ENERGY FUELS

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October 19, 2020

Sent VIA E-MAIL AND OVERNIGHT DELIVERY

Mr. Ty L. Howard
Director
Division of Waste Management and Radiation Control
Utah Department of Environmental Quality
195 North 1950 West
P.O. Box 144880
Salt Lake City, UT 84114-4880

Re: Transmittal of Source Assessment Report for MW-28 White Mesa Mill Groundwater Discharge Permit UGW370004

Dear Mr. Howard:

Enclosed are two copies of Energy Fuels Resource (USA) Inc.'s ("EFRI's") Source Assessment Report ("SAR") for MW-28 at the White Mesa Mill. This SAR addresses the constituents that were identified as exceeding the GWCL in the 1st Quarter 2020 as described in the Division of Waste Management and Radiation Control ("DWMRC")-approved Q1 2020 Plan and Time Schedule. EFRI submitted the Plan and Time Schedule for MW-28 on May 21, 2020. DWMRC approval of the Plan and Time Schedule was received by EFRI on June 22, 2020. An extension request for the SAR due date was submitted on September 2, 2020 and approved by DWMRC on September 3, 2020. Pursuant to the Plan and Time Schedule EFRI has prepared this SAR.

This transmittal also includes two CDs each containing a word searchable electronic copy of the report.

If you should have any questions regarding this report please contact me.

Yours very truly,

ENERGY FUELS RESOURCES (USA) INC.
Kathy Weinel
Quality Assurance Manager

CC: David C. Frydenlund
Terry Slade
Logan Shumway
Scott Bakken
Stewart Smith (HGC)
Angie Persico (Intera)

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White Mesa Uranium Mill

State of Utah Groundwater Discharge Permit No. UGW370004

Source Assessment Report Under Part I.G.4

For Exceedances in MW-28 in the First Quarter of 2020

Prepared by:

Energy Fuels Resources (USA) Inc.
225 Union Boulevard, Suite 600
Lakewood, CO 80228

October 19, 2020

EXECUTIVE SUMMARY

This Source Assessment Report ("SAR") is an assessment of the sources, extent, and potential dispersion of uranium and selenium in MW-28 at the White Mesa Mill ("the Mill") as required under State of Utah Groundwater Discharge Permit UGW370004 (the "GWDP") Part I.G.4, resulting from out-of-compliance status under Part I.G.2 of the GWDP relating to those constituents in MW-28. Each of those constituents occurs naturally at the Mill (INTERA, 2008) and has exhibited exceedances of the applicable Groundwater Compliance Limits ("GWCLs") in various other wells at the site over time and from time-to-time. As will be demonstrated in this SAR, the increased concentrations of uranium and selenium in MW-28 are the result of implications from the existing nitrate/chloride plume, which is currently being remediated under a Corrective Action Plan ("CAP") for nitrate + nitrite and chloride in groundwater, and are not the result of any potential seepage from the Mill's tailings management system ("TMS").

Groundwater at the Mill site has been evaluated in multiple recent investigations and reports, including the Revised Background Groundwater Quality Report (INTERA, 2007a) and the New Wells Background Report (INTERA, 2008) (collectively with INTERA, 2007b, the "Background Reports"), the pH Report (INTERA, 2012), an isotopic investigation (Hurst and Solomon, 2008), a report discussing the occurrence and likely impact of naturally-occurring pyrite on perched (shallow) groundwater (the Pyrite Report [HGC, 2012a]), and multiple SARs.

At the time of the Background Reports, MW-28 had a limited data set comprised of 11 data points per GWDP parameter. Significantly more data points are now available, providing a more robust understanding of the water quality and behavior of MW-28. In general, the behavior of the key indicator parameters, chloride, fluoride and sulfate, in MW-28 has not changed significantly since the time of the Background Reports. Chloride concentrations in MW-28 were increasing at the time of the Background Reports, although not significantly. The increasing concentrations of chloride, which currently have a statistically significant increasing trend, have continued as a result of MW-28's location within the downgradient toe of the nitrate/chloride plume (which pre-dates the Mill and originates upgradient of the Mill and TMS). Fluoride concentrations were decreasing at the time of the Background Reports, and continue to exhibit a decreasing trend that is not currently significant. Sulfate concentrations were increasing (not significantly) at the time of the Background Reports and currently exhibit no trend. Uranium concentrations were exhibiting no trend at the time of the Background Reports. Although concentrations of uranium remain relatively low for the Mill site, the concentrations began to increase more recently and now exhibit a statistically significant increasing trend.

As demonstrated herein, mass balance analysis and geochemical considerations indicate that potential TMS seepage is not contributing to the groundwater chemistry at MW-28. Migration of the nitrate/chloride plume; oxidation of pyrite by nitrate; and mobilization of uranium and selenium by nitrate are the most likely causes of the increases in chloride, selenium, and uranium measured in MW-28. In addition, uranium may also be mobilized by increased bicarbonate in the perched groundwater from natural background influences; and selenium may be generally elevated within the nitrate/chloride plume due to its primary source (the historical pond, which pre-dates the Mill and is located upgradient of the Mill and TMS) having seeped through Mancos Shale, a known source of selenium contamination. Increased chloride, uranium, and selenium concentrations that are unrelated to potential TMS impacts is consistent with previous mass balance analyses performed on the nitrate/chloride plume that were based on nitrate concentrations within the plume as described in the December 2009 Contamination Investigation Report (INTERA, 2009).

In sum, the increasing trends in uranium and selenium in MW-28 are the result of implications from the nitrate/chloride plume, which is already being remediated under the CAP, and from natural background influences, and is not the result of any potential seepage from the Mill's TMS or other activities at the Mill. As a result, it is appropriate to adjust the GWCLs for uranium and selenium in MW-28 to account for these influences. In accordance with the DWMRC-approved Flowsheet (from INTERA [2007a], included as **Appendix E**), increasing trends of this nature (i.e., resulting from implications from an existing plume being remediated by an existing Corrective Action Plan or from background influences) necessitate a modified approach for calculation of GWCLs. The modification in this approach considers a more recent dataset and the greater of (1) mean + 2σ, (2) highest historical value, (3) background x 1.5, or (4) the fractional approach (i.e., the prescribed fraction of the Utah Groundwater Quality Standards applicable to the class of water in the well) , to determine representative and appropriate GWCLs for trending constituents. Regular revisions to GWCLs for constituents in wells with significantly increasing trends over time due to background is consistent with the United States Environmental Protection Agency's ("USEPA's") Unified Guidance (USEPA, 2009). Such revisions account for the trends and minimize unwarranted out-of-compliance status in such wells in the future.

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Background Reports	*collectively refers to relevant background reports for this well and site*: the Existing Wells Background Report (INTERA, 2007a), the Regional Background Report (INTERA, 2007b), and the New Wells Background Report (INTERA, 2008)
CAP	Corrective Action Plan
CFCs	chlorofluorocarbons
CIR	Contaminant Investigation Report
DF	Dilution Factor
DO	Dissolved Oxygen
Director	Director of the Division of Waste Management and Radiation Control
DWMRC	State of Utah Division of Waste Management and Radiation Control
EFRI	Energy Fuels Resources (USA) Inc.
GWCL	Groundwater Compliance Limit
GWDP	State of Utah Ground Water Discharge Permit UGW370004
GWQS	Groundwater Quality Standard
µg/L	micrograms per liter
mg/L	milligrams per liter
Mill	White Mesa Uranium Mill
OOC	out of compliance
pH Report	INTERA (2012b)
P&TS	Plan and Time Schedule
PVC	Polyvinyl Chloride
Pyrite Report	HGC (2012a)
QAM	Quality Assurance Manager
SAR	Source Assessment Report
TDS	Total Dissolved Solids
TMS	Tailings Management System
University of Utah Study	Hurst and Solomon, (2008)
USEPA	United States Environmental Protection Agency

1.0 INTRODUCTION

Energy Fuels Resources (USA) Inc. ("EFRI") operates the White Mesa Uranium Mill (the "Mill"), located near Blanding, Utah (Figure 1). Groundwater is regulated under the State of Utah Groundwater Discharge Permit UGW370004 (the "GWDP"). This is the Source Assessment Report ("SAR") required under Part I.G.4 of the GWDP, relating to Part I.G.2 of the GWDP with respect to uranium and selenium in groundwater compliance monitoring well MW-28. Uranium in MW-28 has had dual exceedances reported prior to the first quarter of 2020 and was the subject of a Plan and Time Schedule ("P&TS") dated December 4, 2014. The December 4, 2014 P&TS was submitted after dual exceedances of uranium in MW-28, that were reported after physical damage to the well and casing in May 2014. Details of the December 4, 2014 P&TS are included in Section 1.1 below.

Part I.G.2 of the GWDP provides that an out-of-compliance ("OOC") status exists when the concentration of a constituent in two consecutive samples from a compliance monitoring point exceeds a Groundwater Compliance Limit ("GWCL") in Table 2 of the GWDP. The GWDP was originally issued in March 2005, at which time GWCLs were set on an interim basis, based on fractions of State of Utah Ground Water Quality Standards ("GWQSs") or the equivalent, without reference to natural background at the Mill. The GWDP also required that EFRI prepare a background groundwater quality report to evaluate all historical data for the purposes of establishing background groundwater quality at the Mill site and developing GWCLs under the GWDP. As required by then Part I.H.3 of the GWDP, EFRI submitted three "Background Groundwater Quality Reports" (INTERA 2007a, 2007b, 2008) (collectively, the "Background Reports") to the Director (the "Director") of the State of Utah Division of Waste Management and Radiation Control ("DWMRC") (the Director was formerly the Executive Secretary of the Utah Radiation Control Board and the Co-Executive Secretary of the Utah Water Quality Board).

Based on a review of the Background Reports and other information and analyses, the Director re-opened the GWDP and modified the GWCLs to be equal to the mean concentration plus two standard deviations ("mean + 2σ") or the equivalent for each constituent in each well, based on an "intra-well" approach. That is, the compliance status for each constituent in a well is determined based on current concentrations of that constituent in that well compared to the historic concentrations for that constituent in that well, rather than compared to the concentrations of the same constituent in other monitoring wells. The modified GWCLs became effective on January 20, 2010. On January 19, 2018, and March 19, 2019, revised GWDPs were issued, which set revised GWCLs for certain constituents in certain monitoring wells as approved by the Director through previously approved SARs relating to those constituents in those wells. GWCLs apply to groundwater monitoring wells located in the perched aquifer at the Mill.

While consecutive exceedances of chloride have been noted in MW-28 and other wells at the Mill, a P&TS and an associated SAR for chloride in MW-28 have not been required or appropriate considering the other actions currently undertaken by EFRI as determined by DWMRC Staff relating to the existing nitrate/chloride plume at the site. Nitrate + nitrite (referred to as nitrate hereinafter) and chloride in monitoring wells at the site have been the subject of ongoing investigations at the Mill. The shallow groundwater nitrate/chloride plume, which consists of the commingled nitrate (nitrate plume) and chloride (chloride plume) components shown in Figures 2 and 3, likely originated primarily from a former stock pond (the historical pond shown on Figure 1)) located ***upgradient*** of the Tailings Management System ("TMS"), but may have received a contribution from a chemical spill also located some distance ***upgradient*** from the TMS. The nitrate plume is defined by groundwater concentrations exceeding 10 milligrams per liter ("mg/L") nitrate as nitrogen; and the commingled chloride plume is defined by groundwater concentrations exceeding 100 mg/L chloride. The nitrate plume boundary is based on the GWQS for nitrate, whereas the chloride plume boundary is defined by a threshold concentration that appears to exceed the background chloride concentrations within the perched groundwater.

EFRI submitted a Corrective Action Plan ("CAP") in February 2012 for nitrate + nitrite and chloride in groundwater. The CAP was approved on December 12, 2012, and the activities associated with the CAP are on-going. These activities include active remediation by pumping since the first quarter of 2013. Although active remediation by pumping removes nitrate mass and accelerates plume remediation, the nitrate plume is also naturally degrading through reaction with naturally-occurring pyrite in the formation. As discussed in HGC (2017), natural degradation provides a significant proportion of total nitrate mass removal.

The nitrate/ chloride plume is located downgradient of the northern wildlife ponds. Prior to the first quarter of 2012, these unlined ponds provided a source of recharge that created a perched groundwater mound and a source of dilution. Although wildlife pond recharge is substantially diminished since 2012, as shown in Figure 4, a remnant of the former groundwater mound still exists upgradient of the TMS. The groundwater mound increased hydraulic gradients that acted to increase plume migration rates while dilution acted to limit dissolved constituent concentrations within the plumes. Since water delivery to the northern ponds ceased in March 2012, the groundwater mounds have declined, hydraulic gradients have diminished, and reduced dilution has caused increases in constituent concentrations in portions of the plumes (HGC, 2018).

Figure 5 is a plot of groundwater elevation over time at MW-28. As shown, groundwater levels increased prior to about 2017 before levelling off. The increase was the result of former wildlife pond recharge and the levelling off due to reduced recharge from the ponds since 2012.

1.1 Previous Plan and Time Schedule

On May 28, 2014, EFRI Environmental Staff identified damage to MW-28 during routine, quarterly sampling activities. Upon arrival at MW-28, EFRI Environmental Staff noticed that there was evidence that a vehicle had struck the outer protective metal casing of MW-28 and it was slightly bent and leaning to the west. Inspection of the inner, 10-inch polyvinyl chloride ("PVC") protective casing and the 4-inch well casing also showed signs of damage. The concrete seal between the 10-inch outer casing and the 4-inch casing was cracked, and EFRI Environmental Staff noted that the inner PVC casing was likely cracked and/or broken. Upon discovery of the damage on May 28, 2014, EFRI Environmental Staff contacted the EFRI Quality Assurance Manager ("QAM"). The EFRI QAM notified DWMRC in person, while at the DWMRC offices in Salt Lake City. On June 2, and June 5, 2014 Environmental Staff and Bayles Exploration repaired the well and removed the debris in the bottom of the well resulting from the damage. The Environmental Staff then over pumped the well and removed over 4 casing volumes to redevelop the well. The well was sampled and the routine, second quarter 2014 sample was collected on June 18, 2014.

Three constituents in MW-28, uranium, vanadium and cadmium, were reported above their respective GWCLs in the second quarter 2014. Per the GWDP, EFRI began accelerated monitoring for these three constituents in the third quarter 2014. The fourth quarter 2014 results for vanadium and cadmium were below the GWCLs. The uranium concentrations remained above the GWCL in the third quarter 2014. Part I.G.4 c) of the GWDP requires a P&TS for constituents exceeding their GWCL over two consecutive monitoring periods. The P&TS specified that an assessment of the uranium concentrations would be completed after the first quarter 2015 sampling event. If the uranium concentrations continued to exceed the GWCL, EFRI would perform a video inspection of the interior of MW-28 to investigate the possibility of additional physical damage to the well structure that may be causing the elevated uranium results. The uranium concentrations in MW-28 fluctuated above and below the GWCL between 2014 and 2018. Beginning in 2019, the uranium concentrations have been consistently above the GWCL. As a result of these uranium results and the consecutive selenium exceedances in Q4 2019 and Q1 2020, a P&TS for uranium and selenium concentrations in MW-28 was submitted to DWMRC on May 21, 2020. The P&TS was approved by DWMRC by letter dated June 22, 2020.

1.2 Source Assessment Report Organization

A description of the approach used for analysis is provided in Section 2.0; the results of the analyses are presented in Section 3.0; the calculation of GWCLs is provided in Section 4.0; and conclusions and recommendations are presented in Section 5.0. Section 6.0 lists references cited.

The analyses performed for this Report are organized in Appendices A through G. **Appendix A** contains a table showing exceedances; **Appendix B** contains the statistical analysis performed on uranium and selenium; **Appendix C** contains the indicator parameter analysis; **Appendix D** contains the mass balance analysis; and **Appendix E** contains the Groundwater Data Preparation and Statistical Process Flow for Calculating Groundwater Protection Standards, White Mesa Mill Site, San Juan County, Utah ("Flowsheet") that was developed based on the United States Environmental Protection Agency's ("USEPA") Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities, Unified Guidance (USEPA, 1989, 1992). This Flowsheet was approved by DWMRC prior to completion of the Background Reports. **Appendix F** contains the flowsheet analysis to address revising GWCLs for constituents with increasing trends. **Appendix G** is included on the compact disc that accompanies this SAR and contains the electronic input and output files used for statistical analysis.

Statistical analysis was performed using the software package "R." R is a free statistical package that allows the analyst to perform statistical analysis and format and output graphs more effectively than the Statistica software package used in the past. Input and output files included in **Appendix G** can be imported into either R or Statistica to replicate the results presented in this SAR.

2.0 CATEGORIES AND APPROACHES FOR ANALYSIS

Previously EFRI has categorized wells and constituents in five categories as follows:

- Constituents Potentially Impacted by Decreasing pH Trends Across the Site
- Newly Installed Wells with Interim GWCLs
- Constituents in Wells with Previously Identified Rising Trends
- Pumping Wells
- Other Constituents

This SAR addresses two constituents (selenium and uranium) in one well (MW-28). These constituents fall into the fifth category: other constituents. It is important to note that selenium and uranium can fall within the first category when downward pH trends are noted; however pH in MW-28 is near-neutral and does not exhibit a decreasing trend.

It is also important to note that the current GWCLs for selenium and uranium were calculated at the time of the Background Reports using 11 data points. The natural variability of groundwater chemistry across the site is well documented, and that variability is expected to increase within the proximity of the commingled nitrate and chloride plume (collectively the nitrate/chloride plume).

Additional factors that may have contributed to a change in behavior of groundwater conditions in MW-28 are discussed in Section 3.2.

2.1 Approach for Analysis

The first step in the analysis is to perform an assessment of the potential sources for the exceedances to determine whether they are due to background influences or Mill activities. If the exceedances are determined to be caused by background influences, then it is not necessary to perform any further evaluations on the extent and potential dispersion of the contamination or to perform an evaluation of potential remedial actions. Monitoring will continue; and, where appropriate, a revised GWCL is proposed to reflect changes in background conditions at the Mill site.

The analysis performed in this SAR considers all available data to date to help determine if there have been any changes in potential TMS seepage indicator parameters (e.g., chloride, sulfate, fluoride, and uranium) since the date of the New Wells Background Report and the influences of the nitrate/chloride plume that may suggest a change in the behavior of the groundwater in the well.

As discussed in the Background Reports (INTERA, 2007a, 2007b, 2008), indicator parameters of potential TMS seepage include chloride, sulfate, fluoride, and uranium. Chloride is the best indicator of potential TMS seepage; however, chloride is problematic as an indicator parameter for those groundwater monitoring wells impacted by the chloride plume (EFRI, 2020). Sulfate and fluoride are useful indicator parameters under geochemical conditions allowing conservative (i.e., non-reactive) behavior. Uranium behavior may range from conservative to non-conservative depending on the geochemical conditions.

Groundwater impacted by any potential seepage from the TMS is expected to exhibit increasing concentrations of chloride, sulfate, fluoride, and uranium, among other constituents. While uranium can be the most mobile of trace metals under certain conditions, it is typically retarded behind chloride, fluoride, and sulfate due to possible sorption and precipitation and would likely not show increasing concentrations in groundwater until sometime after chloride, fluoride, and sulfate concentrations had begun to increase (INTERA, 2007a). Based on data provided in USEPA (2008) uranium is generally expected to sorb and have comparatively poor mobility at the near-neutral pH conditions encountered at MW-28. Regardless, although the absence of a rising trend in constituent concentrations would indicate that there has been no impact from the TMS, a rising trend in concentrations could also result from natural influences (INTERA, 2007a, Section 12.0).

The evaluation of SAR parameters and indicator parameters in MW-28 was supported by a statistical analysis that followed the process outlined in the Flowsheet (INTERA, 2007a) attached as **Appendix E.** As discussed in Section 1.2, the Flowsheet was designed based on USEPA's *Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities, Unified Guidance* (USEPA, 1989, 1992, 2009), and was approved by DWMRC prior to completion of the Background Reports (INTERA, 2007a, 2007b, 2008).

2.2 Approach for Setting Revised GWCLs

If the preceding approach indicates that the previous analysis in the Background Reports has not changed, or that the OOC status of selenium or uranium in MW-28 is due to natural or other site-wide influences that are already being addressed by corrective action, then new GWCLs may be proposed for the constituents. The revised GWCLs use the DWMRC-approved Flowsheet, including the last decision of the process that directs the analyst to consider a modified approach to determining a GWCL if an increasing trend is present.

2.3 University of Utah Study

At the request of the DWMRC, T. Grant Hurst and D. Kip Solomon of the Department of Geology and Geophysics of the University of Utah performed a groundwater study (the "University of Utah Study") at the Mill site in July 2007 (Hurst and Solomon, 2008). The purpose of this study was to characterize groundwater flow, chemical composition, noble gas composition, and water age to evaluate whether the increasing and elevated trace metal concentrations in monitoring wells at the Mill, all of which were identified in the Background Reports (INTERA, 2007a, 2007b, 2008), may indicate that potential seepage from the TMS is occurring.

To evaluate sources of solute concentrations at the Mill, low-flow groundwater sampling was used as a method for collecting groundwater quality samples from 15 monitoring wells. In addition, surface water samples were collected from TMS Cells 1, 3, and 4A, and two wildlife ponds. Passive diffusion samplers were also deployed and collected to characterize the dissolved gas composition of groundwater at different depths within the wells. Samples were collected and analyzed for the following constituents: tritium, nitrate, sulfate, deuterium and oxygen-18 of water, sulfur-34 and oxygen-18 of sulfate, trace metals (uranium, manganese, and selenium), and chlorofluorocarbons ("CFCs").

Hurst and Solomon (2008, page iii) concluded generally that,

> *[t]he data show that groundwater at the Mill is largely older than 50 years, based on apparent recharge dates from chlorofluorocarbons and tritium concentrations. Wells exhibiting groundwater that has recharged within the last 50 years appears to be a result of recharge from wildlife ponds near the site. Stable isotope fingerprints do not suggest contamination of groundwater by tailings cell leakage, evidence that is corroborated by trace metal concentrations similar to historically-observed observations.*

Hurst and Solomon (2008) also concluded that,

> *[i]n general, the data collected in this study do not provide evidence that tailings cell leakage is leading to contamination of groundwater in the area around the White Mesa Mill. Evidence of old water in the majority of wells, and significantly different isotopic fingerprints between wells with the highest concentrations of trace metals and surface water sites, supports this conclusion.*

It should be further noted that subsequent to the University of Utah Study EFRI submitted the *Contaminant Investigation Report ["CIR"], White Mesa Uranium Mill Site, Blanding Utah,* dated December 30, 2009 (INTERA, 2009), in connection with the nitrate/chloride plume at the Mill site.

3.0 RESULTS OF ANALYSIS

This section describes the potential geochemical influences on groundwater in MW-28 and results of the analysis, summaries of which are presented in **Appendices B** and **C**. Supporting analyses are presented in **Appendices D** and **F**.

As shown in Appendix B, and as will be discussed below, both uranium and selenium concentrations are relatively low for the site. Prior to 2012 selenium concentrations are variable. Notable changes in both uranium and selenium occur in 2014 (at the time of the wellhead impact and repair) as well as post 2017. For purposes of evaluating the increasing concentrations of uranium and selenium post 2017, and for calculating appropriate compliance limits, subsets of post 2017 data are analyzed along with the complete data sets as presented in **Appendix F.** For uranium analysis, extreme outliers relating to the wellhead impact were removed from the dataset prior to analysis; however extreme outliers identified as part of the recent increasing trend were retained. For selenium analysis, one extreme outlier was identified as part of the recent (post 2017) increasing trend but was retained for analysis. Post 2017 data for both uranium and selenium are normally distributed and exhibit statistically significant increasing trends.

3.1 Site-Wide pH Changes

As has been documented in INTERA (2012), a decreasing trend in pH has been observed in almost every groundwater monitoring well across the site, including upgradient and far downgradient monitoring wells; and decreasing pH is one of the most important contributors to increasing concentrations of many naturally-occurring parameters.

Hydro Geo Chem, Inc. (["HGC"]), 2012a) ("The Pyrite Report") attributed the decline in pH across the Mill site to the site-wide existence and oxidation of pyrite in the perched groundwater monitored at the site. Based on HGC (2012a) pyrite has been noted in approximately $^{2}/_{3}$ of the lithologic logs for wells installed at the site since 1999, and verified by laboratory analysis in core and cuttings from at least 25 monitoring wells, including MW-28, as well as MW-27, which is located upgradient of MW-28 (Figure 4).

Pyrite may oxidize according to the following reaction (Williamson and Rimstidt, 1994):

$$FeS_{2(s)} + 7/2O_{2(g)} + H_2O \rightarrow Fe^{2+}_{(aq)} + 2SO_4^{2-}{}_{(aq)} + 2H^+ \qquad \text{(reaction 1)}$$

Reaction 1 will increase hydrogen ion (acid) concentrations, which results in decreasing pH. Oxidation of pyrite and the resulting decrease in pH enables subsequent pH-dependent reactions to occur, including the mobilization of naturally-occurring metals and metalloids (such as selenium) in the formation (McClean and Bledsoe, 1992). In addition, pyrite typically contains many contaminants including selenium (Deditius, 2011) that are expected to be released upon pyrite oxidation.

The likely causes for site-wide oxidation of pyrite include processes that increase oxygen transport to groundwater such as the following: (1) infiltration of oxidized water from the wildlife ponds upgradient of the Mill site; (2) changing water levels and incorporation of oxygen in air-filled pore spaces into groundwater; (3) the introduction of oxygen during pumping related treatment of the nitrate/chloride plume; and (4) the introduction of oxygen during increased sampling of monitoring wells (INTERA, 2012). Many of these mechanisms, in particular changing water levels, are expected to impact MW-28. Water levels at many site wells increased due to former seepage from the northern wildlife ponds located upgradient of the TMS. As shown in Figure 5, as a result of former wildlife pond seepage, water levels at MW-28 increased by nearly 5 feet between 2006 and 2017 before levelling off.

However, pyrite may also oxidize in the absence of oxygen by reacting with nitrate within the nitrate/chloride plume. Because of its location at the leading edge of the nitrate/chloride plume, MW-28 is expected to be impacted by this process (Figure 2 and 3).

As discussed in HGC (2017) nitrate consumption through pyrite oxidation is consistent with the stability of nitrate concentrations in MW-30 and MW-31, which are located at the downgradient southern toe of the nitrate plume (Figure 2). As will be discussed below, pyrite oxidation by nitrate may occur by two potential pathways; one which releases acid, and one which consumes acid.

Based on Hayakawa et al (2013), the acid-producing reaction resulting in the oxidation of pyrite in the presence of bacteria and nitrate is as follows:

$$5FeS_2 + 15NO_3^- + 10H_2O \rightarrow {}^{15}/_2N_2 + 10SO_4^{2-} + 5Fe(OH)_3 + 5H^+ \qquad \text{(reaction 2)}$$

Based on Spitieri et al (2008), the acid-consuming reaction resulting in the oxidation of pyrite in the presence of nitrate is as follows:

$$5FeS_2 + 14NO_3^- + 4H^+ \rightarrow 7N_2 + 10SO_4^{2-} + 5Fe^{2+} + 2H_2O \qquad \text{(reaction 3)}$$

The relative dominance of pyrite oxidation by dissolved oxygen (producing acid and sulfate by reaction 1) and/or by nitrate (producing acid and sulfate by reaction 2; or producing sulfate but consuming acid by reaction 3) may result in sulfate production with or without a decrease in pH. Because pH is generally increasing at MW-28 since early to mid-2016 (Figure 6), it appears that reaction 3, at least at the present time, is likely dominating the geochemistry of MW-28 and causing pyrite to oxidize while consuming acid. Prior to 2016, the pH at MW-28 was generally decreasing and was likely dominated by reaction 1 or 2.

The general increase in pH in MW-28 since early to mid-2016 appears to correlate with a general increase in bicarbonate (Figure 6) over the same period. MW-28, although located immediately downgradient of Cell 1, is also located downgradient of the Mill site. Increasing bicarbonate likely originates from enhanced infiltration of precipitation within relatively flat graded areas within the Mill site and surrounding areas that leaches carbonate from alkaline soils overlying the bedrock hosting the perched groundwater. Because negligible bicarbonate concentrations occur within the TMS solutions, the TMS is an unlikely contributor to the bicarbonate in MW-28.

3.2 Changes in Groundwater in MW-28

At the time of the Background Reports, MW-28 had a limited data set composed of 11 data points per GWDP parameter. At the time of this SAR, 40-62 data points are available, providing a more robust understanding of the water quality and behavior of MW-28. Other factors that may also contribute to the behavior of constituents in this well are discussed below.

Increasing concentrations of various analytes in wells located within and marginal to the nitrate/chloride plume are due to the continued downgradient migration of the plume. MW-28 is located within the leading edge of the nitrate/chloride plume and is generally downgradient of the historical pond, the most likely contributor to the nitrate/chloride plume. As discussed in Section 1.0, the historical pond was located upgradient of the Mill and TMS (HGC, 2018). Chloride at MW-28 has been generally increasing since the well was installed (**Appendix C-8**); however nitrate is lagging chloride due to likely degradation by pyrite, and has not yet exceeded 10 mg/L. However, nitrate began increasing in late 2014, reaching 5 mg/L in late 2019.

The increase in nitrate since late 2014 correlates to increases in selenium and uranium concentrations that have resulted in exceedances of the GWCLs (Figure 8 and Figure 9). The increases in selenium concentrations may result from one or more of the following: nitrate oxidizing and mobilizing naturally-occurring selenium (Wright [1999]; Bailey et al [2012]; Shultz et al [2018]); selenium that may be generally elevated in the nitrate/chloride plume due to the historical pond having seeped through the Mancos Shale (a source of selenium [US Department of Energy, 2011]) is now migrating past MW-28; and/or selenium may be released from pyrite oxidized by nitrate or by elevated dissolved oxygen ("DO") in the plume. Pyrite commonly contains selenium and other trace metals as contaminants (Deditius et al [2011]).

