Total U (ug/L)
0
20
40
60
80
100
120
Upstream
Downstream
GS10 - Total Uranium vs. TSS
(4/6/1993 - 4/18/2020)
TSS (mg/L)
0
200
400
600
800
1000
1200
1400
1600
Total U (ug/L)
0
20
40
60
80
100
120
GS08 - Total Uranium vs. TSS
(5/6/1997 - 5/24/2019)
TSS (mg/L)
0
20
40
60
80
100
120
140
160
180
Total U (ug/L)
0
20
40
60
80
100
120

Figure K.1
Uranium Concentration and Natural Percentage
WALPOC



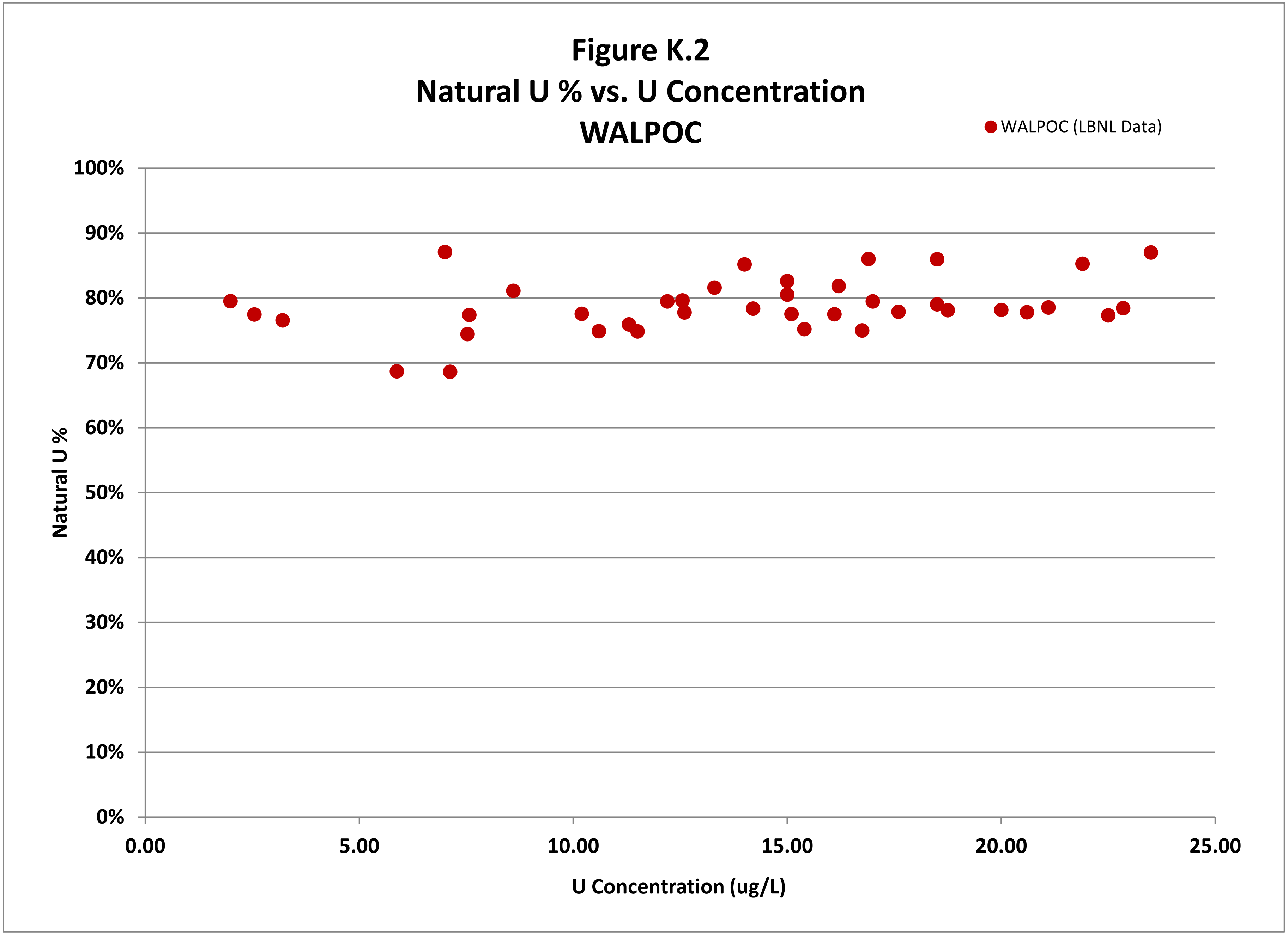


Figure K.2
Natural U % vs. U Concentration
WALPOC
WALPOC (LBNL Data)
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
Natural U %
0.00
5.00
10.00
15.00
20.00
25.00
U Concentration (ug/L)

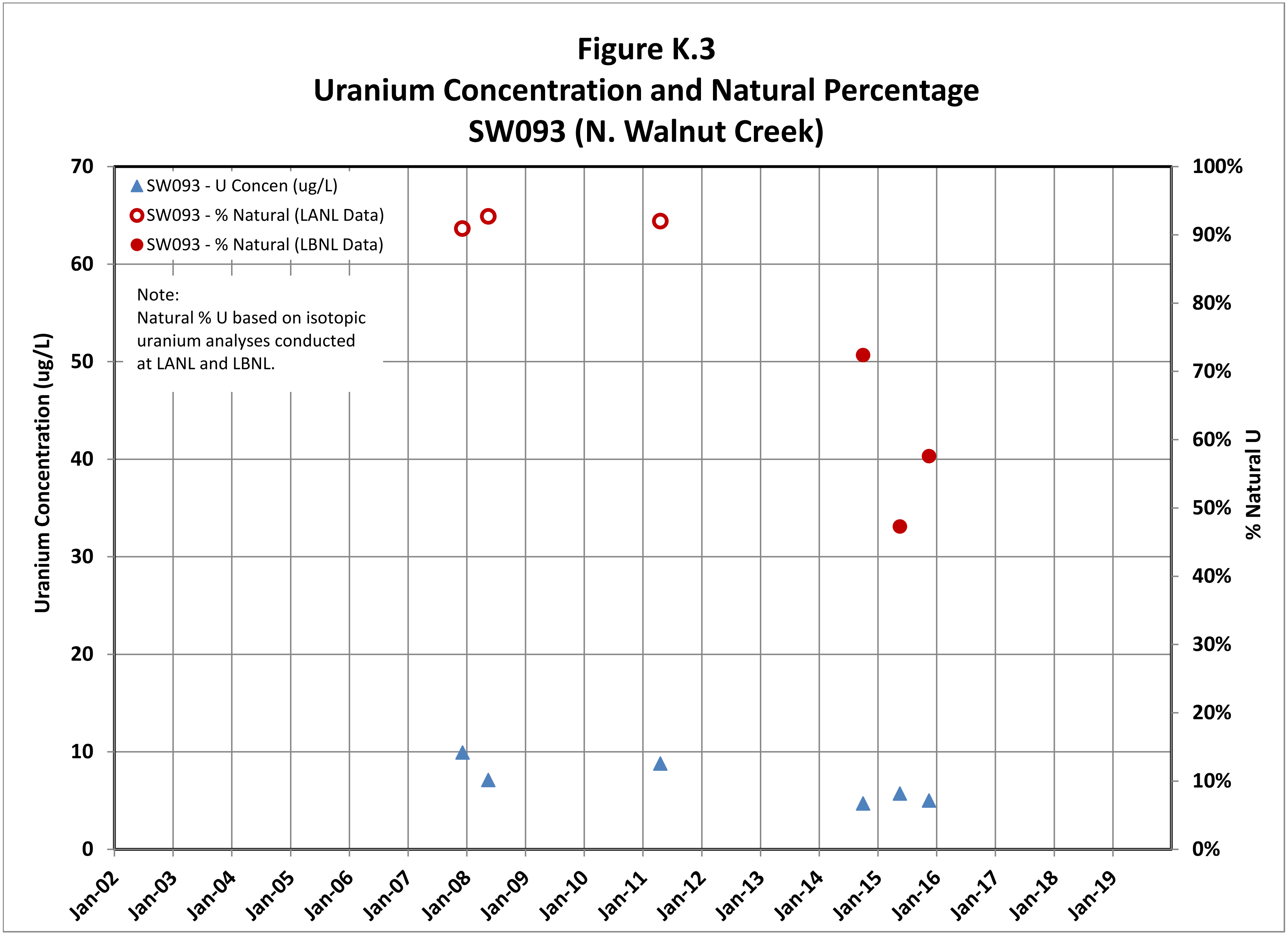


Figure K.3
Uranium Concentration and Natural Percentage
SW093 (N. Walnut Creek)
SW093 - U Concen (ug/L)
SW093 - % Natural (LANL Data)
SW093 - % Natural (LBNL Data)
Note:
Natural % U based on isotopic
uranium analyses conducted
at LANL and LBNL.
Uranium Concentration (ug/L)
% Natural U
0
10
20
30
40
50
60
70
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
Jan-02
Jan-03
Jan-04
Jan-05
Jan-06
Jan-07
Jan-08
Jan-09
Jan-10
Jan-11
Jan-12
Jan-13
Jan-14
Jan-15
Jan-16
Jan-17
Jan-18
Jan-19

Figure K.4
Uranium Concentration and Natural Percentage
SPOUT (N. Walnut Creek)

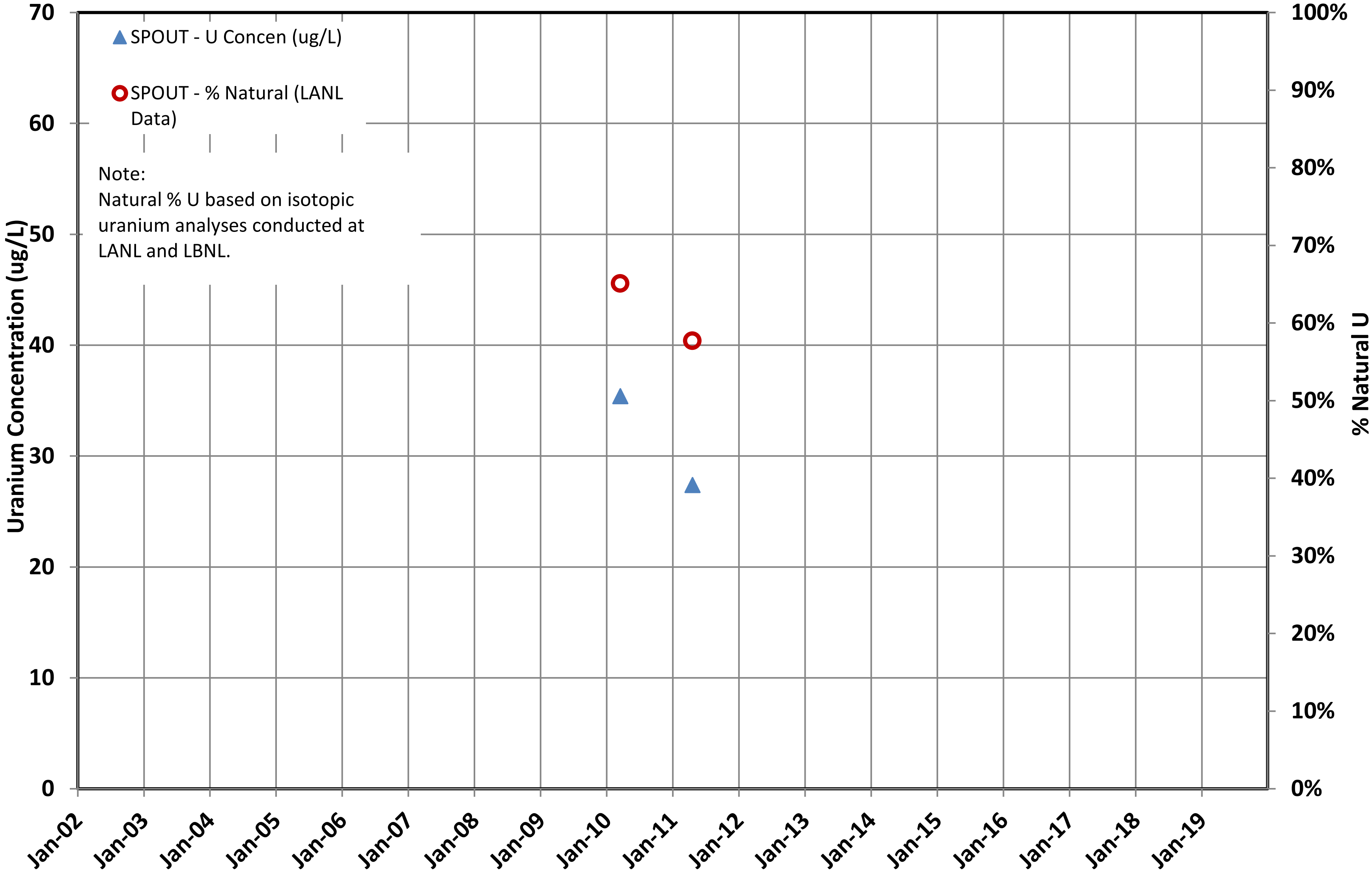


Figure K.5
Uranium Concentration and Natural Percentage
GS13 (N. Walnut Creek)

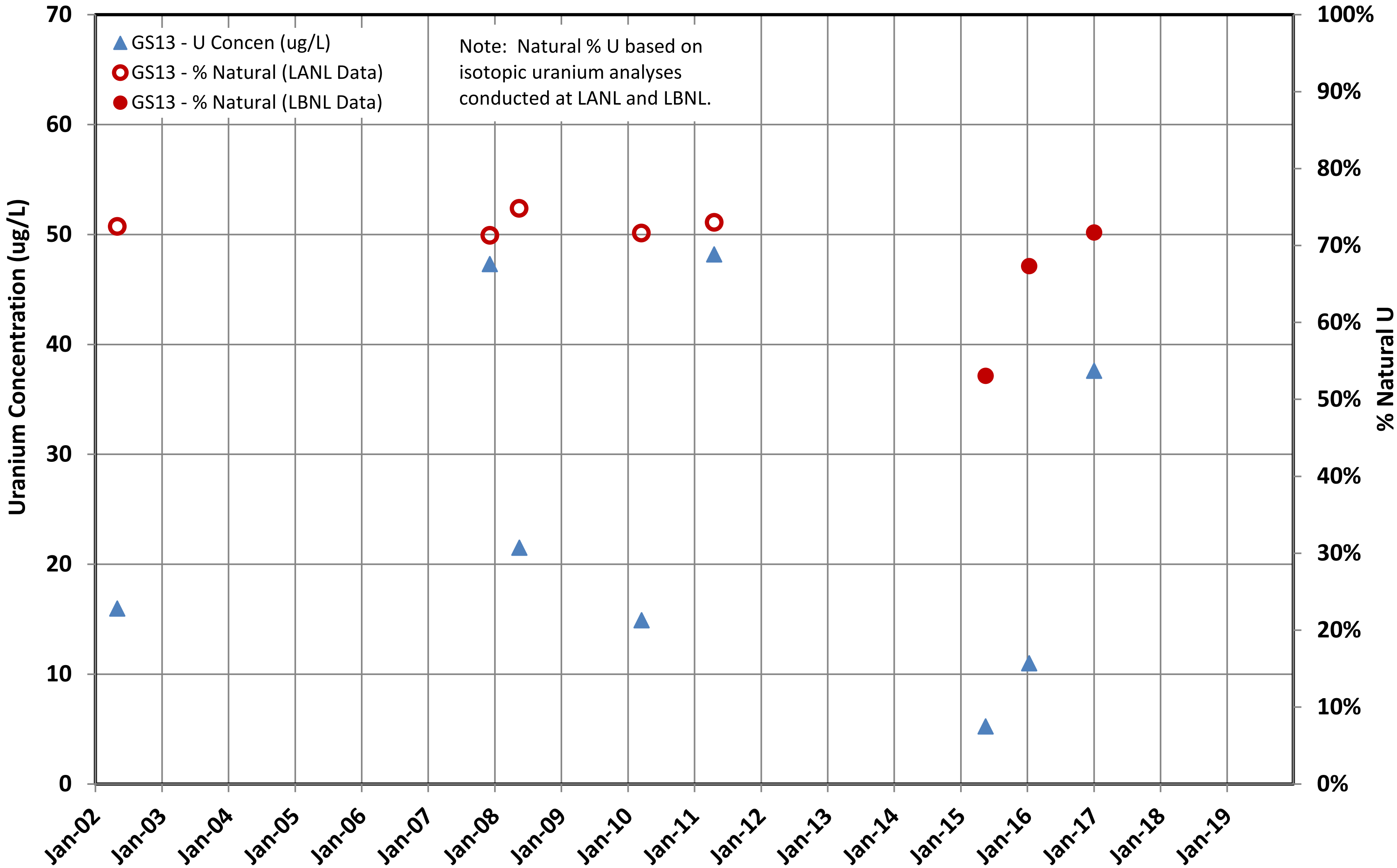
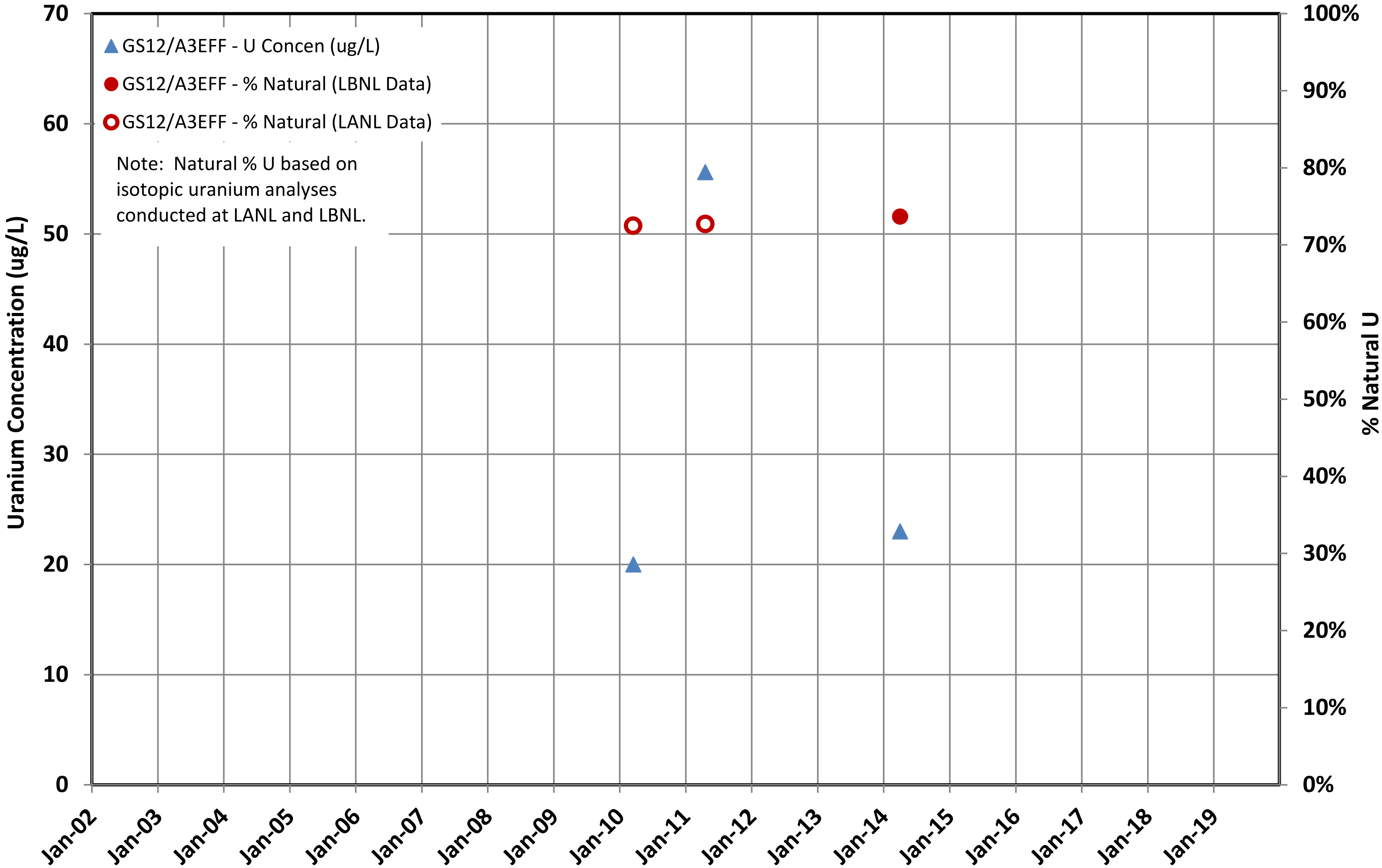


Figure K.6
Uranium Concentration and Natural Percentage
GS12/A3EFF (N. Walnut Creek)



