Hecla
GREENS CREEK

ACTIVE TAILINGS AND PRODUCTION ROCK SITE
2018 ANNUAL REPORT

Hecla Greens Creek Mining Company

April 30, 2019

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1.0 OVERVIEW

This annual report has been prepared by Hecla Greens Creek Mining Company in accordance with Alaska Waste Management Permit number 2014DB0003 issued on August 11, 2014. The monitoring of sites within this report is now a part of General Plan of Operations Appendix 1 (Integrated Monitoring Plan). This annual report addresses permit requirements found in Alaska Waste Management Permit number 2014DB0003 section 2.3 and 2.4.

2.0 INTRODUCTION

This report has been prepared by Hecla Greens Creek Mining Company (HGCMC) in accordance with the General Plan of Operations (Appendix 3) approved by the United States Forest Service and the Alaska Department of Environmental Conservation (ADEC) Waste Management Permit No. 2014DB0003 (WMP), issued August 11, 2014. This report presents the results from inspections and monitoring performed during 2018 (January - December) as required by the WMP and as described in the *Hecla Greens Creek General Plan of Operations Appendix 1 – Integrated Monitoring Plan (IMP)*. Compliance monitoring of wastewater and storm water discharges, air emissions and other resources, such as Hawk Inlet monitoring, are addressed under specific permits and not included in this document.

3.0 AQUATIC BIO-MONITORING

Aquatic bio-monitoring, at Sites 63 and 54 on Greens Creek and Site 9 on Tributary Creek, is performed annually during the month of July by the Alaska Department of Fish and Game (ADFG). Results from the annual monitoring are documented in a Technical Report, prepared by ADFG. Monitoring results from 2018 are presented in Technical Report No. 19-07.

4.0 TAILINGS DISPOSAL FACILITY (TDF)

4.1 Background

The mill at the Greens Creek Mine generates approximately 1,800 dry short tons (DST) of filter-pressed tailings per day, or approximately 650,000 DST of tailings annually. These tailings are dewatered in a filter press at the mill, with about 50% of the tailings being mixed with cement and hauled back into the underground mine for disposal in mined-out areas as mine backfill. The remaining 50% of the tailings are trucked from the mill and placed in a surface tailings disposal facility. The TDF is situated near Hawk Inlet in the upper reaches of the Tributary Creek drainage. Placement utilizes dry-stack tailings disposal techniques.

4.2 Facility Operation and Management

Standard development and placement methodologies at the TDF have been established and reviewed. These methodologies will be continued for future disposal activities. A detailed description of the TDF operation and management, including standard operating procedures, are presented in GPO Appendix 3 – Tailings Disposal Facility Management Plan.

4.2.1 Material Placement Records

Table 4.2.a contains the monthly placement records for tailings, production rock and other materials at the TDF for 2018. Production rock from Site 23 used for road access and erosion control contributed approximately 9,360 tons to the facility. An additional 31,830 tons of other material were also placed at the facility in 2018. The calculated tonnage of tailings was derived by subtracting the tons of production rock and other material from the surveyed total. Estimates of other miscellaneous materials disposed in the facility are shown in Table 4.2.b. Tailings generated but not hauled to the TDF were disposed of in the underground mine. In 2018 367,988 tons (79%) of tailings were placed in the stage 3 phase 1 area (S3P1) and 100,312 tons (21%) in the east. Approximately 8,700 tons of the total 367,988 tons placed in the S3P1 area were tailings removed from the east.

The 2013 Final Environmental Impact Statement and Record of Decision approved approximately 2.1 million cubic yards of tailings storage extending south (S3P1) of the existing TDF (Attachment G, Tailings As-built). The pile currently contains approximately 5.0 million cubic yards of material. Based on the survey data presented in Table 4.2.a there is a remaining capacity of approximately 2.0 million cubic yards. Though difficult to determine the exact amount of time it will take to fill the TDF, HGCMC estimates that, at current production rates that, there is ~9 years of capacity remaining.

Table 4.2.a Tailings Placement							
Date	Surveyed Volume		Tonnage				
	Monthly (cy)	Cumulative (cy)	Waste Rock (tons)	Other (tons)	Tailings* (tons)	Monthly (tons)	Cumulative (tons)
Jan 2018	21,194	4,815,247	2,151	0	45,779	47,930	8,769,003
Feb 2018	18,908	4,834,155	3,820	0	40,841	44,661	8,809,845
Mar 2018	20,613	4,854,768	62	6,842	39,524	39,586	8,854,369
Apr 2018	16,500	4,871,268	0	11,710	34,980	34,980	8,890,009
May 2018	21,228	4,892,496	0	3,954	41,898	41,898	8,935,861
Jun 2018	17,973	4,910,469	1,739	0	38,822	40,561	8,974,683
Jul 2018	23,500	4,933,969	1,058	2,863	47,897	48,955	9,025,443
Aug 2018	19,748	4,953,717	529	78	42,578	43,107	9,068,099
Sep 2018	17,855	4,971,572	0	1,716	36,851	36,851	9,106,665
Oct 2018	14,580	4,986,152	0	1,667	29,826	29,826	9,138,158
Nov 2018	15,587	5,001,739	0	2,000	31,668	31,668	9,171,826
Dec 2018	17,887	5,019,626	0	1,000	37,636	37,636	9,210,462
TOTAL	**225,573**		**9,359**	**31,830**	**468,300**	**477,659**	

*Tonnage calculated using a density of 160 pounds per cubic foot.

Table 4.2.b Miscellaneous 2018 Materials Disposal Estimates			
Surface Tailings	**CY**	**Underground**	**CY**
Pressed Sewage Sludge	13	Tires, Sump Sediment, Shop, Mine, Electrical & Mill Refuse	2,800
Pressed Water Treatment Plant Sludge	275		
Incinerator Ash	0		
Site E	0		

4.2.2 Compaction

Historically, tailings placement compaction has been tested to monitor the performance goal of achieving 90 percent or greater compaction relative to a standard Proctor density. HGCMC staff utilizes the sand cone method (ASTM D1556) and the soil density gauge (ASTM D6938) in the field for determining the density of placed tails. Dry densities are calculated and compared to laboratory measured standard Proctors.