Since 2016, concentrations of bicarbonate (and calcium) at MW-28 appear to be generally increasing (Figure 6). The recently elevated concentrations of calcium and bicarbonate are consistent with mobilization of naturally-occurring uranium in the formation. As discussed in Desbarats et al (2017), and Drage and Kennedy (2013), high mobility and elevated concentrations of uranium are frequently associated with relatively high calcium and carbonate species concentrations; and Burow et al (2017) note the correlation between increases in groundwater uranium and bicarbonate concentrations in the arid west.

There is also abundant evidence in the literature of the association between increased nitrate and increased uranium in groundwater, which has been documented in many aquifers. Mechanisms for mobilization of uranium by nitrate are discussed in Senko et al (2005); Wu et al (2010); Westrop et al (2018); and Asta et al (2020).

3.3 Indicator Parameter Analysis

As discussed in the Background Reports (INTERA, 2007a, 2007b, 2008), indicator parameters of potential TMS seepage include chloride, sulfate, fluoride, and uranium. Chloride is the best indicator of potential TMS seepage; however, chloride is problematic as an indicator parameter for those groundwater monitoring wells impacted by the chloride plume (EFRI, 2020). Sulfate and fluoride are useful indicator parameters under geochemical conditions allowing conservative (i.e., non-reactive) behavior. Uranium behavior may range from conservative to non-conservative depending on the geochemical conditions.

Groundwater impacted by any potential seepage from the TMS is expected to exhibit increasing concentrations of chloride, sulfate, fluoride, and uranium, among other constituents. While uranium can be the most mobile of trace metals under certain conditions, it is typically retarded behind chloride, fluoride, and sulfate due to possible sorption and precipitation and would likely not show increasing concentrations in groundwater until sometime after chloride, fluoride, and sulfate concentrations had begun to increase (INTERA, 2007a). Based on data provided in USEPA (2008) uranium is generally expected to sorb and have comparatively poor mobility at the near-neutral to slightly acidic pH conditions encountered at MW-28. Regardless, although the absence of a rising trend in constituent concentrations would indicate that there has been no impact from the TMS, a rising trend in concentrations could also result from natural influences (INTERA, 2007a, Section 12.0).

In general, the behavior of indicator parameters in MW-28 has not changed significantly since the time of the Background Reports. A summary of statistical analysis of indicator parameters is included in **Appendix C-1**. **Appendix C-2** presents a comparison of descriptive statistics for indicator parameters from the Background Reports and this 2020 SAR. Data used in the analysis and data removed prior to analysis are presented in Appendices **C-3** and **C-4**, respectively. The distribution and identification of outliers and extreme outliers in indicator parameter concentration data sets are demonstrated in the box plots included in **Appendix C-5.** A Piper diagram, which can be used to distinguish between different waters, is presented in **Appendix C-6.**

Chloride concentrations in MW-28 were increasing at the time of the Background Reports, although not significantly. The increasing concentrations of chloride have continued and the trend is currently statistically significant (see **Appendix C-8** for a time series). Fluoride concentrations were decreasing at the time of the Background Report, and continue to exhibit a decreasing trend that is not significant at the time of this SAR. Uranium concentrations were exhibiting no trend at the time of the Background Report. Although concentrations of uranium remain relatively low compared to the Mill site generally (**Appendix B-10**), the concentrations began to increase more recently (post 2017) and now exhibit a statistically significant increasing trend. Time series plots with vertical lines to indicate events that may have contributed to observed changes in indicator parameters are included in **Appendix B-12** and **Appendix C-9**. Sulfate concentrations were increasing (not significantly) at the time of the Background Reports. Currently, sulfate concentrations in MW-28 exhibit no trend.

3.4 Mass Balance Analyses

The 2020 SAR for MW-31 (INTERA, 2020), another well impacted by the nitrate/chloride plume, included a mass balance analysis to predict fluoride concentrations assuming a hypothetical situation under which potential TMS seepage has entered the groundwater and has become diluted during transport before reaching MW-31. Predicted fluoride concentrations were based on dilution factors ("DFs") calculated for other indicator parameters (uranium, chloride, and sulfate) using average TMS Cell 1 concentrations and current MW-31 concentrations. A similar mass balance analysis has been performed for MW-28.

The mass balance model is based on current concentrations of fluoride, uranium, chloride, sulfate and selenium in MW-28 and mean concentrations of the same constituents in Cell 1 water. The mean concentrations in Cell 1 were based on data collected between 2003 and 2019 (EFRI 2019). Samples of Cell 1 water have produced variable results between 2003 and 2019, so average concentrations were used to describe the Cell 1 water. The model calculates estimated fluoride contributions to MW-28 groundwater from hypothetical TMS seepage based on measured concentrations of chloride, sulfate, uranium and selenium. The model assumes potential TMS seepage has entered the groundwater and has become diluted during transport before reaching MW-28 and that this occurred far enough in the past to potentially reach MW-28 at the present time. Therefore, the most recent analyses of MW-28 groundwater were selected to represent modern MW-28 water.

For this mass balance calculation, indicator parameters are assumed to be conservative tracers (INTERA, 2007a) and not subject to attenuation during transport. Therefore, if the TMS is a source of contamination at MW-28, the concentration of fluoride in MW-28 is expected to be proportional to the concentrations of uranium, chloride, sulfate, and selenium in the TMS solutions. Although this model assumes only hypothetical TMS seepage and dilution by natural groundwater at MW-28, the most likely causes of increasing constituent concentrations in this well include the nitrate/chloride plume and oxidization of naturally occurring pyrite, as discussed in Section 3.2, and as will be discussed in more detail below.

Model calculations are presented in **Appendix D**. The mass balance calculations are based on DFs computed as the ratio of a particular constituent's current (Q2 2020) concentration in MW-28 to its average concentration in TMS Cell 1 solutions since 2003. The DFs calculated for all indicator parameters based on the ratio of Cell 1 and MW-28 constituent concentrations vary by four orders of magnitude.

Based on the computed DFs for uranium, chloride, sulfate, and selenium, the predicted MW-28 fluoride concentrations are 0.033, 11.9, 30.1 and 0.0028 mg/L, respectively; yet the most recent observed concentration of fluoride in MW-28 is 0.687 mg/L. The dissimilarity between predicted and measured fluoride concentrations and the large range in calculated DFs for the four indicator parameters indicate that potential TMS seepage is not a contributor to the groundwater chemistry of MW-28. Instead, fluoride concentrations in MW-28 are similar to most natural waters (< 1 mg/L; Hem 1985) and are more consistent with natural processes.

If the same mass balance methodology is applied to uranium, the predicted MW-28 uranium concentrations range from 0.5 micrograms per liter ("µg/L") (based on the fluoride DF) to 5,349 µg/L (based on the sulfate DF); yet the most recent observed concentration of uranium in MW-28 is 5.91 ug/L. As with fluoride, the dissimilarity between predicted and observed uranium concentrations and the large range in calculated DFs for the four indicator parameters indicate that potential TMS seepage is not a contributor to the groundwater chemistry at MW-28.

In addition, if the same mass balance methodology is applied to selenium, the predicted MW-28 selenium concentrations range from 120 µg/L (based on the uranium DF) to 108,892 µg/L (based on the sulfate DF). All of the predicted concentrations of selenium substantially exceed the most recent observed selenium concentration of approximately 10.2 µg/L, an even more compelling indication that potential TMS seepage is not a contributor to the groundwater chemistry at MW-28.

Both fluoride and sulfate concentrations at MW-28 are stable (**Appendix C**), which is inconsistent with potential TMS seepage. Because chloride and fluoride are the most conservative and mobile parameters, and because concentrations of chloride are increasing and fluoride is stable, the ratio of chloride to fluoride concentrations is increasing (Figure 7). If the chloride in MW-28 resulted from a potential TMS impact, the MW-28 chloride to fluoride ratio should be decreasing (rather than increasing) because the chloride to fluoride ratio in Cell 1 (approximately 11 based on average concentrations) is much lower than the ratio at MW-28 (188 as of Q2 2020, Figure 7). Based on the ratio of the most conservative parameters (chloride to fluoride), the MW-28 'geochemical signature' is becoming more and more unlike the signature of TMS solution. The increase in the chloride to fluoride ratio at MW-28 is, however, consistent with the position of MW-28 in the downgradient toe of the nitrate/chloride plume and the ongoing downgradient migration of the plume. As discussed in Section 3.2 and INTERA (2009), the nitrate/chloride plume originated primarily from an upgradient pre-Mill source. This source (the historical pond) was located approximately 500 feet upgradient (northeast) of TMS Cell 1 (INTERA, 2009).

Furthermore, the ratios of other indicator parameters in MW-28 differ substantially from ratios of the same constituents in Cell 1 solutions. The average chloride to average sulfate ratio in Cell 1 is approximately 0.14 while the Q2 2020 ratio in MW-28 is approximately 0.06; the ratio of average chloride to average uranium in Cell 1 is approximately 61 while the Q2 2020 ratio in MW-28 is approximately 21,827; and the ratio of average chloride to average selenium in Cell 1 is approximately 3 while the Q2 2020 ratio in MW-28 is approximately 12,647. None of these ratios are reflective of a TMS impact.

Finally, nitrate, a component of the nitrate/chloride plume which originates upgradient of the Mill and TMS, is an anion with a mobility in soils and groundwater that is expected to be comparable to chloride and fluoride, which generally migrate at about the same velocity as the groundwater; whereas uranium and selenium are expected to be significantly retarded with respect to these conservative parameters and to migrate substantially more slowly than groundwater. However, beginning in 2015, there is a strong correlation between increases in uranium and nitrate (Figure 8), and between increases in selenium and nitrate (Figure 9). Because 1) nitrate is an anion with a mobility comparable to chloride; 2) uranium and selenium are expected to be retarded with respect to nitrate; and 3) uranium and nitrate, and selenium and nitrate, are increasing nearly simultaneously; the behavior of these parameters at MW-28 is consistent with geochemical changes in the immediate vicinity of the well and not to a relatively remote potential source such as TMS seepage.

Based on the correlations between uranium and nitrate, and between selenium and nitrate, the most likely mechanisms for increases in uranium and selenium are 1) mobilization of naturally occurring uranium and selenium in the formation by nitrate; and 2) release of selenium from selenium-bearing pyrite via oxidation by nitrate as discussed in Section 3.2. The lack of decrease in pH at MW-28 suggests that pyrite oxidation by nitrate occurs through the pathway (reaction 3 described above and in HGC, 2017) that consumes rather than produces acid. In addition, as discussed in Sections 3.1 and 3.2, increased bicarbonate from background influences may mobilize naturally-occurring uranium; and selenium may be generally elevated within the nitrate/chloride plume due to its potential primary source (the historical pond) having seeped through Mancos Shale.

Overall, the mass balance analysis and geochemical considerations indicate that potential TMS seepage is not a contributor to the groundwater chemistry at MW-28. Migration of the nitrate/chloride plume; oxidation of pyrite by nitrate; and mobilization of uranium and selenium by nitrate are the most likely causes of the increases in chloride, selenium, and uranium measured in MW-28, which is located in the downgradient toe of the plume where such increases would be expected (as indicated above). In addition, uranium may be mobilized by increased bicarbonate from background influences in the perched groundwater; and selenium may be generally elevated within the nitrate/chloride plume due to its primary source (the historical pond) having seeped through Mancos Shale. That increased chloride, uranium and selenium are unrelated to potential TMS impacts is consistent with previous mass balance analyses performed on the nitrate/chloride plume that were based on nitrate concentrations within the plume as described in the December 2009 CIR (INTERA, 2009).

The nitrate mass balance calculation presented in INTERA (2009) suggested that groundwater mounding would occur underneath the TMS if the nitrate/chloride plume was caused by hypothetical TMS seepage. The results of this calculation predicted that a 5-foot groundwater mound would be expected if the nitrate/chloride plume was caused by TMS seepage. This nitrate mass balance calculation was updated in the 2015 SAR (INTERA, 2015, **Appendix F-2**). Although a substantial groundwater mound was predicted, such a mound has not been identified beneath the TMS cells (Figure 4).

3.5 Summary of Results

As discussed in the Background Reports (INTERA, 2007a, 2007b, 2008), indicator parameters of potential tailings system seepage include chloride, sulfate, fluoride, and uranium. Chloride is the best indicator of potential TMS seepage; however, chloride is problematic as an indicator parameter for those groundwater monitoring wells at the Mill impacted by the chloride plume (EFRI, 2020). MW-28 is located within the leading edge of the nitrate/chloride plume, which originates upgradient of the Mill and TMS. Analysis of the next most conservative constituents fluoride and sulfate demonstrate that changes in chemistry at MW-28 are inconsistent with a TMS impact. Fluoride and sulfate concentrations at MW-28 are decreasing or stable, respectively; the ratios of chloride to fluoride and of chloride to sulfate at MW-28 differ substantially from average ratios of these constituents within Cell 1; and the ratios of chloride to fluoride at MW-28 and of average chloride to average fluoride in Cell 1 are becoming more different over time; all of which are inconsistent with potential TMS impact. The increasing ratio of chloride to fluoride at MW-28 is, however, consistent with continued downgradient migration of the nitrate/chloride plume past MW-28.

3.5.1 Uranium

As noted in Section 3.3 above, uranium concentrations are relatively low for the site, and as shown in **Appendix B** are exhibiting a statistically significant increasing trend. Notable changes in uranium concentration trends occur in 2014 at the time of the wellhead impact and repair, and again in 2017. The subset of data post 2017 that were analyzed alongside the complete data set and presented in **Appendix F** are normally distributed and exhibit a significantly increasing trend.

However, in addition to the behavior of indicator parameters discussed above in Section 3.5, which are inconsistent with a potential TMS impact, the ratio of average chloride to average uranium in Cell 1 is approximately 61 while the Q2 2020 ratio in MW-28 is approximately 21,827, also not reflective of a potential TMS impact. Furthermore, in performing the mass balance analysis discussed in Section 3.4, the inability of any of the calculated DFs for chloride, fluoride, sulfate or selenium to predict the concentration of uranium at MW-28 to within even an order of magnitude, is also inconsistent with a potential TMS impact.

As discussed above in Section 3.4, the most likely mechanisms for increased uranium at MW-28 are 1) mobilization of naturally occurring uranium in the formation by nitrate supplied by the nitrate/chloride plume; and 2) increased mobility of naturally-occurring uranium resulting from generally increased bicarbonate from natural background influences. The nearly simultaneous increases in highly mobile nitrate and relatively immobile uranium at MW-28 are reflective of geochemical changes in the immediate vicinity of the well and not of any potential seepage from the TMS.

3.5.2 Selenium

Selenium concentrations are relatively low for the site. The time series plot provided in **Appendix B** shows the variability in selenium concentrations prior to 2012, as well as an increase in concentration following the 2014 wellhead impact and repair. As with uranium, concentrations of selenium begin to increase more steeply in 2017. The subset of data post 2017 analyzed alongside the complete data set as presented in **Appendix F** are normally distributed and exhibit a significantly increasing trend.

However, in addition to the behavior of indicator parameters discussed above in Section 3.5, which are inconsistent with a potential TMS impact, the ratio of average chloride to average selenium in Cell 1 is approximately 3 while the Q2 2020 ratio in MW-28 is approximately 12,647, also inconsistent with a potential TMS impact. Furthermore, in performing the mass balance analysis discussed in Section 3.4, the inability of any of the calculated DFs for chloride, fluoride, sulfate or uranium to predict the concentration of selenium at MW-28 to within even an order of magnitude; and the one to more than four order of magnitude overprediction of selenium concentrations based on DFs; are also inconsistent with a potential TMS impact.

As discussed above in Section 3.4, the most likely mechanisms for increased selenium at MW-28 are 1) mobilization of naturally occurring selenium in the formation by nitrate supplied by the nitrate/chloride plume; 2) oxidation of selenium-bearing pyrite by nitrate; and 3) generally elevated selenium concentrations within the nitrate/chloride plume now migrating past MW-28. As discussed above, the likely source of the potentially elevated selenium in the nitrate/chloride plume is the Mancos Shale. The nearly simultaneous increases in highly mobile nitrate and relatively immobile selenium at MW-28 are reflective of geochemical changes in the immediate vicinity of the well and not of any potential seepage from the TMS.

4.0 CALCULATIONS OF GROUNDWATER COMPLIANCE LIMITS

The findings of analyses discussed above support the conclusions that (1) MW-28 is not being impacted by any potential TMS seepage, and (2) increasing concentrations of constituents in MW-28 are the result of background and/or influences such as the nitrate/chloride plume, which are already being addressed under the CAP. Furthermore, the existing GWCLs for MW-28 were developed at the time of the Background Reports using 11 data points that are no longer representative of current conditions at that location. Therefore, revision of GWCLs for SAR parameters in MW-28 is proposed.

4.1 Evaluation of Modified Approaches to Calculation of GWCLs for Trending Constituents

According to the DWMRC-approved Flowsheet (**Appendix E**), if an increasing trend is present, a modified approach should be considered for determining GWCLs. The constituents included in this SAR, uranium and selenium in MW-28 are exhibiting significantly increasing trends that can be attributed to one or more of the following: (1) natural background conditions; (2) pyrite oxidation in the aquifer, which can release metals and/or increase the mobility of metals, (3) the location of this well within the nitrate/chloride plume, which is actively being remediated according to the CAP (HGC, 2012b); and/or (4) effects of recent events on groundwater in MW-28, such as the wellhead impact and repair.

The Flowsheet contemplates GWCLs being set in various circumstances based on (1) the fractional approach; (2) the highest historical value; and (3) the mean + 2σ, and states that for rising trends a modified approach can be considered. In proposing a modified approach for the GWCLs for uranium and selenium in MW-28, the following alternative approaches to calculating GWCLs have been considered, in addition to the fractional approach, highest historical value, and mean + 2σ:

1. 1.5 times background concentration as defined in Utah Administrative Code ("UAC") R317-6-4.3.

The UAC R317-6-4.3 recognizes that "contaminants" may be present as part of naturally occurring background conditions:

> *When a contaminant is present in a detectable amount as a background concentration, the concentration of the pollutant may not exceed the greater of 1.5 times the background concentration or 0.5 times the ground water quality standard or background plus two standard deviations...*

In this rule, background concentration is defined as the "concentration of a pollutant in ground water upgradient or lateral hydraulically equivalent point from a facility, practice or activity which has not been affected by that facility, practice or activity." Background at the Mill has been determined on an intrawell basis, as defined in the Background Reports. Therefore, to be conservative, the mean concentration is proposed to be used as background for the purposes of this calculation. The mean concentration would assume all data to date (or a data subset as described below), after following the data quality steps of the Flowsheet.

2. Using recent data to calculate GWCLs.

This approach follows the DWMRC-approved Flowsheet (**Appendix E**) by taking into account increasing trends and processing the data consistently with previously determined GWCLs. In this approach, the complete data set, which exhibits an increasing trend for uranium and selenium over the history of the well record, is divided into a subset of data based on identification of a point of inflection where the results have shifted. This approach is appropriate in wells, such as MW-28, that have been thoroughly investigated and where the causes of increasing trends are not due to any potential TMS seepage or other Mill-related impacts that are not already being addressed. For purposes of this modified approach and to be consistent with previous SARs, a point of inflection was identified in the uranium and selenium data sets, and data from post-April 2017 were evaluated (**Appendix F**) in addition to the full data sets. Both of the uranium and selenium post-April 2017 data sets are normally distributed, and exhibit significantly increasing trends.

These two modified approaches, in addition to (1) the fractional approach; (2) the highest historical value; and (3) the mean + 2σ, have been considered for developing revised GWCLs for uranium and selenium in MW-28, which are increasing in concentration for reasons other than any potential TMS impact. Based on this analysis, the most appropriate GWCL for uranium and selenium in MW-28, considering increasing trends, is proposed as the highest of the following: (1) fractional approach; (2) highest historical value; (3) mean + 2σ, calculated using either the full data set or the post April-2017 data set; or (4) 1.5 times background, calculated using either the full data set or the post April-2017 data set. This modified approach of choosing the highest of these values combines elements from the Flowsheet and from previously approved GWCLs (DWMRC, 2016).

4.2 Proposed Revised GWCLs

In accordance with the Flowsheet, the increasing trends identified for selenium and uranium warrant a modified approach to the calculation of GWCLs. For both of these SAR parameters, concentrations are significantly increasing with a non-parametric distribution. Post inflection data are significantly increasing with a normal distribution. Considering the increasing trends, a modified approach of choosing the highest of the following: (1) fractional approach; (2) highest historical value; (3) mean + 2σ, calculated using either the full data set or the post April-2017 data set; or (4) 1.5 times background, calculated using either the full data set or the post April-2017 data set, would be appropriate. Flowsheet analysis has been performed for these data subsets and the complete datasets and is summarized in **Appendix B-1** and **Appendix F-1.**

GWCLs determined according to the Flowsheet using all data to date and the post April-2017 data are presented in **Appendix B-1.** In both the Flowsheet and the modified approach, the fractional approach to GWCL is selected as the most appropriate GWCL (**Table 1**), because it is the greater of: (1) the fractional approach; (2) he highest historical value, (3) the mean + 2σ, calculated using either the full data set or the post April-2017 data set; and (4) 1.5 times background, calculated using either the full data set or the post April-2017 data set.

As a result of this analysis, the proposed revised GWCLs are set out on Table 1 below.

Table 1 Proposed GWCLs

Parameter	GWCL[a]	Flowsheet Revised GWCL	Rationale
Selenium (ug/L)	11.1	25	Fractional Approach
Uranium (ug/L)	4.9	15	Fractional Approach

Notes:
a = 2019 GWDP No.UGW370004.

5.0 CONCLUSIONS AND RECOMMENDATIONS

Background groundwater quality at the Mill site was thoroughly studied as described in the Background Reports (INTERA, 2007a, 2007b, 2008) and in the University of Utah Study (Hurst and Solomon, 2008). The Background Reports and the University of Utah Study concluded that groundwater at the Mill site has not been impacted by Mill operations. These studies also acknowledged that there are natural influences operating at the Mill site that have caused increasing trends and general variability in background groundwater quality.

Consistent with the conclusions of the Background Reports and the University of Utah Study, the conclusion of this SAR is that groundwater in MW-28 is not impacted by potential TMS seepage. Mass balance calculations have demonstrated that concentrations of SAR parameters, and indicator parameters are consistent with background groundwater concentrations, and not the result of potential TMS seepage. Increasing chloride at MW-28 is attributed to its location within the downgradient toe of the nitrate/chloride plume that was identified in 2009, and that is currently addressed under a separate corrective action (HGC, 2012b).

One goal of this SAR was to identify any changes in circumstances identified in previous studies. Accordingly the change in MW-28 parameter concentrations is attributed to migration of the nitrate/chloride plume and oxidation of pyrite by nitrate contained within the nitrate/chloride plume. As discussed in Section 3.2, nitrate mobilizes naturally occurring uranium and selenium in the formation and pyrite oxidation releases selenium from selenium-bearing pyrite. The lack of decrease in pH at MW-28 suggests that pyrite oxidation by nitrate occurs through the pathway (reaction 3 described in Section 3.1 above and in HGC, 2017) that consumes rather than produces acid. In addition, as discussed in Sections 3.1 and 3.2, increased bicarbonate at MW-28 from natural background influences may mobilize naturally-occurring uranium; and selenium may be generally elevated within the nitrate/chloride plume due to its primary source (the historical pond) having seeped through Mancos Shale, a known source of selenium contamination. Furthermore, increases in water levels at MW-28 related to former wildlife pond recharge, and increased sampling frequency, may influence constituent concentrations. Therefore, increasing constituent concentrations result from background influences and/or changes in sampling frequency that are unrelated to the TMS.

In addition to the above factors, a site-wide comparison of constituent concentrations in MW-28 shows that even though many constituents have significant increasing long-term trends, their concentrations are less than or within the range of site-wide background concentrations. This constitutes further evidence that increasing chloride, selenium, and uranium concentrations in MW-28 are likely due to background influences and the location of this well at the leading edge of the existing nitrate/chloride plume, and not to potential TMS seepage.

Finally, the nitrate/chloride plume originates upgradient from the Mill and TMS demonstrating that the TMS is not contributing to the increases in concentrations observed in MW-28. The nitrate/chloride plume likely originated primarily from a former stock pond ***upgradient*** of the TMS, although it may have received a contribution from a chemical spill some distance also ***upgradient*** from the TMS.

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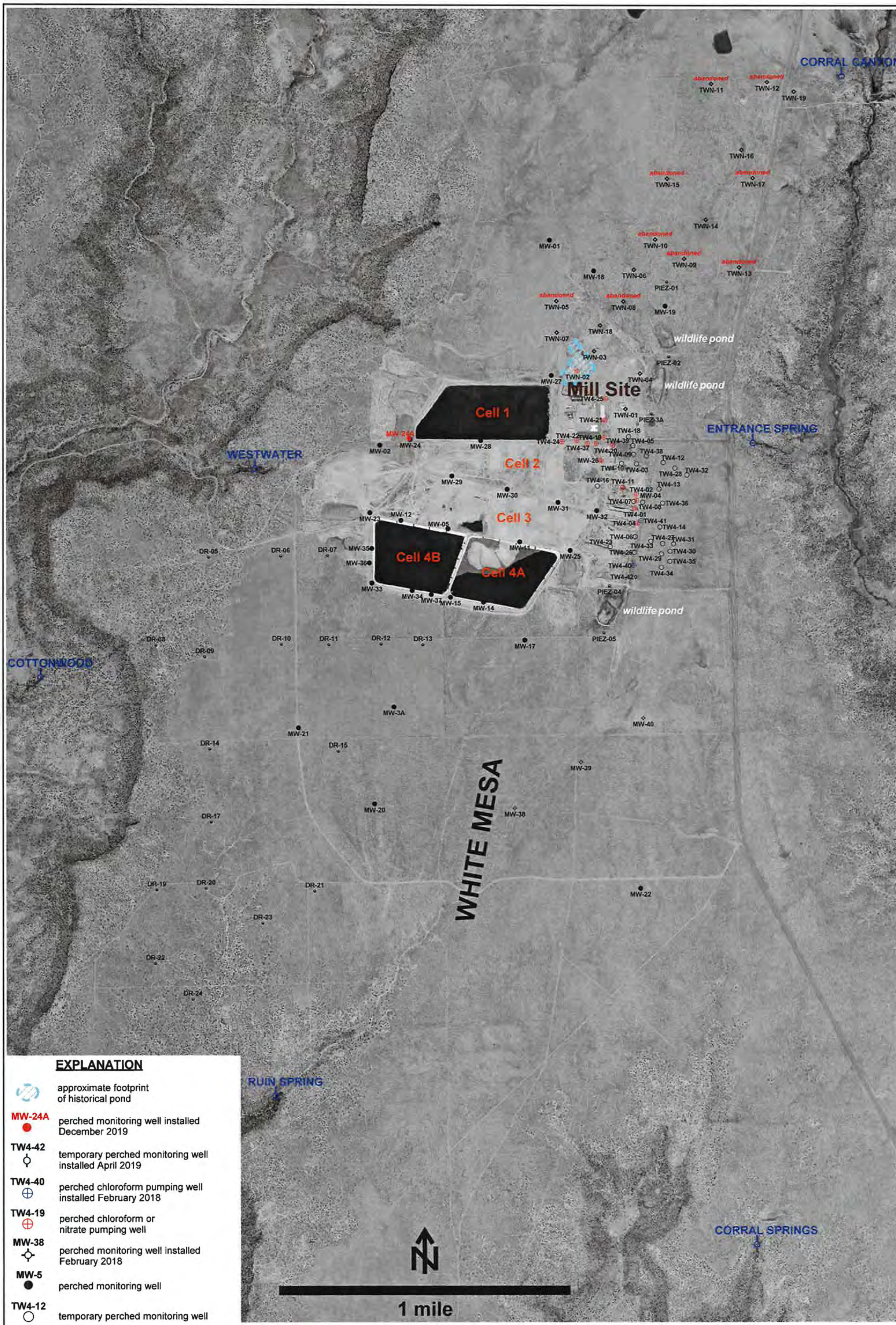
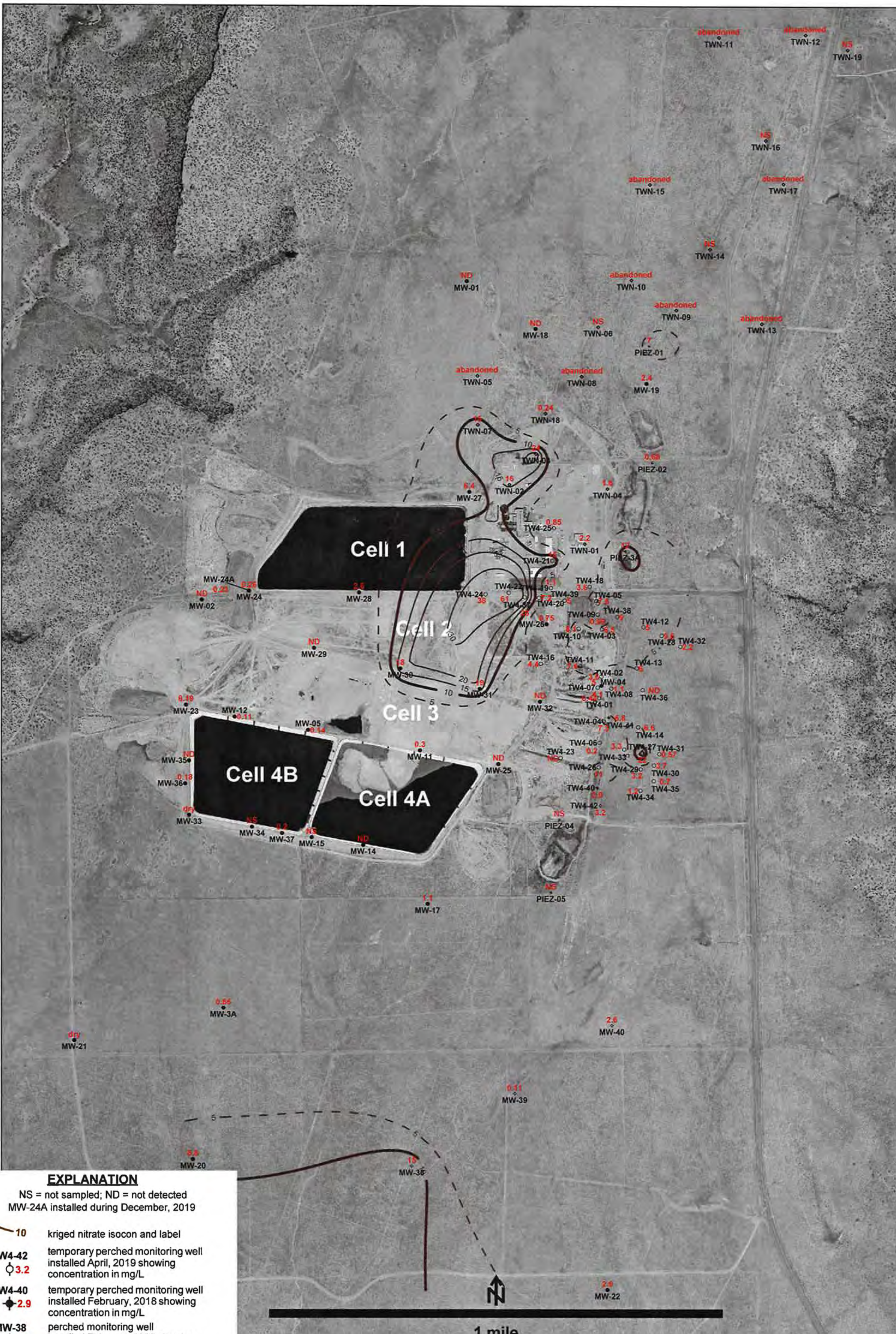
FIGURES



HYDRO GEO CHEM, INC.