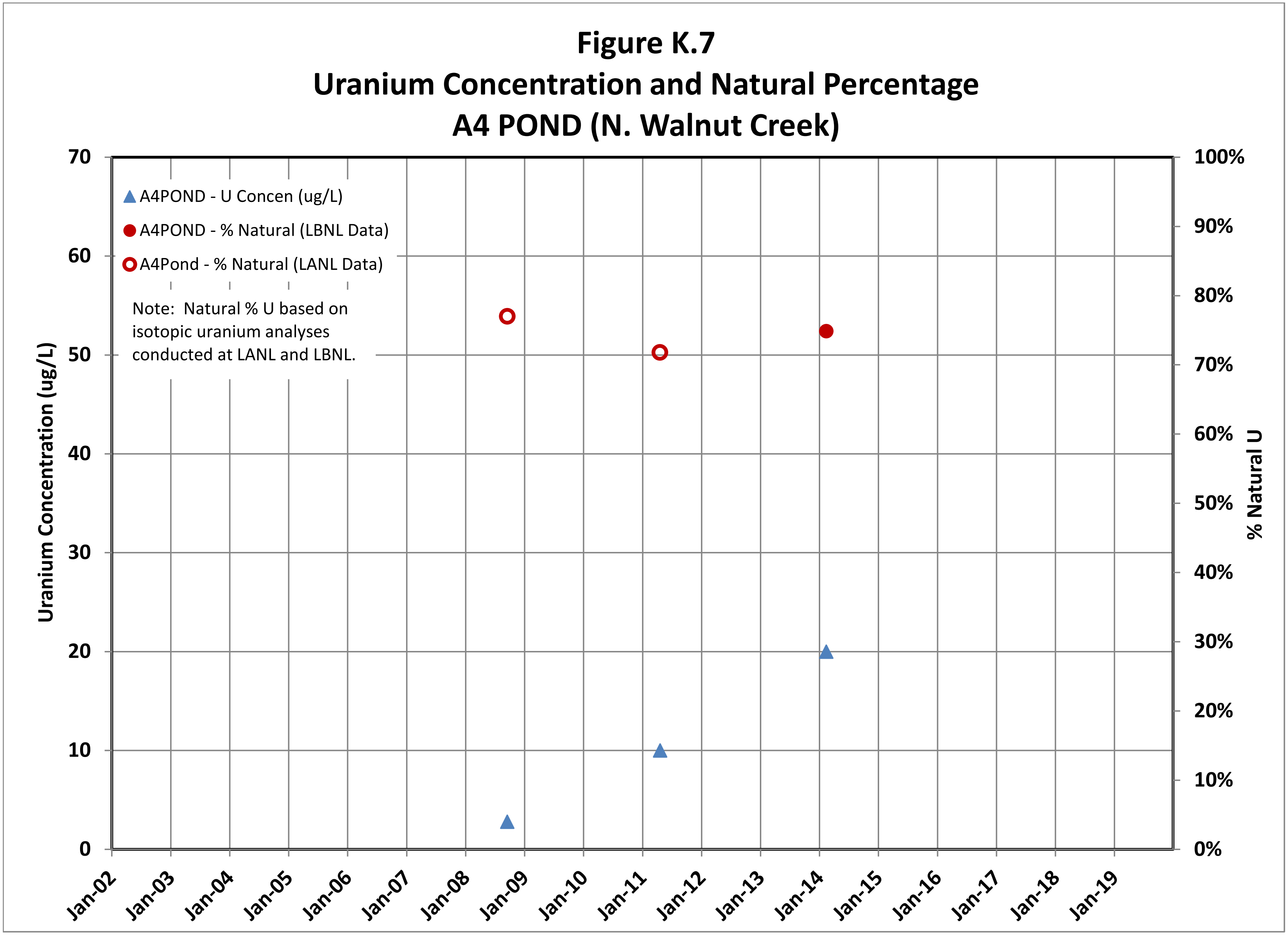


Figure K.7
Uranium Concentration and Natural Percentage
A4 POND (N. Walnut Creek)
A4POND - U Concen (ug/L)
A4POND - % Natural (LBNL Data)
A4Pond - % Natural (LANL Data)
Note: Natural % U based on isotopic uranium analyses conducted at LANL and LBNL.
Uranium Concentration (ug/L)
% Natural U
0
10
20
30
40
50
60
70
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
Jan-02
Jan-03
Jan-04
Jan-05
Jan-06
Jan-07
Jan-08
Jan-09
Jan-10
Jan-11
Jan-12
Jan-13
Jan-14
Jan-15
Jan-16
Jan-17
Jan-18
Jan-19

Figure K.8
Uranium Concentration and Natural Percentage
GS11 (N. Walnut Creek)

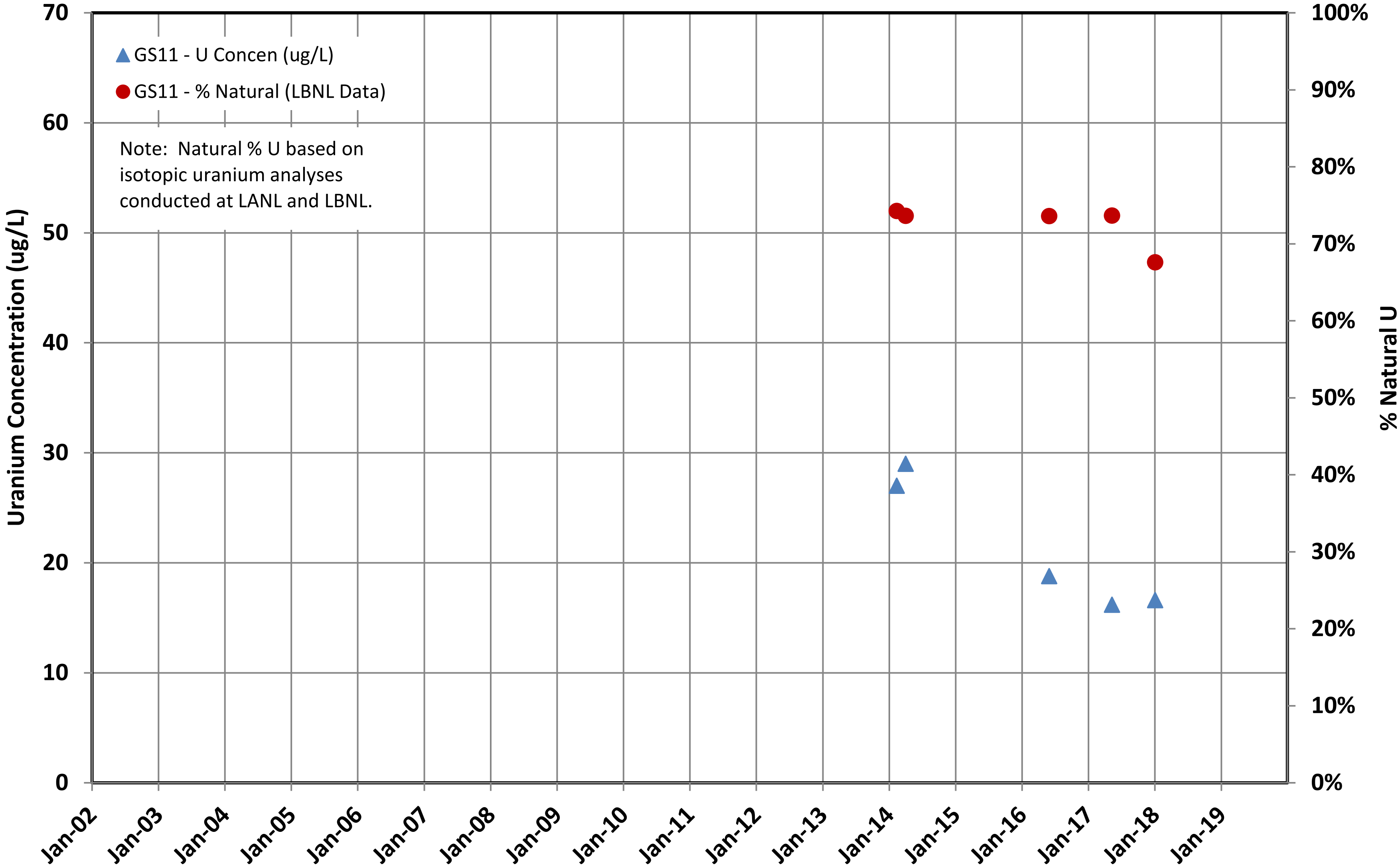


Figure K.9
Uranium Concentration and Natural Percentage
FC4EFF (S. Walnut Creek)

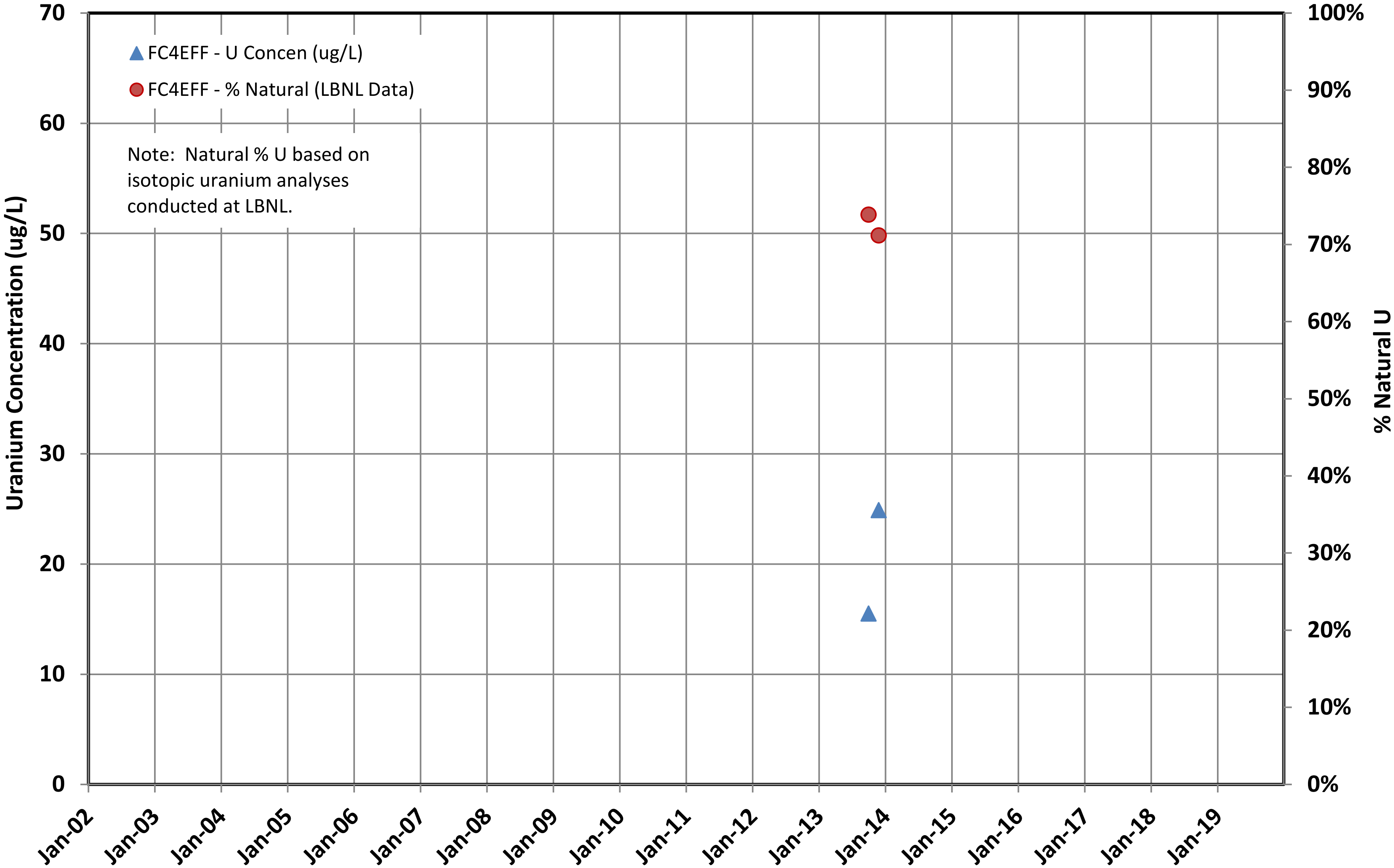


Figure K.10
Uranium Concentration and Natural Percentage
SEEP995A (S. Walnut Creek)

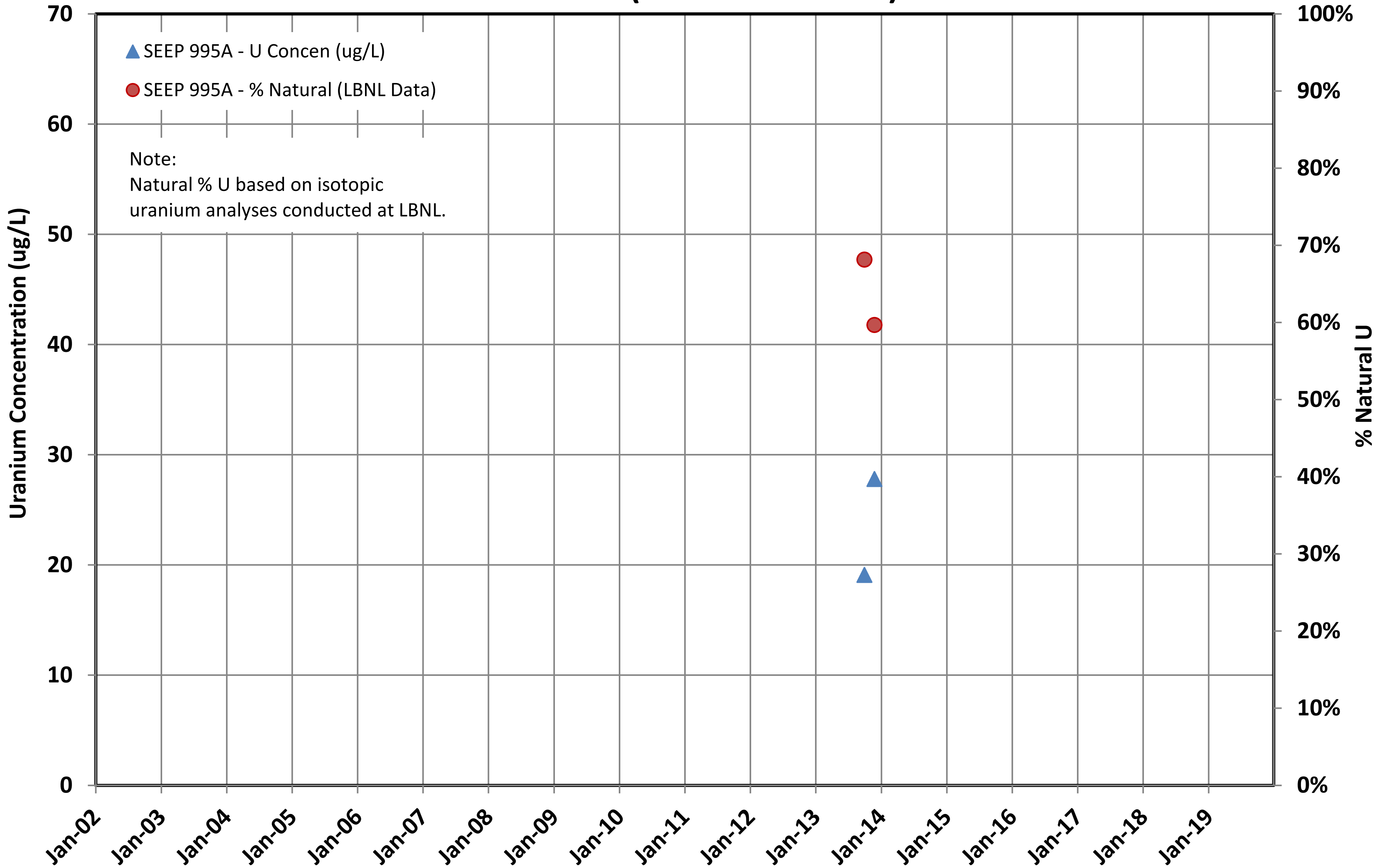
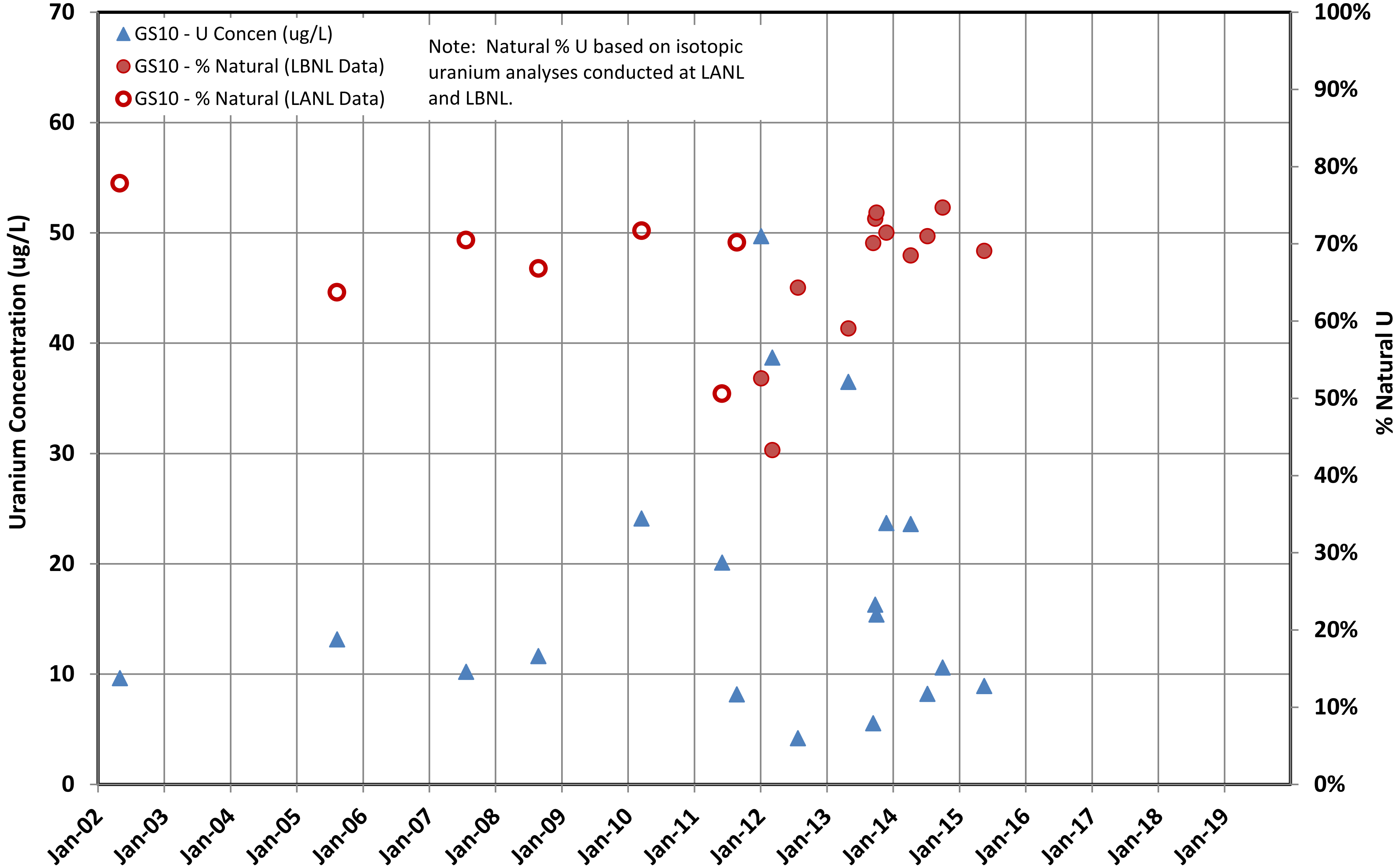


Figure K.11
Uranium Concentration and Natural Percentage
GS10 (S. Walnut Creek)