In 2018, tailings samples were tested in the HGCMC laboratory on an approximate monthly basis for measurement of 1-pt. Proctor. Samples were also collected at least quarterly and submitted to an off-site laboratory for measurement of 3-pt. Proctor. Laboratory results are shown in Table 4.2.c and are consistent with historical samples. There were no field density measurements collected in 2018.

Table 4.2.c Summary Statistics for Tailings Compaction Testing						
Method	Compaction Variable	Mean	Max	Min	Std. Dev	n
IGES Lab	Std. Proctor ASTM #D698 (pcf)	141	150	135	6	5
	Opt. Moisture (%)	12.3	13.2	11.4	0.8	5
HGCMC Lab 1-pt Proctor	Measured Dry Density (pcf)	135	141	129	4	20
	Measured Moisture (%)	13.6	15.3	12.2	0.9	20

4.2.3 Inspections

Several independent inspections are carried out at the TDF throughout the year. Operators working at the site carry out daily visual work place inspections. The Surface Civil Engineer and/ or Surface Operations Shifter or designees carry out weekly visual inspections of the TDF area, as well as a checklist inspection of Ponds 7 and 10. The environmental department carries out a monthly checklist inspection of the TDF.

An ADNR representative inspected the site once in 2018 on December 6. ADF&G representatives inspected the site 5 times in 2018. During 2018 the USFS conducted 11 routine inspections (Site inspections #391 - #401) to monitor for best management practices effectiveness and compliance to the General Plan of Operations. No issues of non-compliance or poor operations practices of the TDF were noted during the routine inspections. The USFS typically noted that the facility is being developed and operated to required operations and maintenance specifications of GPO Appendix 3.

4.2.3 Acid-Base Accounting (ABA)

Greens Creek Mine tailings contain pyritic sulfur, which through weathering processes can lead to acid generation. However, the tailings also contain significant carbonate, which neutralizes acid. Previous studies have shown that the lag time to acid generation of exposed tailings is on the order of decades. The prevention of acid generation from the TDF is one of the primary management objectives. As part of the standard operating procedure for the TDF, composite samples are collected from the mill filter press on a monthly basis for ABA analyses. Analytical results for samples collected during 2018 are shown in Table 4.2.d below. As shown, tailings samples had an average acid potential of 426 $tCaCO_3$/kt, average neutralization potential of 258 $tCaCO_3$/kt, and an average net neutralization of -169 $tCaCO_3$/kt. A graph showing results from tails monthly composite ABA samples collected since 2001 is included in Attachment L.

Table 4.2.d Tailings Acid-Base Accounting ($tCaCO_3/kt$)			
2018	**Acid Potential**	**Neutralization Potential**	**Net Neutralization Potential**
January	382.27	288.61	-93.66
February	463.57	230.32	-233.25
March	442.67	263.05	-179.61
April	495.47	287.07	-208.40
May	446.32	299.14	-147.18
June	403.90	278.67	-125.23
July	360.90	268.66	-92.24
August	420.46	270.12	-150.33
September	409.69	203.22	-206.47
October	461.71	205.96	-255.76
November	411.85	257.11	-154.73
December	408.26	241.46	-166.80
Average	**426.46**	**257.87**	**-168.58**

4.2.4 Meteorology

HGCMC maintains meteorological stations near the TDF and at the 920 mill that record air temperature, precipitation, relative humidity, barometric pressure, wind speed and wind direction. Table 4.2.e shows temperature and precipitation data collected near the TDF during 2018. Table 4.2.f shows temperature and precipitation data collected at the 920 mill.

Table 4.2.e Meteorological Data at TDF				
Month	**Min Temp (°C)**	**Max Temp (°C)**	**Avg Temp (°C)**	**Precipitation (in)**
January	-11.6	9.8	-0.7	5.3
February	-10.8	4.7	-2.8	1.2
March	-6.0	9.2	1.2	1.6
April	-3.3	13.8	5.2	1.7
May	-0.6	22.1	8.9	5.2
June	3.5	30.5	11.9	3.3
July	8.4	28.5	15.1	2.5
August	7.4	24.3	14.1	4.1
September	1.2	22.2	10.9	2.3
October	-0.5	16.8	7.2	7.8
November	-3.2	9.8	3.4	4.4
December	-4.3	10.2	0.9	2.6
2018			**6.3**	**42.1**

Table 4.2.f Meteorological Data at 920 Mill				
Month	**Min Temp (°C)**	**Max Temp (°C)**	**Avg Temp (°C)**	**Precipitation (in)**
January	-13.6	15.0	-1.9	4.1
February	-12.3	2.8	-4.7	1.7
March	-10.2	10.0	-0.5	2.0
April	-6.4	12.5	3.5	2.2
May	-1.0	20.9	7.6	5.2
June	2.5	27.6	10.5	4.5
July	6.3	27.0	14.1	2.4
August	6.7	24.4	12.9	5.4
September	1.4	20.4	9.9	2.7
October	-0.5	14.5	6.0	9.7
November	-4.8	9.1	2.1	5.8
December	-7.3	6.5	-0.6	5.4
2018			**4.9**	**51.1**

4.2.5 Visual Inspections

In addition to the daily inspections performed by the Surface Operations Department, monthly inspections of the TDF are also performed by the Environmental Department. There were no unsatisfactory findings or action items during the 2018 reporting period.