WHITE MESA SITE PLAN SHOWING LOCATIONS OF PERCHED WELLS AND PIEZOMETERS

APPROVED	DATE	REFERENCE	FIGURE
		H:/718000/MW28/ 2020_SAR/F1_Uwelloc.srf	1



EXPLANATION

NS = not sampled; ND = not detected
MW-24A installed during December, 2019

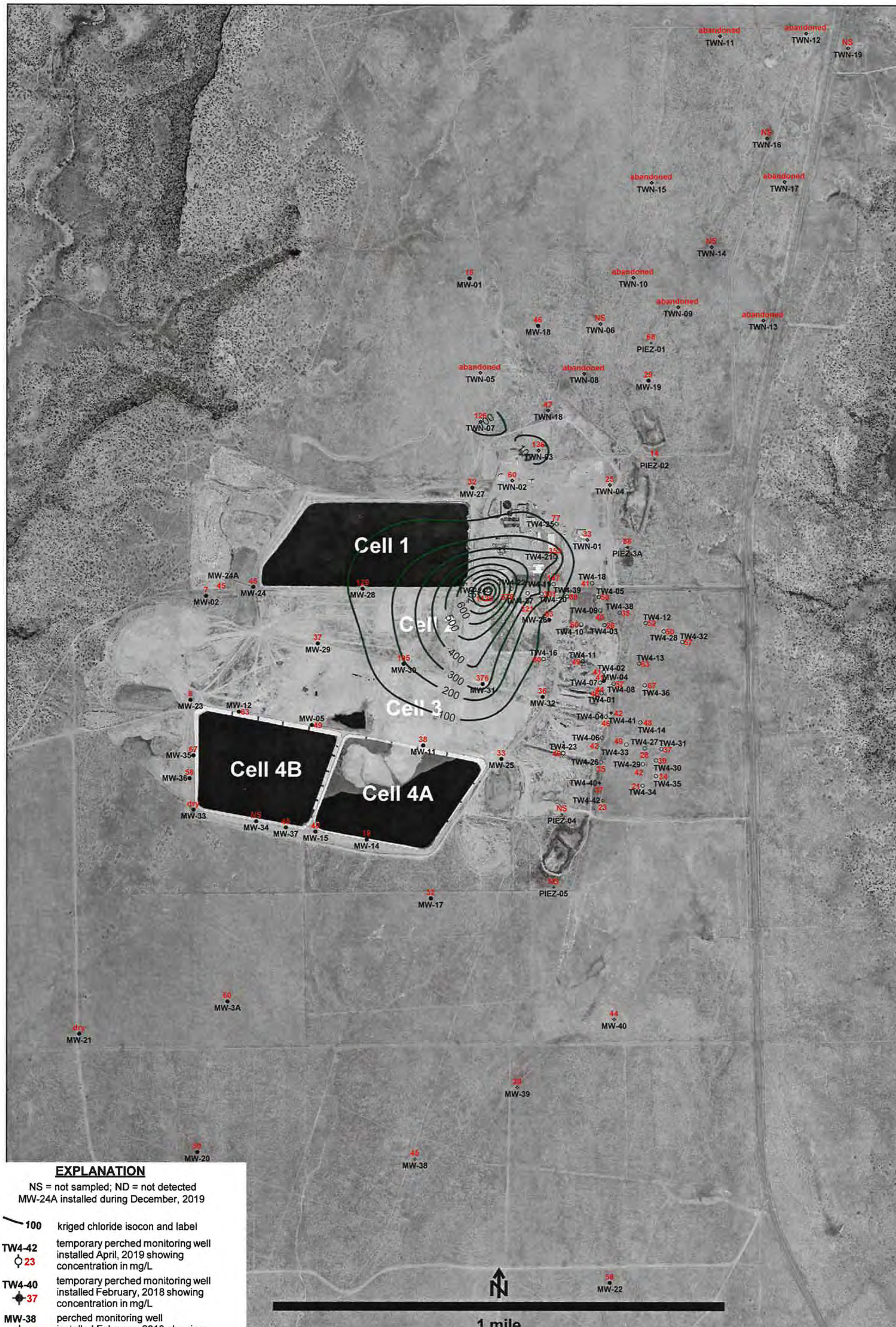
10	kriged nitrate isocon and label
TW4-42 3.2	temporary perched monitoring well installed April, 2019 showing concentration in mg/L
TW4-40 2.9	temporary perched monitoring well installed February, 2018 showing concentration in mg/L
MW-38 15	perched monitoring well installed February, 2018 showing concentration in mg/L
MW-32 ND	perched monitoring well showing concentration in mg/L
TW4-7 4.1	temporary perched monitoring well showing concentration in mg/L
TWN-1 2.2	temporary perched nitrate monitoring well showing concentration in mg/L
PIEZ-1 7	perched piezometer showing concentration in mg/L

NOTES: MW-4, MW-26, TW4-1, TW4-2, TW4-4, TW4-11, TW4-19, TW4-20, TW4-21, TW4-37, TW4-39, TW4-40 and TW4-41 are chloroform pumping wells; TW4-22, TW4-24, TW4-25 and TWN-2 are nitrate pumping wells.

HYDRO GEO CHEM, INC.

KRIGED 2nd QUARTER, 2020 NITRATE (mg/L) (NITRATE + NITRITE AS N) WHITE MESA SITE

APPROVED	DATE	REFERENCE	FIGURE
		H:/718000/aug20/nitrate/Unt0620.srf	2



EXPLANATION

NS = not sampled; ND = not detected
MW-24A installed during December, 2019

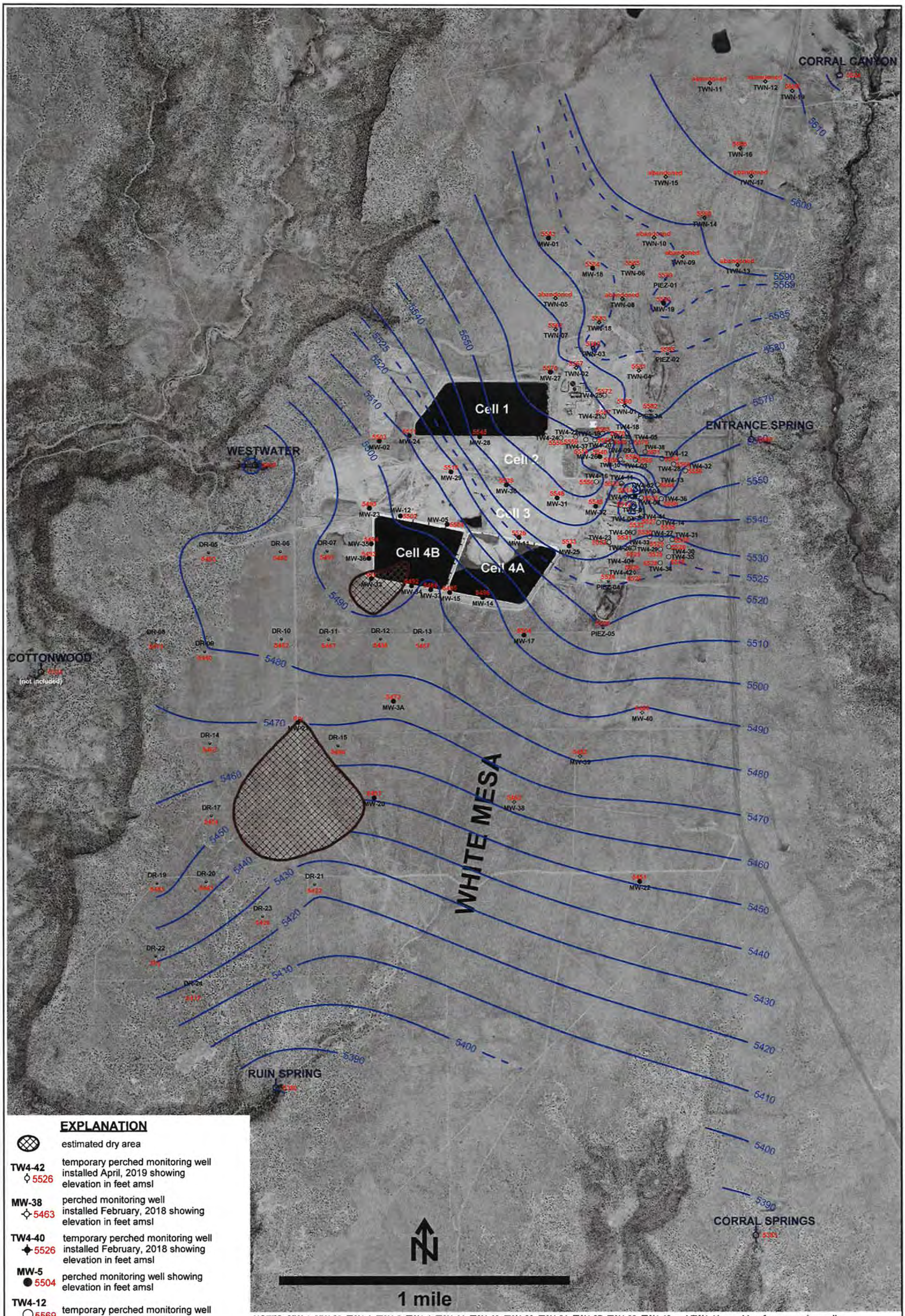
100	kriged chloride isocon and label
TW4-42 23	temporary perched monitoring well installed April, 2019 showing concentration in mg/L
TW4-40 37	temporary perched monitoring well installed February, 2018 showing concentration in mg/L
MW-38 45	perched monitoring well installed February, 2018 showing concentration in mg/L
MW-32 36	perched monitoring well showing concentration in mg/L
TW4-7 44	temporary perched monitoring well showing concentration in mg/L
TWN-1 33	temporary perched nitrate monitoring well showing concentration in mg/L
PIEZ-1 68	perched piezometer showing concentration in mg/L

NOTES: MW-4, MW-26, TW4-1, TW4-2, TW4-4, TW4-11, TW4-19, TW4-20, TW4-21, TW4-37, TW4-39, TW4-40 and TW4-41 are chloroform pumping wells; TW4-22, TW4-24, TW4-25 and TWN-2 are nitrate pumping wells.

HYDRO GEO CHEM, INC.

KRIGED 2nd QUARTER, 2020 CHLORIDE (mg/L) WHITE MESA SITE

APPROVED	DATE	REFERENCE	FIGURE
		H:/718000/aug20/chloride/Ucl0620.srf	3



EXPLANATION

(hatched symbol)	estimated dry area
TW4-42 5526	temporary perched monitoring well installed April, 2019 showing elevation in feet amsl
MW-38 5463	perched monitoring well installed February, 2018 showing elevation in feet amsl
TW4-40 5526	temporary perched monitoring well installed February, 2018 showing elevation in feet amsl
MW-5 5504	perched monitoring well showing elevation in feet amsl
TW4-12 5569	temporary perched monitoring well showing elevation in feet amsl
TWN-7 5567	temporary perched nitrate monitoring well showing elevation in feet amsl
PIEZ-1 5589	perched piezometer showing elevation in feet amsl
RUIN SPRING 5380	seep or spring showing elevation in feet amsl

NOTES: MW-4, MW-26, TW4-1, TW4-2, TW4-4, TW4-11, TW4-19, TW4-20, TW4-21, TW4-37, TW4-39, TW4-40 and TW4-41 are chloroform pumping wells; TW4-22, TW4-24, TW4-25 and TWN-2 are nitrate pumping wells; TW4-1, TW4-2 and TW4-11 water levels are below the base of the Burro Canyon Formation

HYDRO GEO CHEM, INC.

KRIGED 2nd QUARTER, 2020 WATER LEVELS WHITE MESA SITE

APPROVED	DATE	REFERENCE	FIGURE
		H:/718000/aug20/WL/Uwl0620.srf	4

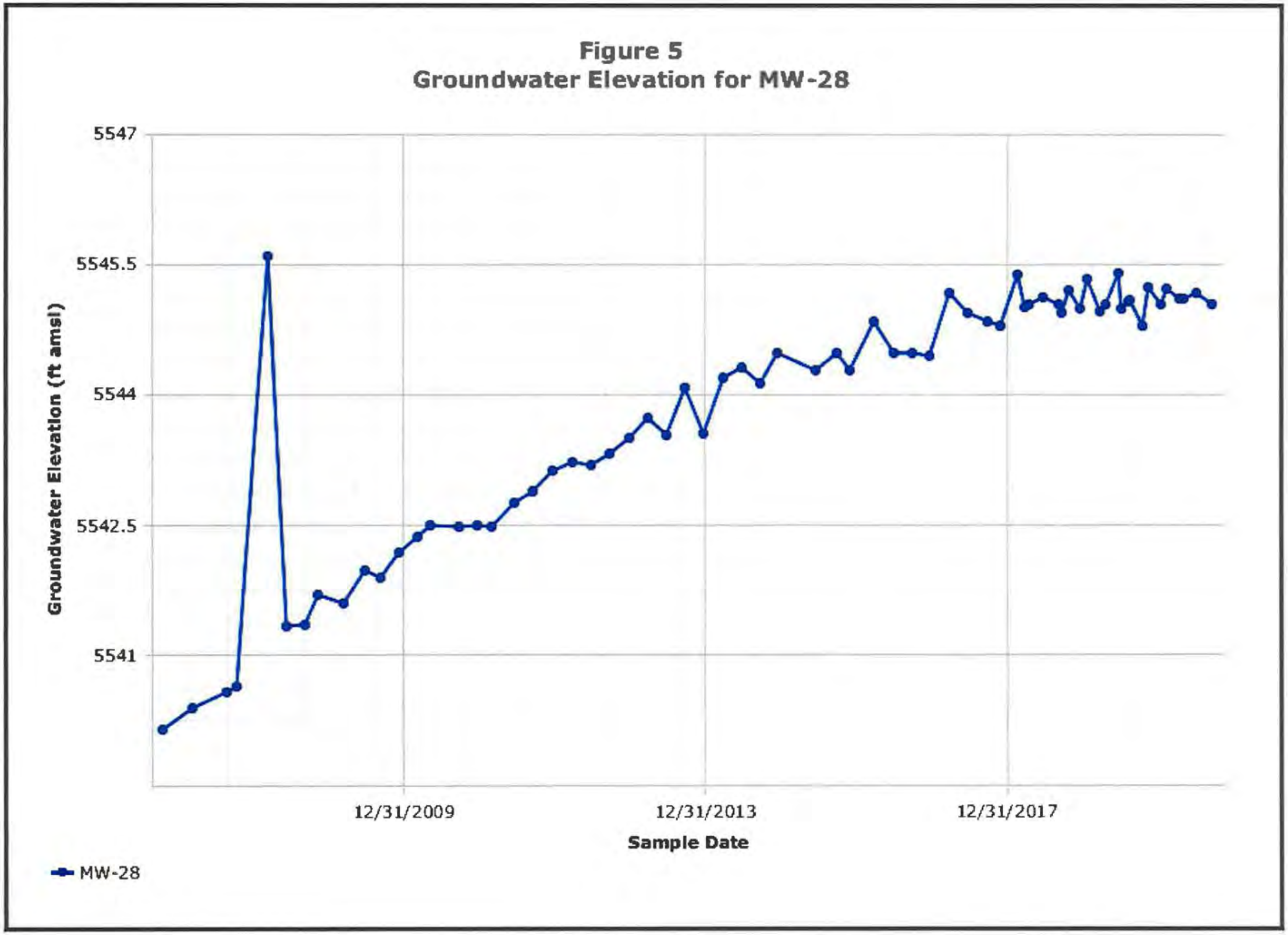
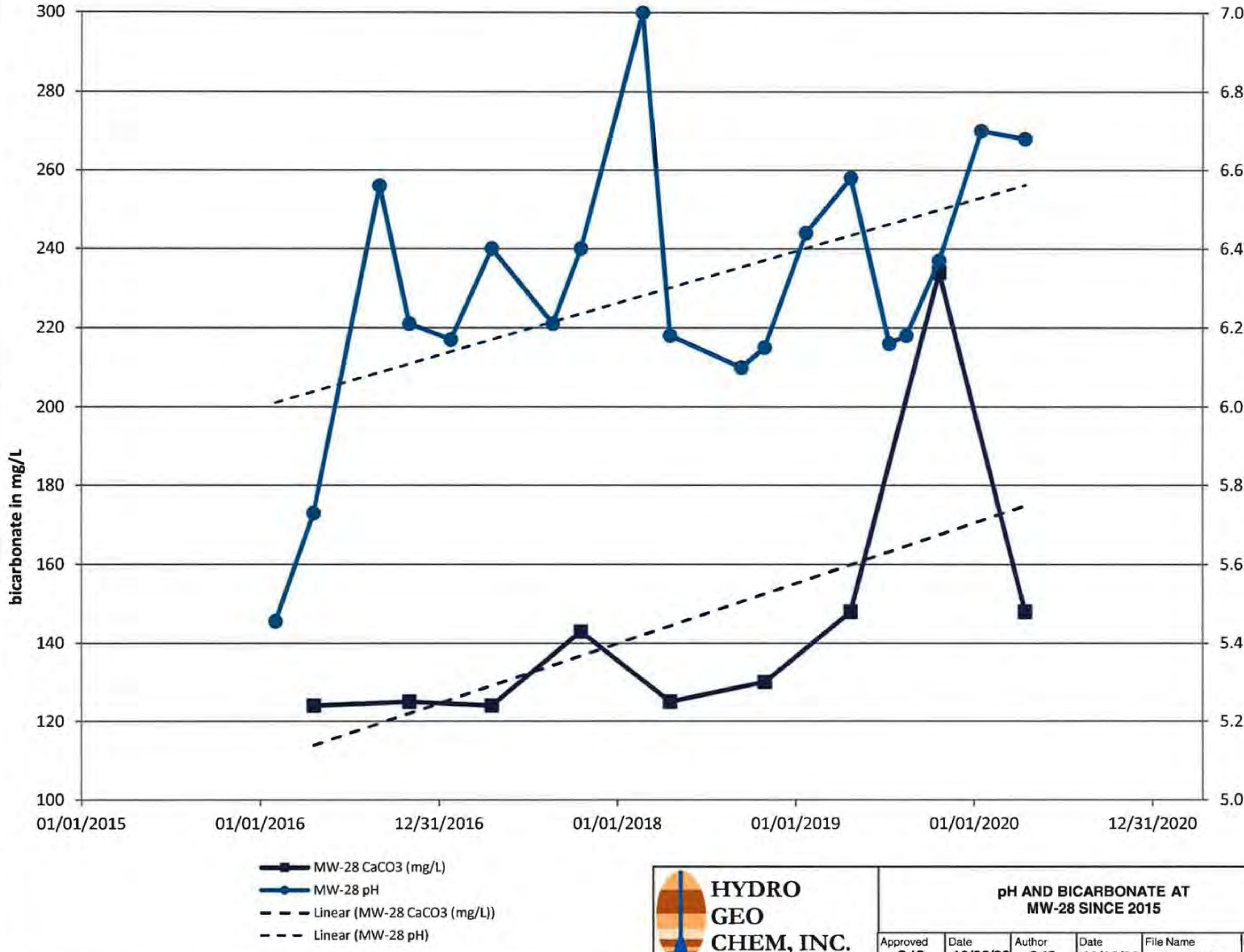


Figure 5
Groundwater Elevation for MW-28
5547
5545.5
5544
5542.5
5541
Groundwater Elevation (ft amsl)
12/31/2009
12/31/2013
12/31/2017
Sample Date
MW-28

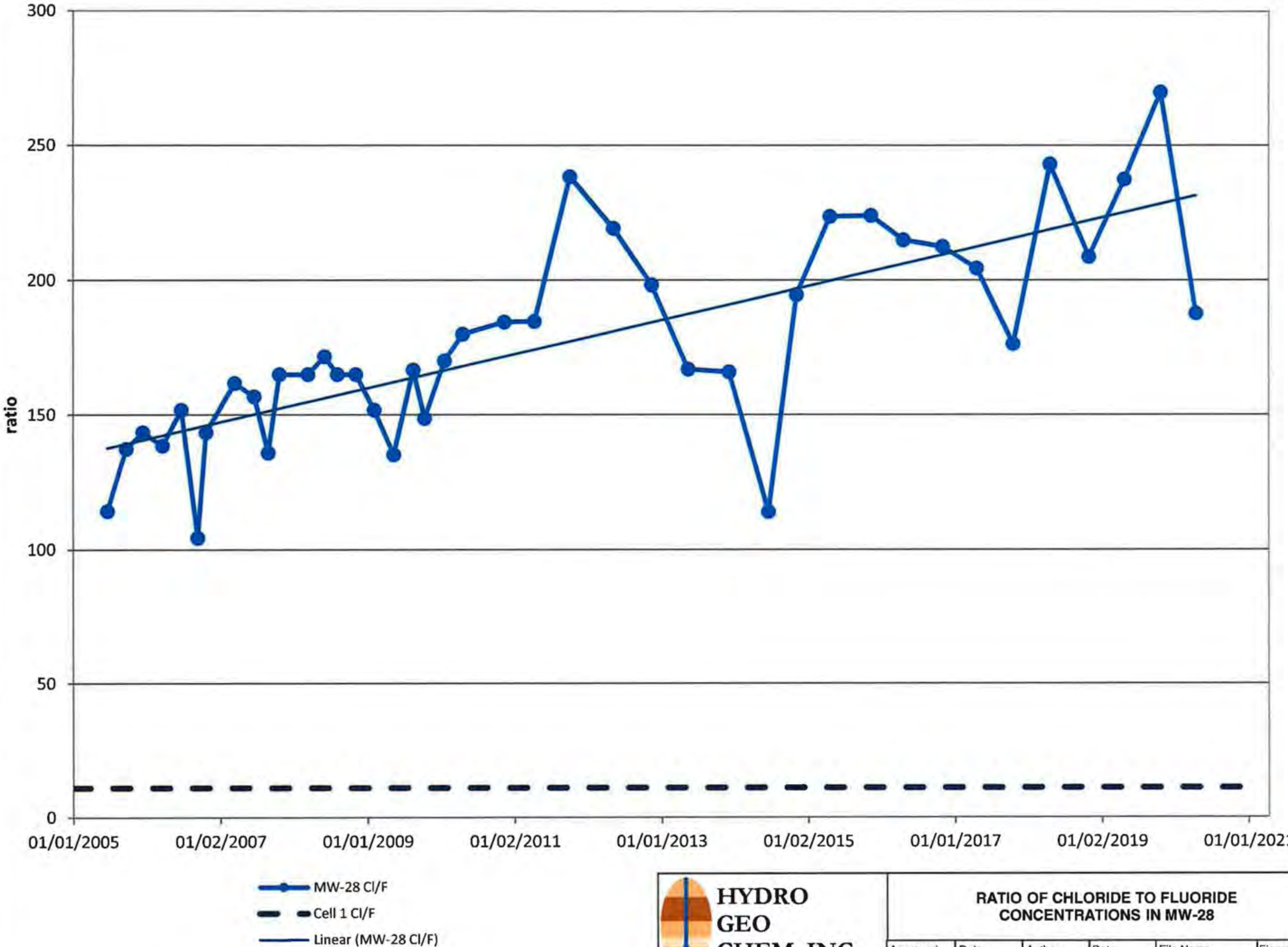


HYDRO GEO CHEM, INC.

pH AND BICARBONATE AT MW-28 SINCE 2015

Approved	Date	Author	Date	File Name	Figure
SJS	10/06/20	SJS	10/06/20	pH & bicarb	6

S:\Environmental\UT\WhiteMesaMill\Source Assessment Reports\MW-28 10.2020\Figures\MW28_SAR_Table_Figures_SJS.xlsx: Fig pH and bicarb

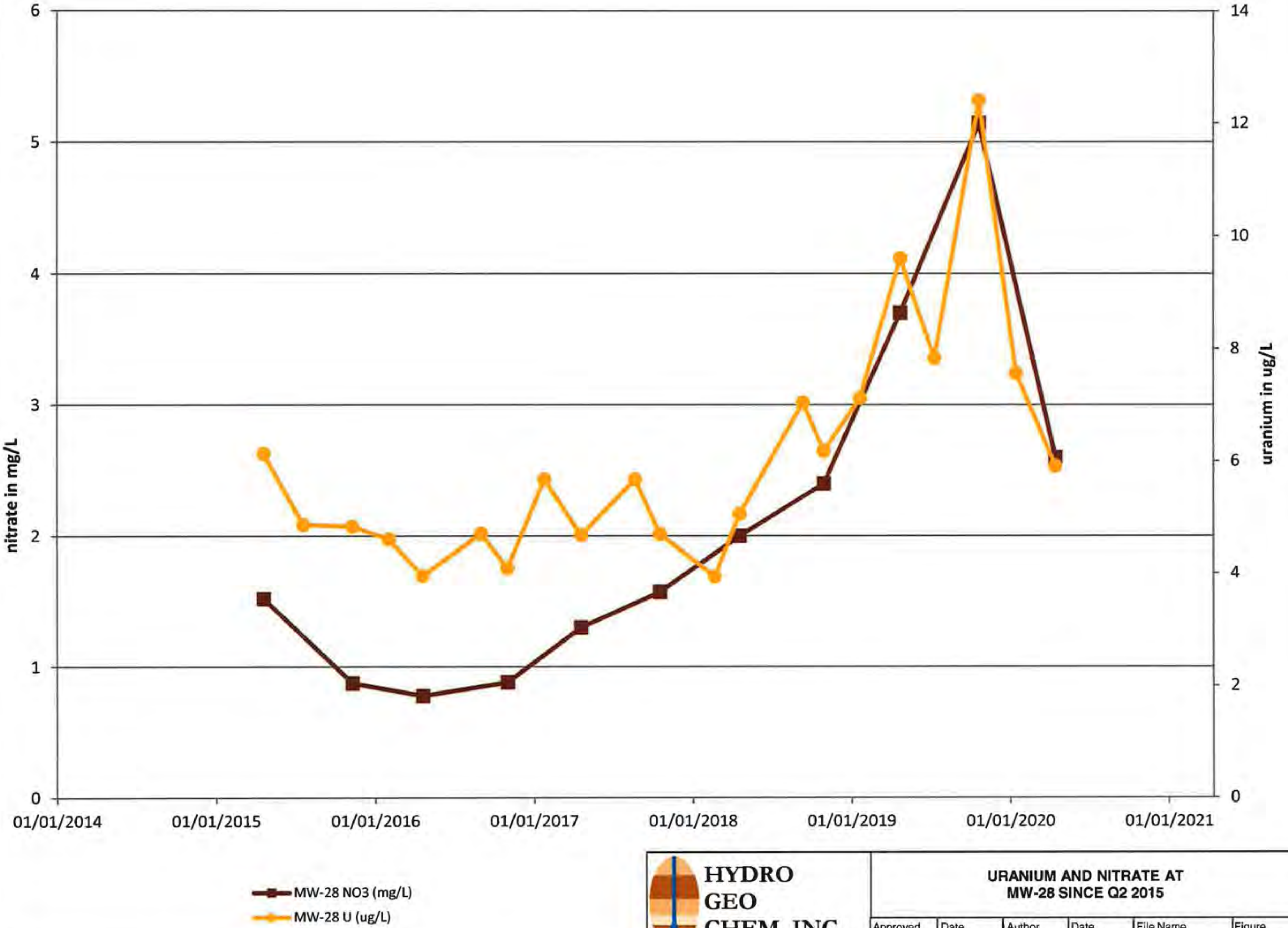


HYDRO GEO CHEM, INC.