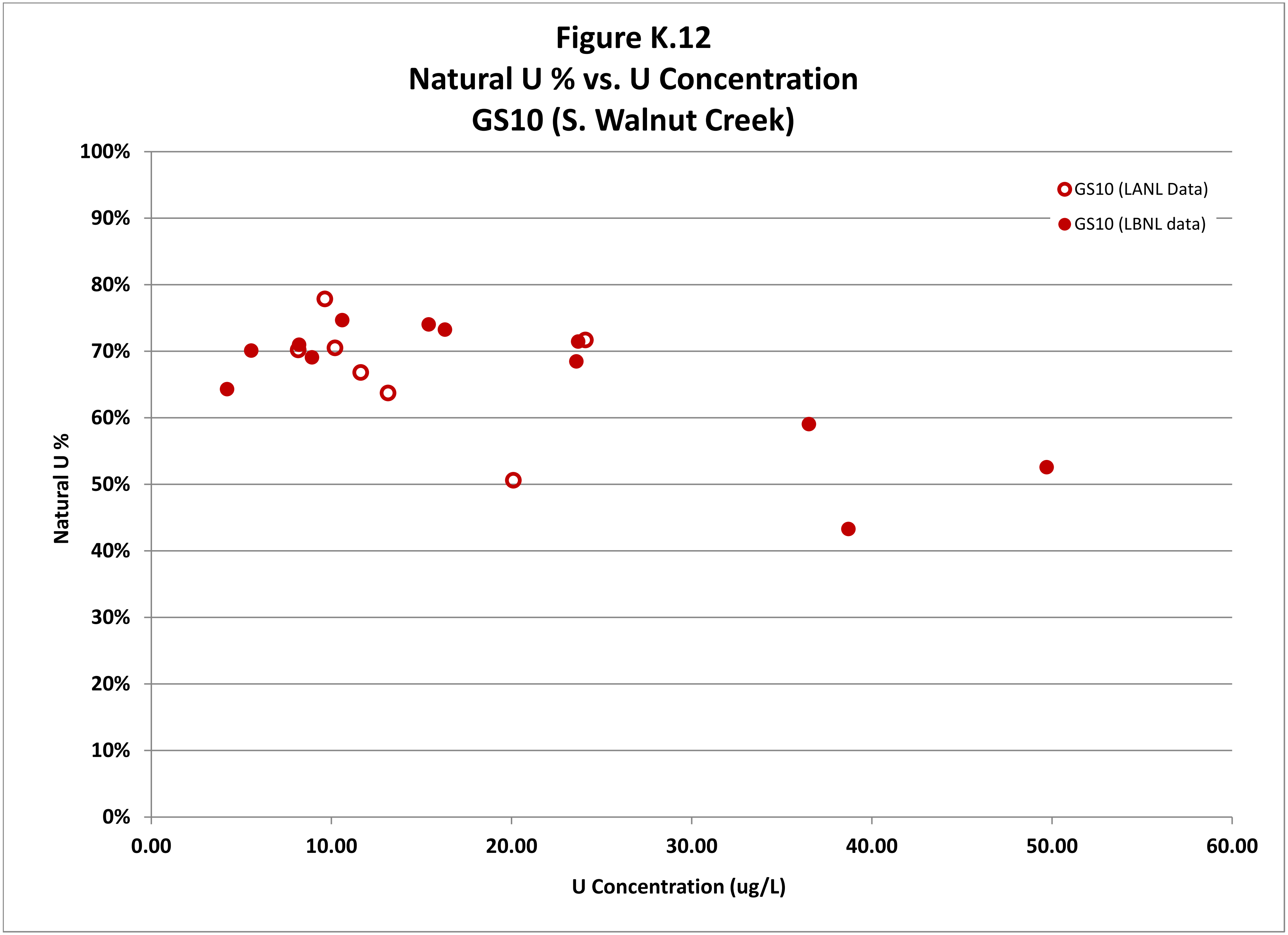


Figure K.12
Natural U % vs. U Concentration
GS10 (S. Walnut Creek)
GS10 (LANL Data)
GS10 (LBNL data)
Natural U %
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
0.00
10.00
20.00
30.00
40.00
50.00
60.00
U Concentration (ug/L)

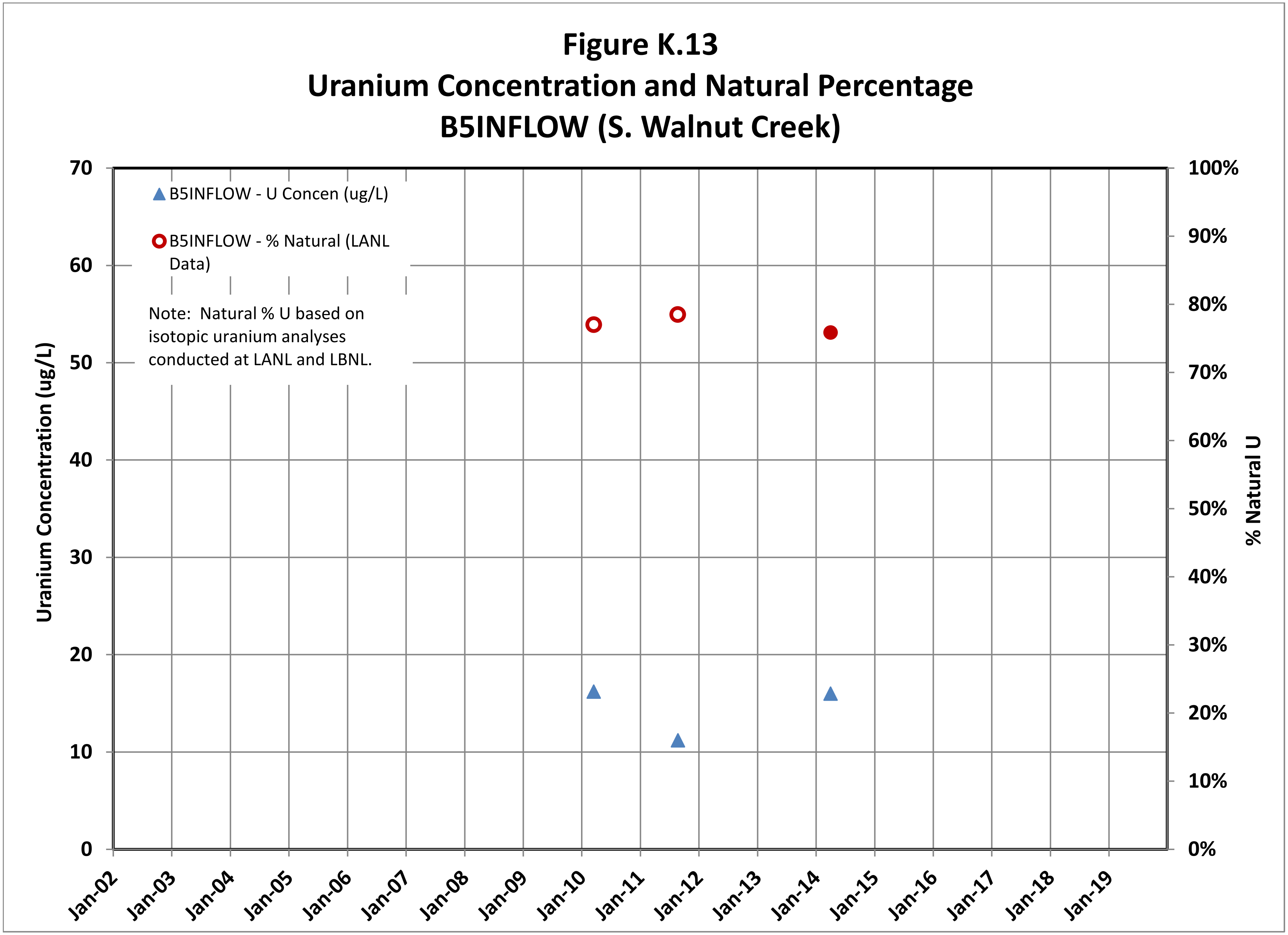


Figure K.13
Uranium Concentration and Natural Percentage
B5INFLOW (S. Walnut Creek)
B5INFLOW - U Concen (ug/L)
B5INFLOW - % Natural (LANL Data)
Note: Natural % U based on isotopic uranium analyses conducted at LANL and LBNL.
Uranium Concentration (ug/L)
% Natural U
0
10
20
30
40
50
60
70
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
Jan-02
Jan-03
Jan-04
Jan-05
Jan-06
Jan-07
Jan-08
Jan-09
Jan-10
Jan-11
Jan-12
Jan-13
Jan-14
Jan-15
Jan-16
Jan-17
Jan-18
Jan-19

Figure K.14
Uranium Concentration and Natural Percentage
B5POND (S. Walnut Creek)

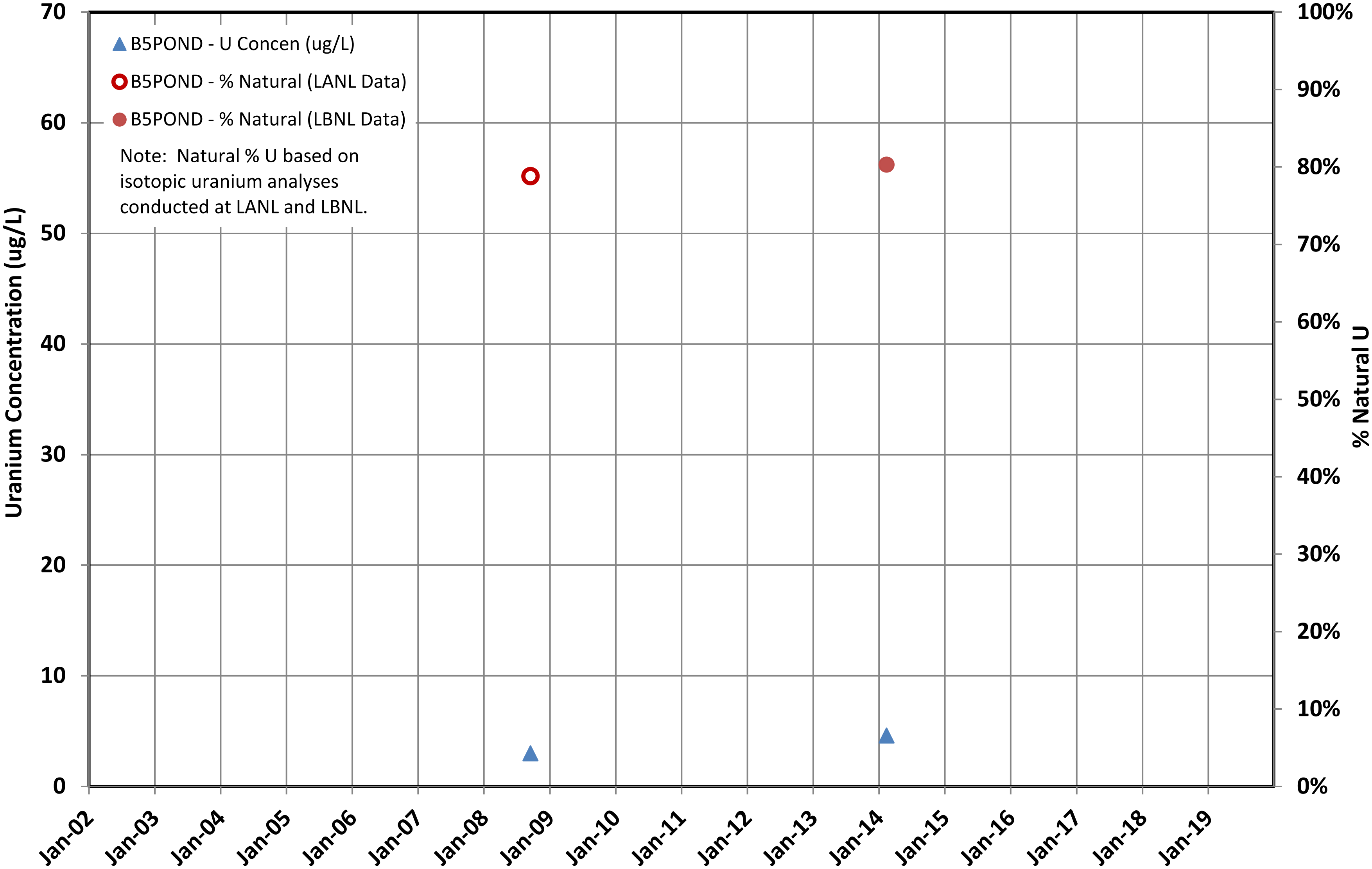
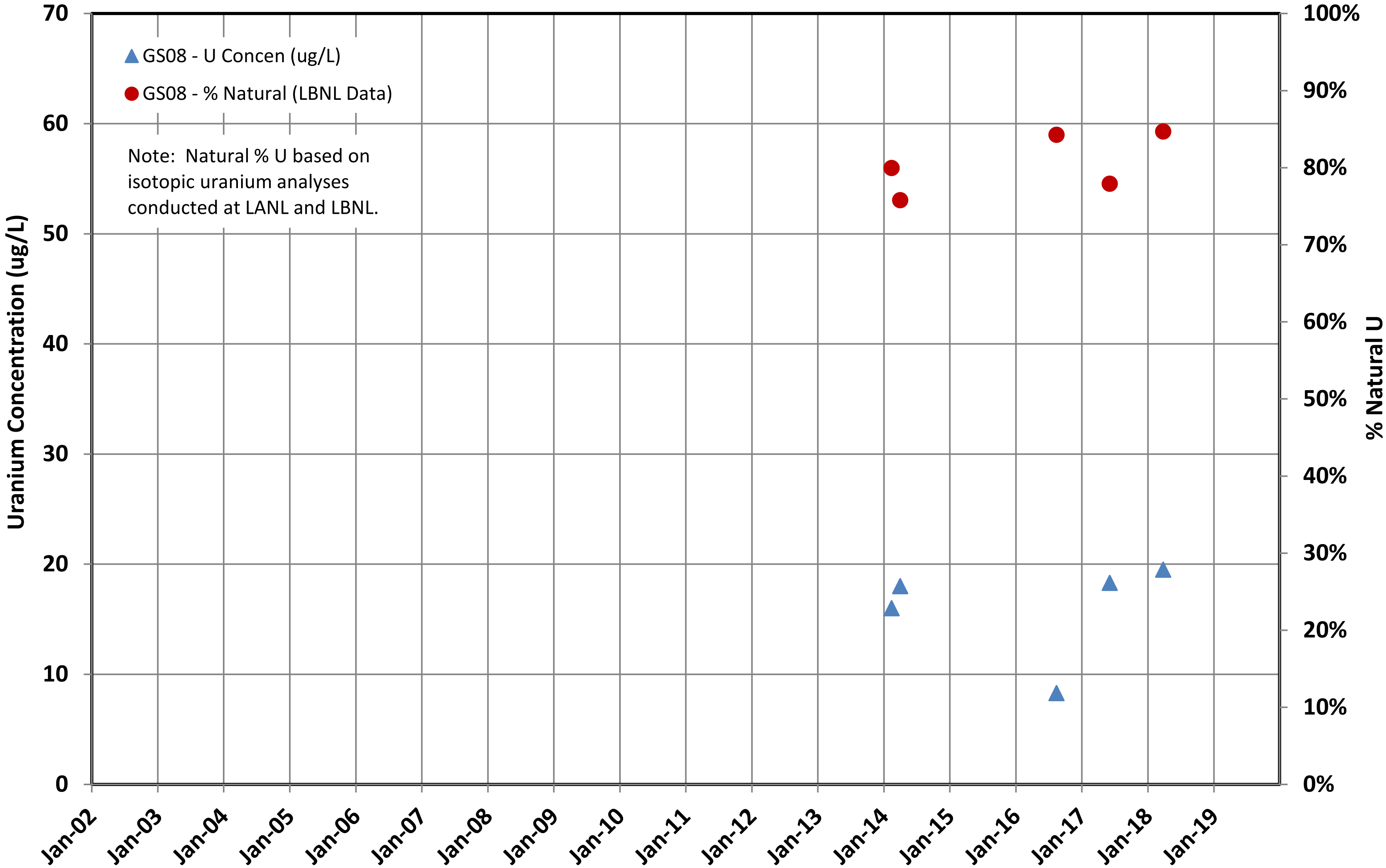


Figure K.15
Uranium Concentration and Natural Percentage
GS08 (S. Walnut Creek)



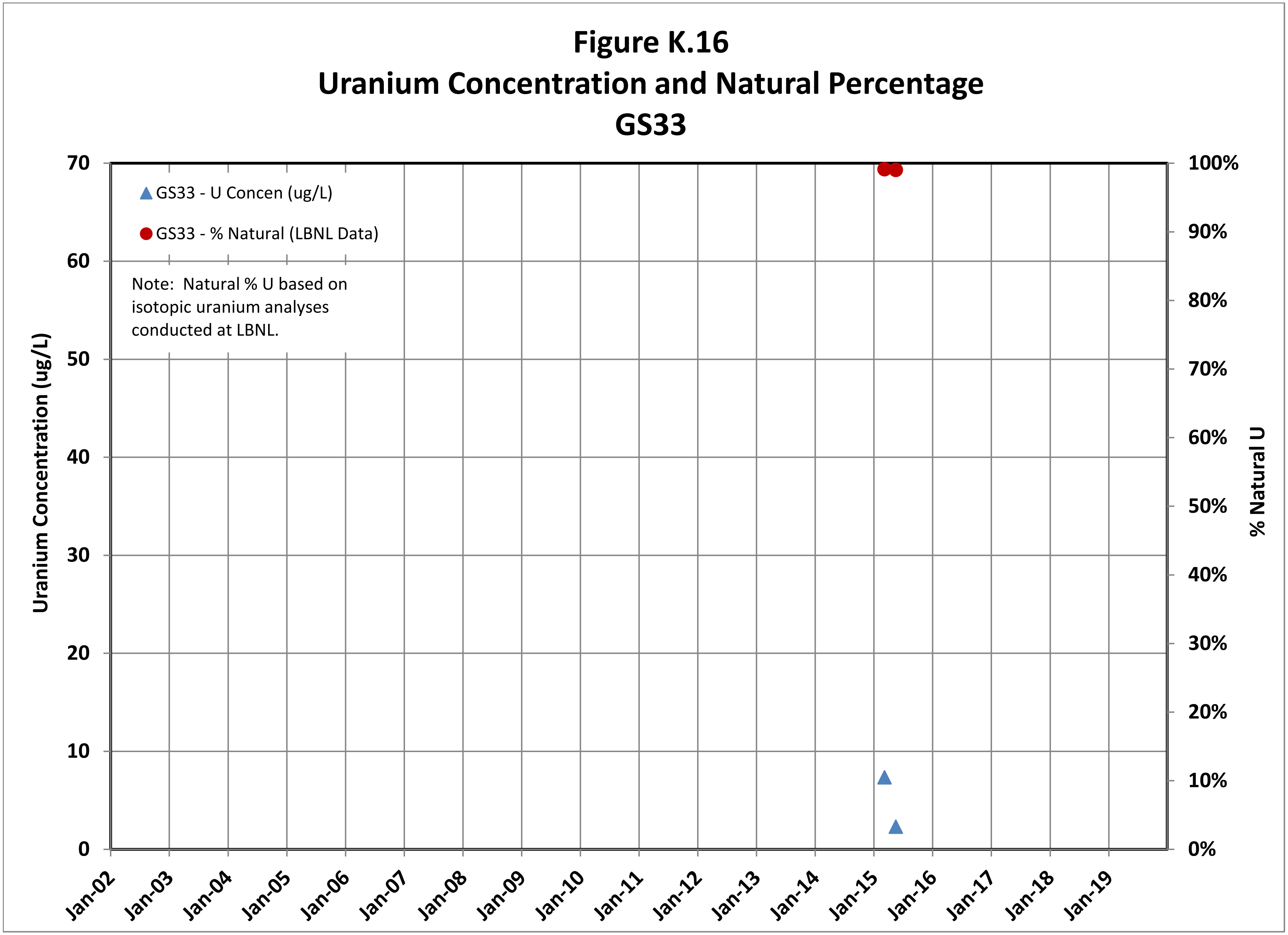
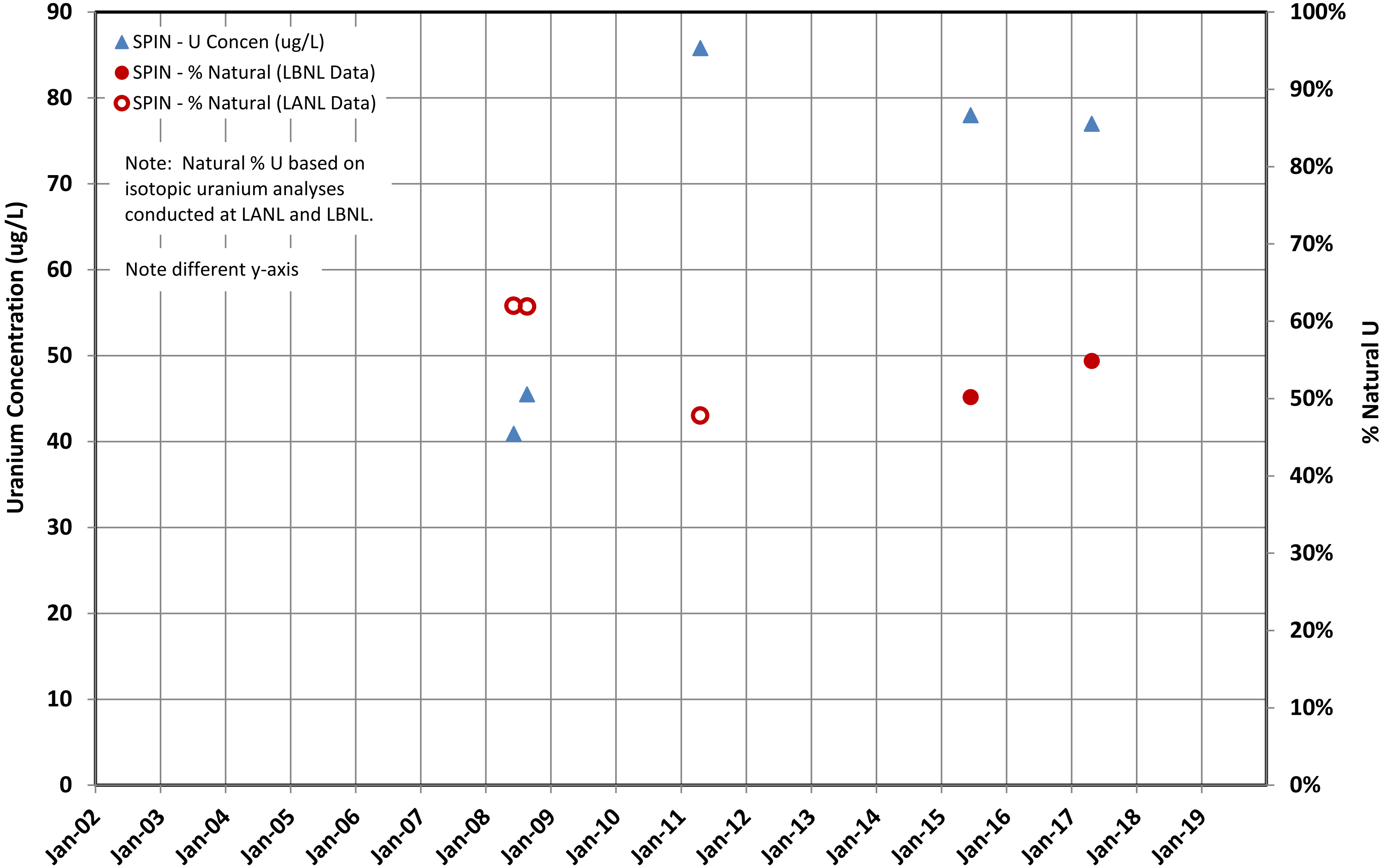