4.2.6 Water Level Data

The Tailings Facility as-built is shown in Attachment G. The maximum saturated thickness (approximately 35 feet) occurs near the center of the main portion of the pile. However, this elevated water table level does not extend close to the down-slope toe of the pile. The foundations of the West Buttress and southern portion of the pile are well drained, as indicated by typically consistent unsaturated conditions in the blanket drains and at the base of the West Buttress (piezometer 74 in Attachment E). Low head elevations near the pile toe maximize the pile's geotechnical stability. Intermittent head increases in the foundation drains are localized and of short duration and should not have an adverse effect on pile stability.

4.2.7 Dust Monitoring and Abatement

Dust monitoring and abatement is a required mitigation measure in the 2013 Final Environmental Impact Statement and Record of Decision for the TDF expansion. Dust monitoring is also a requirement of the WMP. Since 2011 HGCMC has been monitoring fugitive dust emissions from the TDF using 10-liter Atmospheric Depositional Pails (ADP) mounted approximately 1.3 meters off the ground. Five ADP systems have been deployed 50-100 meters from the base of the dry stack tailings pile. Four of the ADPs loosely correlate to the cardinal points on a compass, with the fifth system in the southwest position. On an approximate two-week cycle, the ADPs are collected and filtered through a pre-weighed 90 mm glass fiber filter with a 1.5-micron pore size. The filters are then dried and weighed in order to measure the total loading. Following this process, the filters are analyzed for total lead and total zinc. Results from the analysis equate to the amount of material that passes through the opening of the ADP over a known period. Therefore, it is possible to calculate the average daily load per given area.

Data presented in Tables 4.2.g through 4.2.i supports and verifies the statements made previously about the seasonality (winter) of fugitive dust emissions: the majority of the dusting occurs under cold, dry desiccating conditions with moderate wind speeds from the north or northeast. These conditions typically occur for short periods between mid-December and late February. For presentation of results (Table 4.2.g and Table 4.2.i), the annual ADP data is grouped into two general time periods, November 13th through March 11th (Period 1) and March 12th through November 12th (Period 2). This equates to a 120-day duration for Period 1 and a 245-day duration for Period 2 (Table 4.2.h). The south and southwest ADP systems, which are downwind of the TDF, historically have higher rates of loading than the others. As shown in Table 4.2.i, the vast majority of the loading in these two systems occurs during Period 1 (winter).

Table 4.2.g Summary of 2018 Lead Loading by Period at the TDF							
	Period Start Date	West $\mu g/m^2$/period (Lead)	Southwest $\mu g/m^2$/period (Lead)	South $\mu g/m^2$/period (Lead)	Northeast $\mu g/m^2$/period (Lead)	East $\mu g/m^2$/period (Lead)
Period 1	01/10/18	188	172	27,045	126	189
	01/17/18	380	694	126,452	233	858
	02/08/18	256	258	1,269	246	222
	02/20/18	487	480	6,993	314	266
Period 2	03/12/18	270	383	13,157	186	458
	03/28/18	492	422	1,408	241	295
	04/12/18	283	344	804	172	855
	04/26/18	319	154	473	273	592
	05/10/18	787	116	816	541	760
	05/23/18	858	312	475	246	499
	06/06/18	750	529	336	519	753
	06/21/18	814	111	309	507	709
	07/05/18	283	78	200	370	614
	07/18/18	1,445	61	113	424	507
	08/02/18	841	326	210	278	383
	08/15/18	612	125	225	305	546
	09/05/18	273	178	1,279	263	169
	09/24/18	524	383	668	417	439
	10/15/18	358	275	495	305	297
	10/29/18	373	225	356	290	239
Period 1	11/13/18	258	348	490	280	261
	12/04/18	402	283	509	275	283
	Total	**11,252**	**6,256**	**184,081**	**6,810**	**10,192**
		$\mu g/m^2$/year	$\mu g/m^2$/year	$\mu g/m^2$/year	$\mu g/m^2$/year	$\mu g/m^2$/year

The data collected to date shows that the zinc loading from fugitive dust emissions is consistently nearly double the quantity of lead loading, as is illustrated graphically in Attachment K. This is due to the tailings composition, which typically contain at least two times the amount of zinc compared to lead. However, this report focuses on the lead loading data because monitoring performed under the FWMP has identified lead levels in three shallow peat wells south (Site 27) and west (Site 29 and Site 32) of the TDF that approach or exceed Alaska water quality standards. The formation water in these wells is generally very dilute (low conductivity and hardness) and acidic (due to the organic acids), which is ideal for promoting lead mobility. Dust from the tailings pile may contribute to the lead levels observed in these wells. Table 4.2.g presents the lead loading data from all five ADP systems in 2018. Table 4.2.h presents a summary of the standard dust loading periods and Table 4.2.i yearly lead loading data from the west, southwest and south ADP's.

Table 4.2.h Summary of Dust Loading Periods

Period	Date Range	Days	Percentage of Year
1	Winter: January 1st through March 11th and November 13th through December 31st	120	33%
2	Spring, Summer, Fall: March 12th through November 12th	245	67%

Table 4.2.i Summary of Yearly Lead Loading at the west, southwest, and south ADPs

Year	Period	West Lead $\mu g/m^2/year$	Percent	Southwest Lead $\mu g/m^2/year$	Percent	South Lead $\mu g/m^2/year$	Percent
2014	1	50,121	83%	25,819	74%	109,552	97%
	2	10,202	17%	8,871	26%	3,771	3%
	Total	**60,323**	$\mu g/m^2/year$	**34,691**	$\mu g/m^2/year$	**113,323**	$\mu g/m^2/year$
2015	1	66,646	75%	75,122	92%	203,723	97%
	2	22,257	25%	6,684	8%	5,401	3%
	Total	**88,904**	$\mu g/m^2/year$	**81,806**	$\mu g/m^2/year$	**209,124**	$\mu g/m^2/year$
2016	1	5,059	42%	3,606	53%	73,926	91%
	2	7,016	58%	3,154	47%	7,180	9%
	Total	**12,075**	$\mu g/m^2/year$	**6,760**	$\mu g/m^2/year$	**81,106**	$\mu g/m^2/year$
2017	1	3,973	45%	10,044	59%	117,410	84%
	2	4,879	55%	6,919	41%	21,928	16%
	Total	**8,852**	µg/m2/year	**16,963**	µg/m2/year	**139,338**	µg/m2/year
2018	1	1,972	18%	2,235	36%	162,757	88%
	2	9,280	82%	4,021	64%	21,324	12%
	Total	**11,252**	$\mu g/m^2/year$	**6,256**	$\mu g/m^2/year$	**184,081**	$\mu g/m^2/year$

For 2018, the south ADP had the highest yearly accumulative lead load of 184,081 µg/m^2 followed by the west system with accumulative lead load of 11,252 µg/m^2. The southwest, east and northeast systems were comparable with values between 6,000 and 11,000 µg/m^2 (Table 4.2.g).