RATIO OF CHLORIDE TO FLUORIDE CONCENTRATIONS IN MW-28

Approved	Date	Author	Date	File Name	Figure
SJS	10/06/20	SJS	10/06/20	Cl to F	7

S:\Environmental\UT\WhiteMesaMill\Source Assessment Reports\MW-28 10.2020\Figures\MW28_SAR_Table_Figures_SJS.xlsx: Fig Cl to F

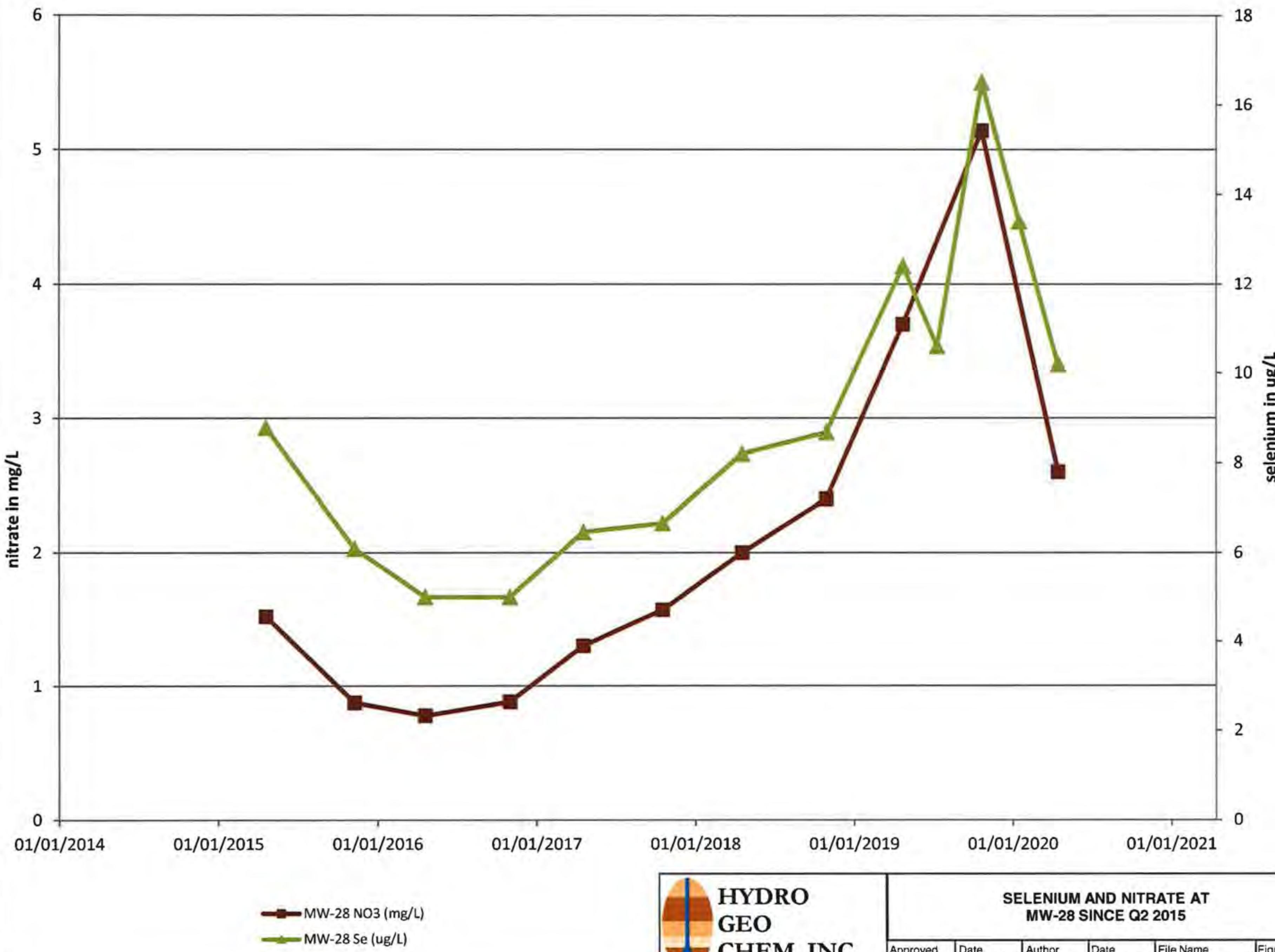


HYDRO GEO CHEM, INC.

URANIUM AND NITRATE AT MW-28 SINCE Q2 2015

Approved	Date	Author	Date	File Name	Figure
SJS	10/06/20	SJS	10/06/20	NO3 & U	8

S:\Environmental\UT\WhiteMesaMill\Source Assessment Reports\MW-28 10.2020\Figures\MW28_SAR_Table_Figures_SJS.xlsx: Fig NO3 and U



HYDRO GEO CHEM, INC.	SELENIUM AND NITRATE AT MW-28 SINCE Q2 2015					
	Approved SJS	Date 10/06/20	Author SJS	Date 10/06/20	File Name NO3 & Se	Figure 9

S:\Environmental\UT\WhiteMesaMill\Source Assessment Reports\MW-28 10.2020\Figures\MW28_SAR_Table_Figures_SJS.xlsx: Fig NO3 and Se

APPENDIX A

GWCL Exceedances for Fourth Quarter 2019 under the March 19, 2019 GWDP

Monitoring Well (Water Class)	Constituent Exceeding GWCL	GWCL in March 19, 2019 GWDP	Q2 2019 Sample Date	Q2 2019 Result	May 2019 Monthly Sample Date	May 2019 Monthly Result	June 2019 Monthly Sample Date	June 2019 Monthly Result	Q3 2019 Sample Date	Q3 2019 Result	August 2019 Monthly Sample Date	August 2019 Monthly Result	Sept. 2019 Monthly Sample Date	Sept. 2019 Monthly Result	Q4 2019 Sample Date	Q4 2019 Result	November 2019 Monthly Sample Date	November 2019 Monthly Result	December 2019 Monthly Sample Date	December 2019 Monthly Result
			Q2 2019 Results						Q3 2019 Results						Q4 2019 Results					
Required Quarterly Sampling Wells																				
MW-11 (Class II)	Chloride (mg/L)	39.16	4/24/2019	34	5/7/2019	NA	6/3/2019	NA	7/16/2019	**48.4**	8/5/2019	NA	9/24/2019	NA	10/15/2019	30.8	11/12/2019	39.1	12/3/2019	35.4
	Sulfate (mg/L)	1309		1160		NA		NA		**1410**		NA		NA		1290		1140		1100
	Manganese (ug/L)	164.67		**181**		**210**		**210**		**199**		**202**		**174**		**185**		**206**		**167**
MW-14 (Class III)	Fluoride (mg/L)	0.22	4/23/2019	<0.100	NS	NA	NS	NA	7/15/2019	**0.248**	NS	NA	NS	NA	10/9/2019	<0.100	11/13/2019	0.127	12/3/2019	0.120
	Sulfate (mg/L)	2330		1780		NA		NA		**2450**		NA		NA		2180		2110		2120
MW-25 (Class III)	Cadmium (ug/L)	1.5	4/10/2019	1.30	5/8/2019	1.41	6/4/2019	1.47	7/15/2019	1.23	8/6/2019	1.37	9/23/2019	1.38	10/9/2019	1.45	11/13/2019	1.36	12/4/2019	1.45
MW-26 (Class III)	Nitrate + Nitrite (as N) (mg/L)	0.62	4/24/2019	**3.00**	5/7/2019	**0.986**	6/4/2019	**3.16**	7/16/2019	**2.06**	8/6/2019	**3.10**	9/24/2019	**1.59**	10/9/2019	**2.35**	11/13/2019	**2.90**	12/4/2019	**2.32**
	Chloroform (ug/L)	70		**4140**		**1140**		**778**		**3110**		**1090**		**1540**		**1710**		**1280**		**1110**
	Chloride (mg/L)	58.31		**82.0**		**73.0**		**72.6**		**75.2**		**83.5**		**62.1**		**73.8**		**62.3**		57.7
	Methylene Chloride (ug/L)	5		4.16		1.69		<1.00		**10.7**		1.12		3.35		2.95		1.73		2.64
	Nitrogen, Ammonia as N	0.92		0.104		0.479		0.0919		0.357		0.164		0.496		0.273		0.178		0.207
MW-30 (Class II)	Nitrate + Nitrite (as N) (mg/L)	2.5	4/9/2019	**18.5**	5/7/2019	**17.9**	6/3/2019	**15.8**	7/16/2019	**19.3**	8/6/2019	**15.8**	9/24/2019	**17.9**	10/8/2019	**18.2**	11/13/2019	**17.2**	12/4/2019	**17.8**
	Chloride (mg/L)	128		**138**		**175**		**165**		**181**		**190**		**176**		**170**		**180**		**185**
	Selenium (ug/L)	47.2		**53.6**		47.1		**49.9**		**48.4**		**50.9**		**49.1**		**56.8**		**47.8**		**56.4**
	Uranium (ug/L)	8.32		**8.62**		8.15		**8.88**		**9.03**		**9.39**		8.12		**8.69**		**9.29**		**8.99**
	Field pH (S.U.)	6.47 - 8.5		7.06		7.00		7.12		6.86		7.42		7.00		7.16		7.21		7.22
MW-31 (Class III)	Nitrate + Nitrite (as N) (mg/L)	5	4/10/2019	**19.7**	5/7/2019	**18.9**	6/3/2019	**19.7**	7/15/2019	**19.8**	8/5/2019	**17.0**	9/23/2019	**19.5**	10/9/2019	**19.8**	11/12/2019	**18.8**	12/3/2019	**18.3**
	Sulfate (mg/L)	993		917		NA		NA		**1150**		NA		NA		**1010**		990		**1020**
	TDS (mg/L)	2132		2080		NA		NA		**2580**		NA		NA		**2280**		**2650**		2030
	Chloride (mg/L)	143		**294**		**346**		**325**		**374**		**372**		**365**		**318**		**338**		**343**
MW-36 (Class III)	Sulfate (mg/L)	3146.21	4/18/2019	2470	5/21/2019	NA	6/3/2019	NA	7/16/2019	**3170**	8/6/2019	NA	9/23/2019	NA	10/8/2019	2850	11/13/2019	2590	12/3/2019	2710
	Field pH (S.U.)	6.49 - 8.5		7.05		6.73		7.01		6.60		7.33		6.92		7.05		7.09		7.24
Required Semi-Annual Sampling Wells																				
MW-12 (Class III)	Uranium (ug/L)	23.5	4/25/2019	23.2	NS	NA	NS	NA	7/11/2019	23.1	NS	NA	NS	NA	10/23/2019	21.6	NS	NA	NS	NA
MW-24 (Class III)	Beryllium (ug/L)	2	5/2/2019	**2.83**	NS	NA	NS	NA	7/18/2019	**2.94**	NS	NA	NS	NA	11/6/2019	**3.25**	NS	NA	NS	NA
	Cadmium (ug/L)	6.43		**8.24**		NA		NA		**8.37**		NA		NA		**9.31**		NA		NA
	Fluoride (mg/L)	0.47		**0.839**		NA		NA		**0.996**		NA		NA		**0.667**		NA		NA
	Nickel (mg/L)	50		**63.9**		NA		NA		**70.6**		NA		NA		**75.4**		NA		NA
	Manganese (ug/L)	7507		7020		NA		NA		NA		NA		NA		**7700**		NA		NA
	Thallium (ug/L)	2.01		**2.73**		NA		NA		**2.61**		NA		NA		**2.88**		NA		NA
	Sulfate (mg/L)	2903		2790		NA		NA		NA		NA		NA		2630		NA		NA
	Field pH (S.U.)	5.03 - 8.5		**4.53**		NA		NA		5.03		NA		NA		5.19		NA		NA
MW-27 (Class III)	Nitrate + Nitrite (as N) (mg/L)	5.6	4/23/2019	**6.33**	NS	NA	NS	NA	7/12/2019 8/15/2019	**6.50**	NS	NA	NS	NA	10/22/2019	**6.27**	NS	NA	NS	NA
MW-28 (Class III)	Chloride (mg/L)	105	4/24/2019	**165**	NS	NA	NS	NA	7/12/2019 8/16/2019	**133**	NS	NA	NS	NA	10/22/2019	**149**	NS	NA	NS	NA
	Selenium (ug/L)	11.1		**12.4**		NA		NA		10.6		NA		NA		**16.5**		NA		NA
	Nitrate + Nitrite (as N) (mg/L)	5		3.7		NA		NA		NA		NA		NA		**5.14**		NA		NA
	Gross Alpha (pCi/L)	2.42		1.94		NA		NA		1.20		NA		NA		<1.00		NA		NA
	Uranium (ug/L)	4.9		**9.60**		NA		NA		**7.83**		NA		NA		**12.4**		NA		NA
MW-32 (Class III)	Chloride (mg/L)	35.39	4/9/2019	34.5	NS	NA	NS	NA	8/15/2019	**35.7**	NS	NA	NS	NA	10/8/2019	35.3	NS	NA	NS	NA
MW-35 (Class II)	Nitrogen, Ammonia as N	0.14	4/18/2019	0.0634	NS	NA	NS	NA	7/11/2019	0.0935	NS	NA	NS	NA	10/8/2019	<0.0500	NS	NA	NS	NA

Notes:

NS= Not Required and Not Sampled

NA= Not Applicable

Exceedances are shown in yellow

GWCL Exceedances for First Quarter 2020 under the March 19, 2019 GWDP

			Q1 2020 Results					
Monitoring Well (Water Class)	Constituent Exceeding GWCL	GWCL in March 19, 2019 GWDP	Q1 2020 Sample Date	Q1 2020 Result	February 2020 Monthly Sample Date	February 2020 Monthly Result	March 2020 Monthly Sample Date	March 2020 Monthly Result
Required Quarterly Sampling Wells								
MW-11 (Class II)	Chloride (mg/L)	39.16	1/15/2020 1/28/2020	38.9	2/4/2020	***42.1***	3/10/2020	***41.0***
	Sulfate (mg/L)	1309		1180		1260		1120
	Manganese (ug/L)	164.67		***169***		***227***		***183***
MW-14 (Class III)	Fluoride (mg/L)	0.22	1/15/2020	0.128	2/4/2020	0.145	3/10/2020	<0.100
	Sulfate (mg/L)	2330		2250		2190		2150
MW-25 (Class III)	Cadmium (ug/L)	1.5	1/15/2020	1.35	2/5/2020	***1.52***	3/11/2020	1.41
MW-26 (Class III)	Nitrate + Nitrite (as N) (mg/L)	0.62	1/15/2020	***0.873***	2/4/2020	***0.978***	3/10/2020	***1.60***
	Chloroform (ug/L)	70		***1260***		***1640***		***1720***
	Chloride (mg/L)	58.31		***78.8***		***66.9***		***76.9***
	Methylene Chloride (ug/L)	5		2.79		2.76		4.44
	Nitrogen, Ammonia as N	0.92		0.578		0.602		0.387
MW-30 (Class II)	Nitrate + Nitrite (as N) (mg/L)	2.5	1/15/2020	***16.4***	2/5/2020	***17.8***	3/11/2020	***19.0***
	Chloride (mg/L)	128		***182***		***187***		***182***
	Selenium (ug/L)	47.2		***49.7***		***49.9***		***48.1***
	Uranium (ug/L)	8.32		***8.88***		***9.06***		***9.50***
	Field pH (S.U.)	6.47 - 8.5		7.31		7.30		7.18
MW-31 (Class III)	Nitrate + Nitrite (as N) (mg/L)	5	1/14/2020	***17.5***	2/4/2020	***18.0***	3/10/2020	***19.2***
	Sulfate (mg/L)	993		***1120***		***1150***		***1080***
	TDS (mg/L)	2132		***2220***		***2240***		***2380***
	Chloride (mg/L)	143		***381***		***370***		***368***
MW-36 (Class III)	Sulfate (mg/L)	3146.21	1/14/2020	2660	2/5/2020	2540	3/10/2020	2890
	Field pH (S.U.)	6.49 - 8.5		7.01		7.18		7.24
Required Semi-Annual Sampling Wells								
MW-12 (Class III)	Uranium (ug/L)	23.5	1/16/2020	21.9	NS	NA	NS	NA
MW-24 (Class III)	Beryllium (ug/L)	2	1/22/2020	***2.07***	NS	NA	NS	NA
	Cadmium (ug/L)	6.43		***7.30***		NA		NA
	Fluoride (mg/L)	0.47		***0.805***		NA		NA
	Nickel (mg/L)	50		***68.1***		NA		NA
	Manganese (ug/L)	7507		7010		NA		NA
	Thallium (ug/L)	2.01		1.92		NA		NA
	Sulfate (mg/L)	2903		***2960***		NA		NA
	Field pH (S.U.)	5.03 - 8.5		6.01		NA		NA
MW-27 (Class III)	Nitrate + Nitrite (as N) (mg/L)	5.6	1/16/2020	***6.18***	NS	NA	NS	NA
MW-28 (Class III)	Chloride (mg/L)	105	1/16/2020	***151***	NS	NA	NS	NA
	Selenium (ug/L)	11.1		***13.4***		NA		NA
	Nitrate + Nitrite (as N) (mg/L)	5		NA		NA		NA
	Gross Alpha (pCi/L)	2.42		1.79		NA		NA
	Uranium (ug/L)	4.9		***7.56***		NA		NA
MW-32 (Class III)	Chloride (mg/L)	35.39	1/14/2020	***38.0***	NS	NA	NS	NA
MW-35 (Class II)	Nitrogen, Ammonia as N	0.14	1/16/2020	0.0919	NS	NA	NS	NA

Notes:

NS= Not Required and Not Sampled
NA= Not Applicable

Exceedances are shown in yellow

Pursuant to the DWMRC letter of February 24, 2020, these constituents will no longer be monitored on an accelerated schedule. These constituents will be dropped from this report after this quarter.

APPENDIX B

Appendix B-1: Summary of Statistical Analysis for Out of Compliance Constituents in MW-28

Well	Data Set	Constituent	Units	N	% Non-Detected Values	Mean	Standard Deviation	Shapiro-Wilk Test for Normality		Normally or Lognormally distributed?	Mann Kendall Trend Analysis		Linear Trend Analysis		Significant Trend	Previously Identified Increasing Trend?	Current GWCL[a]	Mean + 2σ	Mean x 1.5	Highest Historical Value (HHV)	Fractional Approach GWCL	Flowsheet GWCL	Rationale
								W	p		S	p	r^2	p									
MW-28	ALL 2020 SAR Data	Selenium	µg/L	44	0.432	6.98	NA	0.79	1.77E-06	Not Normal	254	3.54E-03	NA	NA	Increasing	No	11.10	NA	10.47	16.50	25	25	Fractional Approach
	GWCL Subset Post 2017		µg/L	10	0	10.86	3.52	0.95	6.78E-01	Normal	31	3.65E-03	0.68485	3.12E-03	Increasing	No	11.10	17.90	16.29	16.50	25	25	Fractional Approach
MW-28	ALL 2020 SAR Data	Uranium	µg/L	52	0	4.83	2.22	0.86	1.90E-05	Not Normal	695	0	NA	NA	Increasing	No	4.90	9.28	7.25	12.40	15	15	Fractional Approach
	GWCL Subset Post 2017		µg/L	14	0	7.11	2.59	0.96	7.25E-01	Normal	55	1.56E-03	0.51844	3.68E-03	Increasing	No	4.90	12.29	10.66	12.40	15	15	Fractional Approach

Notes:

σ = sigma
µg/L = micrograms per liter
N = number of valid data points

p = probability
W = Shapiro Wilk test value
S = Mann-Kendall statistic

r^2 = The measure of how well the trendline fits the data where r2=1 represents a perfect fit.
FA= Fraction of GWQS as defined in UAC R317-6
NA= Not Applicable

Distribution = Distribution as determined by the Shapiro-Wilk distribution test for constituents with % Detect > 50% and N>8
Mean = The arithmatic mean as determined for normally or log-normally distributed constituents with % Detect > 50%
Standard Deviation = The standard deviation as determined for normally or log-normally distributed constituents with % Detect > 85%
Highest Historical Value = The highest observed value for constituents with % Detect < 50%
Flowsheet GWCL does not take into account increasing trends
a = GWCL is based on the GWDP using 11 data points available at the time of the background report (INTERA, 2008)

ALL 2020 SAR Data = All data with extremes removed
GWCL Subset Post 2017 = All data post April 2017

INTERA

Appendix B-2: Comparison of Calculated and Measured TDS in MW-28

Date Sampled	Alkalinity (mg/L as HCO_3)	Calcium (mg/L)	Chloride (mg/L)	Potassium (mg/L)	Magnesium (mg/L)	Sodium (mg/L)	Sulfate (mg/L)	Measured TDS (mg/L)	Calculated TDS (mg/L)	Ratio
6/21/2005	155	452	80	11.6	148	302	2010	3720	3159	85%
9/22/2005	152	514	96	10.6	166	286	2310	3590	3535	98%
12/14/2005	165	532	86	12.5	203	303	2380	3770	3682	98%
3/22/2006	152	515	83	11.8	188	294	2320	3640	3564	98%
6/23/2006	174	491	91	11.9	167	276	2190	3540	3401	96%
9/12/2006	95	521	73	12.2	190	299	2380	3720	3570	96%
10/24/2006	156	518	86	12.1	184	294	2520	3600	3770	105%
3/15/2007	139	519	97	14.3	192	332	2340	3800	3633	96%
6/20/2007	151	521	94	12.4	188	291	2360	3770	3617	96%
8/28/2007	161	530	95	11.1	180	266	2440	3700	3683	100%
10/23/2007	162	538	99	11.4	184	282	2370	3600	3646	101%
3/12/2008	159	490	99	11.4	160	292	2310	3640	3521	97%
6/3/2008	149	514	103	11.1	167	303	2360	3580	3607	101%
8/6/2008	160	546	99	11.5	179	311	2340	3590	3647	102%
11/5/2008	154	546	99	12.0	176	312	2340	3650	3639	100%
2/4/2009	154	479	91	11.0	157	286	2340	3730	3518	94%
5/12/2009	156	483	81	10.2	162	289	2410	3620	3591	99%
8/17/2009	153	526	100	11.7	169	302	2360	3680	3622	98%
10/12/2009	158	512	104	11.4	168	308	2380	3710	3641	98%
1/19/2010	165	517	102	11.6	168	0.6	2340	3490	3304	95%
4/19/2010	158	500	108	11.4	163	303	2310	3670	3553	97%
11/12/2010	157	492	107	11.7	162	288	2290	3630	3508	97%
4/11/2011	155	513	109	11.9	167	310	2090	3690	3356	91%
10/5/2011	146	505	143	11.1	167	270	2340	3610	3582	99%
5/8/2012	160	522	114	12.9	177	298	2290	3820	3574	94%
11/14/2012	151	507	115	13.7	175	309	1710	3610	2981	83%
5/15/2013	156	487	102	11.4	163	338	2030	3480	3288	94%
12/4/2013	176	475	109	10.6	162	287	2270	3610	3489	97%
6/18/2014	293	554	114	12.5	180	313	2410	3680	3876	105%
11/5/2014	176	478	117	11.9	162	277	2250	3660	3472	95%
4/21/2015	183	531	125	12.0	186	329	2490	3370	3856	114%
11/10/2015	161	531	116	11.0	181	308	2440	3450	3748	109%
4/20/2016	151	506	121	11.2	175	296	2350	3540	3610	102%
11/1/2016	153	487	126	12.8	168	296	2280	3660	3522	96%
4/19/2017	151	485	120	12.6	168	308	1970	3450	3215	93%
10/18/2017	174	484	123	13.0	184	311	1960	3440	3249	94%
4/19/2018	153	532	138	12.9	180	313	2280	3460	3608	104%
10/30/2018	159	580	119	13.3	203	365	2040	3380	3479	103%
4/24/2019	181	574	165	12.9	198	380	2390	3500	3900	111%
10/22/2019	285	569	149	11.9	209	351	2420	3780	3995	106%
4/15/2020	181	538	129	12.9	190	344	2280	3520	3674	104%

INTERA

Appendix B-3: Charge Balance Calculations for Major Cations and Anions in MW-28

Well	Date	Calcium (meq/L)	Sodium (meq/L)	Magnesium (meq/L)	Potassium (meq/L)	Total Cation Charge (meq/L)	HCO_3 (meq/L)	Chloride (meq/L)	SO_4 (meq/L)	Total Anion Charge (meq/L)	Charge Balance Error
MW-28	6/21/2005	22.55	13.14	12.18	0.30	**48.16**	-2.54	-2.26	-41.85	**-46.65**	1.60%
MW-28	9/22/2005	25.65	12.44	13.66	0.27	**52.02**	-2.49	-2.71	-48.09	**-53.29**	-1.21%
MW-28	12/14/2005	26.55	13.18	16.70	0.32	**56.75**	-2.70	-2.43	-49.55	**-54.68**	1.85%
MW-28	3/22/2006	25.70	12.79	15.47	0.30	**54.26**	-2.49	-2.34	-48.30	**-53.14**	1.04%
MW-28	6/23/2006	24.50	12.01	13.74	0.30	**50.55**	-2.85	-2.57	-45.60	**-51.02**	-0.46%
MW-28	9/12/2006	26.00	13.01	15.63	0.31	**54.95**	-1.56	-2.06	-49.55	**-53.17**	1.65%
MW-28	10/24/2006	25.85	12.79	15.14	0.31	**54.08**	-2.56	-2.43	-52.47	**-57.45**	-3.02%
MW-28	3/15/2007	25.90	14.44	15.80	0.37	**56.50**	-2.28	-2.74	-48.72	**-53.73**	2.51%
MW-28	6/20/2007	26.00	12.66	15.47	0.32	**54.44**	-2.47	-2.65	-49.14	**-54.26**	0.16%
MW-28	8/28/2007	26.45	11.57	14.81	0.28	**53.11**	-2.64	-2.68	-50.80	**-56.12**	-2.76%
MW-28	10/23/2007	26.85	12.27	15.14	0.29	**54.54**	-2.65	-2.79	-49.34	**-54.79**	-0.23%
MW-28	3/12/2008	24.45	12.70	13.16	0.29	**50.61**	-2.61	-2.79	-48.09	**-53.49**	-2.77%
MW-28	6/3/2008	25.65	13.18	13.74	0.28	**52.85**	-2.44	-2.91	-49.14	**-54.48**	-1.52%
MW-28	8/6/2008	27.25	13.53	14.73	0.29	**55.79**	-2.62	-2.79	-48.72	**-54.13**	1.51%
MW-28	11/5/2008	27.25	13.57	14.48	0.31	**55.60**	-2.52	-2.79	-48.72	**-54.04**	1.43%
MW-28	2/4/2009	23.90	12.44	12.92	0.28	**49.54**	-2.52	-2.57	-48.72	**-53.81**	-4.13%
MW-28	5/12/2009	24.10	12.57	13.33	0.26	**50.26**	-2.56	-2.28	-50.18	**-55.02**	-4.52%
MW-28	8/17/2009	26.25	13.14	13.90	0.30	**53.59**	-2.51	-2.82	-49.14	**-54.46**	-0.81%
MW-28	10/12/2009	25.55	13.40	13.82	0.29	**53.06**	-2.59	-2.93	-49.55	**-55.08**	-1.86%
MW-28	1/19/2010	25.80	0.03	13.82	0.30	**39.94**	-2.70	-2.88	-48.72	**-54.30**	-15.24%
MW-28	4/19/2010	24.95	13.18	13.41	0.29	**51.83**	-2.59	-3.05	-48.09	**-53.73**	-1.80%
MW-28	11/12/2010	24.55	12.53	13.33	0.30	**50.71**	-2.57	-3.02	-47.68	**-53.27**	-2.47%
MW-28	4/11/2011	25.60	13.48	13.74	0.30	**53.13**	-2.54	-3.07	-43.51	**-49.13**	3.91%
MW-28	10/5/2011	25.20	11.74	13.74	0.28	**50.97**	-2.39	-4.03	-48.72	**-55.15**	-3.94%
MW-28	5/8/2012	26.05	12.96	14.56	0.33	**53.90**	-2.62	-3.22	-47.68	**-53.52**	0.36%
MW-28	11/14/2012	25.30	13.44	14.40	0.35	**53.49**	-2.48	-3.24	-35.60	**-41.33**	12.83%
MW-28	5/15/2013	24.30	14.70	13.41	0.29	**52.71**	-2.56	-2.88	-42.27	**-47.70**	4.98%
MW-28	12/4/2013	23.70	12.48	13.33	0.27	**49.79**	-2.88	-3.07	-47.26	**-53.22**	-3.33%
MW-28	6/18/2014	27.64	13.61	14.81	0.32	**56.39**	-4.80	-3.22	-50.18	**-58.19**	-1.57%
MW-28	11/5/2014	23.85	12.05	13.33	0.30	**49.53**	-2.88	-3.30	-46.85	**-53.03**	-3.40%
MW-28	4/21/2015	26.50	14.31	15.30	0.31	**56.42**	-3.00	-3.53	-51.84	**-58.37**	-1.70%
MW-28	11/10/2015	26.50	13.40	14.89	0.28	**55.07**	-2.64	-3.27	-50.80	**-56.71**	-1.47%
MW-28	04/20/2016	25.25	12.88	14.40	0.29	**52.81**	-2.48	-3.41	-48.93	**-54.82**	-1.87%
MW-28	11/1/2016	24.30	12.88	13.82	0.33	**51.33**	-2.50	-3.55	-47.47	**-53.52**	-2.10%
MW-28	4/19/2017	24.20	13.40	13.82	0.32	**51.74**	-2.48	-3.39	-41.02	**-46.88**	4.93%
MW-28	10/18/2017	24.15	13.53	15.14	0.33	**53.15**	-2.86	-3.47	-40.81	**-47.14**	6.00%
MW-28	4/19/2018	26.55	13.61	14.81	0.33	**55.30**	-2.50	-3.89	-47.47	**-53.86**	1.32%
MW-28	10/30/2018	28.94	15.88	16.70	0.34	**61.86**	-2.60	-3.36	-42.47	**-48.43**	12.18%
MW-28	4/24/2019	28.64	16.53	16.29	0.33	**61.79**	-2.96	-4.65	-49.76	**-57.37**	3.71%
MW-28	10/22/2019	28.39	15.27	17.19	0.30	**61.16**	-4.68	-4.20	-50.39	**-59.27**	1.57%
MW-28	4/15/2020	26.85	14.96	15.63	0.33	**57.77**	-2.96	-3.64	-47.47	**-54.07**	3.31%

meq/L = milliequivalent per liter

HCO_3 = Bicarbonate

SO_4 = Sulfate

Appendix B-4: Descriptive Statistics for Out of Compliance Constituents in MW-28

Data Set	Analyte	Units	% Non-Detects	N	Distribution	Mean	Min. Conc.	Max. Conc.	Std. Dev.	Range	Geometric Mean	Skewness	Q25	Median	Q75
2008 Background Report	Selenium	µg/L	0.273	11	Normal	5.4	2.5	8.0	2.1	5.5	5.0	-0.4	2.5	5.5	7.6
2020 SAR	Selenium	µg/L	0.432	44	Not Normal	6.98	5	16.5	2.9	11.5	6.5	1.8	5.0	5.6	7.8
2008 Background Report	Uranium	µg/L	0	11	Normal	3.7	2.7	4.9	0.6	2.2	3.6	0.8	3.4	3.5	3.9
2020 SAR	Uranium	µg/L	0	52	Not Normal	4.8	2.7	12.4	2.2	9.7	4.5	1.98	3.4	3.9	5.2