Figure K.16
Uranium Concentration and Natural Percentage
GS33
GS33 - U Concen (ug/L)
GS33 - % Natural (LBNL Data)
Note: Natural % U based on isotopic uranium analyses conducted at LBNL.
Uranium Concentration (ug/L)
% Natural U
0
10
20
30
40
50
60
70
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
Jan-02
Jan-03
Jan-04
Jan-05
Jan-06
Jan-07
Jan-08
Jan-09
Jan-10
Jan-11
Jan-12
Jan-13
Jan-14
Jan-15
Jan-16
Jan-17
Jan-18
Jan-19

Figure K.17
Uranium Concentration and Natural Percentage
SPIN (N. Walnut Creek)



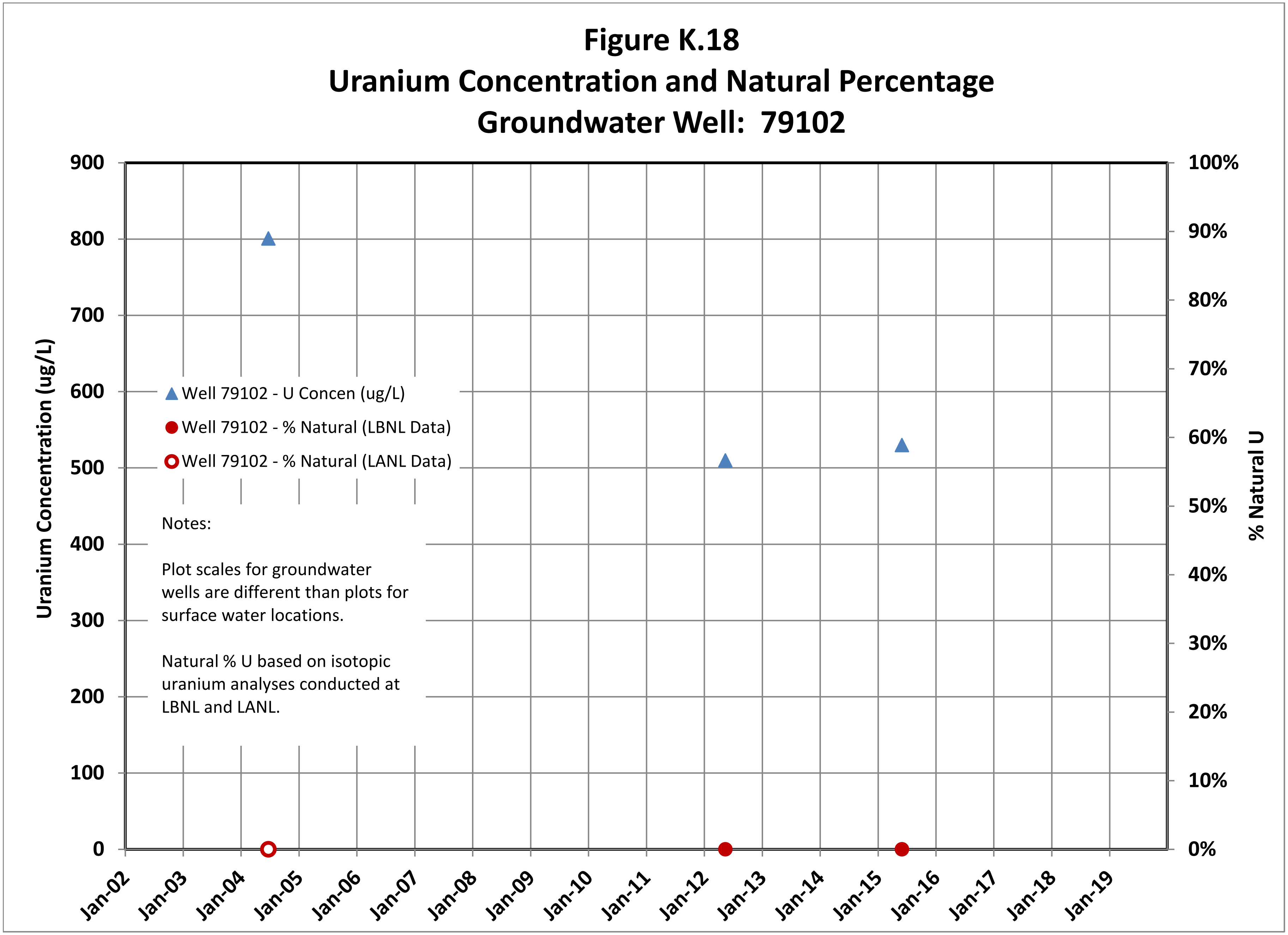


Figure K.18
Uranium Concentration and Natural Percentage
Groundwater Well: 79102
Uranium Concentration (ug/L)
% Natural U
900
800
700
600
500
400
300
200
100
0
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
Jan-02
Jan-03
Jan-04
Jan-05
Jan-06
Jan-07
Jan-08
Jan-09
Jan-10
Jan-11
Jan-12
Jan-13
Jan-14
Jan-15
Jan-16
Jan-17
Jan-18
Jan-19
Well 79102 - U Concen (ug/L)
Well 79102 - % Natural (LBNL Data)
Well 79102 - % Natural (LANL Data)
Notes:
Plot scales for groundwater wells are different than plots for surface water locations.
Natural % U based on isotopic uranium analyses conducted at LBNL and LANL.

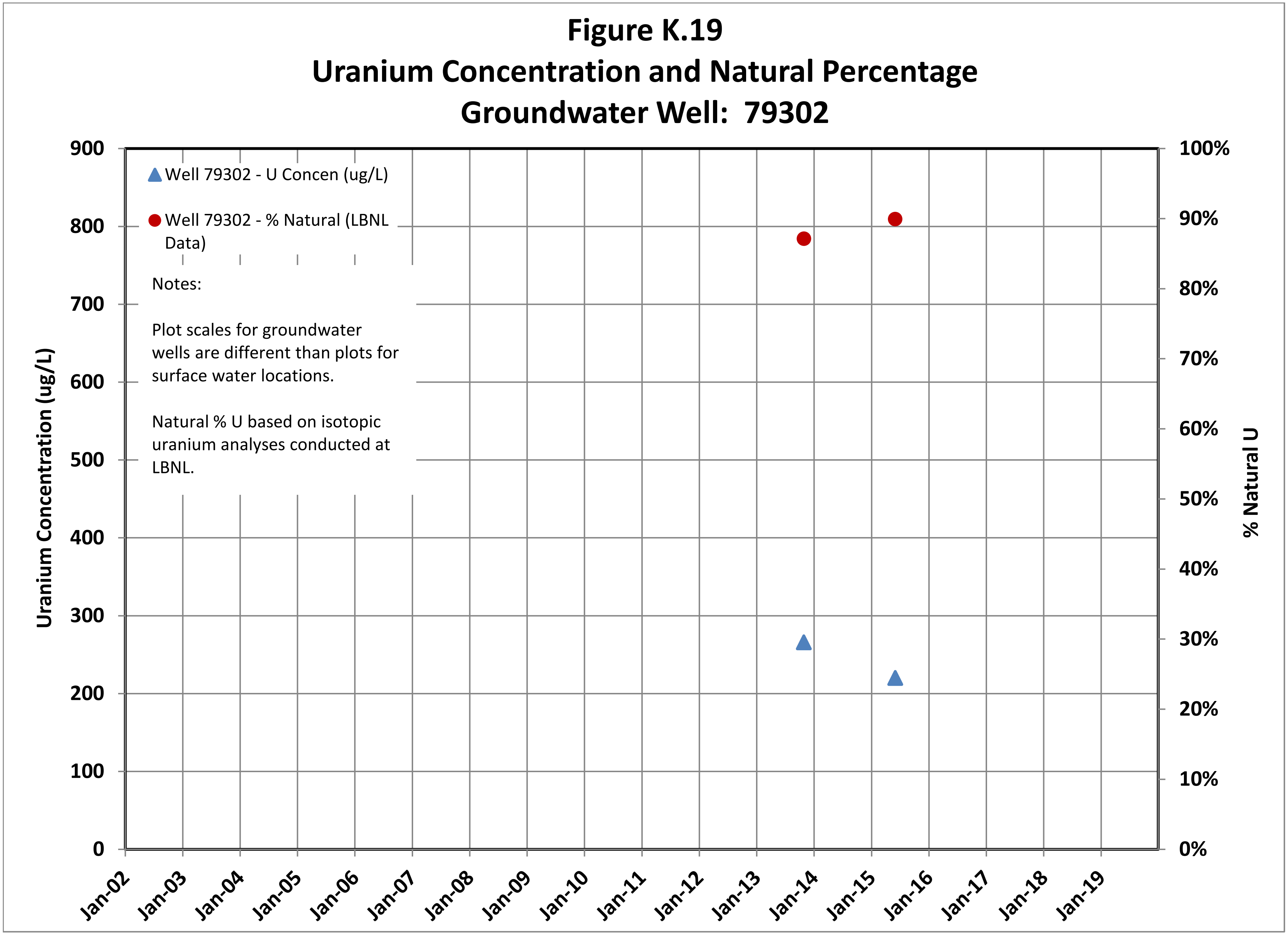


Figure K.19
Uranium Concentration and Natural Percentage
Groundwater Well: 79302
Well 79302 - U Concen (ug/L)
Well 79302 - % Natural (LBNL Data)
Notes:
Plot scales for groundwater wells are different than plots for surface water locations.
Natural % U based on isotopic uranium analyses conducted at LBNL.
Uranium Concentration (ug/L)
% Natural U
900
800
700
600
500
400
300
200
100
0
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
Jan-02
Jan-03
Jan-04
Jan-05
Jan-06
Jan-07
Jan-08
Jan-09
Jan-10
Jan-11
Jan-12
Jan-13
Jan-14
Jan-15
Jan-16
Jan-17
Jan-18
Jan-19

Figure K.20
Uranium Concentration and Natural Percentage
Groundwater Well: 79502

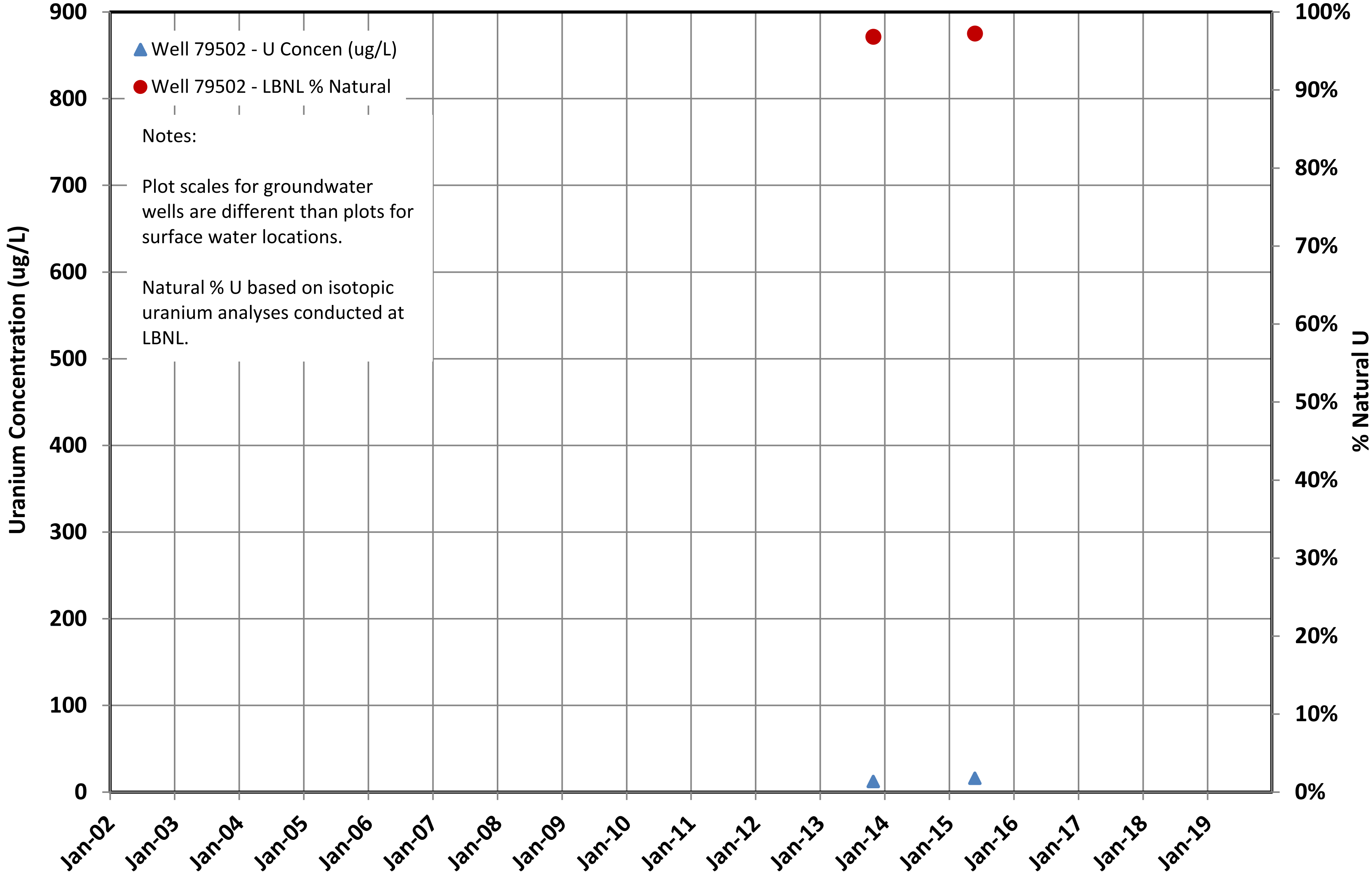
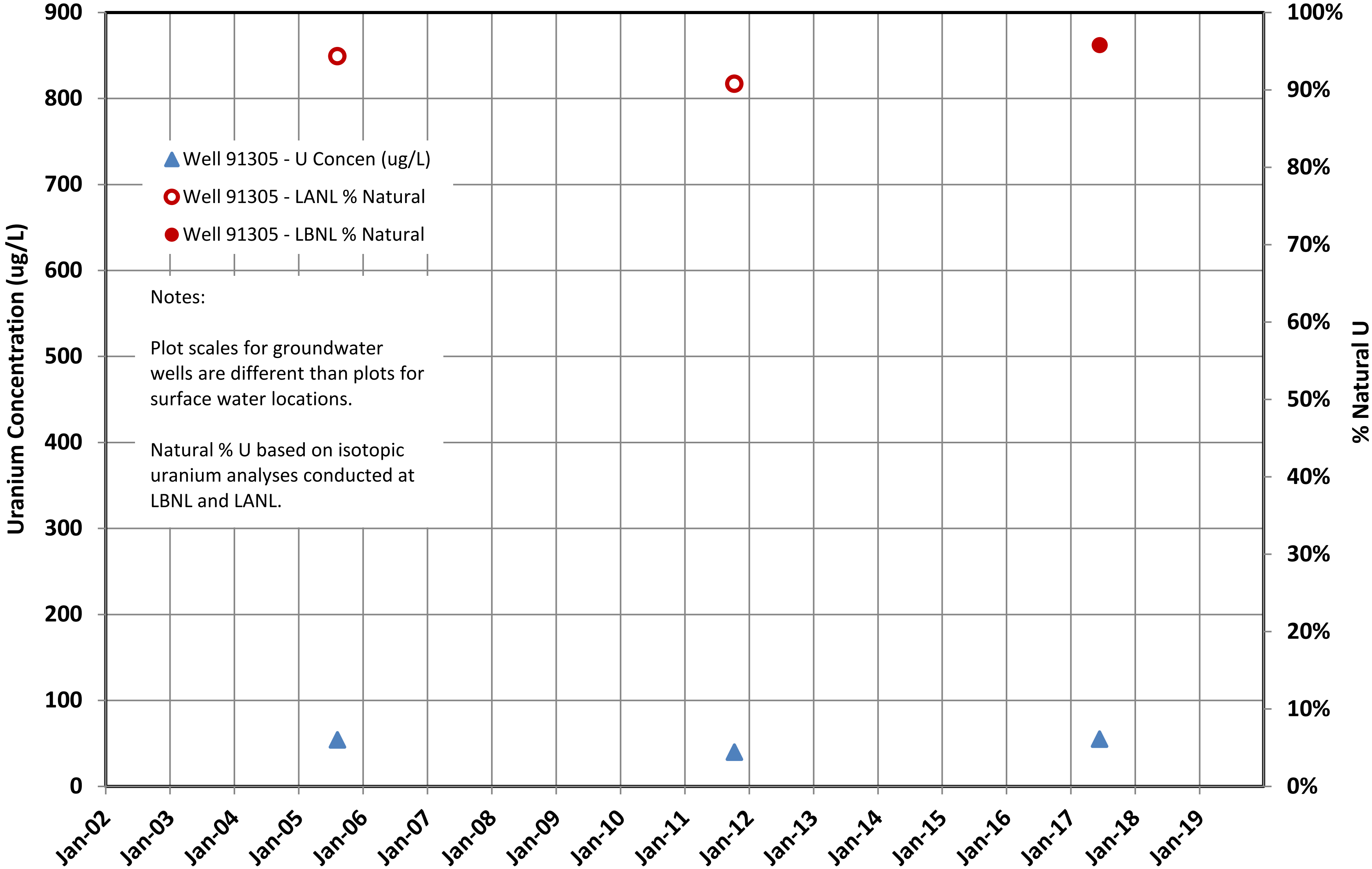


Figure K.21
Uranium Concentration and Natural Percentage
Groundwater Well: 91305



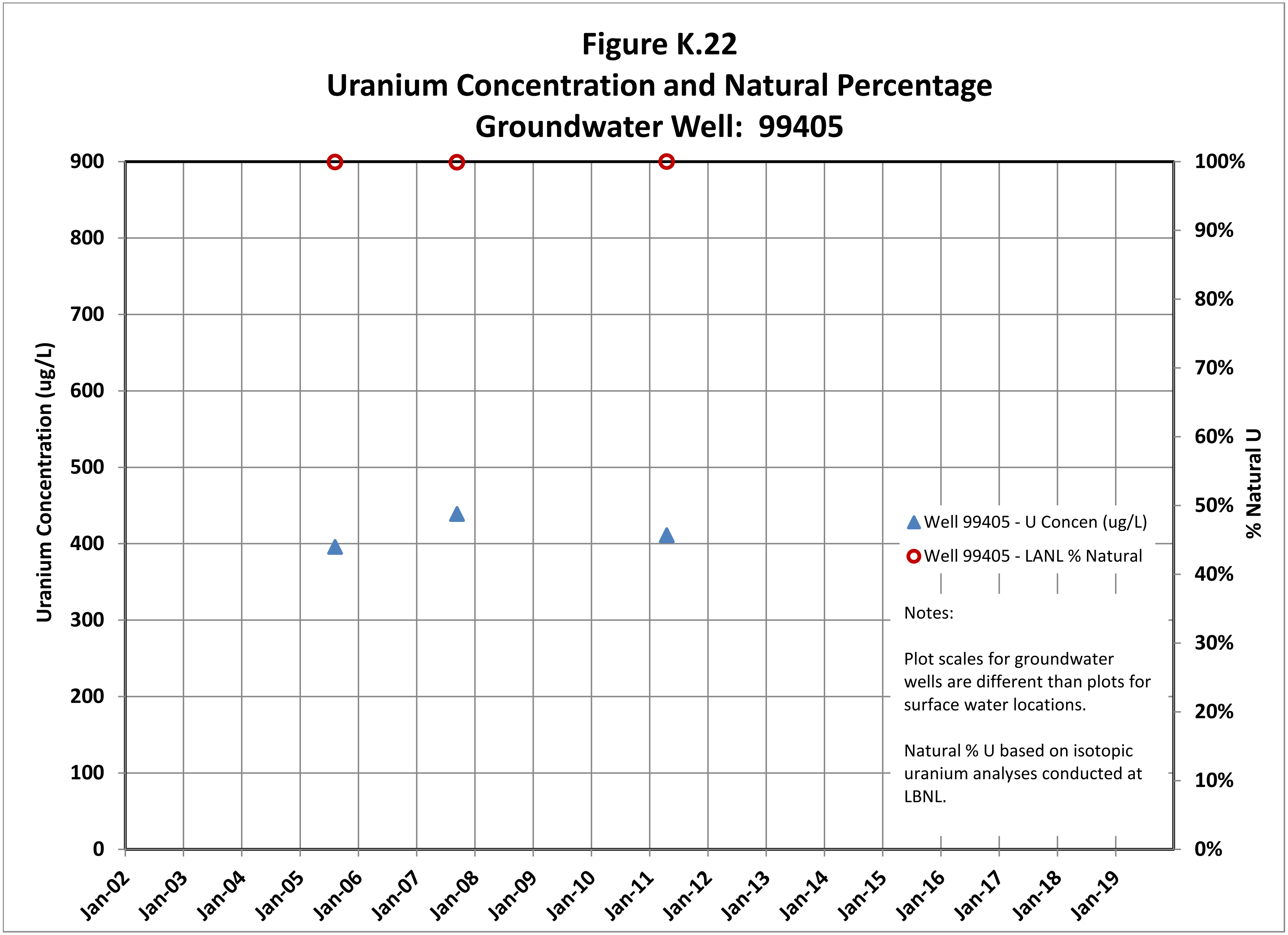


Figure K.22
Uranium Concentration and Natural Percentage
Groundwater Well: 99405
Uranium Concentration (ug/L)
% Natural U
900
800
700
600
500
400
300
200
100
0
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
Jan-02
Jan-03
Jan-04
Jan-05
Jan-06
Jan-07
Jan-08
Jan-09
Jan-10
Jan-11
Jan-12
Jan-13
Jan-14
Jan-15
Jan-16
Jan-17
Jan-18
Jan-19
Well 99405 - U Concen (ug/L)
Well 99405 - LANL % Natural
Notes:
Plot scales for groundwater wells are different than plots for surface water locations.
Natural % U based on isotopic uranium analyses conducted at LBNL.