Based on the predominant winds out of the north/northeast and the fact that tailings placement occurred mostly in the S3P1 area (79%) the expected area of loading would occur to the south of the TDF as supported by the data. Construction season activities at the TDF in 2018 contributed to Period 2 loading values. Reduced activity in the west and northwest portions of the TDF and placement of interim organic cover on the north side of the TDF led to lower loading in the west and southwest system relative to previous years.

The following measures are taken to reduce dust loss from the tailings pile:

- Snow fence were installed on the north and south crests of the tailings pile
- Three rows of wind fence were installed on the northern border of the TDF with an additional one placed on the southern end at the upper elevation of the pile
- Snow removal is limited to only active placement areas
- Interim slopes are covered with rock
- Outer slopes are hydroseeded where appropriate
- Water is applied to areas of tailings during below freezing temperatures to create an ice layer
- Open surfaces are kept at a minimum

4.2.8 West Tailings Water Quality Monitoring

Further Creek is the drainage located immediately west of the TDF. This drainage is monitored to determine if leakage is occurring from the facility. Attachment M provides water quality graphs for Further Creek Lower Reach (Site 609), Further Creek North Fork (Site 610), and Further Creek South Fork (Site 611).

4.3 Internal Water Quality Monitoring

Internal water quality monitoring refers to sampling conducted within the boundaries of the TDF. Sample locations include wet wells that collect flows from above liner and below liner drains. This water is contained within the TDF and is routed to treatment facilities prior to discharge under the HGCMC APDES permit. Therefore, water quality data is not compared to AWQS. The objective of the monitoring is to provide a continuing perspective on in-pile geochemical processes. Maps showing these monitoring locations is provided in Attachment J.

Attachment A provides water quality graphs for Wet Well 3 (Site 380), Wet Well A (Site 1789), Wet Well 14 (Site 2066), S3P1 Expansion above liner drains (Site 1922), and the East Ridge Expansion above liner drains (Site 1424).

Water quality graphs for below liner drains in the East Ridge Expansion (Site 1422), Pond 7 (Site 396), Pond 10 (Site 1924), and the S3P1 Expansion (Sites 1918, 1919, and 1920) are provided in Attachment B. Water quality of the below liner drains in the S3P1 Expansion area is potentially influenced by the imported construction rock.

The current year results are consistent with past years and a detailed analysis of water quality within the TDF can be found in the *Tailings and Production Rock Site 2014 Annual Report.*

4.5 Site as-built

As-built drawings for the TDF are presented in Attachment G. The drawings depict the year-end topography, water management features, monitoring device locations and other significant features of the site. There is an additional drawing that includes cross sections that show the following TDF features:

- existing topographic surface
- prepared ground upon which the pile was constructed

4.6 Reclamation and Closure Plan

HGCMC maintains and periodically updates its reclamation plan and cost estimate for closure, reclamation and long-term maintenance and monitoring (GPO Appendix 14 with attachments). The Reclamation Plan includes all estimated costs (labor, materials, equipment, consumables, administration, monitoring, and long-term maintenance) for task specific work associated with the final closure of the property under a default scenario.

The elements of the plan encompass the entire mine site and include reclamation performance monitoring and facility maintenance after final closure according to the Waste Disposal Permit standards.

The Stage 3 Tailings Expansion process included a National Environmental Policy Act (NEPA) review through an Environmental Impact Statement (2013 EIS) to analyze the potential environmental effects of the project. The renewed Waste Management Permit (Permit Number 2014DB0003) included the increased disturbance from the TDF expansion.

In 2018 HGCMC updated the reclamation and closure plan to account for changes in reclamation material volumes and future pond construction costs. These changes resulted in an increase to the bonding liability. The financial instruments to cover this increase were provided and accepted. With inflation proofing the financial instruments will cover the $89,656,414 reclamation cost.

As part of the WMP renewal, HGCMC submitted (12 April 2019) an updated bond model, and reclamation and closure plan to the applicable agencies. It is expected that this update will be incorporated into the renewed WMP.

4.6.1 Reclamation Projects

HGCMC continued using interim reclamation measures, such as hydroseeding and various erosion controls at the TDF, to improve and maintain established site controls. HGCMC also continued the use of other sediment control measures including silt fencing, jute mat, rock check dams, solid and flexible runoff collection pipes, coarse-rock slope armoring and slope contouring throughout the site. HGCMC is committed to the continued use of site controls as the operation has consistently demonstrated the benefits of these interim reclamation programs to reduce impacts during the operational period.

5.0 WASTE ROCK SITE 23

5.1 Background

Site 23 was constructed in 1995 and is currently the only active surface placement area for waste rock besides the TDF. The site boundary covers approximately 18 acres and has an estimated capacity to receive up to 1.2 million cubic yards of waste rock. See the Site 23 as-built in Attachment H for facility layout. The site is under the regulatory authority of the Forest Service and the ADEC.

5.2 Site 23 Operation and Management

HGCMC manages Site 23 to safely receive material during production, maintain pile stability and reduce impacts to the receiving environment. This is accomplished through proper classification and segregation of waste rock, placement methodologies, and implementation of best management practices to control surface drainage. A detailed description of Site 23 operation and management, including standard operating procedures, is presented in GPO Appendix 11 – Waste Rock Management Plan.