µg/L = micrograms per liter
N = number of valid data points

Appendix B-5: MW-28 Data Used for Analysis

Well	Date Sampled	Parameter Name	Report Result	Report Units	Qualifier
MW-28	6/21/2005	Selenium	6	ug/l	
MW-28	9/22/2005	Selenium	5	ug/l	U
MW-28	12/14/2005	Selenium	8	ug/l	
MW-28	3/22/2006	Selenium	8	ug/l	
MW-28	6/23/2006	Selenium	5	ug/l	U
MW-28	9/12/2006	Selenium	8	ug/l	
MW-28	10/24/2006	Selenium	7	ug/l	
MW-28	3/15/2007	Selenium	5	ug/l	U
MW-28	6/20/2007	Selenium	6	ug/l	
MW-28	8/28/2007	Selenium	5	ug/l	
MW-28	10/23/2007	Selenium	5	ug/l	
MW-28	3/12/2008	Selenium	5	ug/l	U
MW-28	6/3/2008	Selenium	5	ug/l	U
MW-28	8/6/2008	Selenium	5	ug/l	U
MW-28	11/5/2008	Selenium	5	ug/l	U
MW-28	2/4/2009	Selenium	11	ug/l	
MW-28	5/12/2009	Selenium	6	ug/l	
MW-28	8/17/2009	Selenium	5	ug/l	U
MW-28	10/12/2009	Selenium	5	ug/l	U
MW-28	1/19/2010	Selenium	5	ug/l	U
MW-28	4/19/2010	Selenium	7	ug/l	
MW-28	11/12/2010	Selenium	5	ug/l	U
MW-28	4/11/2011	Selenium	7	ug/l	
MW-28	10/5/2011	Selenium	5	ug/l	U
MW-28	5/8/2012	Selenium	5	ug/l	U
MW-28	11/14/2012	Selenium	5	ug/l	U
MW-28	5/15/2013	Selenium	5	ug/l	U
MW-28	12/4/2013	Selenium	5	ug/l	U
MW-28	6/18/2014	Selenium	6	ug/l	
MW-28	11/5/2014	Selenium	5	ug/l	U
MW-28	4/21/2015	Selenium	9	ug/l	
MW-28	11/10/2015	Selenium	6	ug/l	
MW-28	4/20/2016	Selenium	5	ug/l	U
MW-28	11/1/2016	Selenium	5	ug/l	U
MW-28	4/19/2017	Selenium	6	ug/l	
MW-28	10/18/2017	Selenium	7	ug/l	
MW-28	4/19/2018	Selenium	8	ug/l	
MW-28	10/30/2018	Selenium	9	ug/l	
MW-28	4/24/2019	Selenium	12	ug/l	
MW-28	7/12/2019	Selenium	11	ug/l	
MW-28	10/22/2019	Selenium	17	ug/l	
MW-28	1/16/2020	Selenium	13	ug/l	
MW-28	4/15/2020	Selenium	10	ug/l	
MW-28	7/8/2020	Selenium	16	ug/l	
MW-28	6/21/2005	Uranium	3	ug/l	

Appendix B-5: MW-28 Data Used for Analysis

Well	Date Sampled	Parameter Name	Report Result	Report Units	Qualifier
MW-28	9/22/2005	Uranium	4	ug/l	
MW-28	12/14/2005	Uranium	3	ug/l	
MW-28	3/22/2006	Uranium	4	ug/l	
MW-28	6/23/2006	Uranium	5	ug/l	
MW-28	9/12/2006	Uranium	3	ug/l	
MW-28	10/24/2006	Uranium	3	ug/l	
MW-28	3/15/2007	Uranium	3	ug/l	
MW-28	6/20/2007	Uranium	5	ug/l	
MW-28	8/28/2007	Uranium	4	ug/l	
MW-28	10/23/2007	Uranium	3	ug/l	
MW-28	3/12/2008	Uranium	3	ug/l	
MW-28	6/3/2008	Uranium	3	ug/l	
MW-28	8/6/2008	Uranium	3	ug/l	
MW-28	11/5/2008	Uranium	4	ug/l	
MW-28	2/4/2009	Uranium	3	ug/l	
MW-28	5/12/2009	Uranium	3	ug/l	
MW-28	8/17/2009	Uranium	3	ug/l	
MW-28	10/12/2009	Uranium	3	ug/l	
MW-28	1/19/2010	Uranium	4	ug/l	
MW-28	4/19/2010	Uranium	3	ug/l	
MW-28	11/12/2010	Uranium	3	ug/l	
MW-28	4/11/2011	Uranium	3	ug/l	
MW-28	10/5/2011	Uranium	3	ug/l	
MW-28	5/8/2012	Uranium	3	ug/l	
MW-28	11/14/2012	Uranium	3	ug/l	
MW-28	5/15/2013	Uranium	4	ug/l	
MW-28	12/4/2013	Uranium	3	ug/l	
MW-28	9/16/2014	Uranium	11	ug/l	
MW-28	2/9/2015	Uranium	4	ug/l	
MW-28	4/21/2015	Uranium	6	ug/l	
MW-28	7/21/2015	Uranium	5	ug/l	
MW-28	11/10/2015	Uranium	5	ug/l	
MW-28	2/2/2016	Uranium	5	ug/l	
MW-28	4/20/2016	Uranium	4	ug/l	
MW-28	9/1/2016	Uranium	5	ug/l	
MW-28	11/1/2016	Uranium	4	ug/l	
MW-28	1/25/2017	Uranium	6	ug/l	
MW-28	4/19/2017	Uranium	5	ug/l	
MW-28	8/22/2017	Uranium	6	ug/l	
MW-28	10/18/2017	Uranium	5	ug/l	
MW-28	2/21/2018	Uranium	4	ug/l	
MW-28	4/19/2018	Uranium	5	ug/l	
MW-28	9/12/2018	Uranium	7	ug/l	
MW-28	10/30/2018	Uranium	6	ug/l	
MW-28	1/22/2019	Uranium	7	ug/l	

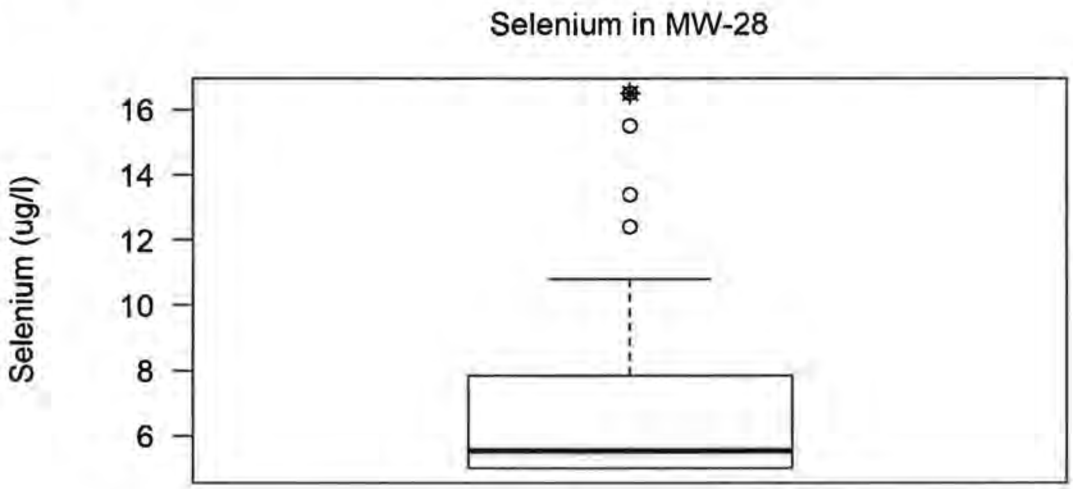
Appendix B-5: MW-28 Data Used for Analysis

Well	Date Sampled	Parameter Name	Report Result	Report Units	Qualifier
MW-28	4/24/2019	Uranium	10	ug/l	
MW-28	7/12/2019	Uranium	8	ug/l	
MW-28	10/22/2019	Uranium	12	ug/l	
MW-28	1/16/2020	Uranium	8	ug/l	
MW-28	4/15/2020	Uranium	6	ug/l	
MW-28	7/8/2020	Uranium	12	ug/l	

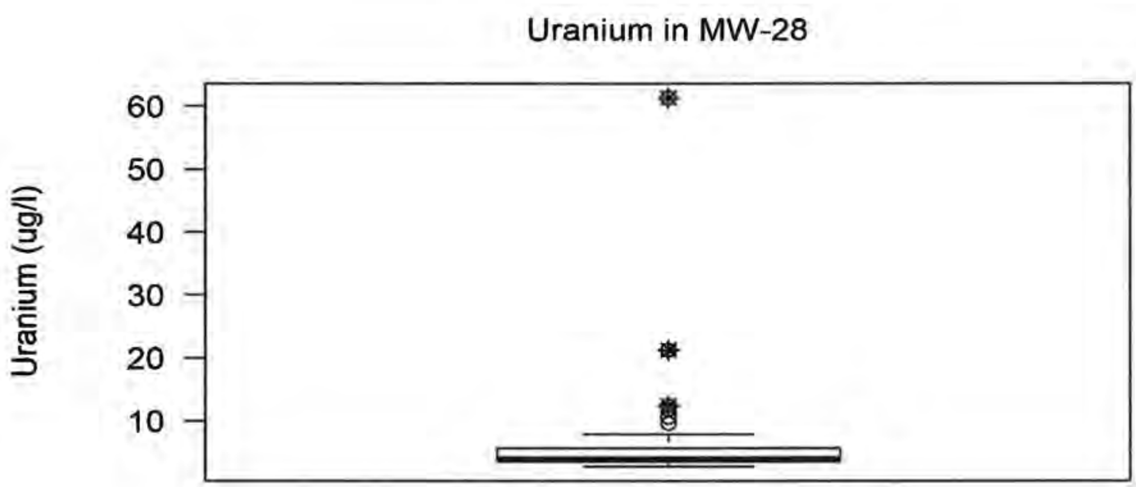
Appendix B-6: Extreme Outlier Status for Use in Analysis

Reason	Location ID	Date Sampled	Parameter Name	Report Result	Report Units
Removed					
Extreme (High)	MW-28	6/18/2014	Uranium	61.3	ug/l
Extreme (High)	MW-28	11/5/2014	Uranium	21.2	ug/l
Included in Analysis					
Extreme (High), Identified as part of an incr	MW-28	10/22/2019	Uranium	12.4	ug/l
Extreme (High), Identified as part of an incr	MW-28	10/22/2019	Selenium	16.5	ug/l

Appendix B-7: Box Plots

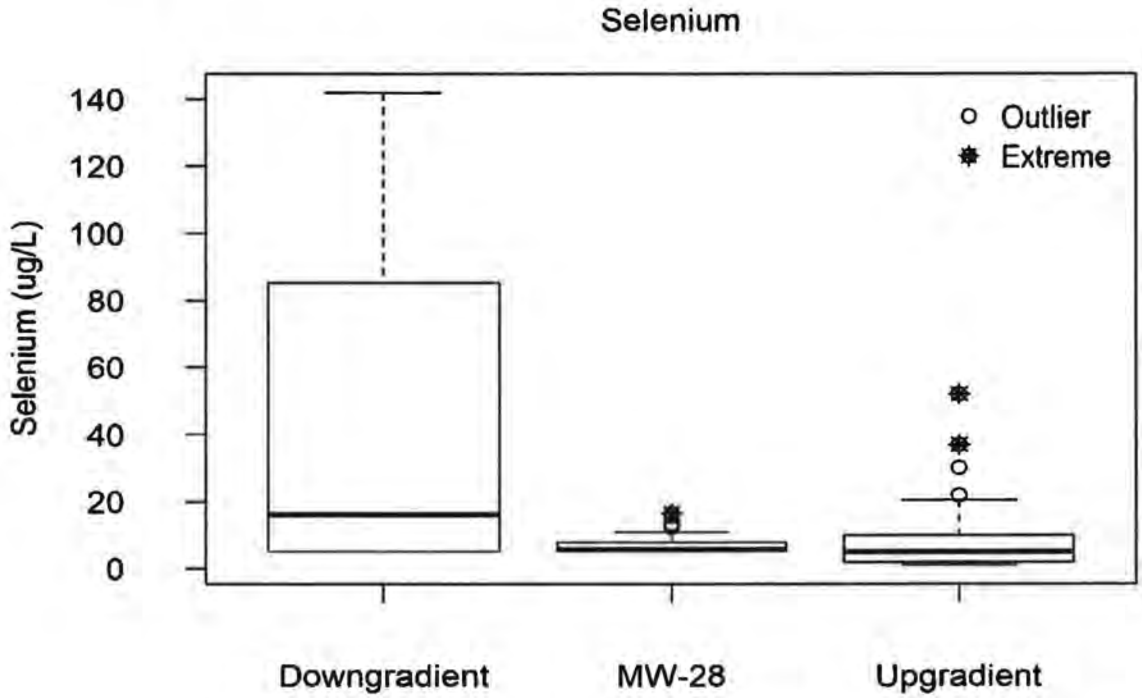


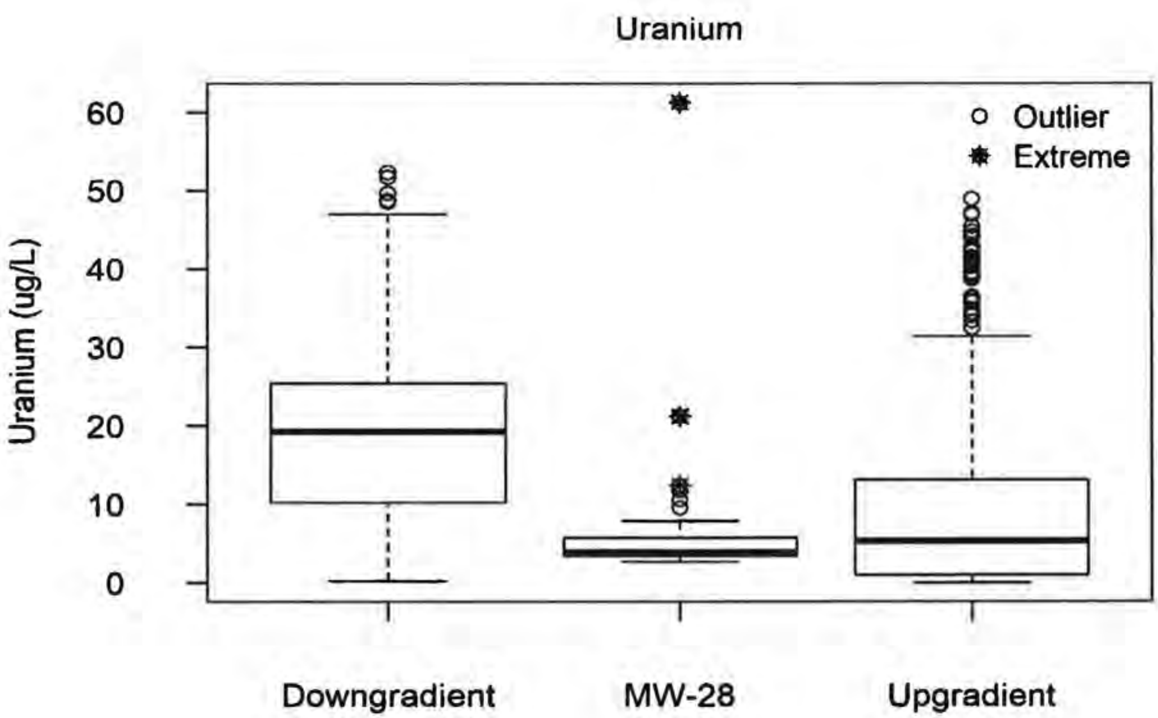
Percent nondetect: 43%
Min: 5, Mean: 6.98, Max: 16.5, Std Dev: 2.93
Upper extreme threshold (Q75 + 3xH): 16.1
Lower extreme threshold (Q25 - 3xH): -3.325



Percent nondetect: 0%
Min: 2.69, Mean: 6.18, Max: 61.3, Std Dev: 8.25
Upper extreme threshold (Q75 + 3xH): 12.3925
Lower extreme threshold (Q25 - 3xH): -3.27

Appendix B-8: Box Plots for MW-28 and Upgradient and Downgradient Wells





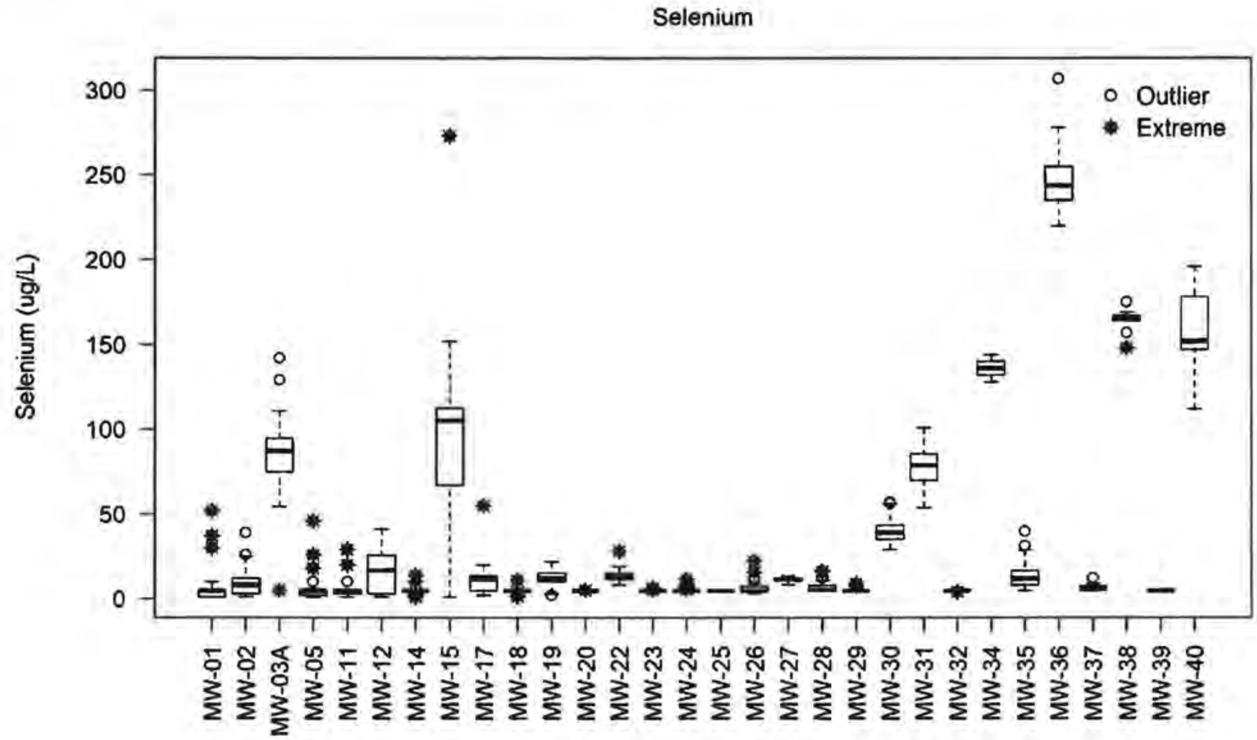
Notes

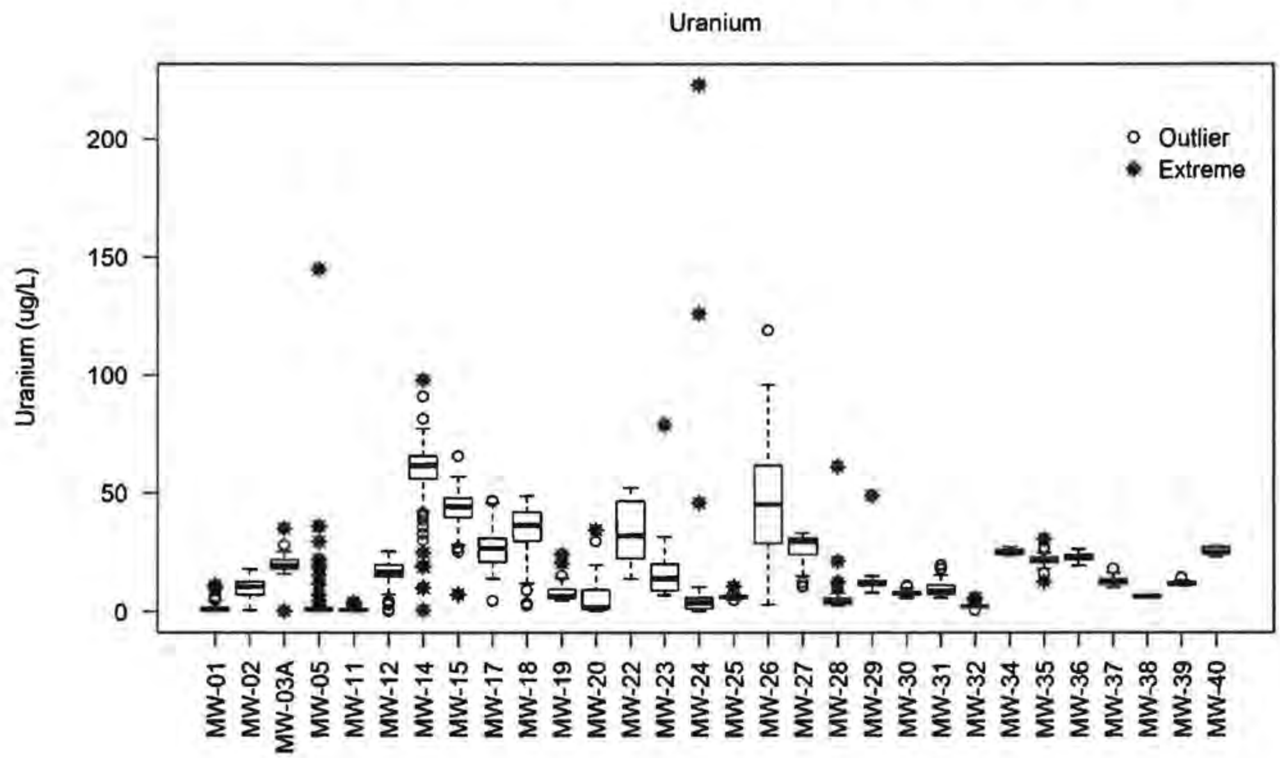
All available data used in box plots

Downgradient wells: MW-3A, MW-20, and MW-22.

Upgradient wells: MW-1, MW-18, and MW-19

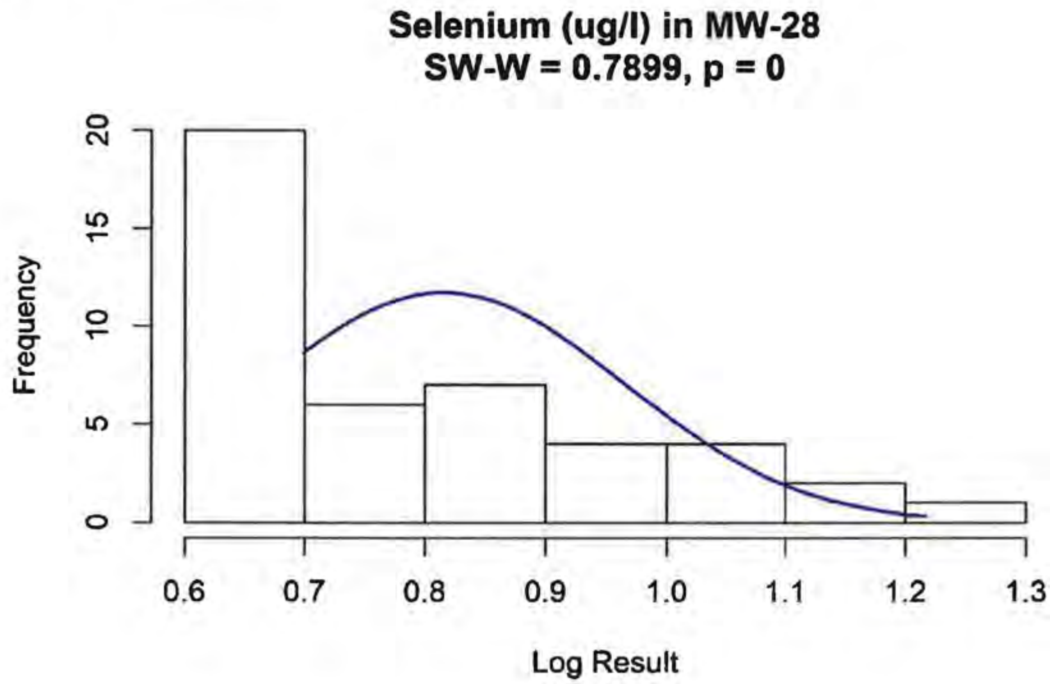
Appendix B-9: Box Plots for SAR Parameters in Groundwater Monitoring Wells

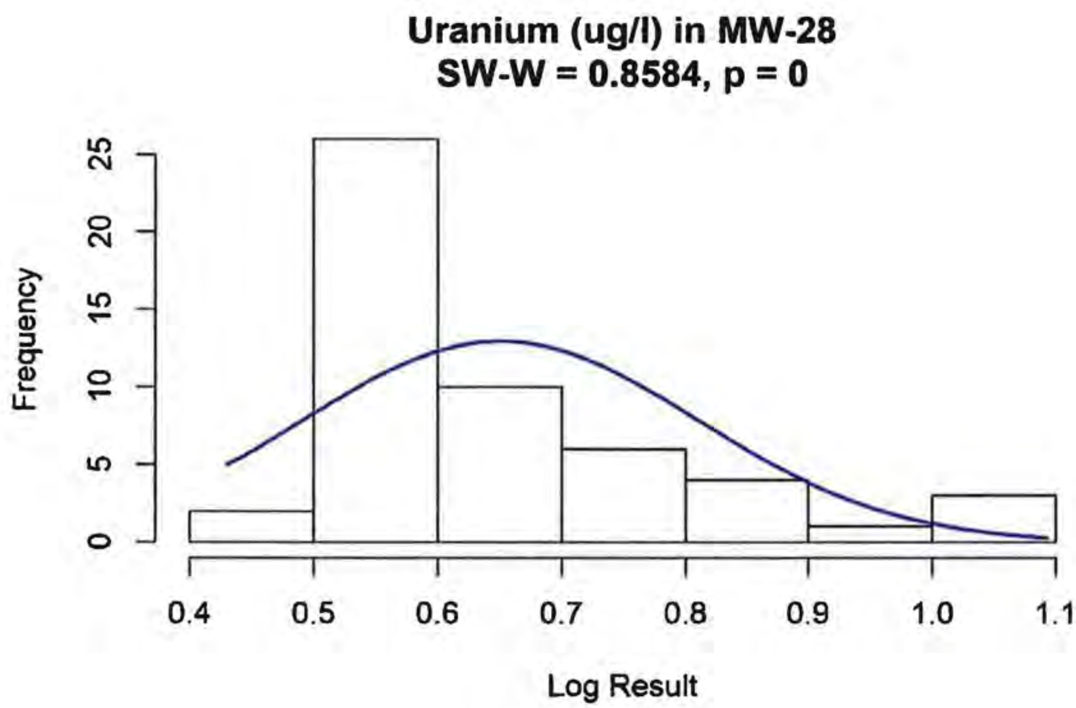




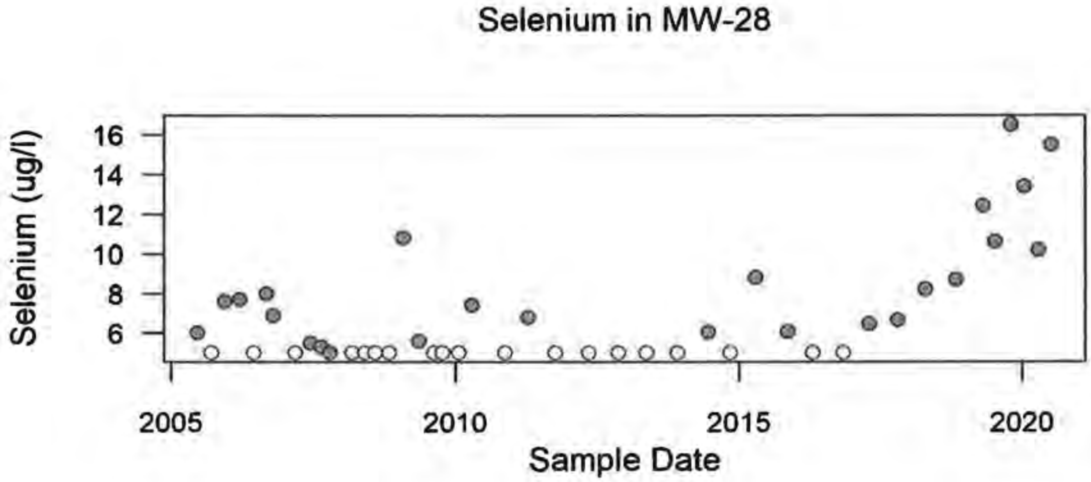
Notes
All available data used in box plots