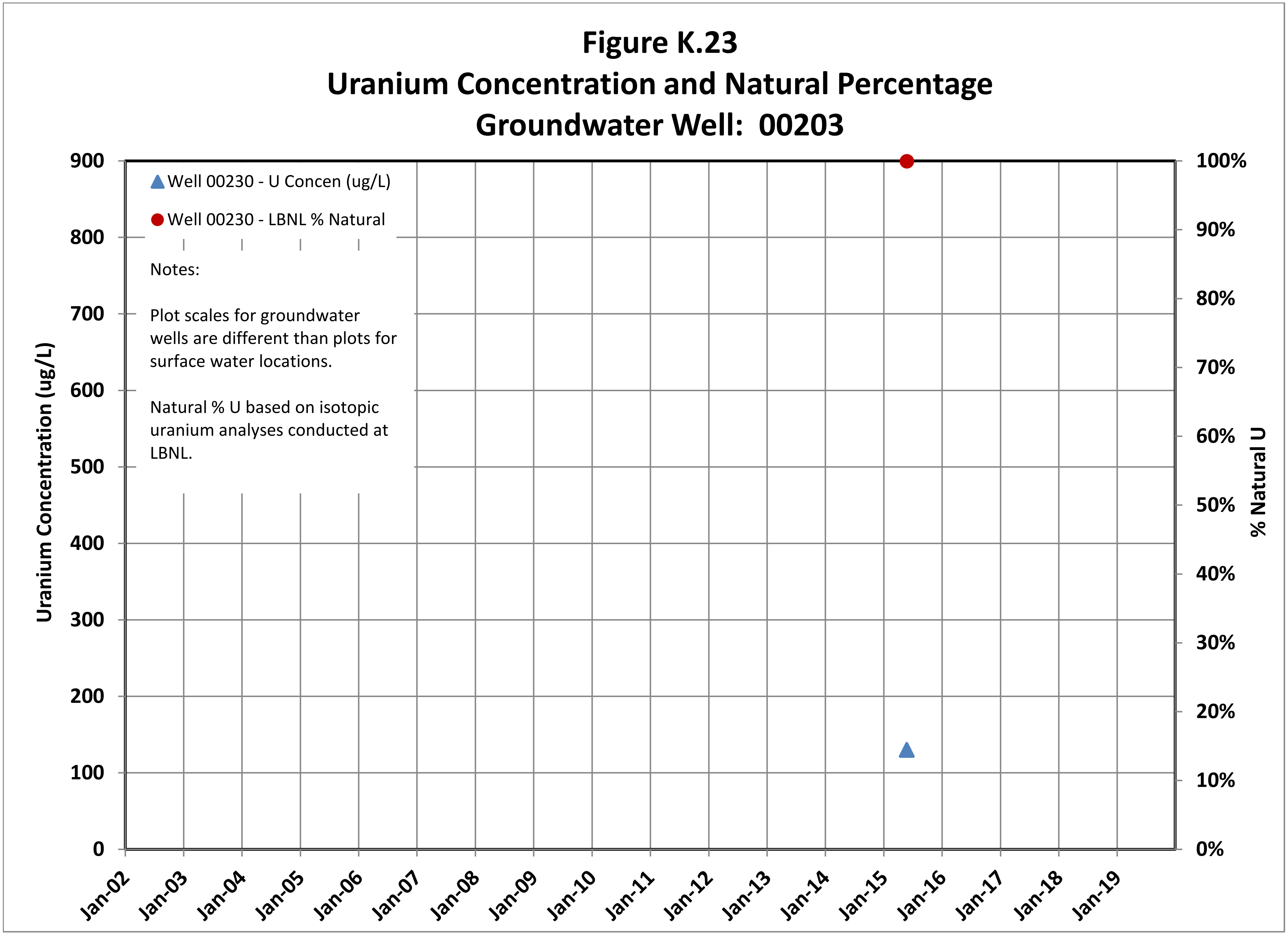


Figure K.23
Uranium Concentration and Natural Percentage
Groundwater Well: 00203
Well 00230 - U Concen (ug/L)
Well 00230 - LBNL % Natural
Notes:
Plot scales for groundwater wells are different than plots for surface water locations.
Natural % U based on isotopic uranium analyses conducted at LBNL.
Uranium Concentration (ug/L)
% Natural U
900
800
700
600
500
400
300
200
100
0
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
Jan-02
Jan-03
Jan-04
Jan-05
Jan-06
Jan-07
Jan-08
Jan-09
Jan-10
Jan-11
Jan-12
Jan-13
Jan-14
Jan-15
Jan-16
Jan-17
Jan-18
Jan-19

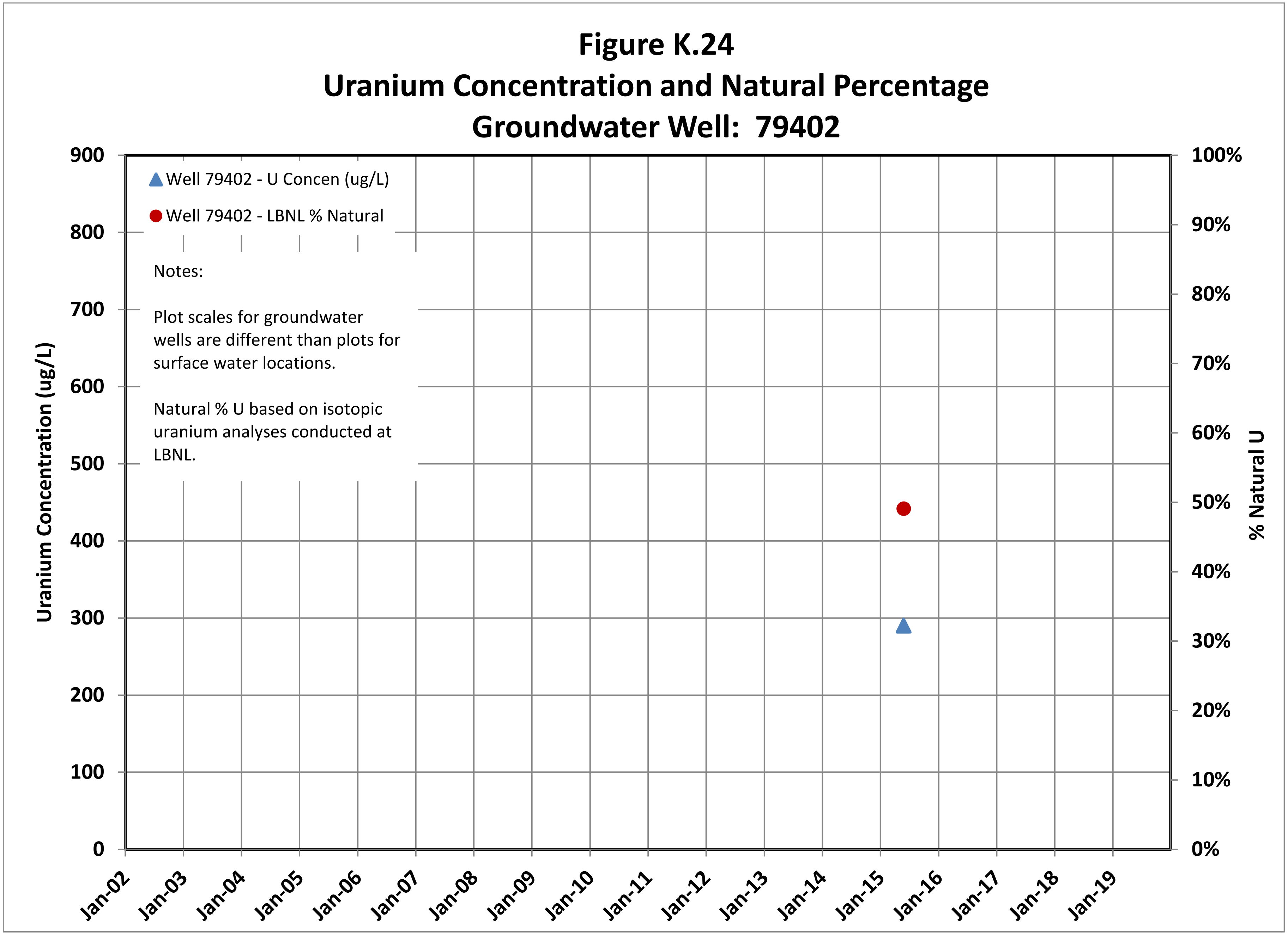


Figure K.24
Uranium Concentration and Natural Percentage
Groundwater Well: 79402
Well 79402 - U Concen (ug/L)
Well 79402 - LBNL % Natural
Notes:
Plot scales for groundwater wells are different than plots for surface water locations.
Natural % U based on isotopic uranium analyses conducted at LBNL.
Uranium Concentration (ug/L)
% Natural U
900
800
700
600
500
400
300
200
100
0
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
Jan-02
Jan-03
Jan-04
Jan-05
Jan-06
Jan-07
Jan-08
Jan-09
Jan-10
Jan-11
Jan-12
Jan-13
Jan-14
Jan-15
Jan-16
Jan-17
Jan-18
Jan-19

Figure K.25
Uranium Concentration and Natural Percentage
Groundwater Well: 79605

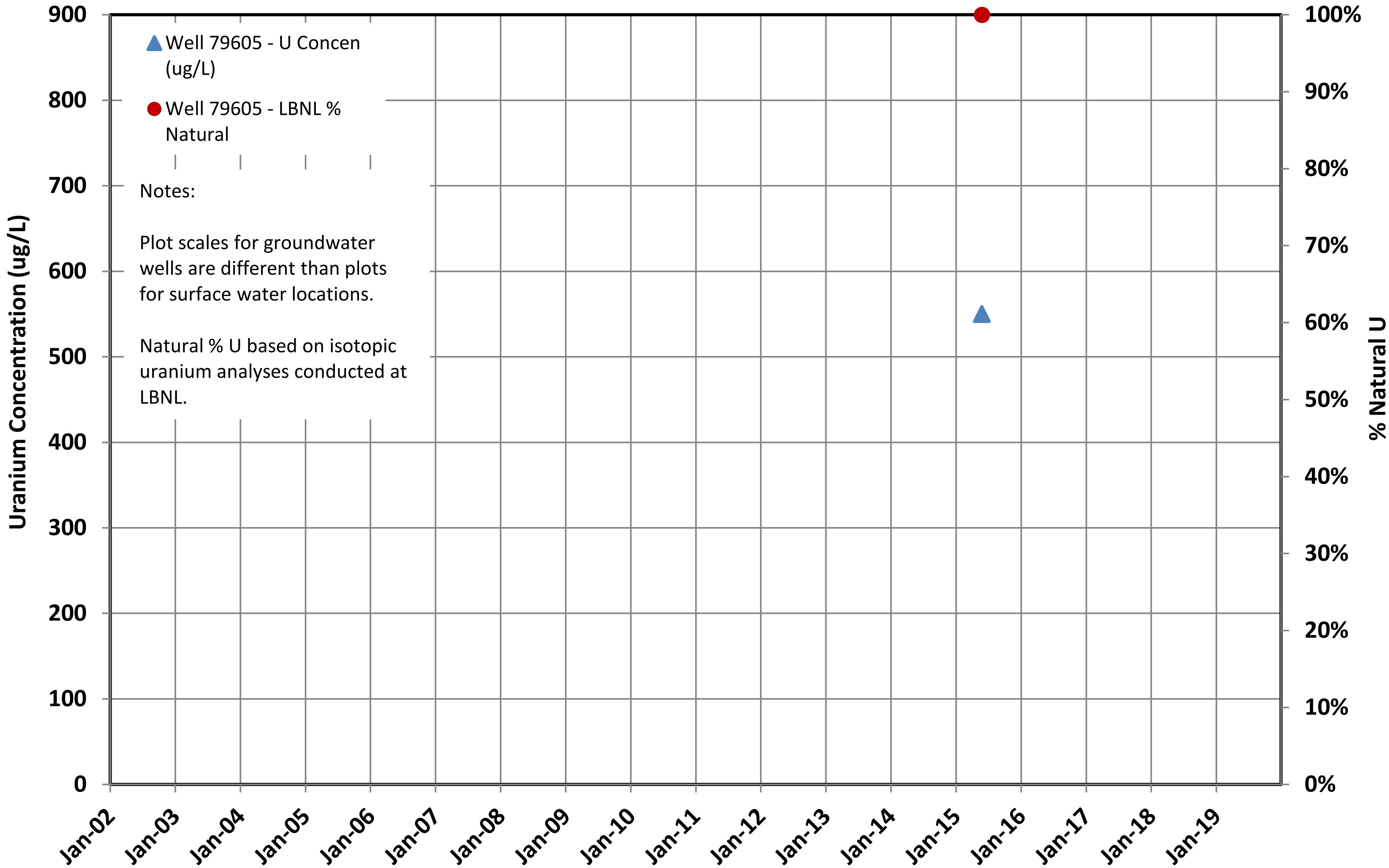


Figure K.26
Uranium Concentration and Natural Percentage
Groundwater Well: P208989

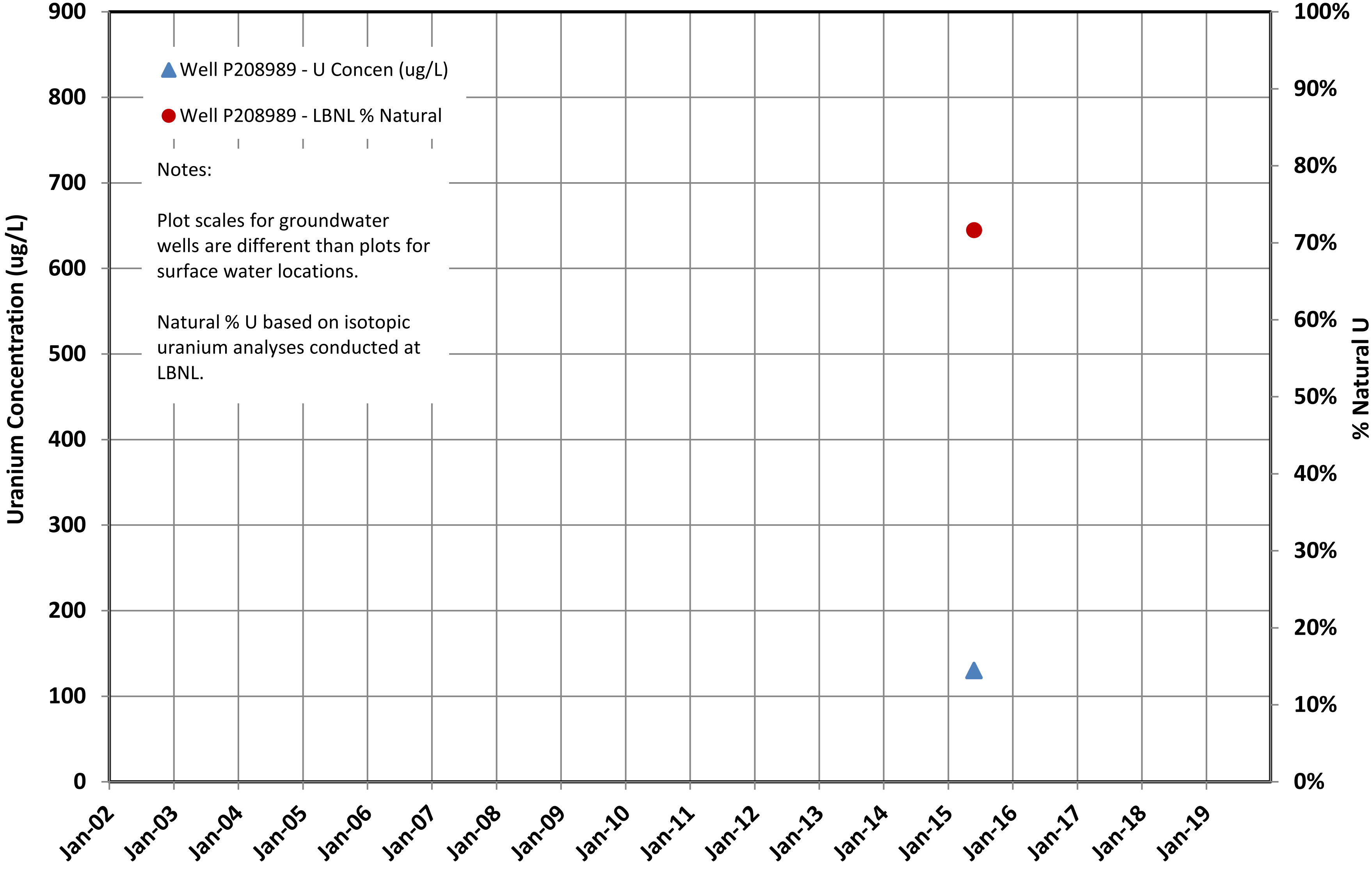


Figure K.27
Uranium Concentration and Natural Percentage
Groundwater Well: 22205

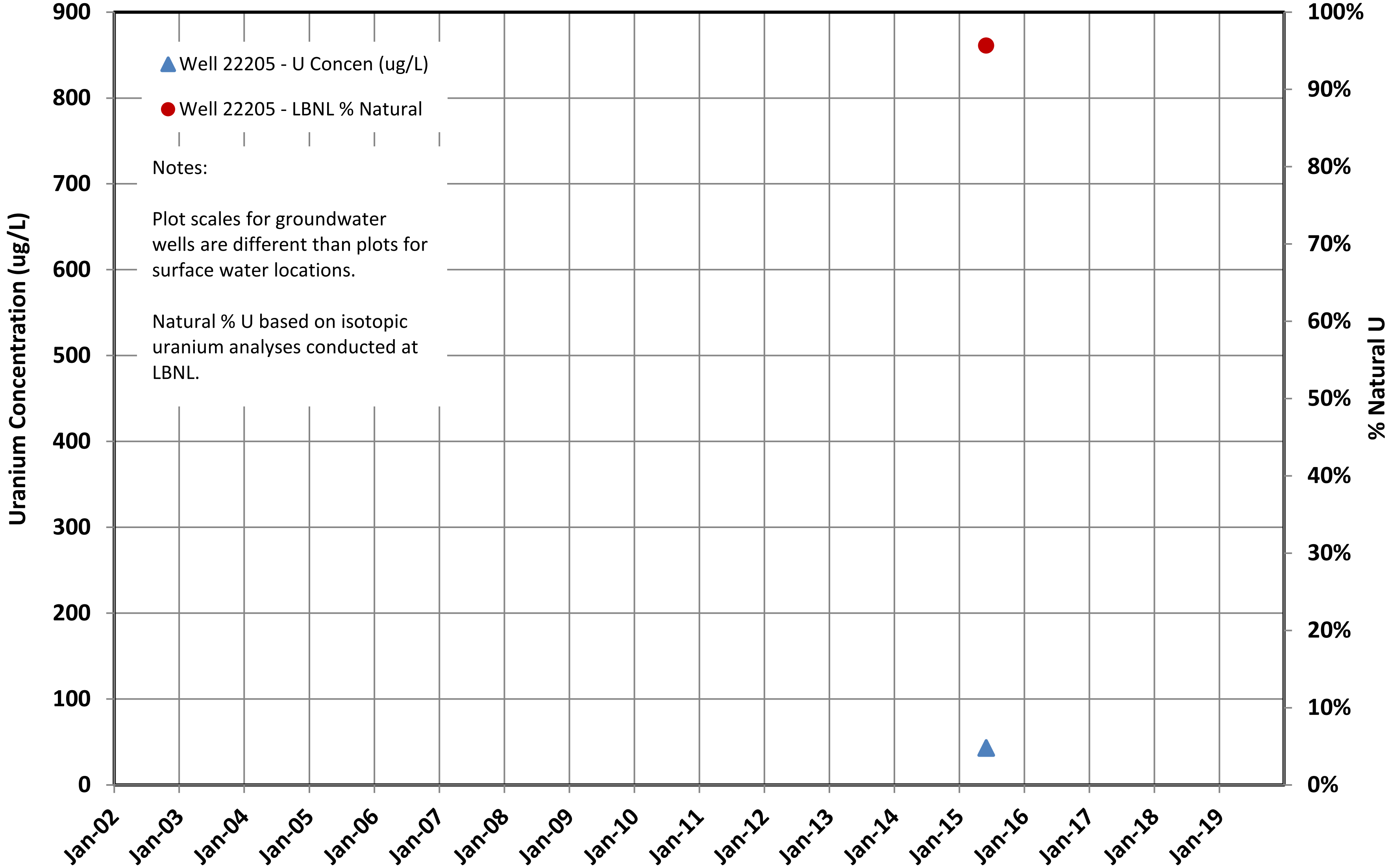


Figure K.28
Uranium Concentration and Natural Percentage
Groundwater Well: P210089