5.2.1 Inspections

Several independent inspections are carried out at Site 23 throughout the year. Operators working at the site carry out daily visual work place inspections. The Senior Civil Engineer, Junior Civil Engineer and or Surface Operations Shifter carry out weekly visual inspections. The Environmental department carries out a monthly checklist inspection. No visible signs of physical instability were observed at Site 23 during this report period.

An ADNR representative inspected the site once in 2018 on December 6. ADF&G representatives inspected the site 5 times in 2018. During 2018 the USFS conducted 11 routine inspections (Site inspections #391 - #401) to monitor for best management practices effectiveness and compliance to the General Plan of Operations. No issues of non-compliance or poor operations practices of the Site 23 were noted during the routine inspections. The USFS typically noted that the facility is being developed and operated to required operations and maintenance specifications of GPO Appendix 11.

5.2.2 Placement Records

Table 5.2.a shows the quantity of waste rock placed at Site 23 during this reporting period. This represents the combined total of Class 1, Class 2 and Class 3 waste rock, as determined by the underground geologists. Class 4 waste rock remains underground as backfill. Some of the Class 1 rock (argillite) is used in the TDF, however prior to it is stockpiled at Site 23.

Table 5.2.a Site 23 Production Rock Placement								
Date	Surveyed Volume		Tonnage					
	Monthly (cy)	Cumulative (cy)	Class 1 (tons)	Class 1* (tons)	Class 2 (tons)	Class 3 (tons)	Monthly (tons)	Cumulative (tons)
Jan 2018	2,543	1,041,743	3,829	-2,151	3,192	112	4,982	1,763,452
Feb 2018	2,947	1,044,690	7,018	-3,820	1,141	1,451	5,790	1,769,242
Mar 2018	6,809	1,051,499	4,299	-62	3,332	3,437	11,006	1,780,248
Apr 2018	4,210	1,055,709	2,780	0	5,618	280	8,678	1,788,926
May 2018	5,688	1,061,397	1,131	0	8,599	1,484	11,214	1,800,140
Jun 2018	6,943	1,068,340	4,569	-1,739	9,553	223	12,606	1,812,746
Jul 2018	7,638	1,075,978	98	-1,058	13,028	0	12,068	1,824,814
Aug 2018	8,720	1,084,698	1,954	-529	11,313	0	12,738	1,837,552
Sep 2018	2,433	1,087,131	1,782	0	2,524	230	4,536	1,842,088
Oct 2018	6,737	1,093,868	6,077	0	5,558	98	11,733	1,853,821
Nov 2018	3,332	1,097,200	676	-1,622	3,918	490	3,462	1,857,283
Dec 2018	2,801	1,100,001	2,146	0	2,153	483	4,782	1,862,065
TOTAL	**60,801**		**36,359**	**-10,981**	**69,929**	**8,288**	**103,595**	

* Some Class 1 material is used in the tailings disposal facility.

5.2.3 Acid-Base Accounting (ABA)

Waste rock from the mine generally consists of two varieties, argillite and phyllite. Characterization of Greens Creek Mine argillite and phyllite using ABA and other laboratory and field testing indicates that argillite is clearly not acid generating and that most samples of phyllite are potentially acid generating. Due to these characteristics, management objectives have been established for management of waste rock materials.

Management and routing of waste rock initiates in the underground mine. Production geologists visually inspect the active mining face and muck piles to determine the waste rock lithology and pyrite content, estimate the Net Neutralization Potential value and assign the heading a class (1-4). Chip samples of the headings are collected and sent to a lab for ABA analysis. The ABA results help document the types of material produced and validates the visual classification system. Attachment L shows the results from the monitoring period visual inspections. Development occurred in ore zones hosted by Class 1 and Class 2 rock. No Class 3 or Class 4 rock was identified by geologists or in laboratory analyses. Results show a correct class determination of 59.3 percent, with 31.5 percent overestimation and a 9.3 percent underestimation out of a total of 54 samples. The overestimation results indicate that the geologist responsible for conducting the visual class determination categorized the rock as a rock with a higher acid generating potential when in fact the laboratory result indicated that the rock had a higher carbonate buffering capacity and a lower acid generating potential. Results for the monitoring period are consistent with previous year's conservative visual inspections. Samples are also collected on a quarterly basis from the active placement areas on Site 23. These results are shown in Attachment L.

The ABA results from samples of Class 1 and Class 2/3 waste rock collected from Site 23 during the monitoring period are shown in Table 5.2.b below and in graph form in Attachment L.

Table 5.2.b Site 23 Acid-Base Accounting ($tCaCO_3/kt$)			
Class / Sample Date	**Acid Potential**	**Neutralization Potential**	**Net Neutralization Potential**
Class 1 – 03/26/18	63.1	393.8	330.7
Class 1 – 03/26/18	73.1	429.4	356.3
Class 1 – 5/18/18	68.4	420.0	351.6
Class 1 – 5/18/18	56.6	333.8	277.2
Class 1 – 9/24/18	112.2	355.1	242.9
Class 1 – 9/24/18	109.4	374.9	265.5
Class 1 – 11/14/18	76.6	324.5	247.9
Class 1 – 11/14/18	61.9	295.9	234.0
Class 1 Average	**77.7**	**365.9**	**288.3**
Class 2/3 – 03/26/18	253.8	447.5	193.8
Class 2/3 – 03/26/18	220.6	509.4	288.8
Class 2/3 – 5/18/18	100.9	224.4	123.5
Class 2/3 – 5/18/18	132.8	283.1	150.3
Class 2/3 – 9/24/18	125.6	108.0	-17.6
Class 2/3 – 9/24/18	136.9	99.3	-37.6
Class 2/3 – 11/14/18	170.3	76.2	-94.1
Class 2/3 – 11/14/18	18.0	19.2	1.2
Class 2/3 Average	**144.9**	**220.9**	**76.0**

5.2.4 Stability

The design, construction, placement methodologies, and implementation of best management practices to control surface runoff ensure the stability of Site 23. The facility is constructed from the bottom up on a prepared foundation. As the height increases, native material is excavated from the backslope and the excavated volume is replaced with production rock. The production rock is placed in 0.6 meter lifts with a dozer and compacted with a 12 ton drum compactor at the end of each shift. Exterior slopes are constructed with a 3H:1V maximum overall slope. Drainage of the foundation is facilitated by a series of finger drains. Upslope diversion ditches route non-contact runoff water around the facility. Surface runoff and drainage from the pile is collected and routed to treatment facilities.