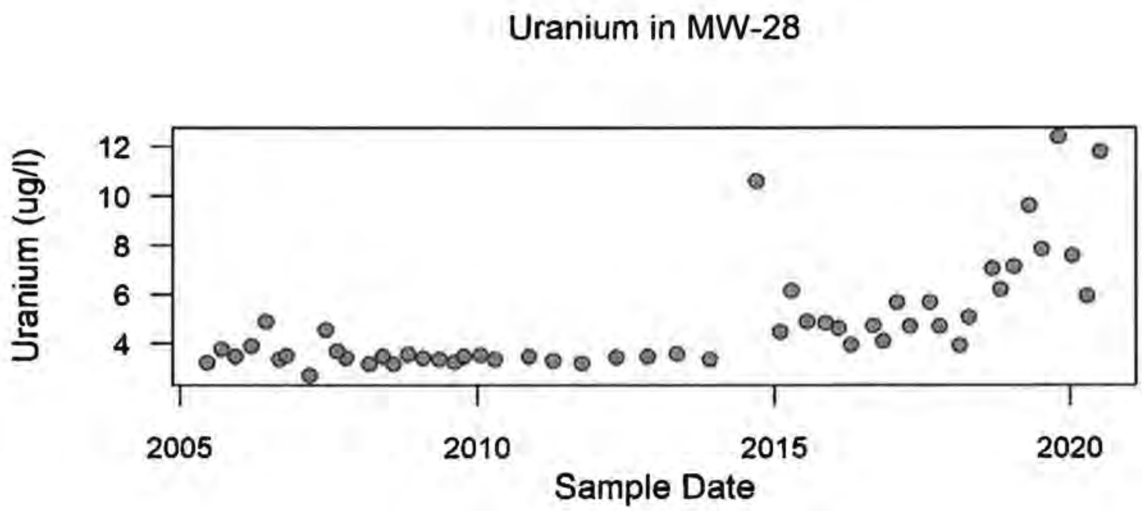
Appendix B-10: Histograms



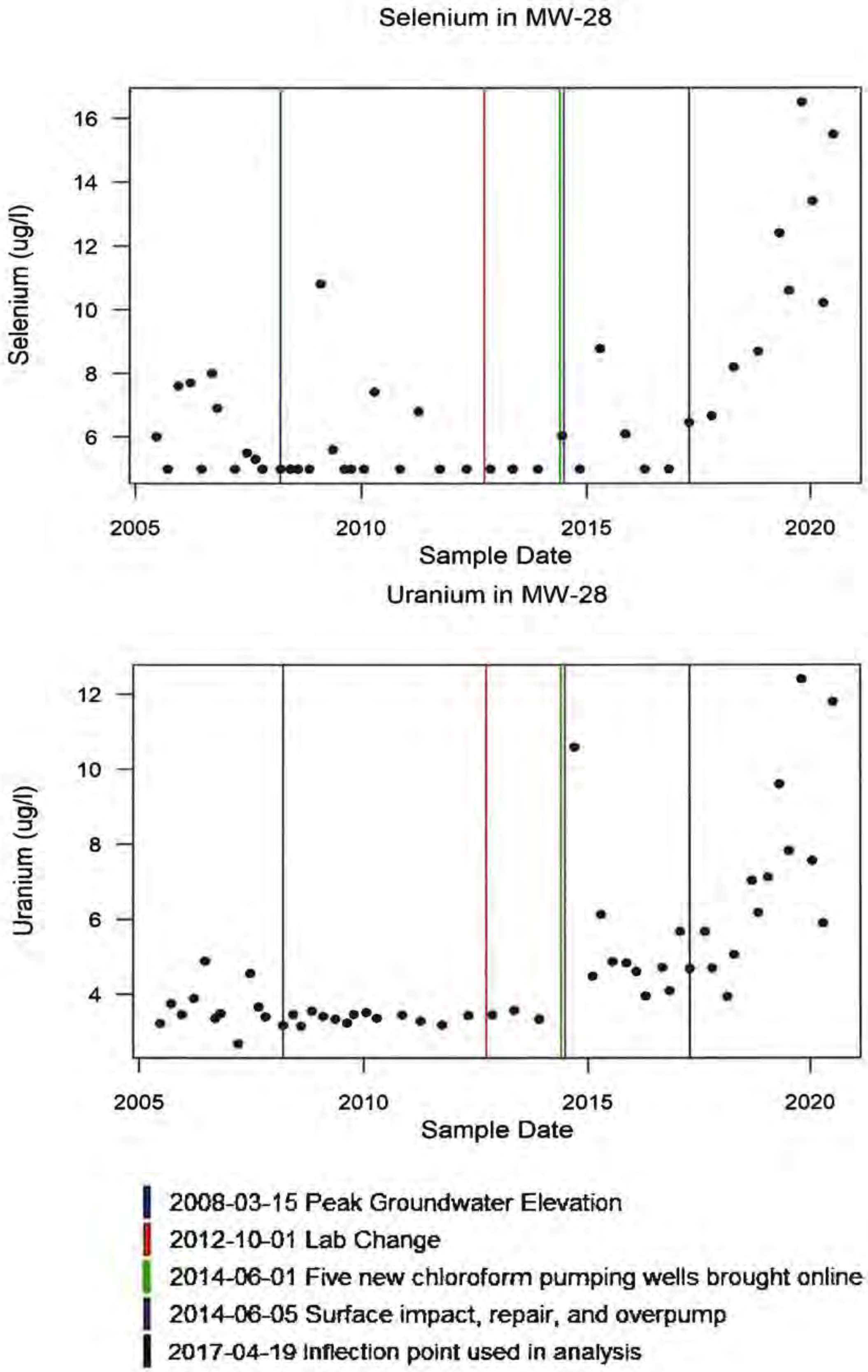


Appendix B-11: Timeseries Plots





Appendix B-12: Timeseries Plots with Events



APPENDIX C

Appendix C-1: Summary of Statistical Analysis for Indicator Parameters in MW-28

Well	Constituent	N	% Non-Detected Values	Mean	Standard Deviation	Shapiro-Wilk Test for Normality		Normally or Lognormally distributed?	Least Squares Regression Trend Analysis[a]		Mann-Kendall Trend Analysis[b]		Background Report Significant Trend?	2020 Significant Trend
						W	p		r^2	p	S	p		
MW-28	Chloride (mg/L)	62	0	113	18.8	0.9949	0.9966	Normal	0.77	1.5E-20	1453	0	No	Increasing
MW-28	Fluoride (mg/L)	40	0	0.608	0.05	0.9614	0.1872	Normal	0.02	3.4E-01	-158	3.34E-02	No	No
MW-28	Sulfate (mg/L)	41	0	2285.1	163.3	0.7952	4.34E-06	Not Normal	NA	NA	-126	7.96E-02	No	No
MW-28	Uranium (µg/L)	52	0	4.83	2.22	0.8584	1.90E-05	Not Normal	NA	NA	695	0	No	Increasing

Notes:

σ = sigma
%ND = percent of non-detected values
µg/L = micrograms per liter
mg/L = milligrams per liter

N = number of valid data points
p = probability
W = Shapiro-Wilk test value
r^2 = The measure of how well the trendline fits the data where r2=1 represents a perfect fit.

S = Mann-Kendall statistic

a = A regression test was performed on data that was determined to have normal or log-normal distribution

b = The Mann-Kendall test was performed on data that are not normally or lognormally distributed

Appendix C-2: Descriptive Statistics of Indicator Parameters in MW-28

Data Set	2008 Background Report				2020 SAR			
Analyte	Chloride	Fluoride	Sulfate	Uranium	Chloride	Fluoride	Sulfate	Uranium
Units	mg/L	mg/L	mg/L	ug/L	mg/L	mg/L	mg/L	ug/L
% Non-Detects	0	0	0	0	0	0	0	0
N	11	11	11	11	62	40	41	52
Normally or Lognormallly Distributed?	Normal	Normal	Normal	Normal	Normal	Normal	Not Normal	Not Normal
Mean	89	0.6	2329	3.7	113	0.6	2285	4.8
Min. Conc.	73	0.6	2010	2.7	73	0.5	1710	2.7
Max. Conc.	99	0.7	2520	4.9	165	0.7	2520	12.4
Std. Dev.	8	0.0	134	0.6	19	0.0	163	2.2
Range	26	0.1	510	2.2	92	0.2	810	9.7
Geometric Mean	89	0.6	2325	3.6	111	0.6	2279	4.5
Skewness	-0.7	-0.8	-1.4	0.8	0.4	0.3	-1.7	2.0
25th Quartile	83	0.6	2310	3.4	99	0.6	2280	3.4
Median	91	0.6	2360	3.5	111	0.6	2340	3.9
75th Quartile	96	0.7	2380	3.9	125	0.6	2380	5.2

Well	Sample Date	Parameter	Result	Units	Qualifier
MW-28	6/21/2005	Chloride	80	mg/l	
MW-28	9/22/2005	Chloride	96	mg/l	
MW-28	12/14/2005	Chloride	86	mg/l	
MW-28	3/22/2006	Chloride	83	mg/l	
MW-28	6/23/2006	Chloride	91	mg/l	
MW-28	9/12/2006	Chloride	73	mg/l	
MW-28	10/24/2006	Chloride	86	mg/l	
MW-28	3/15/2007	Chloride	97	mg/l	
MW-28	6/20/2007	Chloride	94	mg/l	
MW-28	8/28/2007	Chloride	95	mg/l	
MW-28	10/23/2007	Chloride	99	mg/l	
MW-28	3/12/2008	Chloride	99	mg/l	
MW-28	6/3/2008	Chloride	103	mg/l	
MW-28	8/6/2008	Chloride	99	mg/l	
MW-28	11/5/2008	Chloride	99	mg/l	
MW-28	2/4/2009	Chloride	91	mg/l	
MW-28	5/12/2009	Chloride	81	mg/l	
MW-28	8/17/2009	Chloride	100	mg/l	
MW-28	10/12/2009	Chloride	104	mg/l	
MW-28	1/19/2010	Chloride	102	mg/l	
MW-28	4/19/2010	Chloride	108	mg/l	
MW-28	9/14/2010	Chloride	106	mg/l	
MW-28	11/12/2010	Chloride	107	mg/l	
MW-28	2/14/2011	Chloride	114	mg/l	
MW-28	4/11/2011	Chloride	109	mg/l	
MW-28	8/8/2011	Chloride	105	mg/l	
MW-28	10/5/2011	Chloride	143	mg/l	
MW-28	2/28/2012	Chloride	109	mg/l	
MW-28	5/8/2012	Chloride	114	mg/l	
MW-28	7/16/2012	Chloride	105	mg/l	D
MW-28	11/14/2012	Chloride	115	mg/l	
MW-28	3/5/2013	Chloride	110	mg/l	
MW-28	5/15/2013	Chloride	102	mg/l	
MW-28	7/17/2013	Chloride	107	mg/l	
MW-28	12/4/2013	Chloride	109	mg/l	
MW-28	2/26/2014	Chloride	113	mg/l	
MW-28	6/18/2014	Chloride	114	mg/l	
MW-28	9/16/2014	Chloride	112	mg/l	
MW-28	11/5/2014	Chloride	117	mg/l	
MW-28	2/9/2015	Chloride	130	mg/l	
MW-28	4/21/2015	Chloride	125	mg/l	
MW-28	7/21/2015	Chloride	113	mg/l	
MW-28	11/10/2015	Chloride	116	mg/l	
MW-28	2/2/2016	Chloride	130	mg/l	
MW-28	4/20/2016	Chloride	121	mg/l	

Well	Sample Date	Parameter	Result	Units	Qualifier
MW-28	9/1/2016	Chloride	127	mg/l	
MW-28	11/1/2016	Chloride	126	mg/l	
MW-28	1/25/2017	Chloride	131	mg/l	
MW-28	4/19/2017	Chloride	120	mg/l	
MW-28	8/22/2017	Chloride	125	mg/l	
MW-28	10/18/2017	Chloride	123	mg/l	
MW-28	2/21/2018	Chloride	121	mg/l	
MW-28	4/19/2018	Chloride	138	mg/l	
MW-28	9/12/2018	Chloride	148	mg/l	
MW-28	10/30/2018	Chloride	119	mg/l	
MW-28	1/22/2019	Chloride	127	mg/l	
MW-28	4/24/2019	Chloride	165	mg/l	
MW-28	8/16/2019	Chloride	133	mg/l	
MW-28	10/22/2019	Chloride	149	mg/l	
MW-28	1/16/2020	Chloride	151	mg/l	
MW-28	4/15/2020	Chloride	129	mg/l	
MW-28	7/8/2020	Chloride	140	mg/l	
MW-28	6/21/2005	Fluoride	0.69	mg/l	
MW-28	9/22/2005	Fluoride	0.67	mg/l	
MW-28	12/14/2005	Fluoride	0.55	mg/l	
MW-28	3/22/2006	Fluoride	0.65	mg/l	
MW-28	6/23/2006	Fluoride	0.64	mg/l	
MW-28	9/12/2006	Fluoride	0.66	mg/l	
MW-28	10/24/2006	Fluoride	0.57	mg/l	
MW-28	3/15/2007	Fluoride	0.63	mg/l	
MW-28	6/20/2007	Fluoride	0.64	mg/l	
MW-28	8/28/2007	Fluoride	0.67	mg/l	
MW-28	10/23/2007	Fluoride	0.57	mg/l	
MW-28	3/12/2008	Fluoride	0.59	mg/l	
MW-28	6/3/2008	Fluoride	0.63	mg/l	
MW-28	8/6/2008	Fluoride	0.57	mg/l	
MW-28	11/5/2008	Fluoride	0.59	mg/l	
MW-28	2/4/2009	Fluoride	0.60	mg/l	
MW-28	5/12/2009	Fluoride	0.61	mg/l	
MW-28	8/17/2009	Fluoride	0.60	mg/l	
MW-28	10/12/2009	Fluoride	0.67	mg/l	
MW-28	1/19/2010	Fluoride	0.60	mg/l	
MW-28	4/19/2010	Fluoride	0.60	mg/l	
MW-28	11/12/2010	Fluoride	0.58	mg/l	
MW-28	4/11/2011	Fluoride	0.59	mg/l	
MW-28	10/5/2011	Fluoride	0.60	mg/l	
MW-28	5/8/2012	Fluoride	0.52	mg/l	
MW-28	11/14/2012	Fluoride	0.58	mg/l	
MW-28	5/15/2013	Fluoride	0.61	mg/l	
MW-28	12/4/2013	Fluoride	0.66	mg/l	

Well	Sample Date	Parameter	Result	Units	Qualifier
MW-28	11/5/2014	Fluoride	0.60	mg/l	
MW-28	4/21/2015	Fluoride	0.56	mg/l	
MW-28	11/10/2015	Fluoride	0.52	mg/l	
MW-28	4/20/2016	Fluoride	0.56	mg/l	
MW-28	11/1/2016	Fluoride	0.59	mg/l	
MW-28	4/19/2017	Fluoride	0.59	mg/l	
MW-28	10/18/2017	Fluoride	0.70	mg/l	
MW-28	4/19/2018	Fluoride	0.57	mg/l	
MW-28	10/30/2018	Fluoride	0.57	mg/l	
MW-28	4/24/2019	Fluoride	0.70	mg/l	
MW-28	10/22/2019	Fluoride	0.55	mg/l	
MW-28	4/15/2020	Fluoride	0.69	mg/l	
MW-28	6/21/2005	Sulfate	2010	mg/l	
MW-28	9/22/2005	Sulfate	2310	mg/l	D
MW-28	12/14/2005	Sulfate	2380	mg/l	D
MW-28	3/22/2006	Sulfate	2320	mg/l	D
MW-28	6/23/2006	Sulfate	2190	mg/l	D
MW-28	9/12/2006	Sulfate	2380	mg/l	D
MW-28	10/24/2006	Sulfate	2520	mg/l	D
MW-28	3/15/2007	Sulfate	2340	mg/l	D
MW-28	6/20/2007	Sulfate	2360	mg/l	D
MW-28	8/28/2007	Sulfate	2440	mg/l	D
MW-28	10/23/2007	Sulfate	2370	mg/l	D
MW-28	3/12/2008	Sulfate	2310	mg/l	D
MW-28	6/3/2008	Sulfate	2360	mg/l	D
MW-28	8/6/2008	Sulfate	2340	mg/l	D
MW-28	11/5/2008	Sulfate	2340	mg/l	D
MW-28	2/4/2009	Sulfate	2340	mg/l	D
MW-28	5/12/2009	Sulfate	2410	mg/l	D
MW-28	8/17/2009	Sulfate	2360	mg/l	D
MW-28	10/12/2009	Sulfate	2380	mg/l	D
MW-28	1/19/2010	Sulfate	2340	mg/l	D
MW-28	4/19/2010	Sulfate	2310	mg/l	D
MW-28	11/12/2010	Sulfate	2290	mg/l	D
MW-28	4/11/2011	Sulfate	2090	mg/l	D
MW-28	10/5/2011	Sulfate	2340	mg/l	D
MW-28	5/8/2012	Sulfate	2290	mg/l	D
MW-28	11/14/2012	Sulfate	1710	mg/l	
MW-28	5/15/2013	Sulfate	2030	mg/l	
MW-28	12/4/2013	Sulfate	2270	mg/l	
MW-28	6/18/2014	Sulfate	2410	mg/l	
MW-28	11/5/2014	Sulfate	2250	mg/l	
MW-28	4/21/2015	Sulfate	2490	mg/l	
MW-28	11/10/2015	Sulfate	2440	mg/l	
MW-28	4/20/2016	Sulfate	2350	mg/l	

Well	Sample Date	Parameter	Result	Units	Qualifier
MW-28	11/1/2016	Sulfate	2280	mg/l	
MW-28	4/19/2017	Sulfate	1970	mg/l	
MW-28	10/18/2017	Sulfate	1960	mg/l	
MW-28	4/19/2018	Sulfate	2280	mg/l	
MW-28	10/30/2018	Sulfate	2040	mg/l	
MW-28	4/24/2019	Sulfate	2390	mg/l	
MW-28	10/22/2019	Sulfate	2420	mg/l	
MW-28	4/15/2020	Sulfate	2280	mg/l	
MW-28	6/21/2005	Uranium	3.22	ug/l	
MW-28	9/22/2005	Uranium	3.75	ug/l	
MW-28	12/14/2005	Uranium	3.46	ug/l	
MW-28	3/22/2006	Uranium	3.89	ug/l	
MW-28	6/23/2006	Uranium	4.89	ug/l	
MW-28	9/12/2006	Uranium	3.36	ug/l	
MW-28	10/24/2006	Uranium	3.49	ug/l	
MW-28	3/15/2007	Uranium	2.69	ug/l	
MW-28	6/20/2007	Uranium	4.56	ug/l	
MW-28	8/28/2007	Uranium	3.67	ug/l	
MW-28	10/23/2007	Uranium	3.40	ug/l	
MW-28	3/12/2008	Uranium	3.17	ug/l	
MW-28	6/3/2008	Uranium	3.46	ug/l	
MW-28	8/6/2008	Uranium	3.15	ug/l	
MW-28	11/5/2008	Uranium	3.55	ug/l	
MW-28	2/4/2009	Uranium	3.42	ug/l	
MW-28	5/12/2009	Uranium	3.34	ug/l	
MW-28	8/17/2009	Uranium	3.24	ug/l	
MW-28	10/12/2009	Uranium	3.46	ug/l	
MW-28	1/19/2010	Uranium	3.51	ug/l	
MW-28	4/19/2010	Uranium	3.36	ug/l	
MW-28	11/12/2010	Uranium	3.45	ug/l	
MW-28	4/11/2011	Uranium	3.29	ug/l	
MW-28	10/5/2011	Uranium	3.19	ug/l	
MW-28	5/8/2012	Uranium	3.44	ug/l	
MW-28	11/14/2012	Uranium	3.45	ug/l	
MW-28	5/15/2013	Uranium	3.58	ug/l	
MW-28	12/4/2013	Uranium	3.34	ug/l	
MW-28	9/16/2014	Uranium	10.60	ug/l	
MW-28	2/9/2015	Uranium	4.48	ug/l	
MW-28	4/21/2015	Uranium	6.13	ug/l	
MW-28	7/21/2015	Uranium	4.87	ug/l	
MW-28	11/10/2015	Uranium	4.84	ug/l	
MW-28	2/2/2016	Uranium	4.61	ug/l	
MW-28	4/20/2016	Uranium	3.95	ug/l	
MW-28	9/1/2016	Uranium	4.71	ug/l	
MW-28	11/1/2016	Uranium	4.09	ug/l	

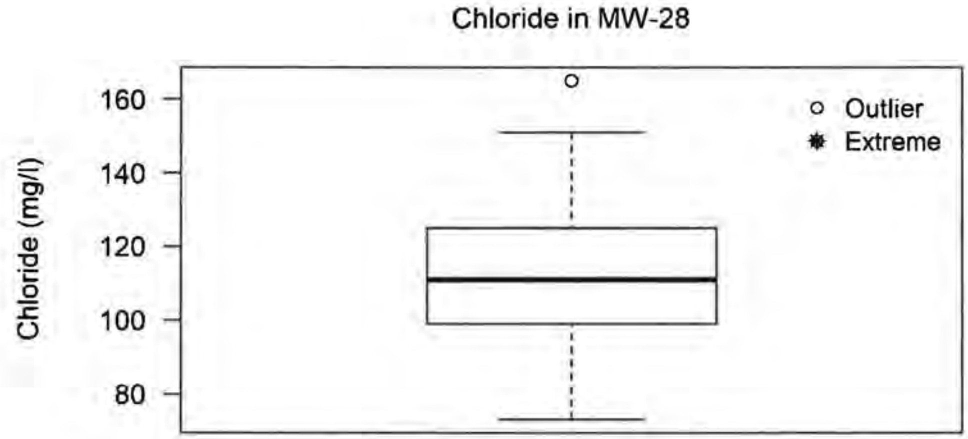
Well	Sample Date	Parameter	Result	Units	Qualifier
MW-28	1/25/2017	Uranium	5.68	ug/l	
MW-28	4/19/2017	Uranium	4.68	ug/l	
MW-28	8/22/2017	Uranium	5.68	ug/l	
MW-28	10/18/2017	Uranium	4.70	ug/l	
MW-28	2/21/2018	Uranium	3.94	ug/l	
MW-28	4/19/2018	Uranium	5.06	ug/l	
MW-28	9/12/2018	Uranium	7.04	ug/l	
MW-28	10/30/2018	Uranium	6.18	ug/l	
MW-28	1/22/2019	Uranium	7.12	ug/l	
MW-28	4/24/2019	Uranium	9.60	ug/l	
MW-28	7/12/2019	Uranium	7.83	ug/l	
MW-28	10/22/2019	Uranium	12.40	ug/l	
MW-28	1/16/2020	Uranium	7.56	ug/l	
MW-28	4/15/2020	Uranium	5.91	ug/l	
MW-28	7/8/2020	Uranium	11.80	ug/l	

Notes: D = Analyte reporting limit increased due to same matrix interference

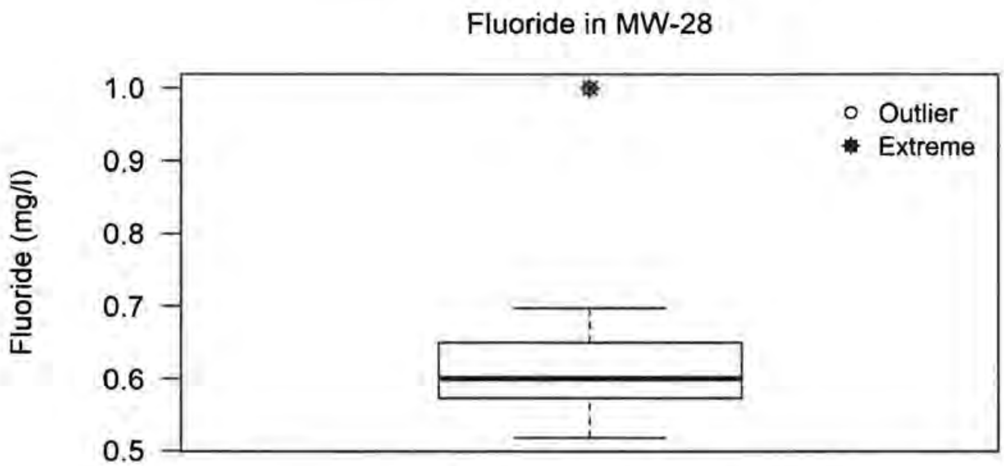
Appendix C-4: Indicator Parameter Data Removed from Analysis

Reason	Location ID	Date Sampled	Parameter Name	Report Result	Report Units
Extreme (High)	MW-28	6/18/2014	Fluoride	1.0	mg/l
Extreme (High)	MW-28	6/18/2014	Uranium	61.3	ug/l
Extreme (High)	MW-28	11/5/2014	Uranium	21.2	ug/l

Appendix C-5: Box Plots for Indicator Parameters in MW-28

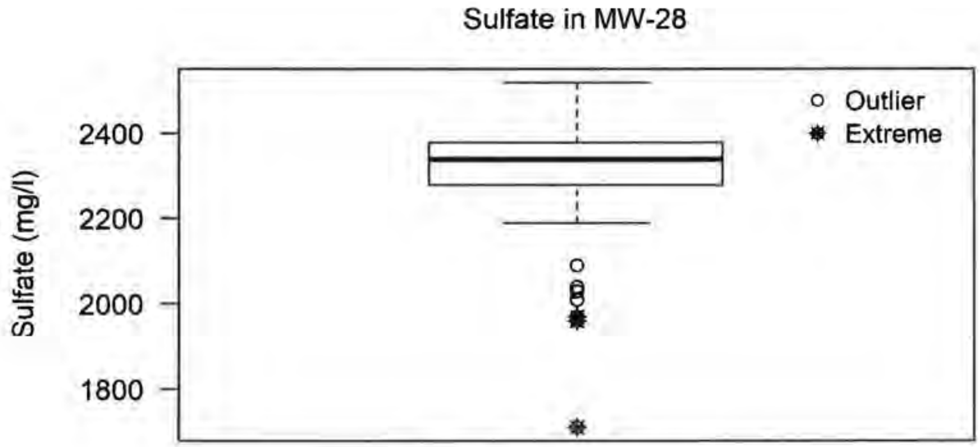


Percent nondetect: 0%
Min: 73, Mean: 112.65, Max: 165, Std Dev: 18.84
Upper extreme threshold (Q75 + 3xH): 202.25
Lower extreme threshold (Q25 - 3xH): 22

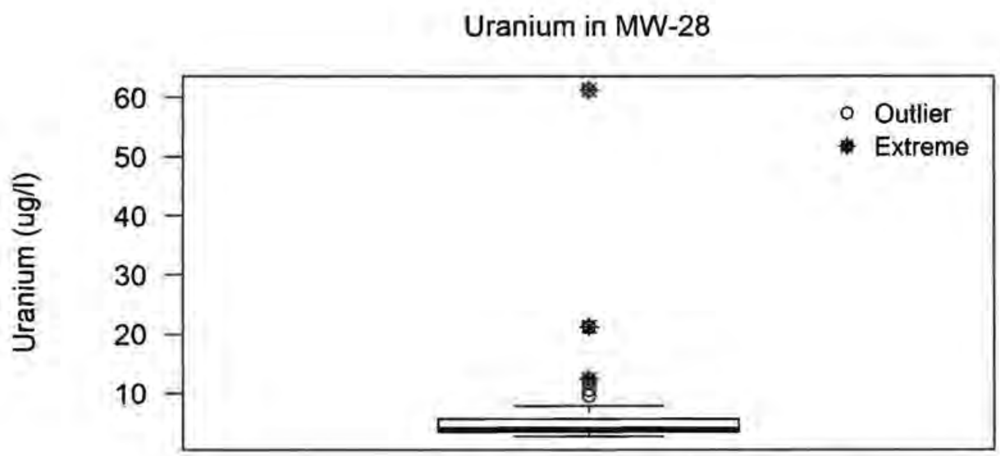


Percent nondetect: 2%
Min: 0.518, Mean: 0.62, Max: 1, Std Dev: 0.08
Upper extreme threshold (Q75 + 3xH): 0.880556
Lower extreme threshold (Q25 - 3xH): 0.342592