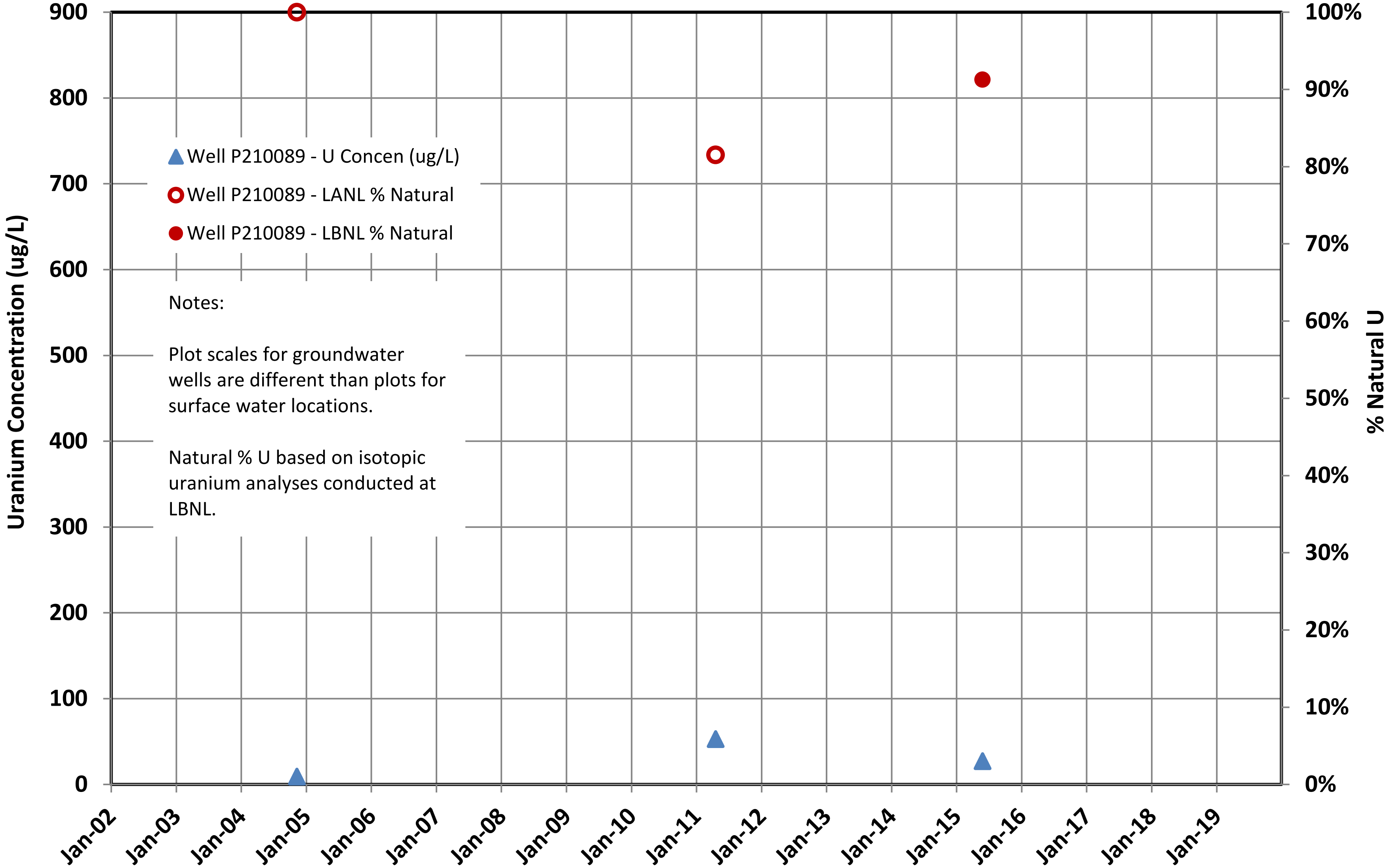
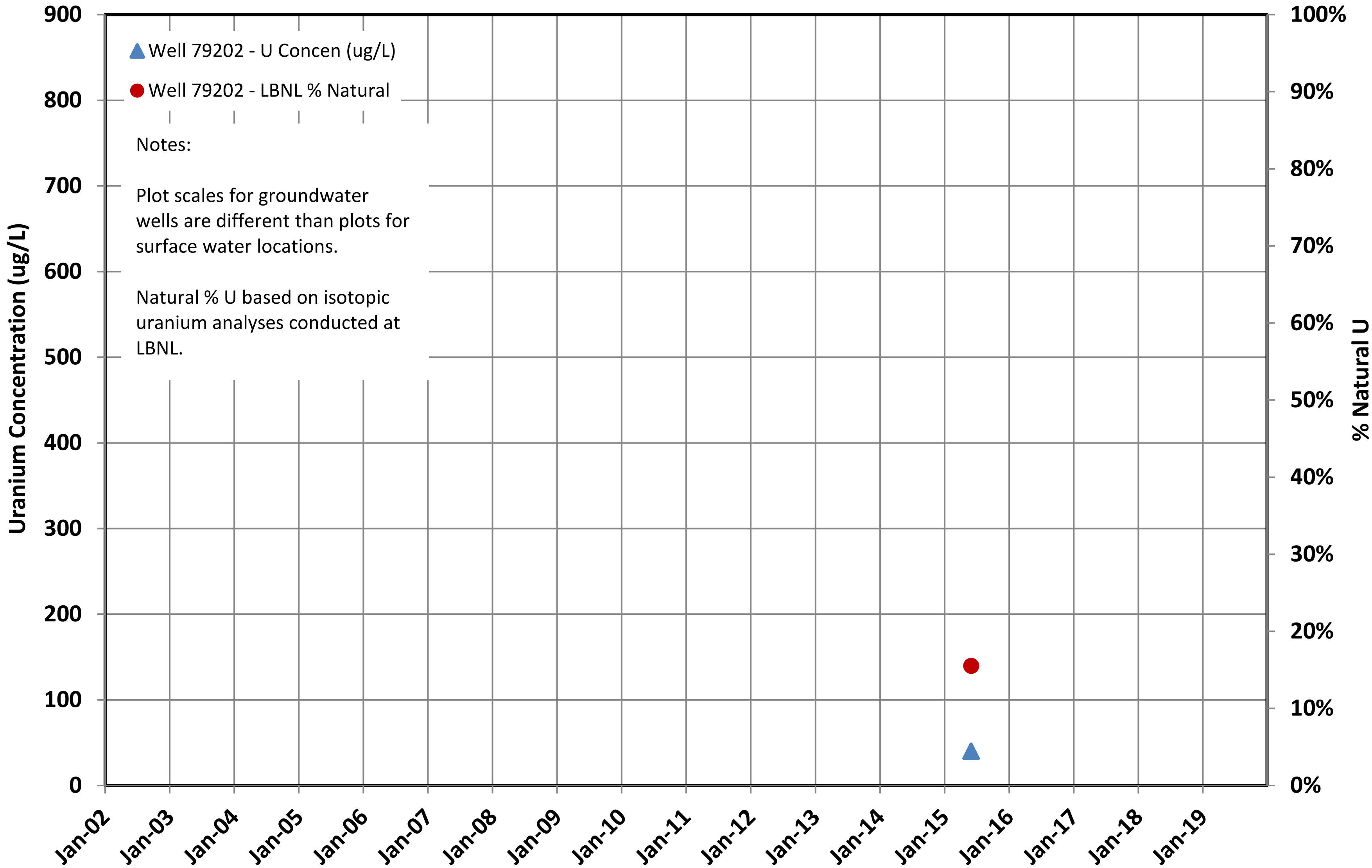


Figure K.29
Uranium Concentration and Natural Percentage
Groundwater Well: 79202



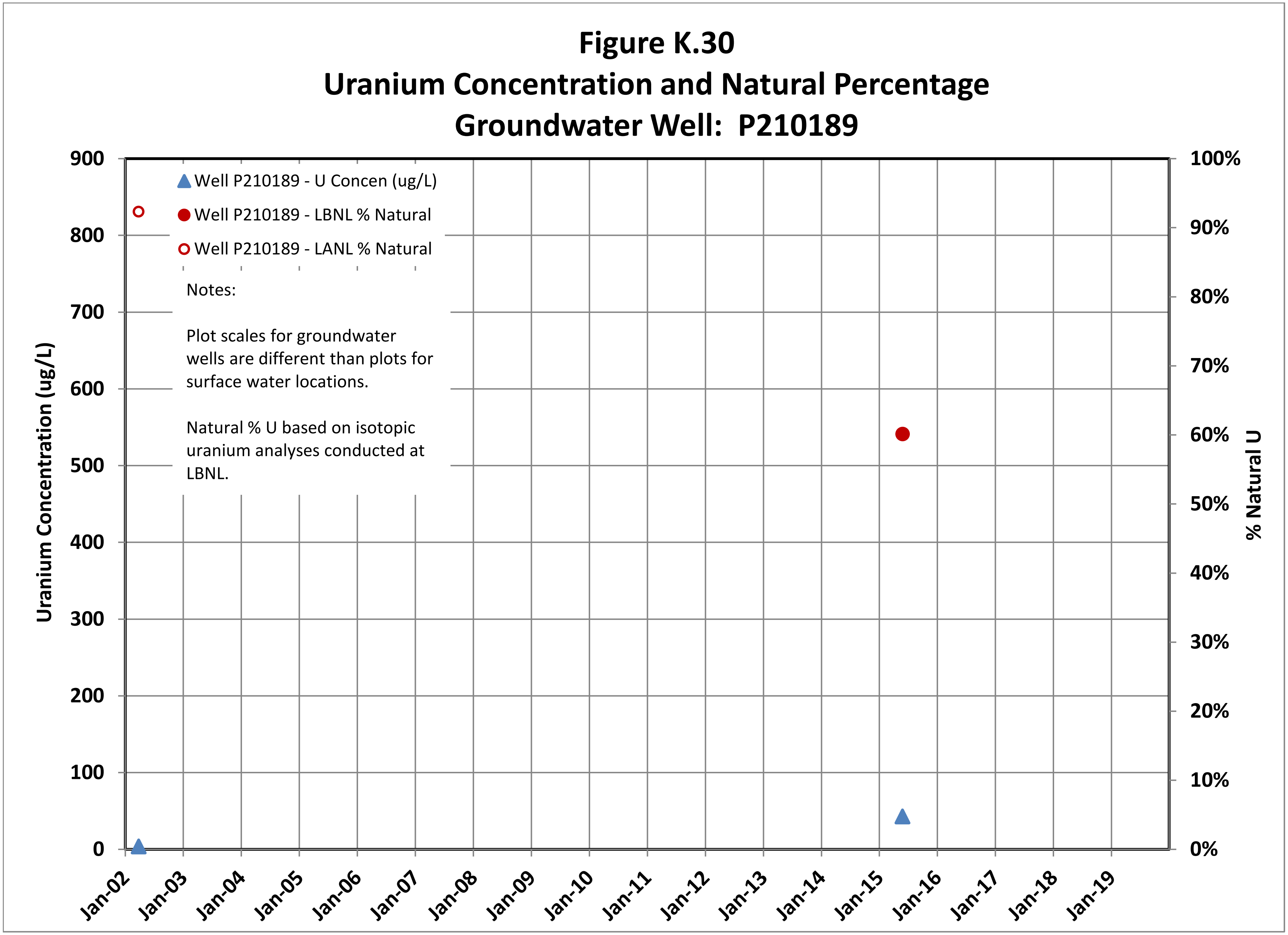


Figure K.30
Uranium Concentration and Natural Percentage
Groundwater Well: P210189
Well P210189 - U Concen (ug/L)
Well P210189 - LBNL % Natural
Well P210189 - LANL % Natural
Notes:
Plot scales for groundwater wells are different than plots for surface water locations.
Natural % U based on isotopic uranium analyses conducted at LBNL.
Uranium Concentration (ug/L)
% Natural U
0
100
200
300
400
500
600
700
800
900
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
Jan-02
Jan-03
Jan-04
Jan-05
Jan-06
Jan-07
Jan-08
Jan-09
Jan-10
Jan-11
Jan-12
Jan-13
Jan-14
Jan-15
Jan-16
Jan-17
Jan-18
Jan-19

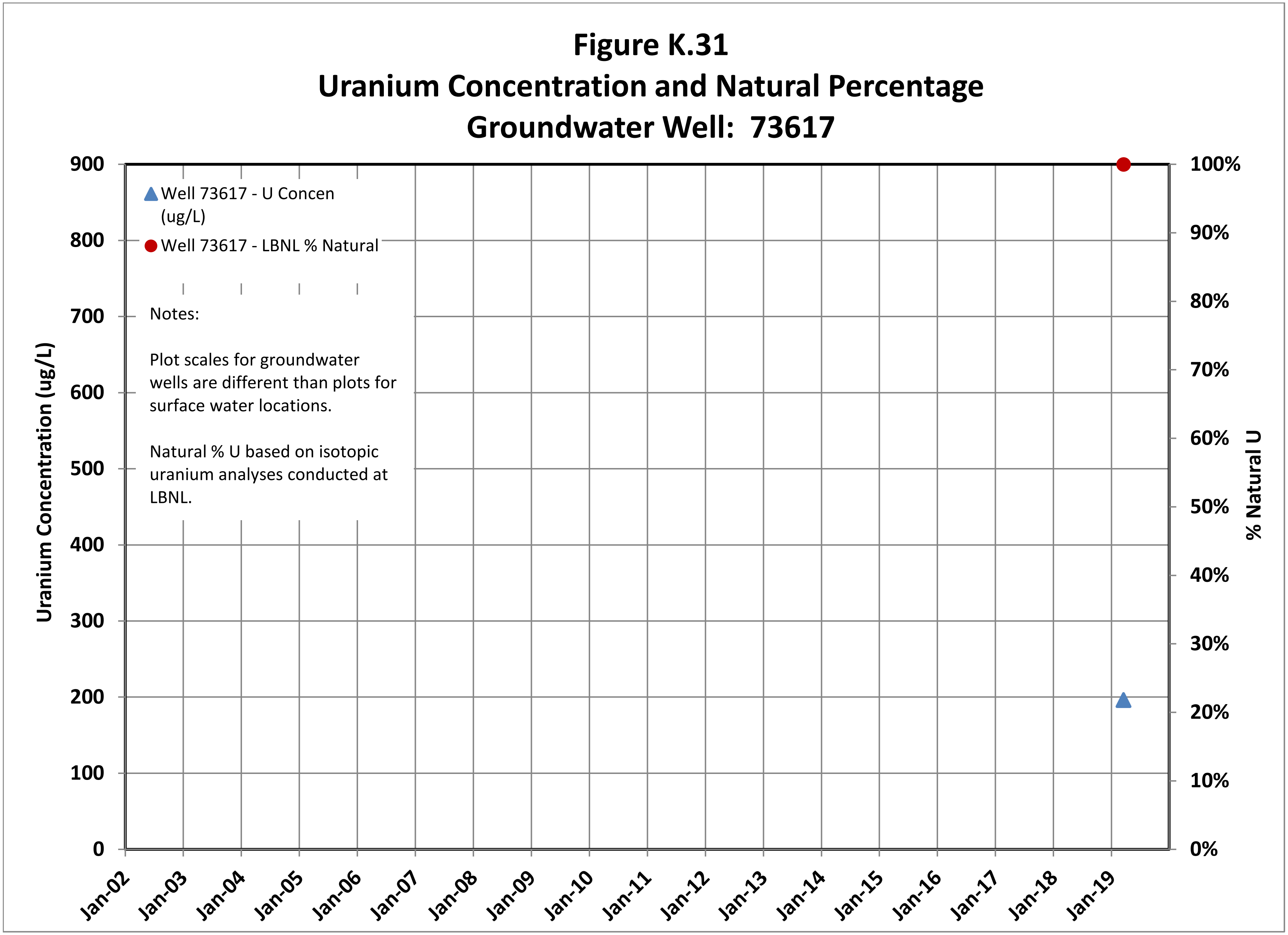
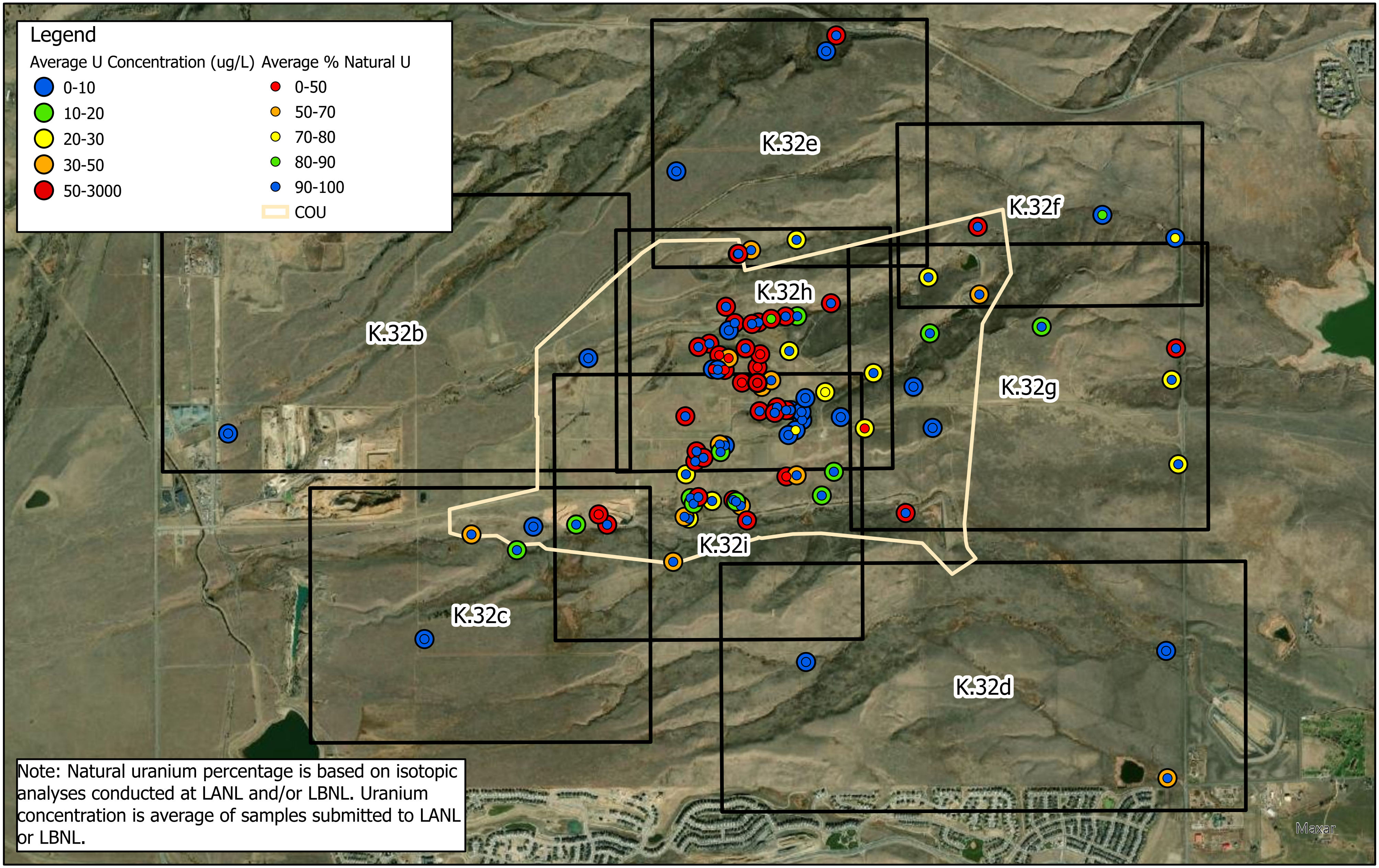


Figure K.31
Uranium Concentration and Natural Percentage
Groundwater Well: 73617
Well 73617 - U Concen (ug/L)
Well 73617 - LBNL % Natural
Notes:
Plot scales for groundwater wells are different than plots for surface water locations.
Natural % U based on isotopic uranium analyses conducted at LBNL.
Uranium Concentration (ug/L)
% Natural U
900
800
700
600
500
400
300
200
100
0
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
Jan-02
Jan-03
Jan-04
Jan-05
Jan-06
Jan-07
Jan-08
Jan-09
Jan-10
Jan-11
Jan-12
Jan-13
Jan-14
Jan-15
Jan-16
Jan-17
Jan-18
Jan-19



Path: Z:\Project Files\07\071-091\071-091.060\CAD-GIS\GIS\01_projects\RockyFlats_GW_2021\RockyFlats_GW_2021.aprx

WRIGHT WATER ENGINEERS, INC.