5.2.5 Slope Monitoring

Geotechnical investigations have concluded that Site 23 is constructed on top of a large regional block slide or sackung, which is defined as a deep-seated gravitational deformation. Four inclinometers have been installed to monitor the movement of the slide. Based on stability analysis, geotechnical engineers have recommended a trigger level for the amount of movement that would warrant an immediate data review and potential remedial action. The recommended trigger is 25.4 millimeters of movement per month or 76.2 millimeters total at the slide plane. Table 5.2.c lists the inclinometers, their general location, the amount of movement measured from October 2017 through October 2018, and the total movement since installation.

Table 5.2.c Site 23 Inclinometers					
Inclinometer ID	**Location**	**Movement 10/2017 – 10/2018**	**Primary Total Movement since Initial Reading**	**Primary Movement Depth (bgs)**	**Initial Reading Date**
IN-23-10-01	Site D	0 mm	0 mm	n/a	Nov. 2010
IN-23-05-01	Central Site 23	6.0 mm	47.0 mm	79.3 ft	Oct. 2006
IN-23-10-02	West of Site 23	2.0 mm	19.2 mm	114.4 ft	Nov. 2010
IN-23-10-08	Above Site 23	1.8 mm	18.5 mm	131.8 ft	Sep. 2010

Note: 1-inch = 25.4 mm; bgs = below ground surface

Inclinometer IN-23-05-01 was installed at Site 23 at the end of 2005 to aid with stability monitoring at Site 23/D. This inclinometer, located at the central area of the site, has been monitored since 2006, with the baseline reading taken in October 2006. The monitoring instrument was most recently calibrated in December 2017. The measurements are presented as incremental displacement and a time plot (Attachment I). A positive deviation on the A axis and a negative deviation on the B axis indicate southerly (downslope) and easterly deviations, respectively. The incremental displacement chart (Attachment I) shows the location and magnitude of displacement since the initial 2006 reading. Displacements at the top of the hole are attributed to frost heaving, grout settling, and damage from bear activity. The incremental displacement view shows the amount of movement has been approximately 47 mm (from 2006 through October 2018; less than approximately 2-inch total movement, refer to time plot). The movement rate increased from an average 3 mm/year (May 2013) to 5.2 mm (May 2013 – Oct 2014). Approximately 6 mm of movement was observed from October 2017 to October 2018. Movement appears to be confined to a surface approximately 79.3 feet below ground surface (864.8 ft elevation). This depth roughly corresponds to the base of the slide/colluvium unit and the top of the dense till in the foundation.

Three additional inclinometers were installed at Site 23 during the summer of 2010 and baseline readings were taken September and November (after instrument calibration). Readings in inclinometers IN-23-10-01, IN-23-10-02, and IN-23-10-08 are consistent with the data obtained previously from IN-23-05-01. Inclinometer IN-23-10-01 was installed in the lower portion of Site D and no movement has been observed in this inclinometer. Inclinometer IN-23-10-02 was installed west of the mid-slope of Site 23 and approximately 2.0 mm of movement was observed at approximately 114.4 ft bgs from October 2017 to October 2018 (approximately 19.2 mm total incremental movement since November 2010). This movement is along a silty sand lens between silt and the glacial till. Inclinometer IN-23-10-08 was installed at the top of Site 23 and the movement zone ranges from 125.8 to 135.8 ft bgs. This movement zone is below the landslide materials and just above the glacial till. The maximum movement in this zone was about 1.8 mm at 131.8 ft bgs from October 2017 to October 2018, with rate remaining relatively constant (approximately 18.5 mm total incremental movement since November 2010).

The 2011 (KCB, 2012) Site 23/D stability update provided recommendations for trigger level monitoring for inclinometer movement rates and piezometer water levels for instrumentation installed at Site 23/D, to ensure stable static site conditions. More frequent monitoring and site reassessment for stability becomes necessary if movement is documented along the slide plane in excess of 1 inch (25.4 mm) per month, or 3 inches (76.2 mm) total. Immediate notification and response action is necessary if movement along the slide plane in excess of 4 inches (101.6 mm) per month is documented. For water levels, the general guidelines are that if water levels are trending 5-ft above the winter average for a given piezometer, that the Surface Operations Manager should notify the Design Engineer for further assessment. If the water levels are trending 10-ft above the winter average for a given piezometer, appropriate emergency response notifications and actions shall be implemented. Piezometer levels are discussed further in the next section of this report.

5.2.6 Water Level Data

Well and piezometer water level data are provided in Attachment F. The lack of significant pressure in piezometers installed close to the base of Site 23 demonstrates that the pile remains free draining. This is consistent with the construction of a network of finger drains under the pile and a blanket drain at the pile toe. The lack of pore pressure at the toe indicates that pile stability has been maximized. The inferred water table is 30 to 60 feet below the base of the production rock pile material up-slope of the Site 23 active placement area and 5 to 20 feet below the base of material placed in Site D and the toe of Site 23, respectively. Observations from wells completed in the colluvium below the sites indicate that perched water tables and braided flow paths exist beneath the site (e.g. compare MW-23-A2D and MW-23-A2S). This unit also shows large (up to 10 feet) fluctuations in head levels, which are consistent with perched, confined conditions and channel-like flow. There is a distinct seasonal pattern to the water level fluctuations beneath Site 23/D, particularly in the alluvial sands (MW-23-A4 and MW-D-94-D3).