Appendix C-5: Box Plots for Indicator Parameters in MW-28

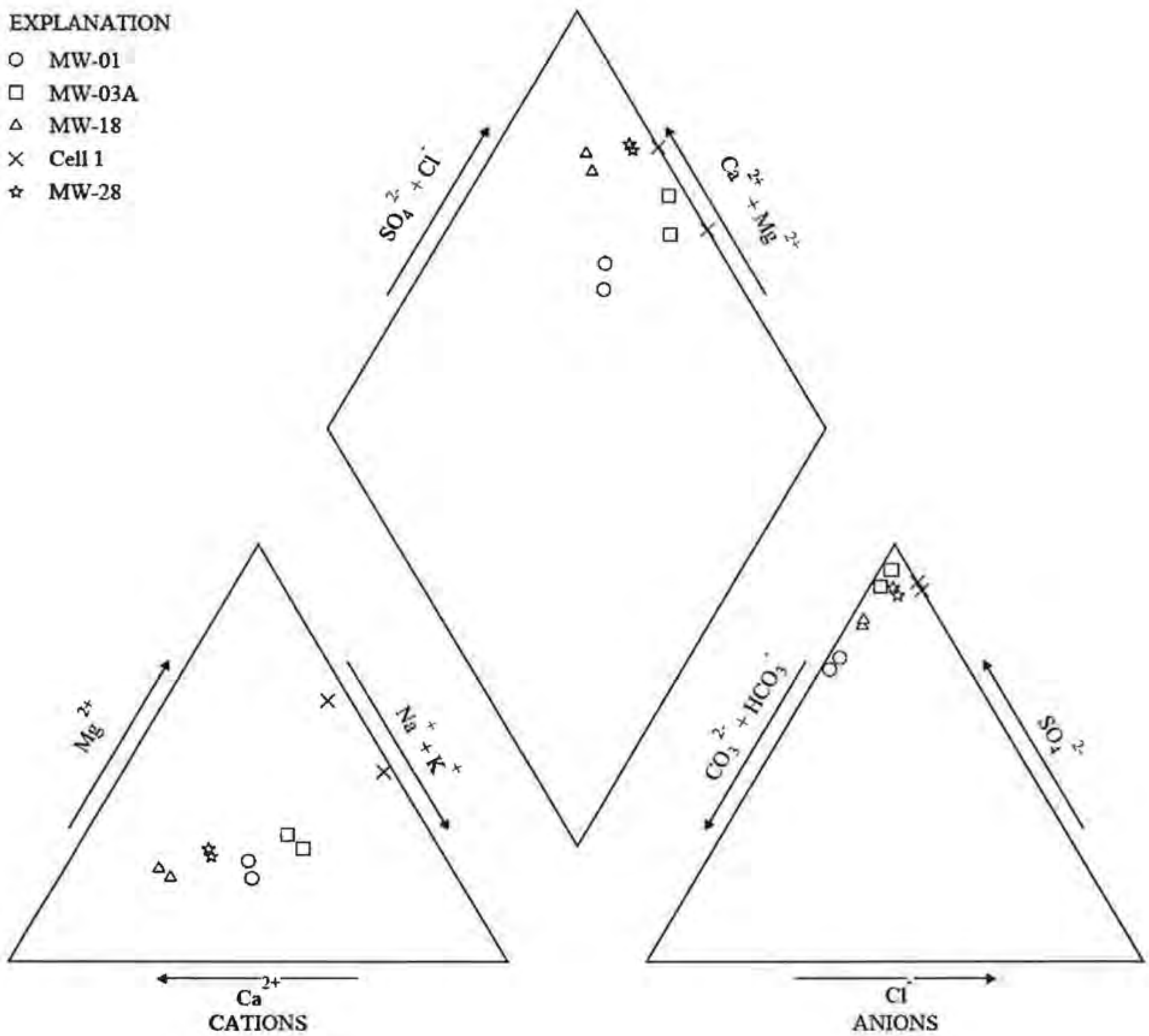


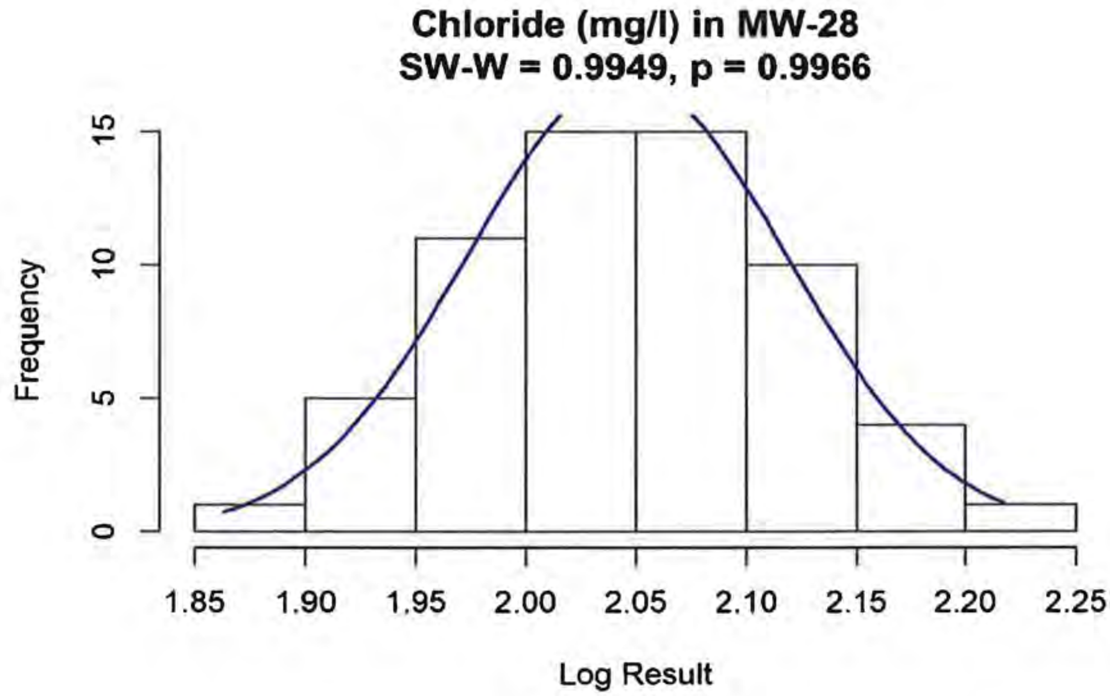
Percent nondetect: 0%
Min: 1710, Mean: 2285.12, Max: 2520, Std Dev: 163.34
Upper extreme threshold (Q75 + 3xH): 2680
Lower extreme threshold (Q25 - 3xH): 1980

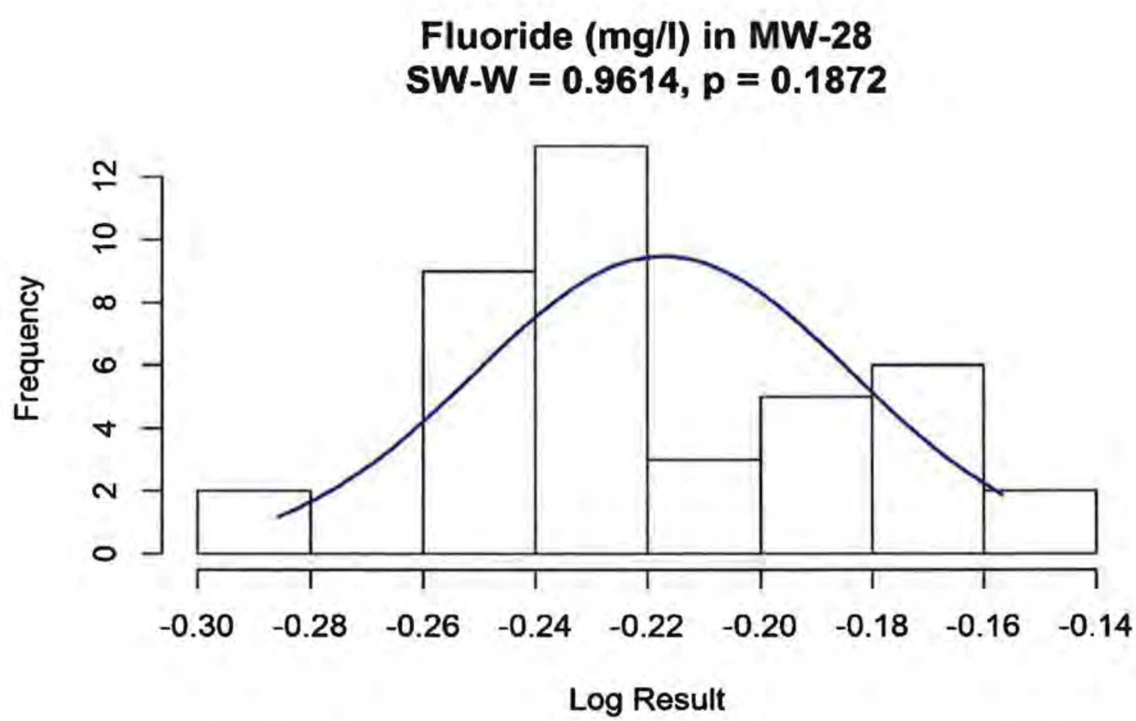


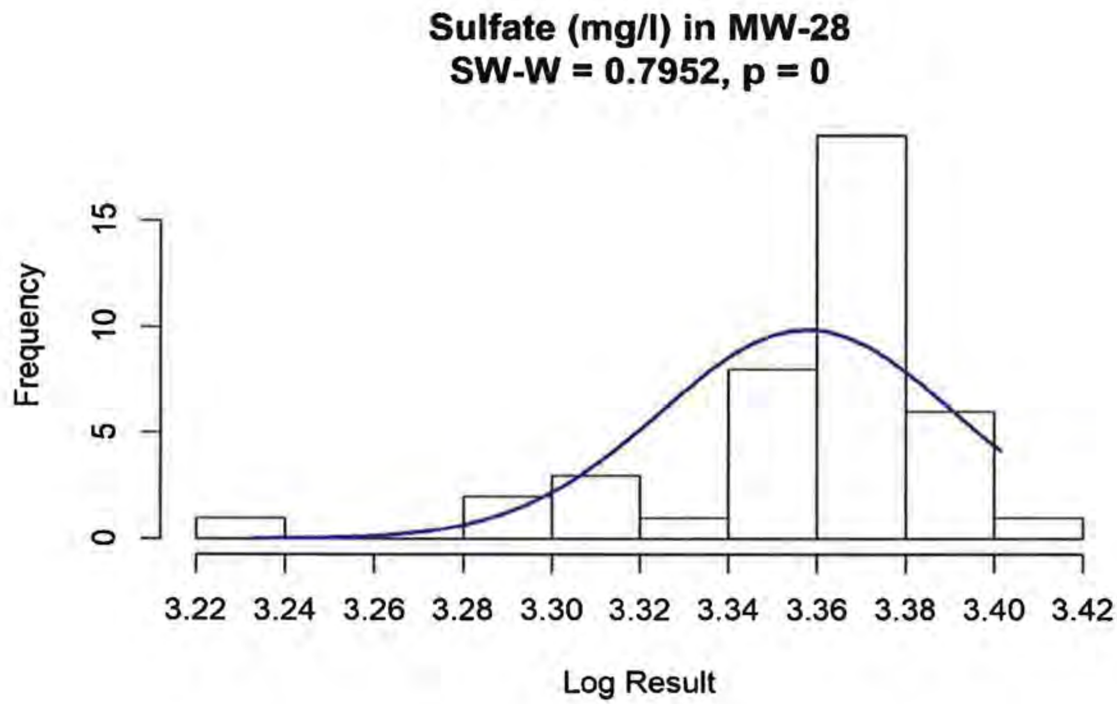
Percent nondetect: 0%
Min: 2.69, Mean: 6.18, Max: 61.3, Std Dev: 8.25
Upper extreme threshold (Q75 + 3xH): 12.3925
Lower extreme threshold (Q25 - 3xH): -3.27

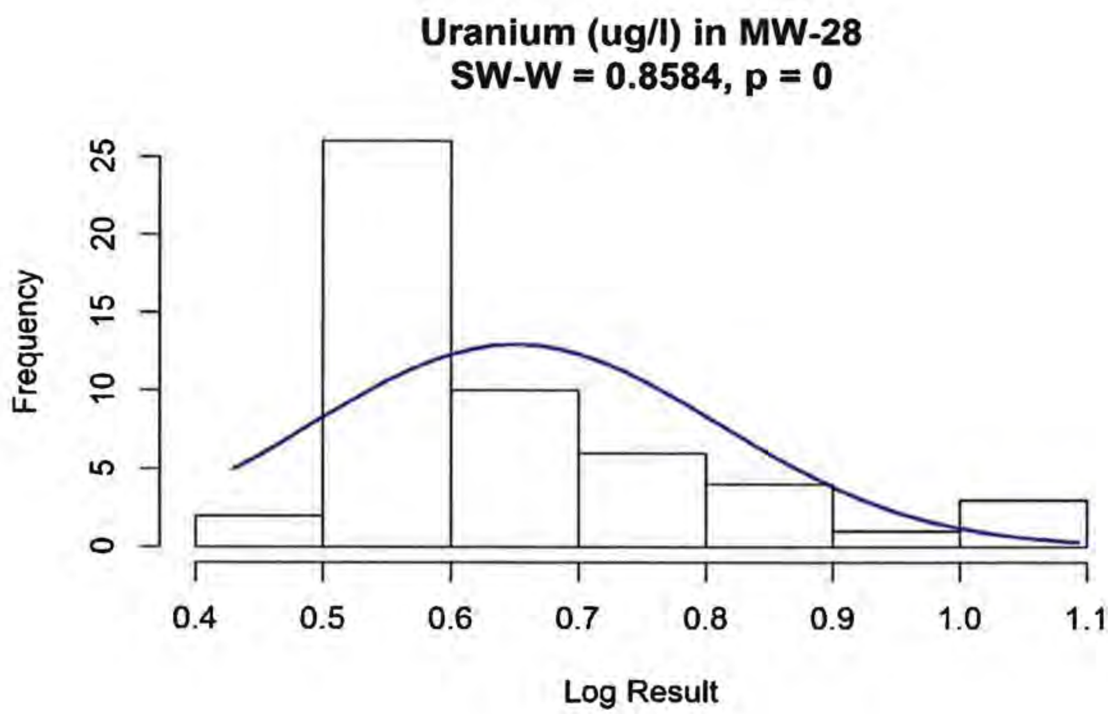
Appendix C-6: Piper Diagram for Cell 1, MW-28, and Ugradient and Downgradient Wells

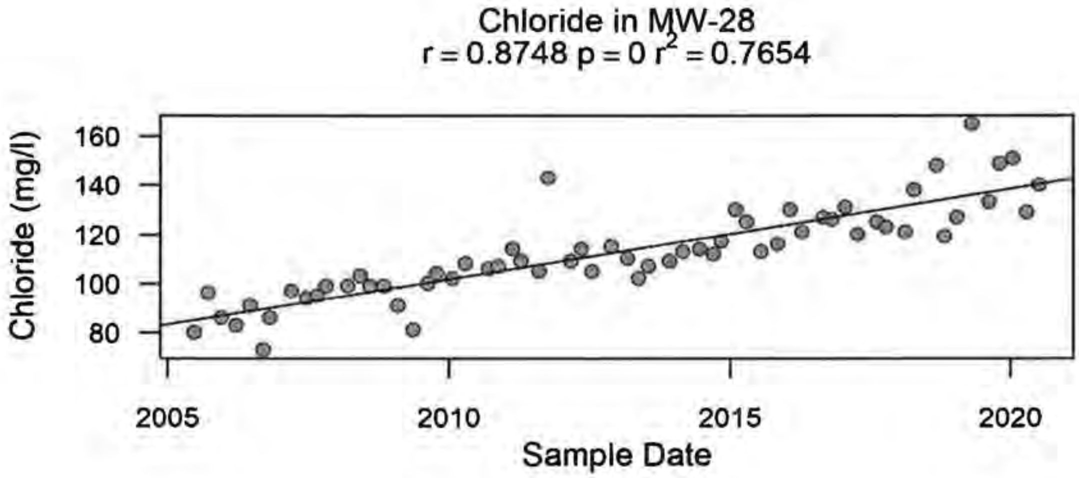


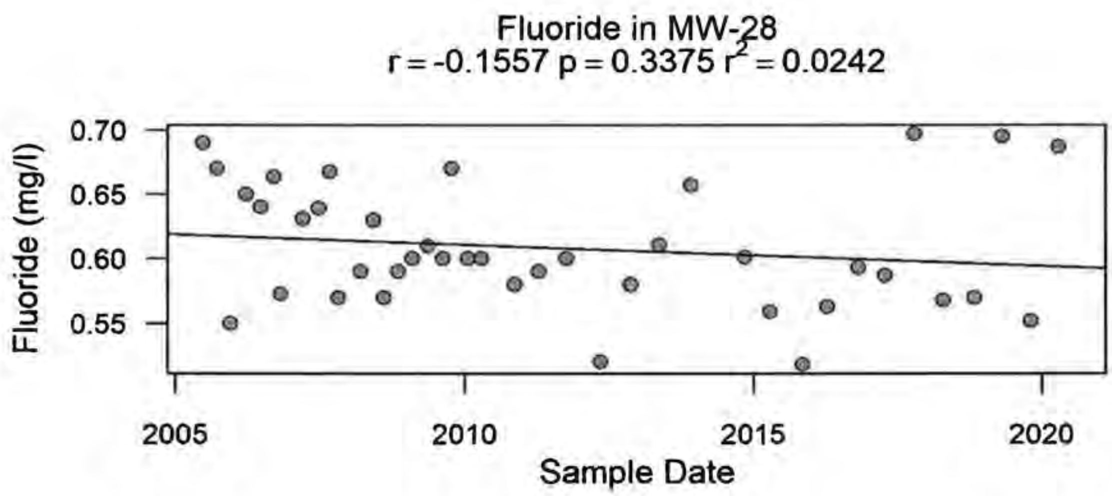

Chloride (mg/l) in MW-28
SW-W = 0.9949, p = 0.9966
Frequency
0
5
10
15
1.85
1.90
1.95
2.00
2.05
2.10
2.15
2.20
2.25
Log Result

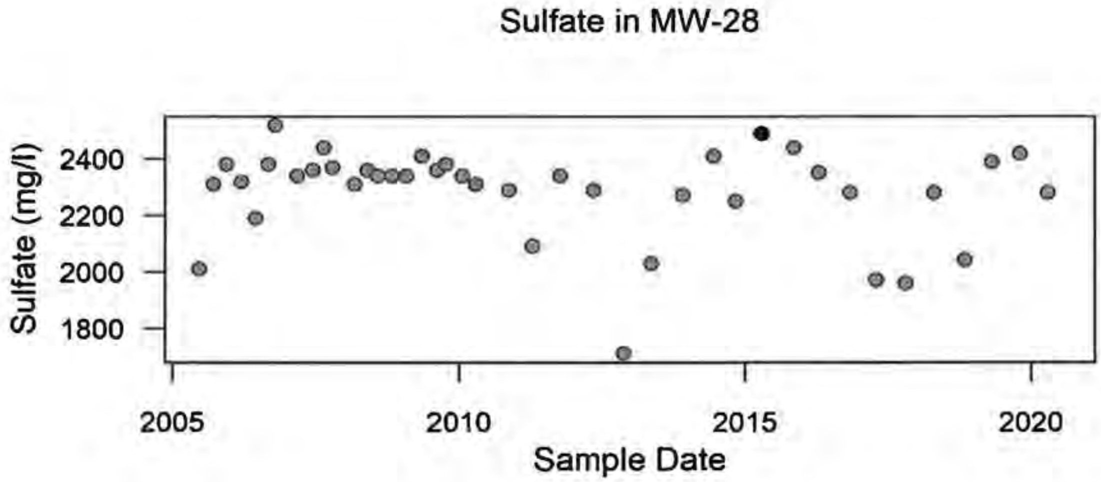

Fluoride (mg/l) in MW-28
SW-W = 0.9614, p = 0.1872
Frequency
0
2
4
6
8
10
12
-0.30
-0.28
-0.26
-0.24
-0.22
-0.20
-0.18
-0.16
-0.14
Log Result

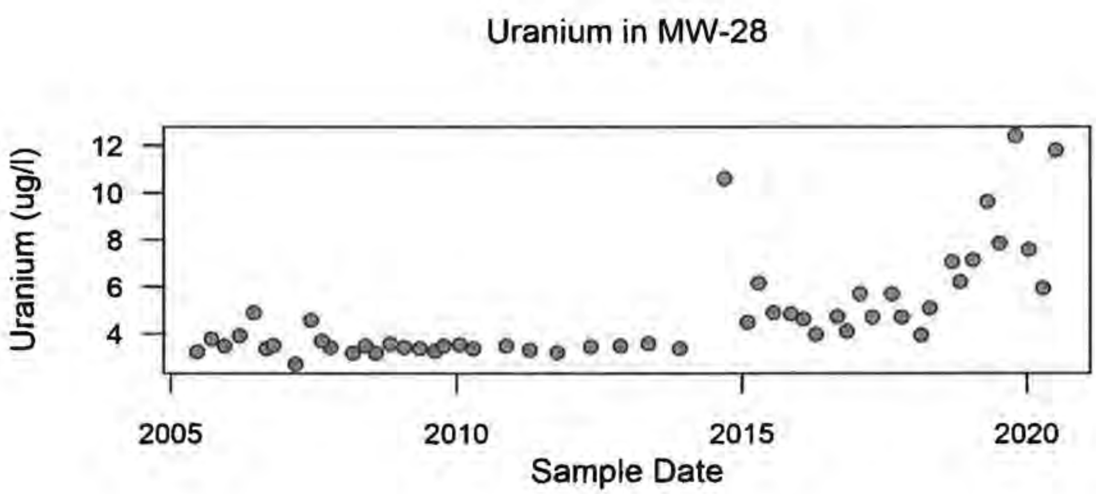

Sulfate (mg/l) in MW-28
SW-W = 0.7952, p = 0
Frequency
0
5
10
15
3.22 3.24 3.26 3.28 3.30 3.32 3.34 3.36 3.38 3.40 3.42
Log Result

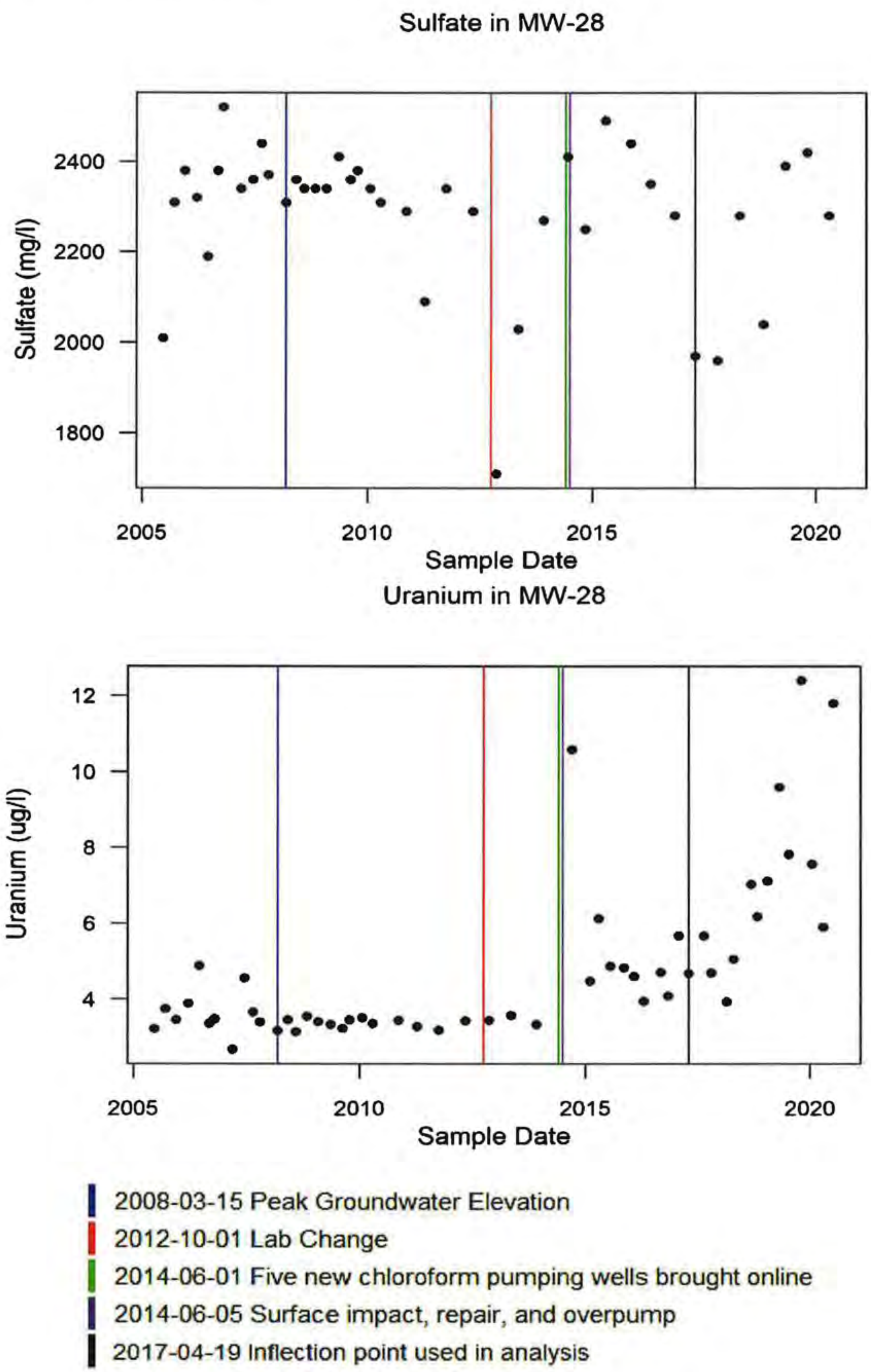

Uranium (ug/l) in MW-28
SW-W = 0.8584, p = 0
Frequency
0
5
10
15
20
25
0.4 0.5 0.6 0.7 0.8 0.9 1.0 1.1
Log Result


Chloride in MW-28
r = 0.8748 p = 0 r2 = 0.7654
Chloride (mg/l)
160
140
120
100
80
2005
2010
2015
2020
Sample Date

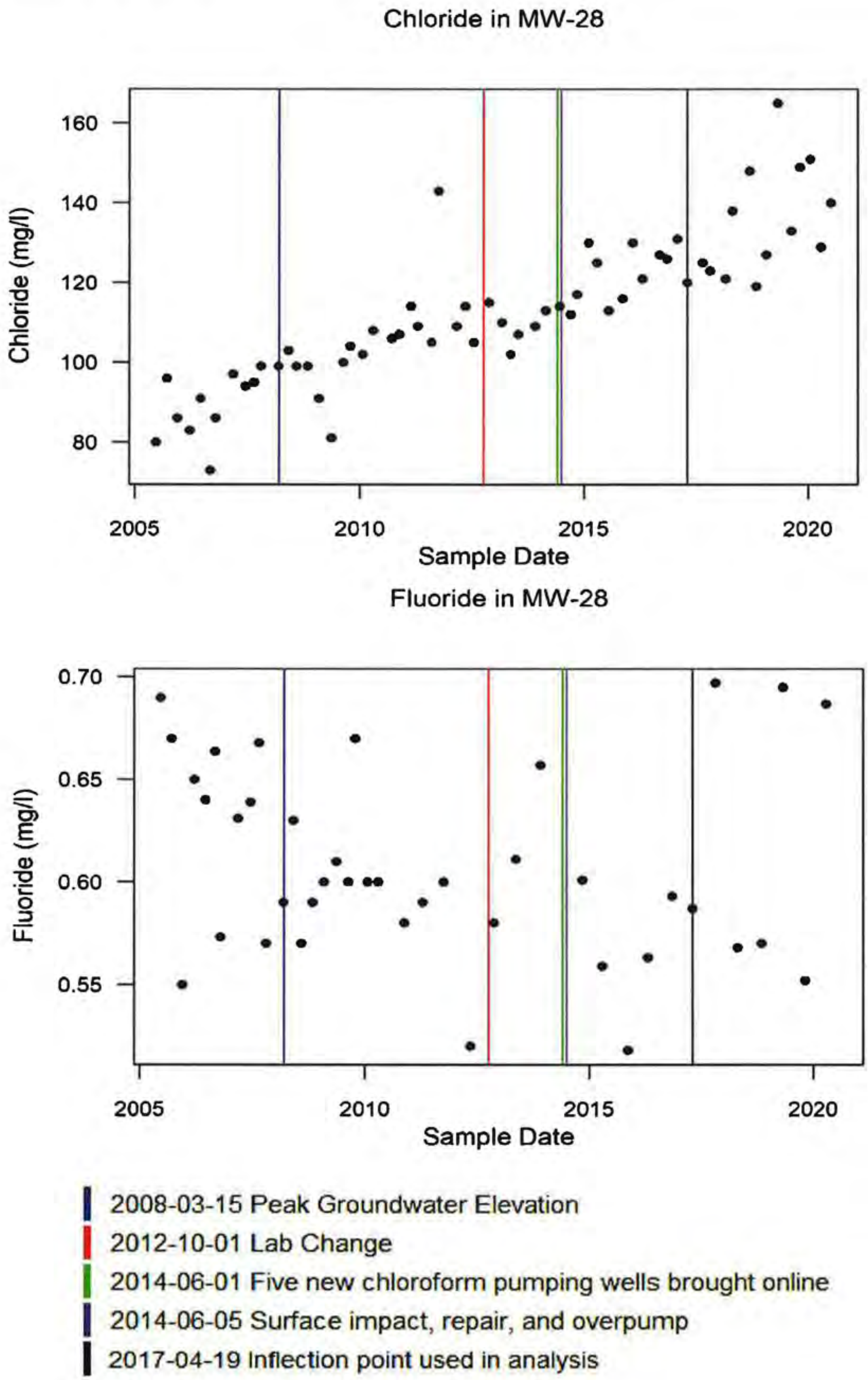

Fluoride in MW-28
r = -0.1557 p = 0.3375 r2 = 0.0242
Fluoride (mg/l)
0.70
0.65
0.60
0.55
2005
2010
2015
2020
Sample Date


Sulfate in MW-28
Sulfate (mg/l)
2400
2200
2000
1800
2005
2010
2015
2020
Sample Date


Uranium in MW-28
Uranium (ug/l)
12
10
8
6
4
2005
2010
2015
2020
Sample Date


Sulfate in MW-28
Sulfate (mg/l)
1800
2000
2200
2400
2005
2010
2015
2020
Sample Date
Uranium in MW-28
Uranium (ug/l)
4
6
8
10
12
2005
2010
2015
2020
Sample Date
2008-03-15 Peak Groundwater Elevation
2012-10-01 Lab Change
2014-06-01 Five new chloroform pumping wells brought online
2014-06-05 Surface impact, repair, and overpump
2017-04-19 Inflection point used in analysis

Appendix C-9: Time Series with Events



APPENDIX D

Appendix D
Dilution Factors and Predicted Fluoride, Uranium and Selenium Concentrations

	fluoride (mg/L)	uranium (ug/L)	chloride (mg/L)	sulfate (mg/L)	selenium (ug/L)
MW-28 concentration (latest)	**0.687**	5.91	1.29E+02	2.28E+03	10.2
Cell 1 concentration (average since 2003)	2.24E+03	3.98E+05	2.42E+04	1.70E+05	8.10E+06
Dilution factor (DF) = C_{mw28}/C_{cell1}	3.07E-04	1.48E-05	5.33E-03	1.34E-02	1.26E-06
		fluoride based on uranium dilution (mg/L)	fluoride based on chloride dilution (mg/L)	fluoride based on sulfate dilution (mg/L)	fluoride based on selenium dilution (mg/L)
Predicted diluted fluoride ($C_{cell1\ F}$ x DF)	–	**0.033**	**11.9**	**30.1**	**0.0028**