JEFFERSON COUNTY, COLORADO

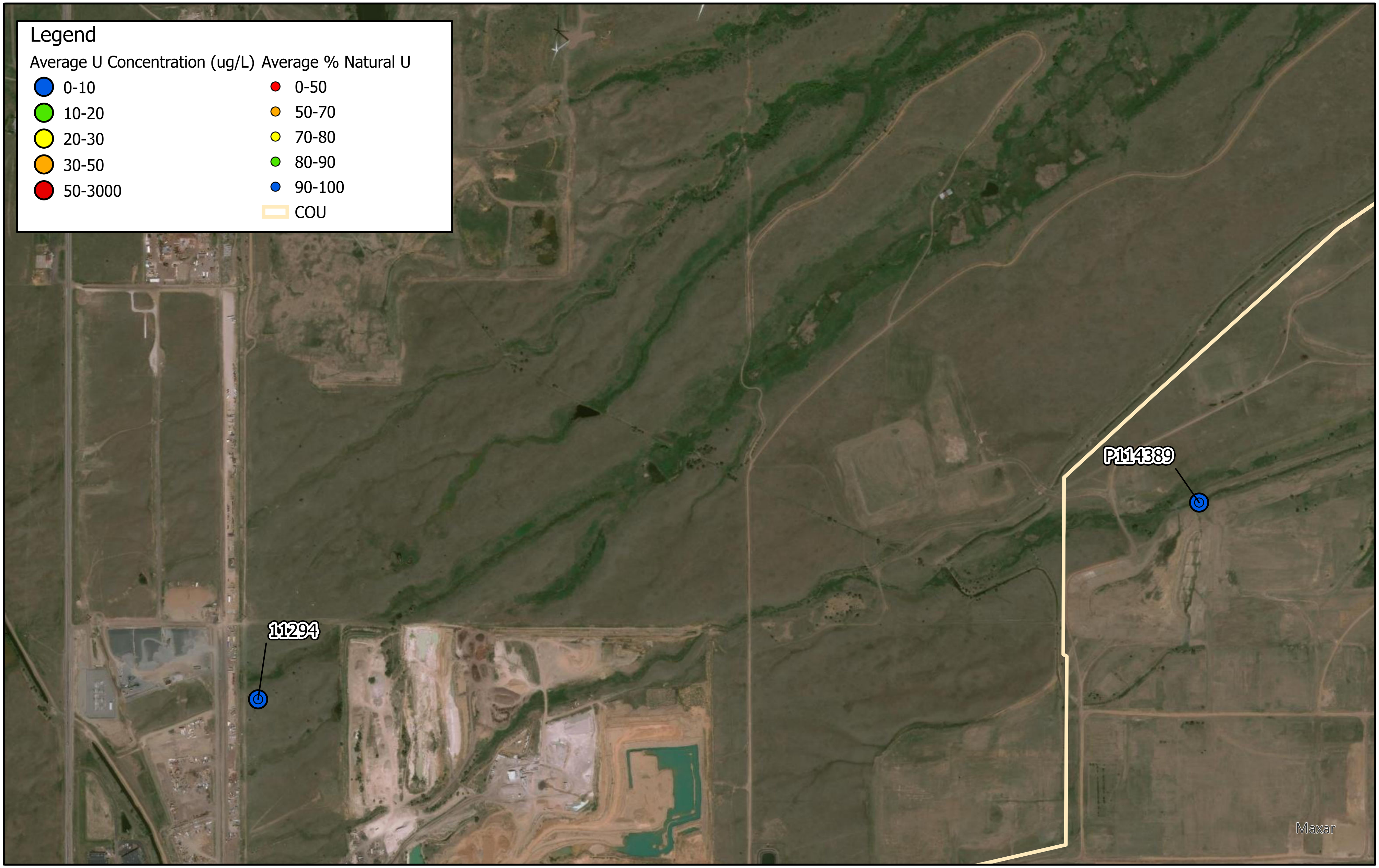
GROUNDWATER NATURAL URANIUM COMPOSITION AT SELECT WELLS 1998 - 2005

ROCKY FLATS SITE

0 1,250 2,500 Feet

PROJECT NO. 071-091.060

FIGURE K.32a



Path: Z:\Project Files\07\071-091\071-091.060\CAD-GIS\GIS\01_projects\RockyFlats_GW_2021\RockyFlats_GW_2021.aprx

WRIGHT WATER ENGINEERS, INC.

JEFFERSON COUNTY, COLORADO

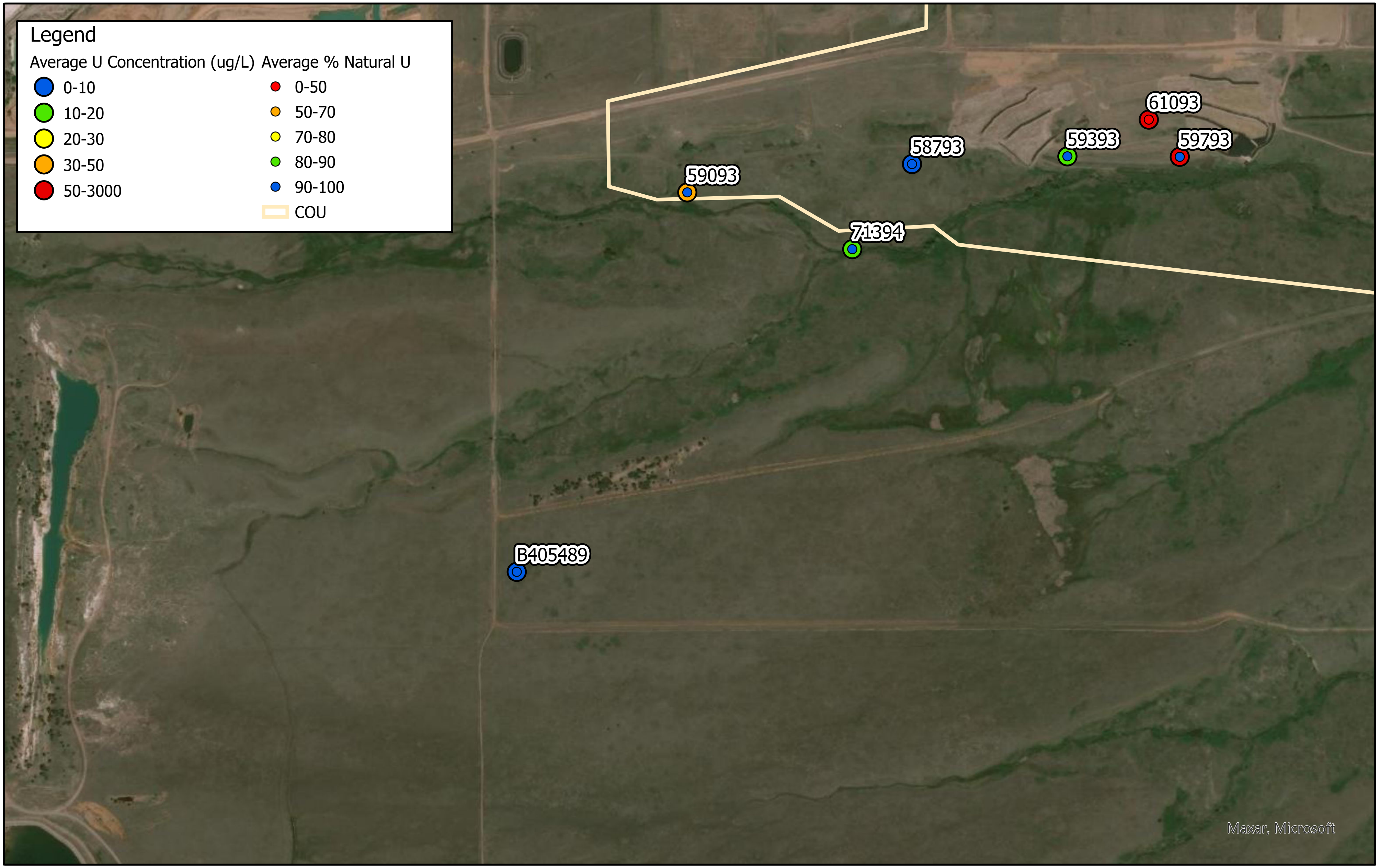
GROUNDWATER NATURAL URANIUM COMPOSITION AT SELECT WELLS 1998 - 2005

ROCKY FLATS SITE

Feet
0 500 1,000

PROJECT NO. 071-091.060

FIGURE K.32b



Path: Z:\Project Files\07\071-091\071-091.060\CAD-GIS\GIS\01_projects\RockyFlats_GW_2021\RockyFlats_GW_2021.aprx

WRIGHT WATER ENGINEERS, INC.

JEFFERSON COUNTY, COLORADO

GROUNDWATER NATURAL URANIUM COMPOSITION AT SELECT WELLS 1998 - 2005

ROCKY FLATS SITE

N W E S

Feet 0 250 500

PROJECT NO. 071-091.060

FIGURE K.32c

Path: Z:\Project Files\07\071-091\071-091.060\CAD-GIS\GIS\01_projects\RockyFlats_GW_2021\RockyFlats_GW_2021.aprx

WRIGHT WATER ENGINEERS, INC.

JEFFERSON COUNTY, COLORADO

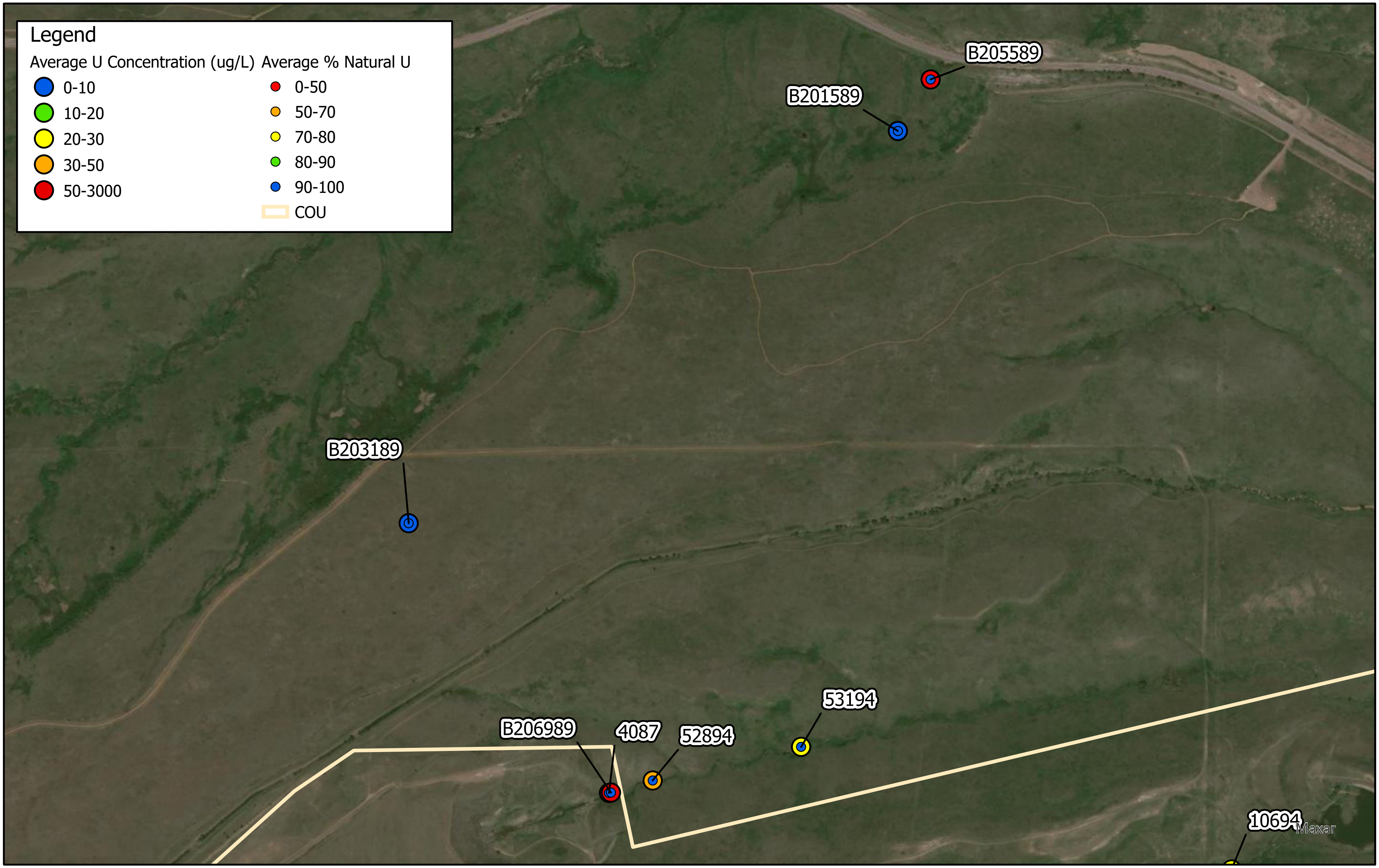
GROUNDWATER NATURAL URANIUM COMPOSITION AT SELECT WELLS 1998 - 2005

ROCKY FLATS SITE

Feet 0 300 600

PROJECT NO. 071-091.060

FIGURE K.32d



Path: Z:\Project Files\07\071-091\071-091.060\CAD-GIS\GIS\01_projects\RockyFlats_GW_2021\RockyFlats_GW_2021.aprx

WRIGHT WATER ENGINEERS, INC.

JEFFERSON COUNTY, COLORADO

GROUNDWATER NATURAL URANIUM COMPOSITION AT SELECT WELLS 1998 - 2005

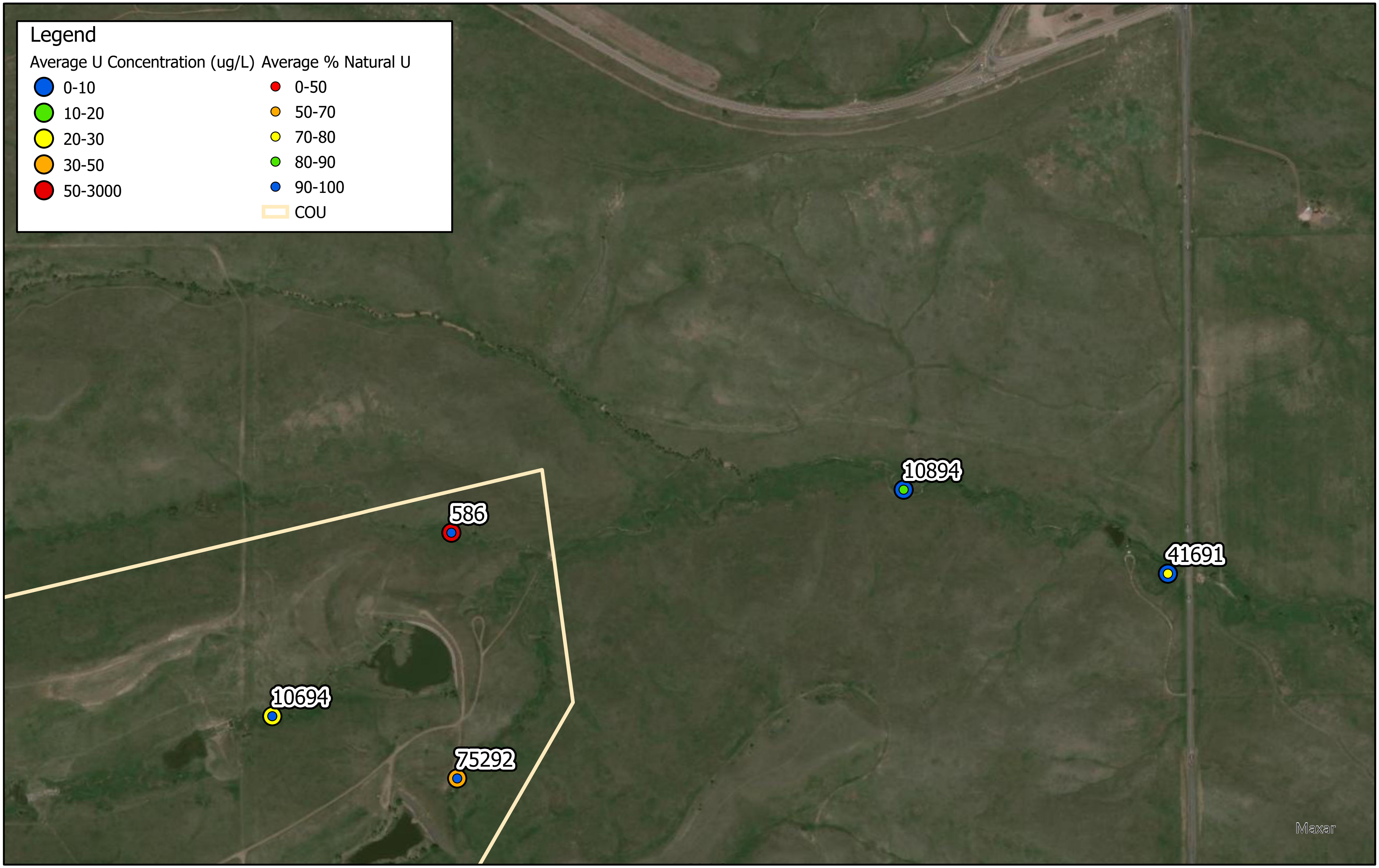
ROCKY FLATS SITE

N W E S

Feet 0 300 600

PROJECT NO. 071-091.060

FIGURE K.32e



Path: Z:\Project Files\07\071-091\071-091.060\CAD-GIS\GIS\01_projects\RockyFlats_GW_2021\RockyFlats_GW_2021.aprx

WRIGHT WATER ENGINEERS, INC.