The silty/clay till that underlies the colluvial unit impedes downward flow and has an upward hydrologic gradient caused by its confining the more permeable bedrock below it. MW-23-98-01 is completed in the till unit and indicates a water table near the top of the till, which is approximately 100 feet below the existing topographic surface. Alluvial sands occur between the colluvial unit and the silt/clay till near the toe of Site 23 and under Site D. Data from MW-23-A4 and MW-D-94-D3 indicate that the sands are saturated. A curtain drain installed in between Site D and Site 23 in 1994 collects water that flows at the base of the colluvial unit and the top of the alluvial sands (see as-built and sections in Attachment H). This drain helps reduce pore pressures in the foundation of Site D, as well as capturing infiltration waters from Site 23.

5.2.7 Hydrology

Surface and groundwater are managed using a network of drains, ditches and ponds at both Site D and Site 23. See the Site 23 as-built (Attachment H) for locations of these features. Water that is collected in the finger drains beneath Site 23 is routed to Pond 23 along with Site 23 runoff via a lined ditch. Pond 23 also periodically receives stormwater via pipeline from the 920 area. A curtain drain below the toe of Site 23 captures groundwater from the colluvial unit beneath the site and reports to the Pond D wet well via pipelines. Pond D also captures surface water and drainage from seeps near the toe of Site D. Pond D water is returned to the Pond 23 pump station where it is either sent to the Mill or down to the Pond 7 water treatment facility. An 18” HDPE pipeline was installed in 2008 to carry stormwater from Pond 23 (which receives water from Pond D) to the Pond 7 water treatment facility. This pipeline, along with the installation of new pumps, increased the stormwater handling capacity of Site 23/D to a 25-year 24-hour storm. Monthly temperature and precipitation data at the Mill are provided in Table 4.2.f.

5.3 Internal Water Quality Monitoring

Internal water quality monitoring refers to sampling conducted within the boundaries of Site 23. Sample locations include the finger drains beneath Site 23, outlets of the curtain drain that was installed below the toe of Site 23, and three monitoring wells in Site 23 and Site D. The finger drains have been monitored extensively since 1999, and are currently monitored on a quarterly schedule. The curtain drain outlets have been monitored since 2003 and are sampled at least annually. The finger drains, and curtain drains with sufficient flow were sampled during this reporting period. Water quality graphs showing the past five years of monitoring data for the Site 23 finger drains (site numbers 310 – 316) are included as Attachment C. Water quality graphs for the Site D drain outlets (site numbers 317, 319 and 328 – 330) are included in Attachment D. These flows are captured and routed to treatment facilities. For a detailed analysis of water quality within the Site 23 / D see the *Tailings and Production Rock Site 2014 Annual Report.* The current year results are consistent with past years and suggest that carbonate minerals in the waste rock continue to maintain near-neutral to alkaline conditions in the drainage from Site 23/D.

6.0 UNDERGROUND MINE WASTE DISPOSAL

Disposal of wastes in the underground workings as backfill is authorized under the WMP. The majority of the backfill consists of cemented tailings and Class 4 waste rock. Other wastes include tires, steel, and small quantities of inert wastes as authorized in the WMP. Table 6.0.a lists the quantities of tailings and waste rock disposed in the underground mine during this reporting period.

Table 6.0.a Quantities of Wastes Disposed in Underground Mine

2018	Tailings (DST)	% of tailings generated	Waste Rock (tons)
January	21,886	38%	10,678
February	19,567	36%	7,296
March	24,287	44%	7,160
April	25,133	47%	5,510
May	21,650	40%	5,596
June	23,285	43%	2,300
July	19,357	33%	5,493
August	20,455	38%	10,961
September	27,701	45%	5,421
October	33,133	58%	6,007
November	21,040	41%	4,457
December	31,197	52%	5,486
Total	**288,692**		**76,365**

7.0 POND 7 / 10 SYSTEM

7.1 Background

The Pond 7 Dam and Pond 10 Dam are referred to collectively as the Pond 7/10 Dam System. The combined capacity is 66.7 acre-ft (21,760,000 gallon) of off channel impoundment designed to retain direct surface runoff and underdrain flows from the TDF, and water via pipelines from the Hawk Inlet Port Facility, Waste Rock Site 23, and the 920 facilities. The design capacity is for containment of the 25-yr/24-hr storm event for the TDF and Site 23, and the 10-yr/24-hr storm event for Hawk Inlet and the 920 facilities. The ponds are located southwest of the TDF.

Pond 7 was constructed in 2005 and has a capacity of 31.5 acre-ft (10,260,000 gallon). It consists of rock fill embankments on the west and southwest sides. The pond bottom and other embankments are bedrock excavations. The pond was constructed with 80-mil HDPE liner placed over a sand bedding layer and has an underdrain collection system. Pond 7 and its embankments are regulated by the Alaska Department of Natural Resources (ADNR) as a Class III Dam (NID No. AK 00307). As required by the ADNR – Dam Safety and Construction Unit, HGCMC prepared an Operation and Maintenance Manual for Pond 7 that lists the operational, maintenance, monitoring and inspection records for the dam and all supporting infrastructure.

As part of the recent expansion of the TDF, HGCMC constructed Pond 10 in 2016-17 to provide adequate containment volume for the modeled 25-yr/24-hr storm event. Pond 10 is 35.2 acre-feet (11,500,000 gallon) pond built adjacent to Pond 7 and interconnected via five, 36-inch diameter pipes. The pipes are set at an elevation that flow between the ponds occurs when Pond 7 reaches approximately 70 percent capacity. Pond 10 is primarily excavated in bedrock and clay, and was constructed with a double layer, 80-mil HDPE liner system. Pond 10 is also regulated by the ADNR as a jurisdictional dam (NID No. AK00316).