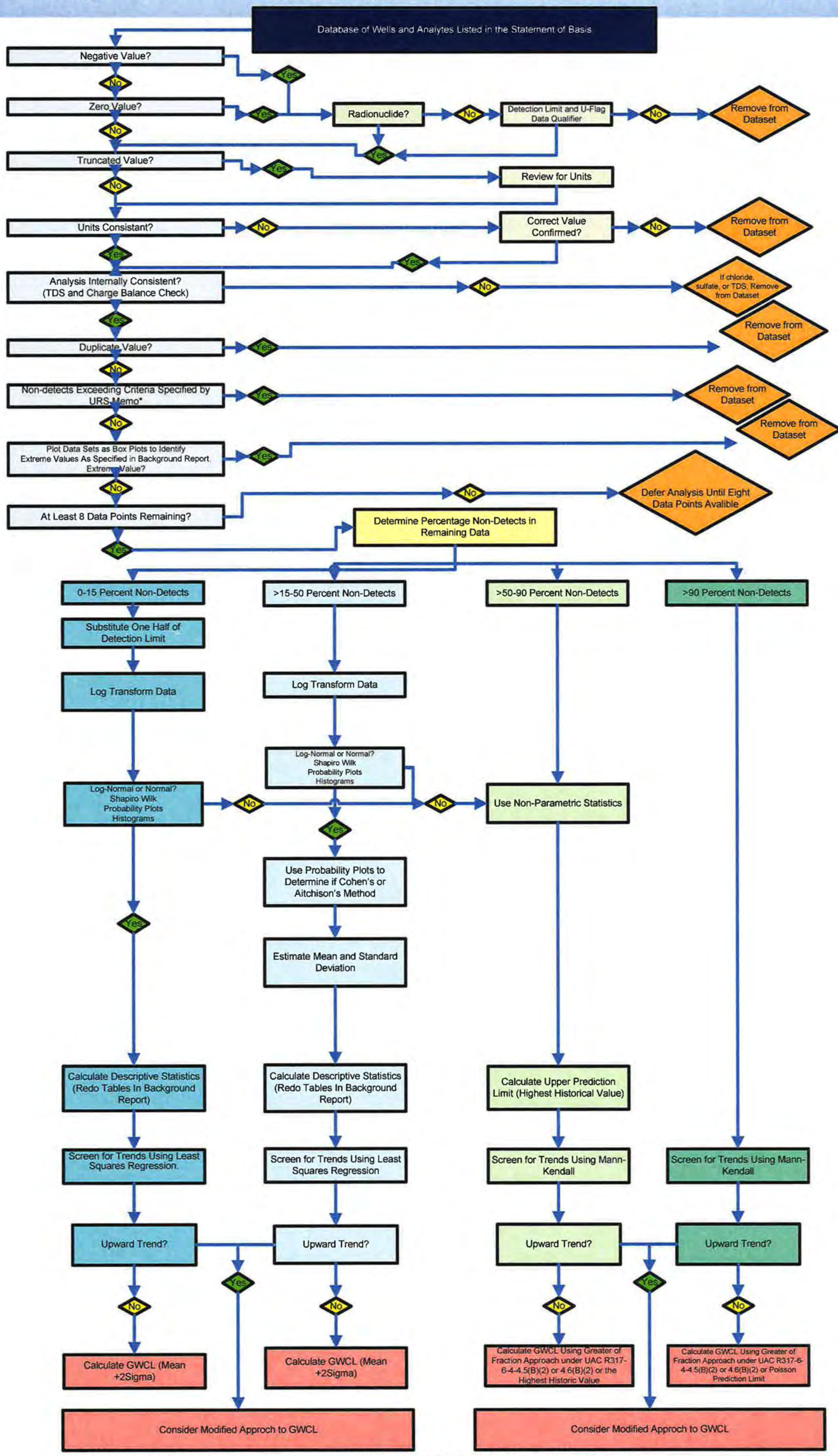
	fluoride (mg/L)	uranium (ug/L)	chloride (mg/L)	sulfate (mg/L)	selenium (ug/L)
MW-28 concentration (latest)	0.687	**5.91**	1.29E+02	2.28E+03	10.2
Cell 1 concentration (average since 2003)	2.24E+06	3.98E+05	2.42E+07	1.70E+08	8.10E+06
Dilution factor (DF) = C_{mw28}/C_{cell1}	3.07E-07	1.48E-05	5.33E-06	1.34E-05	1.26E-06
	uranium based on fluoride dilution (ug/L)		uranium based on chloride dilution (ug/L)	uranium based on sulfate dilution (ug/L)	uranium based on selenium dilution (ug/L)
Predicted diluted uranium ($C_{cell1\ U}$ x DF)	**122**	–	**2,120**	**5,349**	**0.5**

	fluoride (mg/L)	uranium (ug/L)	chloride (mg/L)	sulfate (mg/L)	selenium (ug/L)
MW-28 concentration (latest)	0.687	5.91	1.29E+02	2.28E+03	**10.2**
Cell 1 concentration (average since 2003)	2.24E+06	3.98E+05	2.42E+07	1.70E+08	8.10E+06
Dilution factor (DF) = C_{mw28}/C_{cell1}	3.07E-07	1.48E-05	5.33E-06	1.34E-05	1.26E-06
	selenium based on fluoride dilution (ug/L)	selenium based on uranium dilution (ug/L)	selenium based on chloride dilution (ug/L)	selenium based on sulfate dilution (ug/L)	
Predicted diluted selenium ($C_{cell1\ Se}$ x DF)	**2485**	**120**	**43,163**	**108,892**	–

NOTES:
C_{mw28} = latest concentration at MW-28
C_{cell1} = average concentration in cell 1
ug/L = micrograms per liter

APPENDIX E

Appendix E. Flowsheet
Groundwater Data Preparation and Statistical Process Flow for Calculating Groundwater Protection Standards, White Mesa Mill Site, San Juan County, Utah



*A non-detect considered "insensitive" will be the maximum reporting limit in a dataset and will exceed other non-detects by, for example, an order of magnitude (e.g., <10 versus <1.0 µg/L). In some cases, insensitive non-detects may also exceed detectable values in a dataset (e.g., <10 versus 3.5 µg/L).

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APPENDIX F

Appendix F-1: Descriptive Statistics for Modified GWCL Data Set and All Data

Data Set	Analyte	Units	% Non-Detects	N	Distribution	Mean	Min. Conc.	Max. Conc.	Std. Dev.	Range	Geometric Mean	Skewness	Q25	Median	Q75	Mann Kendall Trend Analysis		Linear Trend Analysis		Significant Trend
																S	p	r^2	p	
ALL 2020 SAR Data	Selenium	µg/L	0.43	44	Not Normal	6.98	5	16.5	2.93	11.5	6.54	1.82	5	5.55	7.78	254	3.54E-03	NA	NA	increasing
GWCL Subset Post 2017		µg/L	0	10	Normal	10.86	6.46	16.5	3.52	10.04	10.35	0.4	8.32	10.4	13.2	31	3.65E-03	0.68	3.12E-03	increasing
ALL 2020 SAR Data	Uranium	µg/L	0	52	Not Normal	4.83	2.69	12.4	2.2	9.71	4.48	1.98	3.44	3.92	5.22	695	0	NA	NA	increasing
GWCL Subset Post 2017		µg/L	0	14	Normal	7.11	3.94	12.4	2.59	8.46	6.72	1.0	5.22	6.61	7.76	55	1.56E-03	0.52	3.68E-03	increasing

Notes:

µg/L = micrograms per liter
N = number of valid data points
p = probability

W = Shapiro Wilk test value
S = Mann-Kendall statistic
r^2 = The measure of how well the trendline fits the data where r2=1 represents a perfect fit.

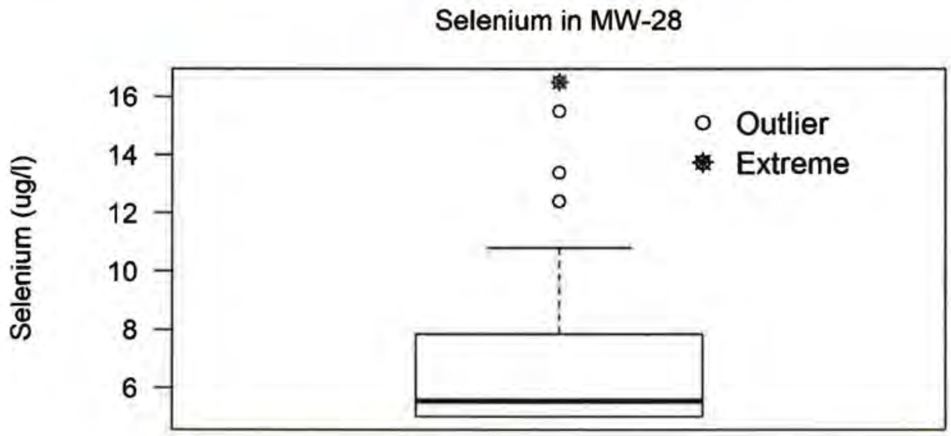
Q25 = 25th quantile
Q75 = 75th quantile
NA= Not Applicable

ALL 2020 SAR Data = All data with extremes removed
GWCL Subset Post 2017 = All data post April 2017

Appendix F-2: MW-28 Data Used for Analysis

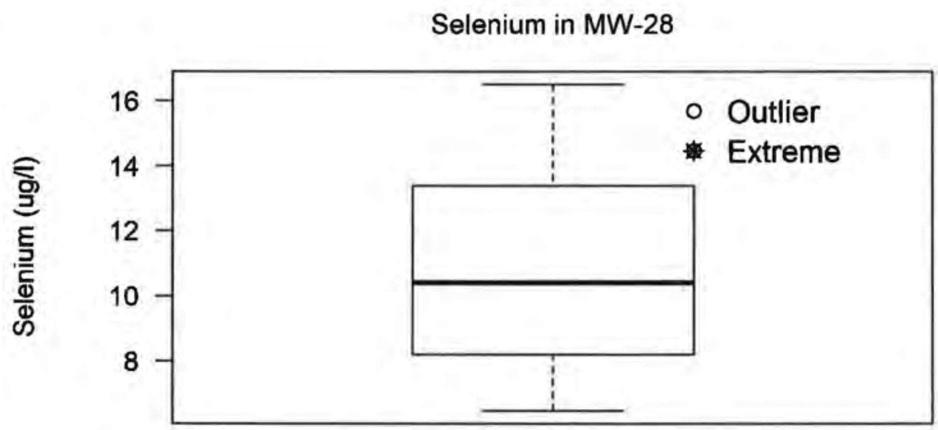
Well	Date Sampled	Parameter Name	Report Result	Report Units
MW-28	4/19/2017	Selenium	6.46	ug/l
MW-28	10/18/2017	Selenium	6.66	ug/l
MW-28	4/19/2018	Selenium	8.20	ug/l
MW-28	10/30/2018	Selenium	8.68	ug/l
MW-28	4/24/2019	Selenium	12.40	ug/l
MW-28	7/12/2019	Selenium	10.60	ug/l
MW-28	10/22/2019	Selenium	16.50	ug/l
MW-28	1/16/2020	Selenium	13.40	ug/l
MW-28	4/15/2020	Selenium	10.20	ug/l
MW-28	7/8/2020	Selenium	15.50	ug/l
MW-28	4/19/2017	Uranium	4.68	ug/l
MW-28	8/22/2017	Uranium	5.68	ug/l
MW-28	10/18/2017	Uranium	4.70	ug/l
MW-28	2/21/2018	Uranium	3.94	ug/l
MW-28	4/19/2018	Uranium	5.06	ug/l
MW-28	9/12/2018	Uranium	7.04	ug/l
MW-28	10/30/2018	Uranium	6.18	ug/l
MW-28	1/22/2019	Uranium	7.12	ug/l
MW-28	4/24/2019	Uranium	9.60	ug/l
MW-28	7/12/2019	Uranium	7.83	ug/l
MW-28	10/22/2019	Uranium	12.40	ug/l
MW-28	1/16/2020	Uranium	7.56	ug/l
MW-28	4/15/2020	Uranium	5.91	ug/l
MW-28	7/8/2020	Uranium	11.80	ug/l

Selenium in MW-28 for All Data



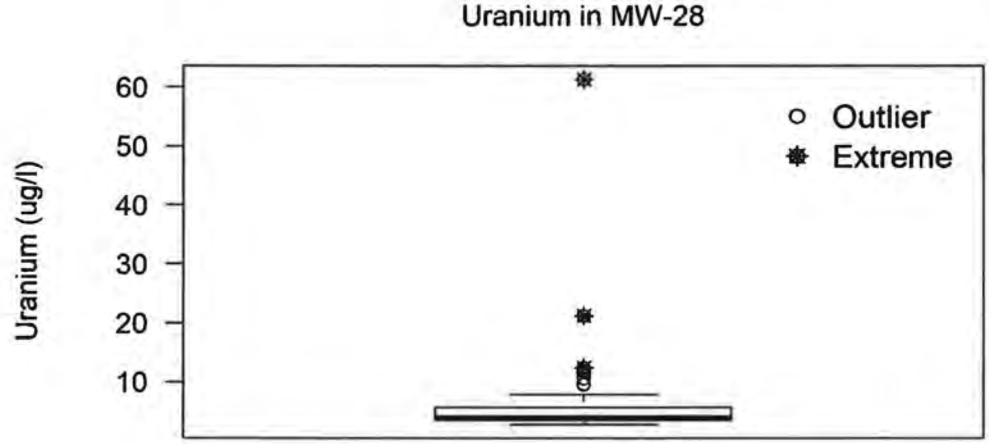
Percent nondetect: 43%
Min: 5, Mean: 6.98, Max: 16.5, Std Dev: 2.93
Upper extreme threshold (Q75 + 3xH): 16.1
Lower extreme threshold (Q25 - 3xH): -3.325

Selenium in MW-28 Post April 2017



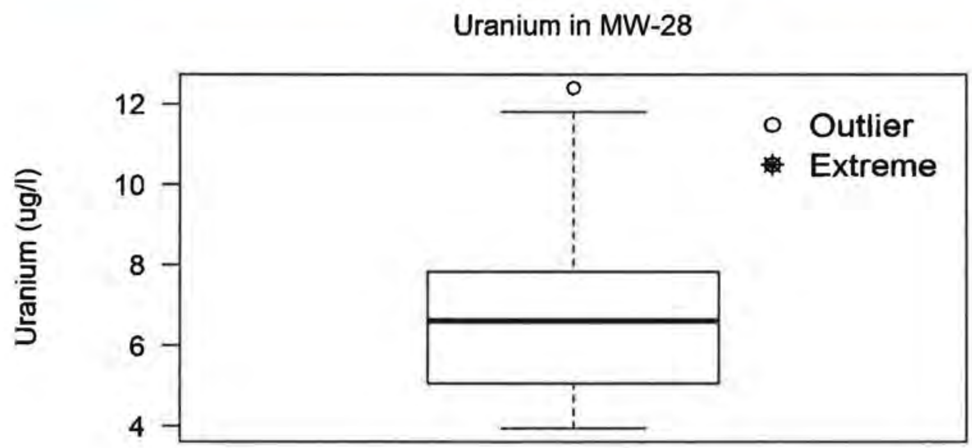
Percent nondetect: 0%
Min: 6.46, Mean: 10.86, Max: 16.5, Std Dev: 3.52
Upper extreme threshold (Q75 + 3xH): 27.64
Lower extreme threshold (Q25 - 3xH): -6.17

Uranium in MW-28 for All Data



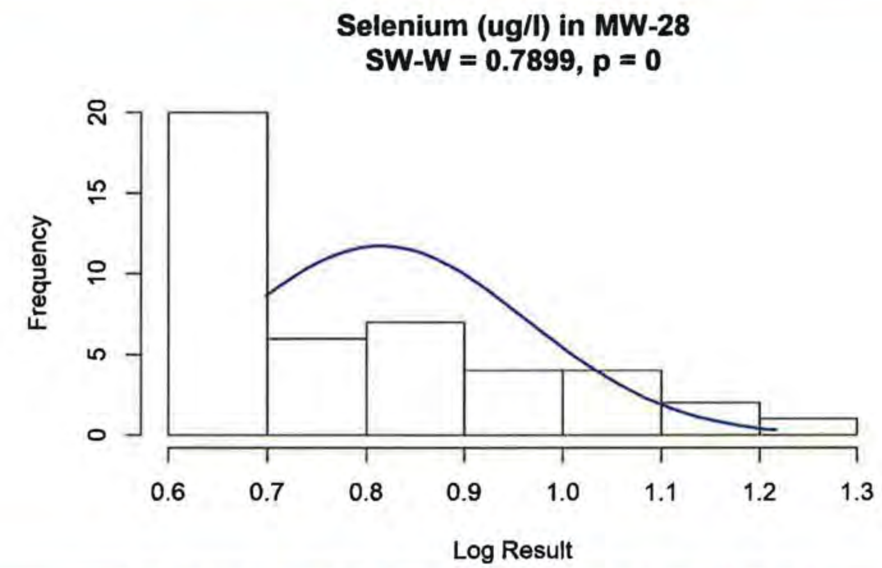
Percent nondetect: 0%
Min: 2.69, Mean: 6.18, Max: 61.3, Std Dev: 8.25
Upper extreme threshold (Q75 + 3xH): 12.3925
Lower extreme threshold (Q25 - 3xH): -3.27

Uranium in MW-28 Post April 2017

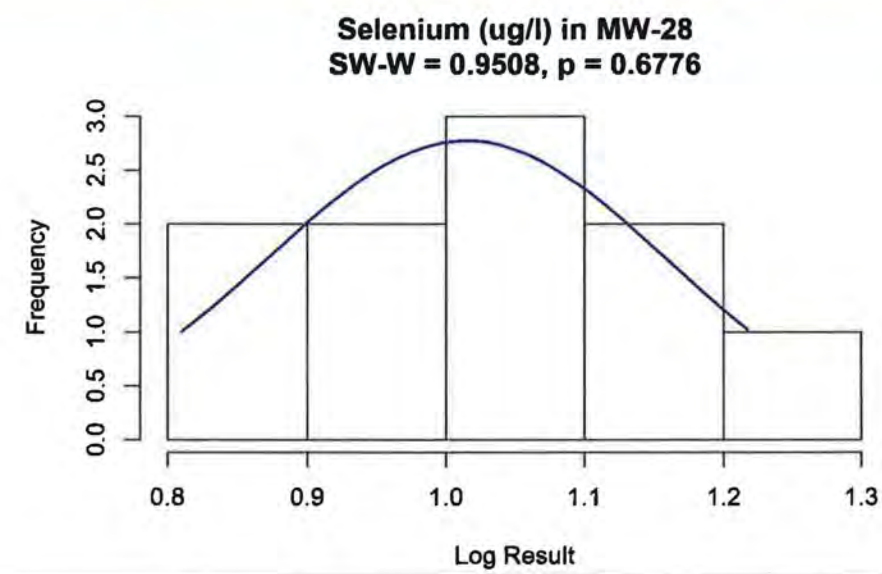


Percent nondetect: 0%
Min: 3.94, Mean: 7.11, Max: 12.4, Std Dev: 2.59
Upper extreme threshold (Q75 + 3xH): 15.405
Lower extreme threshold (Q25 - 3xH): -2.4275

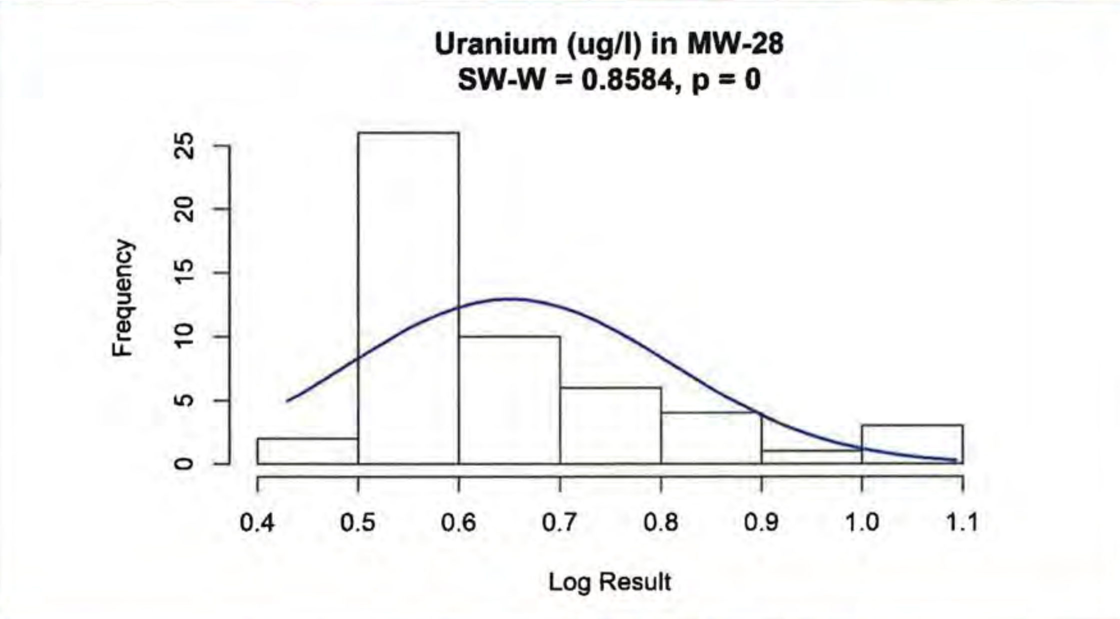
Selenium in MW-28 for All Data



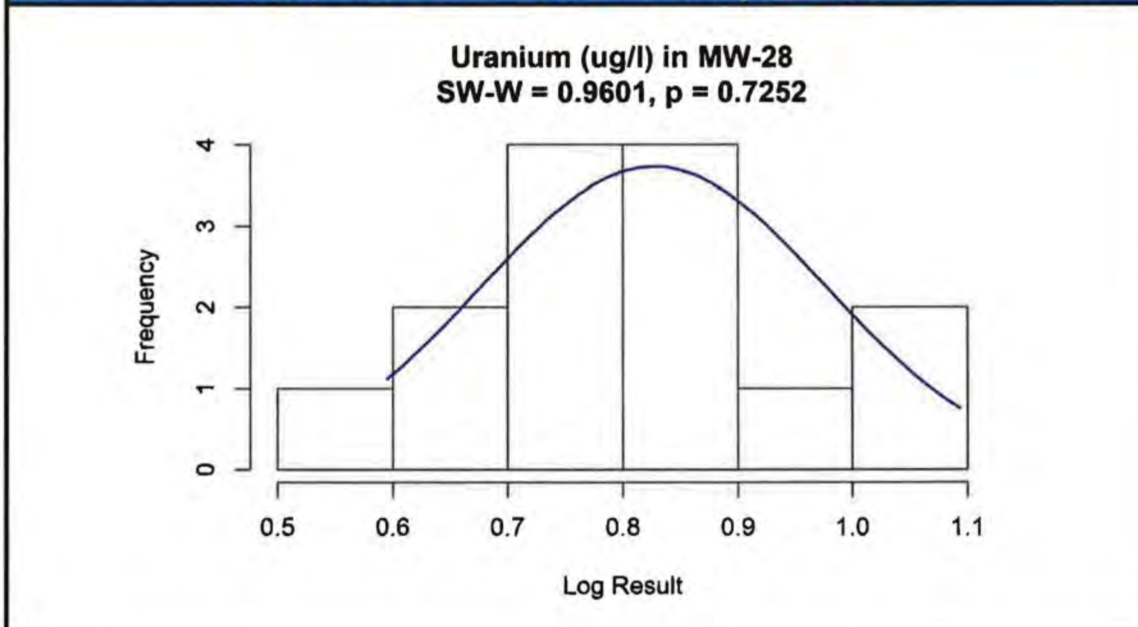
Selenium in MW-28 Post April 2017



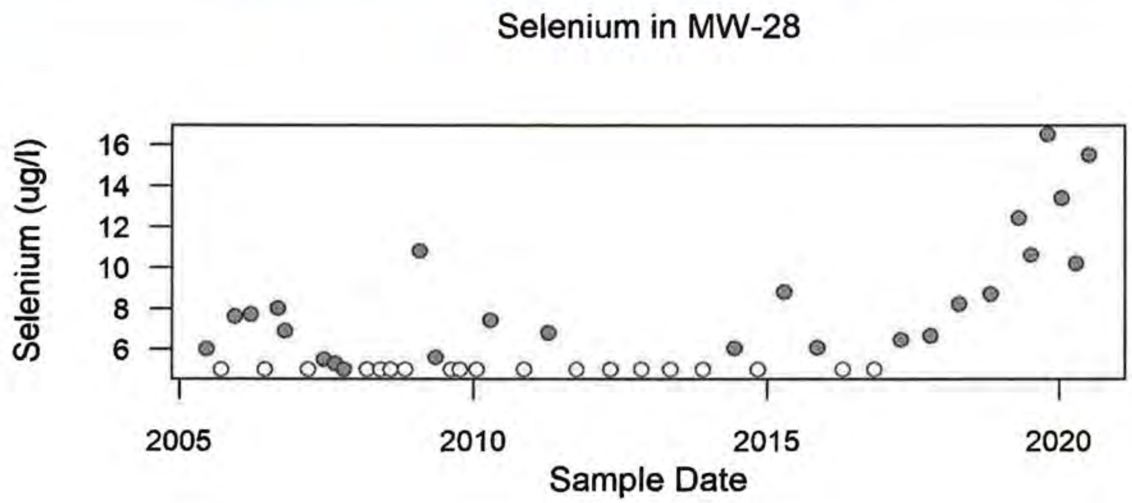
Uranium in MW-28 for All Data



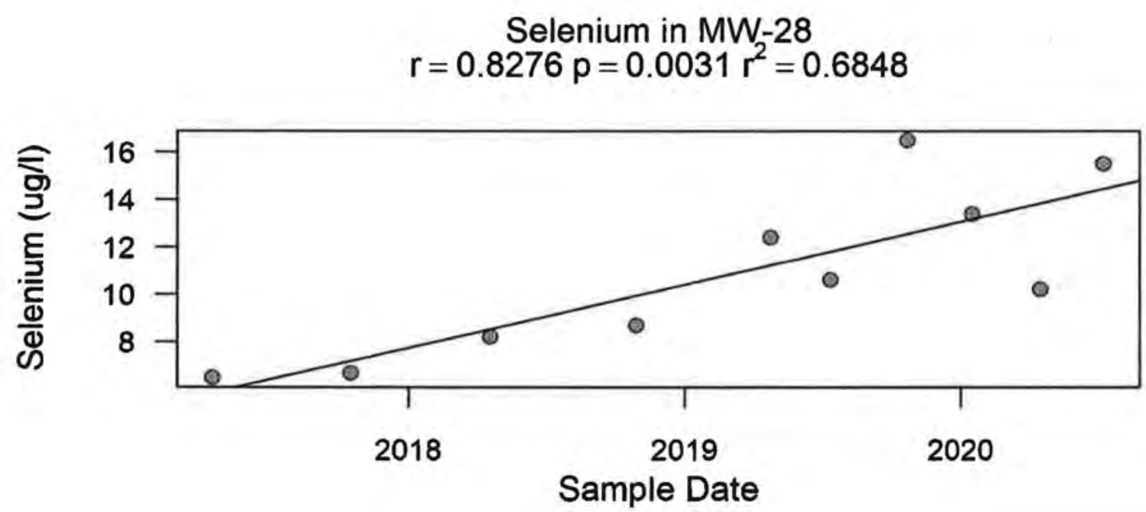
Uranium in MW-28 Post April 2017



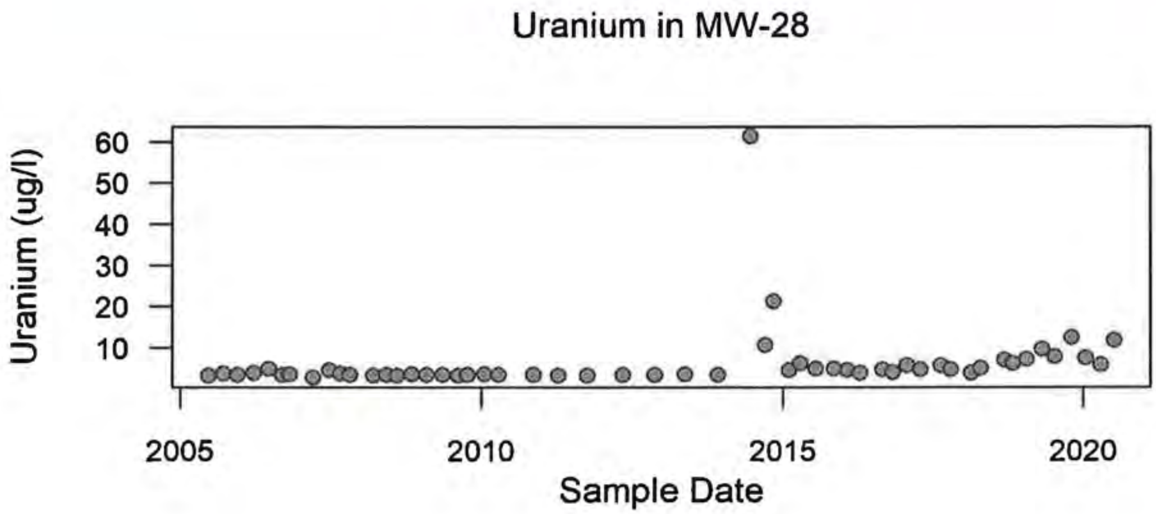
Selenium in MW-28 for All Data



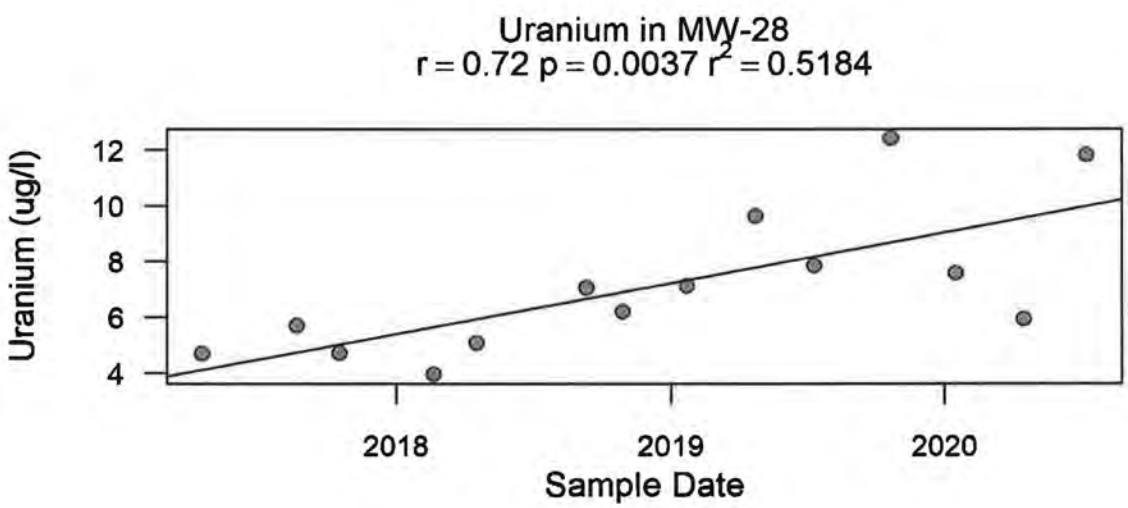
Selenium in MW-28 Post April 2017



Uranium in MW-28 for All Data



Uranium in MW-28 Post April 2017



APPENDIX G
Input and Output Files (Electronic Only)