JEFFERSON COUNTY, COLORADO

GROUNDWATER NATURAL URANIUM COMPOSITION AT SELECT WELLS 1998 - 2005

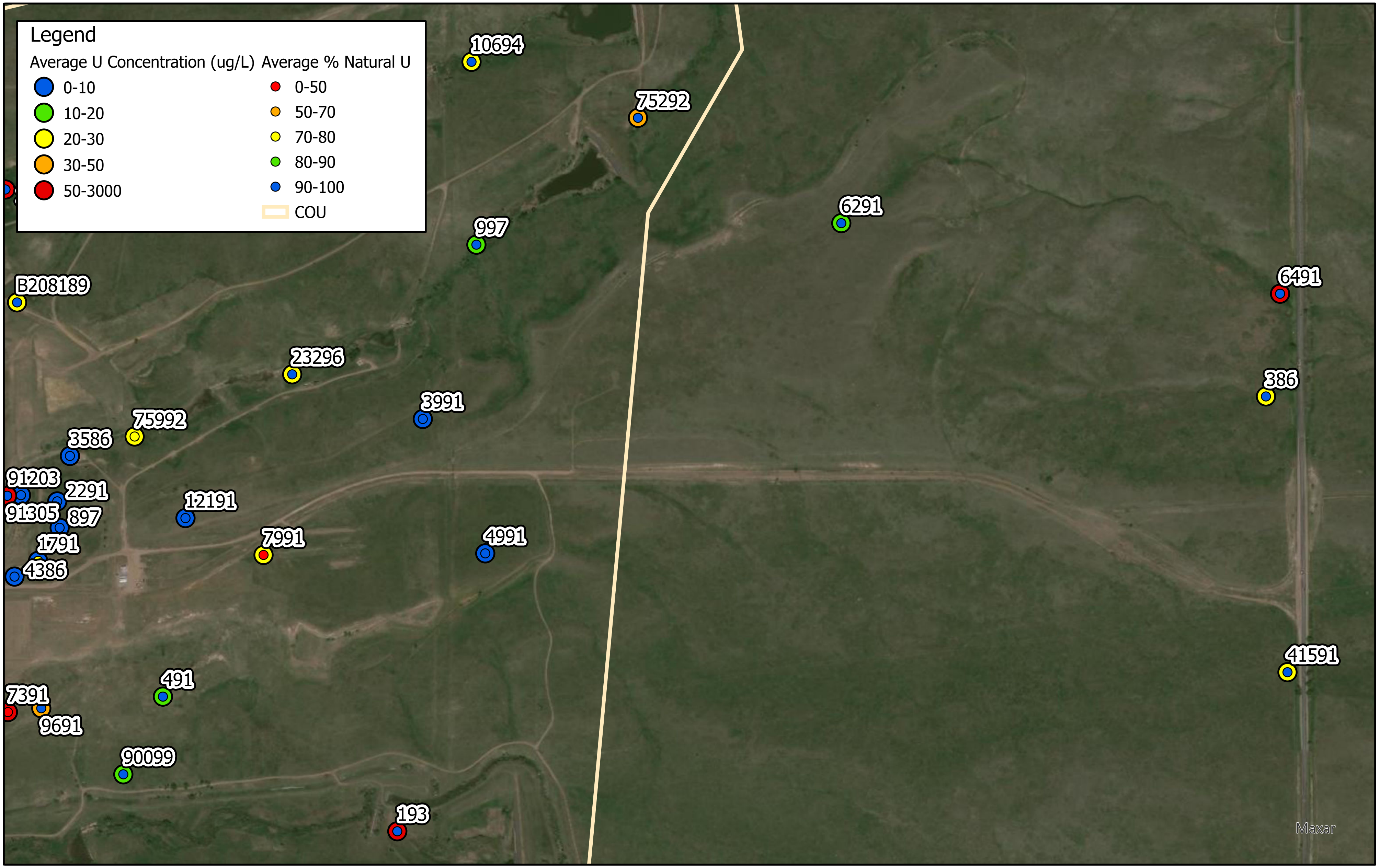
ROCKY FLATS SITE

N W E S

Feet 0 250 500

PROJECT NO. 071-091.060

FIGURE K.32f



Path: Z:\Project Files\07\071-091\071-091.060\CAD-GIS\GIS\01_projects\RockyFlats_GW_2021\RockyFlats_GW_2021.aprx

WWE
WRIGHT WATER ENGINEERS, INC.

JEFFERSON COUNTY, COLORADO

GROUNDWATER NATURAL URANIUM COMPOSITION AT SELECT WELLS
1998 - 2005

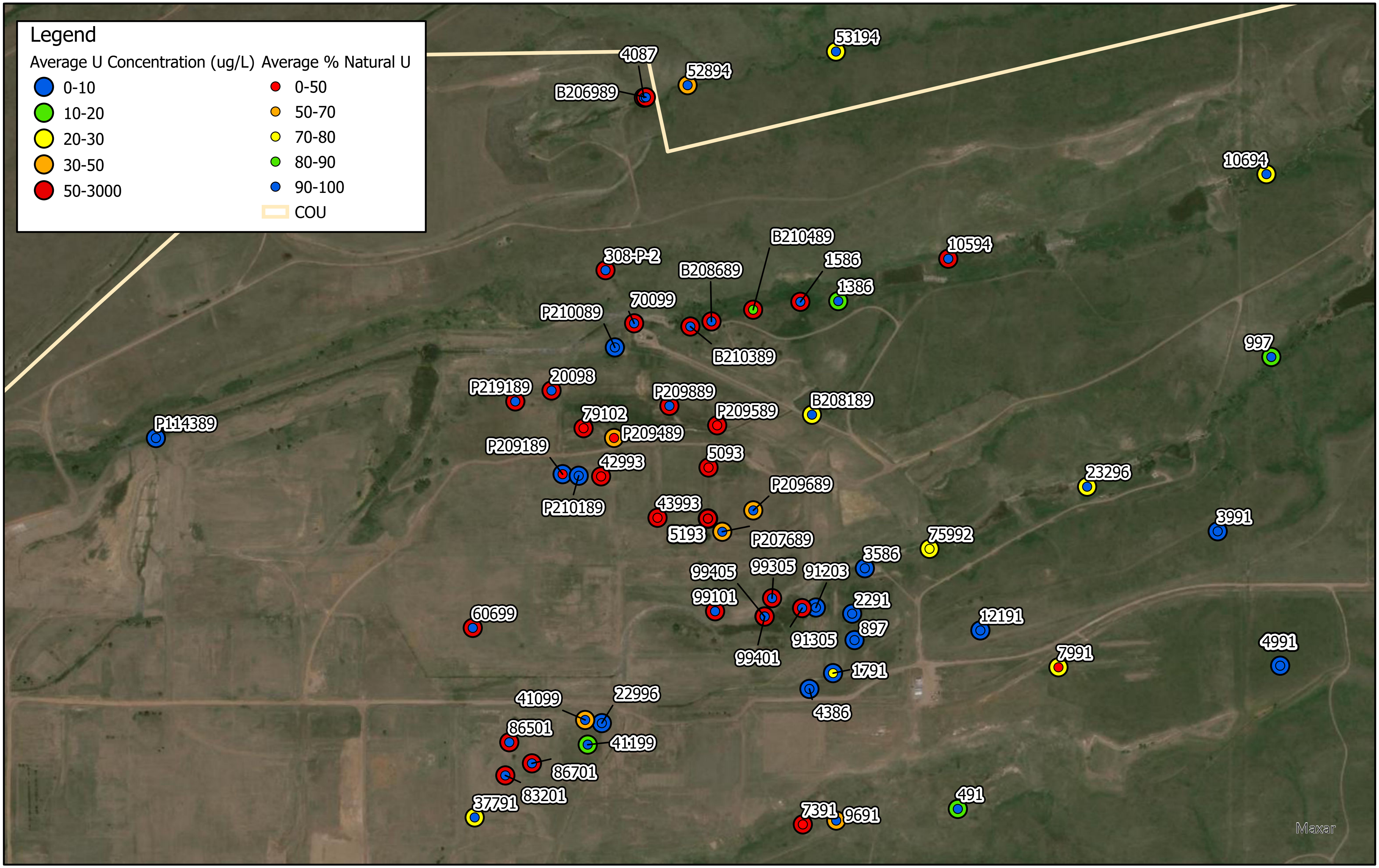
ROCKY FLATS SITE

N W E S

Feet
0 300 600

PROJECT NO.
071-091.060

FIGURE
K.32g



Path: Z:\Project Files\07\071-091\071-091.060\CAD-GIS\GIS\01_projects\RockyFlats_GW_2021\RockyFlats_GW_2021.aprx

WWE
WRIGHT WATER ENGINEERS, INC.

JEFFERSON COUNTY, COLORADO

GROUNDWATER NATURAL URANIUM COMPOSITION AT SELECT WELLS 1998 - 2005

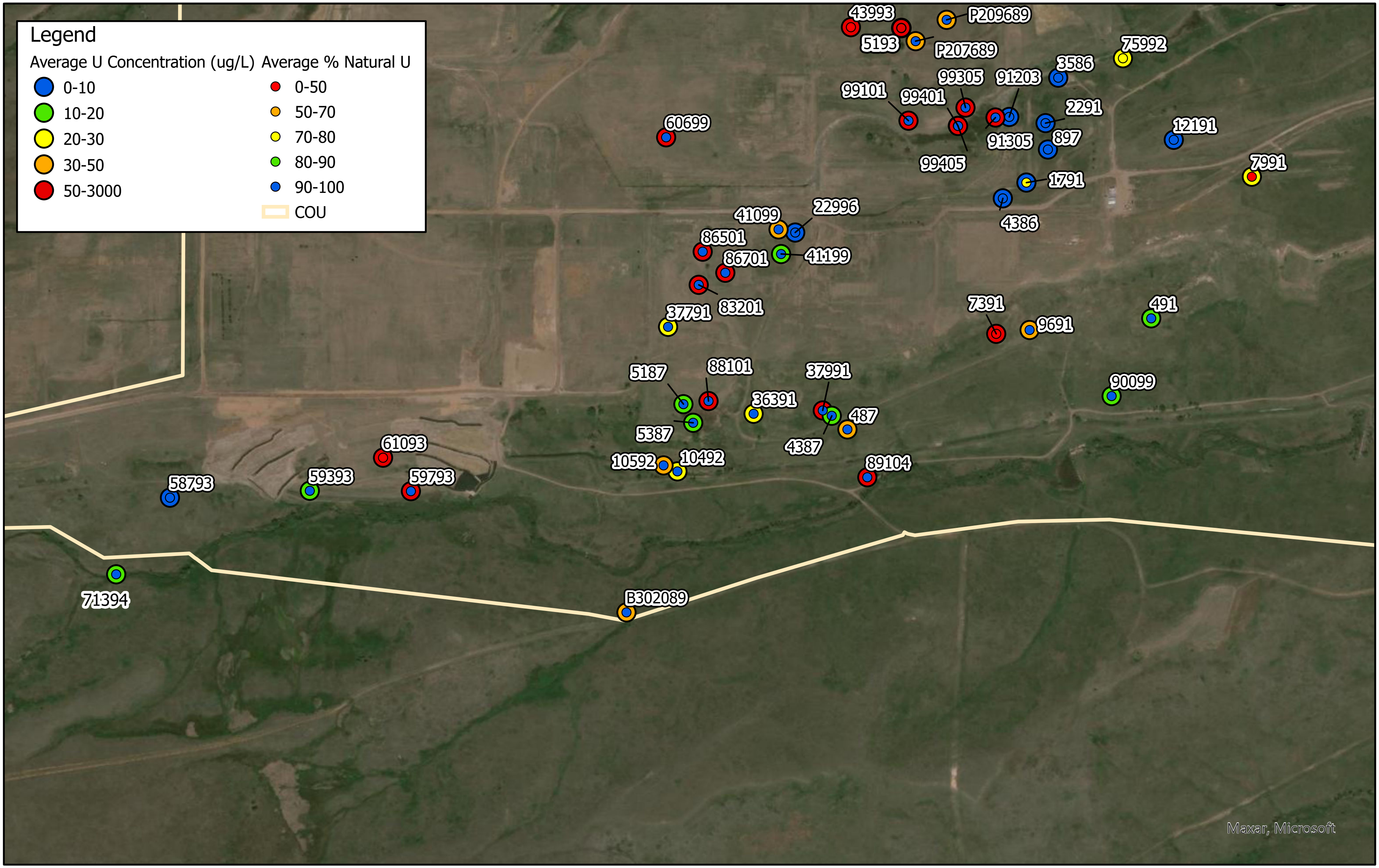
ROCKY FLATS SITE

N W E S

Feet
0 300 600

PROJECT NO. 071-091.060

FIGURE K.32h



Path: Z:\Project Files\07\071-091\071-091.060\CAD-GIS\GIS\01_projects\RockyFlats_GW_2021\RockyFlats_GW_2021.aprx

WWE WRIGHT WATER ENGINEERS, INC.

JEFFERSON COUNTY, COLORADO

GROUNDWATER NATURAL URANIUM COMPOSITION AT SELECT WELLS 1998 - 2005

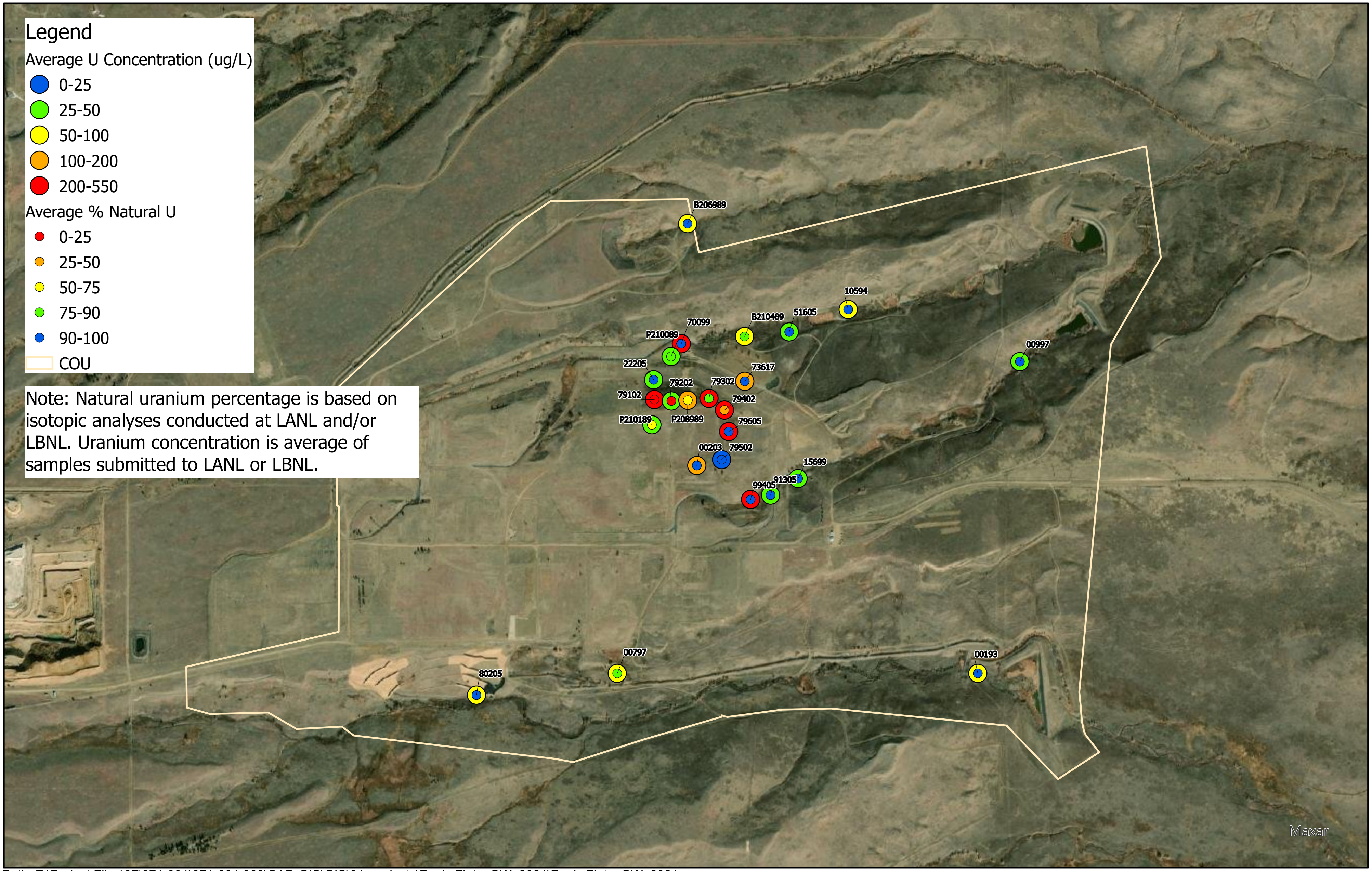
ROCKY FLATS SITE

N W E S

Feet 0 300 600

PROJECT NO. 071-091.060

FIGURE K.32i



Path: Z:\Project Files\07\071-091\071-091.060\CAD-GIS\GIS\01_projects\RockyFlats_GW_2021\RockyFlats_GW_2021.aprx

WWE WRIGHT WATER ENGINEERS, INC.

JEFFERSON COUNTY, COLORADO

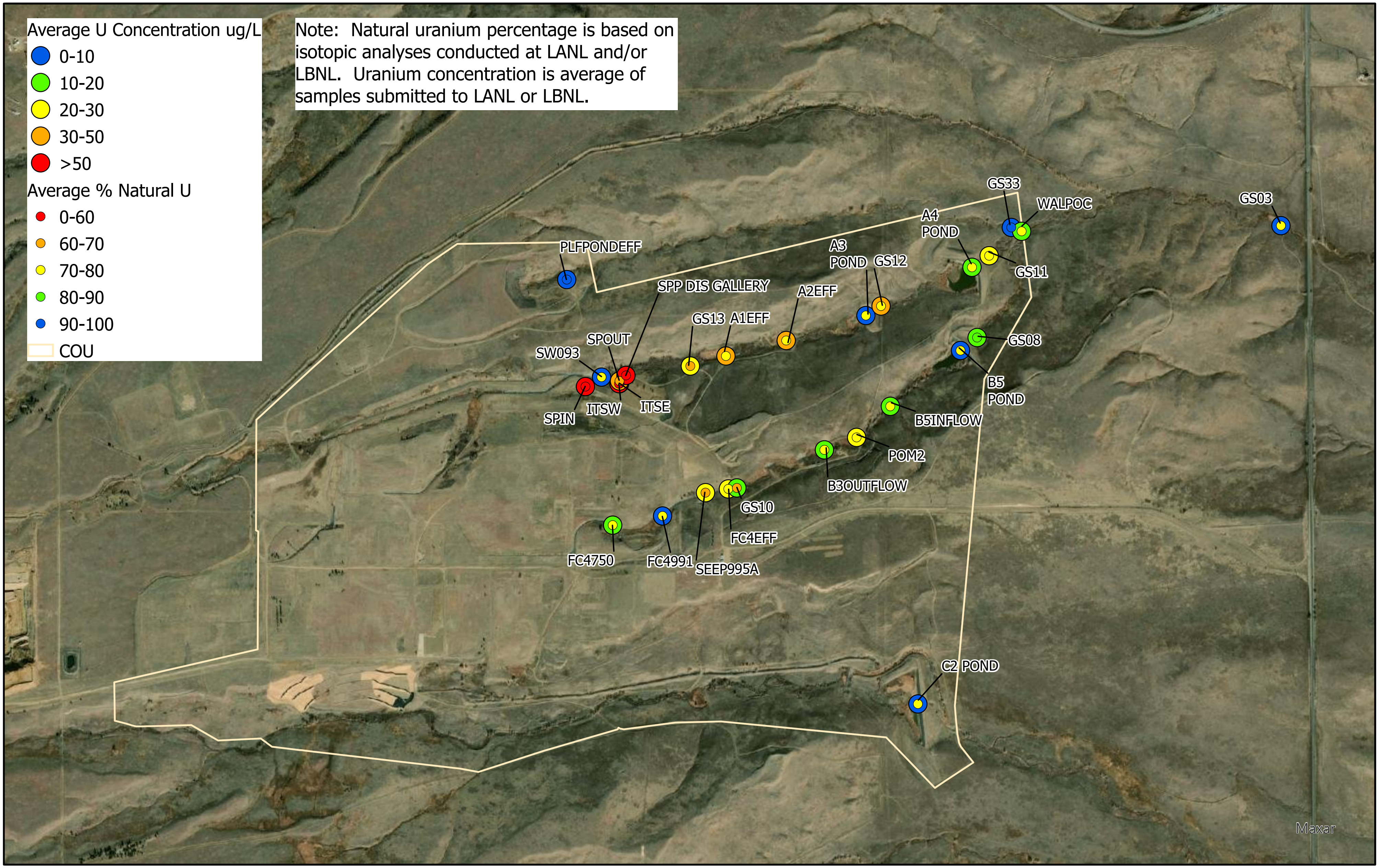
GROUNDWATER NATURAL URANIUM COMPOSITION AT SELECT WELLS 2006-2019

ROCKY FLATS SITE

0 500 1,000 Feet

PROJECT NO. 071-091.060

FIGURE K.33



Path: Z:\Project Files\07\071-091\071-091.060\CAD-GIS\GIS\01_projects\RockyFlats_GW_2021\RockyFlats_GW_2021.aprx

WWE WRIGHT WATER ENGINEERS, INC.

JEFFERSON COUNTY, COLORADO

SURFACE WATER NATURAL URANIUM COMPOSITION (2002 - 2018)

ROCKY FLATS SITE

0 500 1,000 2,000 Feet

PROJECT NO. 071-091.060

FIGURE K.34