7.2 Stability

Pond 7/10 Dam System embankment stability is assessed by conducting annual GPS surveys of permanently embedded concrete monuments. Pond 7 surveys were conducted at a higher frequency until 2011, and then reduced to annual surveys due to the limited movement measured. Key performance parameters require a horizontal movement of less than 3 inches per year and a vertical movement of less than 6 inches per year. Since 2007, the total horizontal and vertical movement for Pond 7 has been well below the threshold. Surveys of the Pond 10 monuments are currently being conducted monthly but will be reduced to semi-annually in 2019. The survey results to date for both ponds do not indicate any concerns with stability of their associated embankments.

7.3 Visual Inspections

Visual inspections of Pond 7/10 Dam System and the embankments are performed on a weekly basis and following significant precipitation and seismic events. Records of the inspections (checklists) are retained at the Pond 7 WTP. There were no unusual findings or observations during this reporting period.

7.4 Water Balance

All waters captured by containment systems and waste waters generated by facility processes are collected in Pond 7/10 Dam System for subsequent treatment and discharge to Hawk Inlet under the HGCMC APDES permit. As required by the APDES permit, HGCMC performs continuous monitoring of effluent discharge flows. The primary sources include the mill process water, Pond 23 flow (all combined groundwater and storm water collected from the underground mine, 920 area and Site 23), the Hawk Inlet port facilities (combined storm water, waste water from the camp facilities and truck wash water), and flows from the TDF area (surface runoff, underdrain collection systems and the truck wash).

Flows from individual sources are highly variable on a day-to-day basis depending on site operations and weather conditions. Operational experience has shown that the percentage of flow from the primary sources is within consistent ranges when longer time periods, such as monthly, are viewed. These ranges are as follows:

- 40 – 50%: Mill process water
- 30 – 40%: Pond 23
- 15 – 20%: Tailings area
- 1 – 3%: Hawk Inlet facilities

Process water generated by the mill remains fairly consistent on a monthly basis. Typically, about 50% of the process water is recycled through the mill and the remainder is sent to the Pond 7 WTP for treatment and discharge. The long-term average flow rate of mill process water to the Pond 7 WTP is about 500 gpm.

Underdrains from a large portion of the TDF are routed to Wet Well 3, Wet Well A, and Wet Well 14. The monthly total volume and average flow rate from each wet well is shown in Table 7.4.a.

The total volume of water and average flow in gallons per minute that was treated and discharged from the Pond 7 WTP, during this reporting period, is shown in 7.4.a.

<table>
<tr><th colspan="7">Table 7.4.a Tailings Facility Underdrain Flows and Pond 7 Treated Volume</th></tr>
<tr><th>2018</th><th colspan="2">Wet Well 3
Flow Data</th><th colspan="2">Wet Well A & Wet Well 14
Flow Data</th><th colspan="2">Pond 7 Treated Volume
Flow Data</th></tr>
<tr><th>Month</th><th>Total
(gallons)</th><th>Average Flow
(gpm)</th><th>Total
(gallons)</th><th>Average
Flow
(gpm)</th><th>Total
(gallons)</th><th>Average
Flow
(gpm)</th></tr>
<tr><td>January</td><td>455,400</td><td>10.2</td><td>998,892</td><td>22.4</td><td>51,425,337</td><td>1,152</td></tr>
<tr><td>February</td><td>307,600</td><td>7.6</td><td>618,782</td><td>15.3</td><td>29,576,500</td><td>734</td></tr>
<tr><td>March</td><td>374,100</td><td>8.4</td><td>709,661</td><td>15.9</td><td>43,832,774</td><td>982</td></tr>
<tr><td>April</td><td>324,000</td><td>7.5</td><td>609,841</td><td>14.1</td><td>36,257,346</td><td>839</td></tr>
<tr><td>May</td><td>345,200</td><td>7.7</td><td colspan="2" rowspan="4">Totalizer not functioning</td><td>37,297,528</td><td>836</td></tr>
<tr><td>June</td><td>276,000</td><td>6.4</td><td>53,871,378</td><td>1,247</td></tr>
<tr><td>July</td><td colspan="2" rowspan="3">Totalizer not functioning</td><td>33,882,341</td><td>759</td></tr>
<tr><td>August</td><td>40,251,293</td><td>902</td></tr>
<tr><td>September</td><td>945,979</td><td>21.9</td><td>36,587,460</td><td>847</td></tr>
<tr><td>October</td><td>818,400</td><td>18.3</td><td>1,314,579</td><td>29.4</td><td>59,919,714</td><td>1,342</td></tr>
<tr><td>November</td><td colspan="2">Totalizer not functioning</td><td>1,914,260</td><td>44.3</td><td>53,622,242</td><td>1,241</td></tr>
<tr><td>December</td><td>267,800</td><td>6.0</td><td>1,165,535</td><td>26.1</td><td>51,515,063</td><td>1,154</td></tr>
</table>

8.0 REFERENCES

Alaska Department of Environmental Conservation (ADEC) Division of Air and Water Quality, Waste Water Discharge Program. *Waste Management Permit 2014DB0003, Hecla Greens Creek Mining Company.* August 11, 2014.

Hecla Greens Creek Mining Company, 2018. General Plan of Operations, Appendix 3: Tailings Disposal Facility Management Plan, July 2018.

Hecla Greens Creek Mining Company, 2014. General Plan of Operations, Appendix 1: Integrated Monitoring Plan, November 2014.

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Hecla Greens Creek Mining Company, 2018. General Plan of Operations, Appendix 14: Reclamation and Closure Plan, July 2018.

Hecla Greens Creek Mining Company, 2013. Pond 7–AK00307 Operation and Maintenance Program, Revised January 2013.

Klohn Crippen, 2012, Site 23 / D Geologic Model and Stability Assessment Update. April 2012.

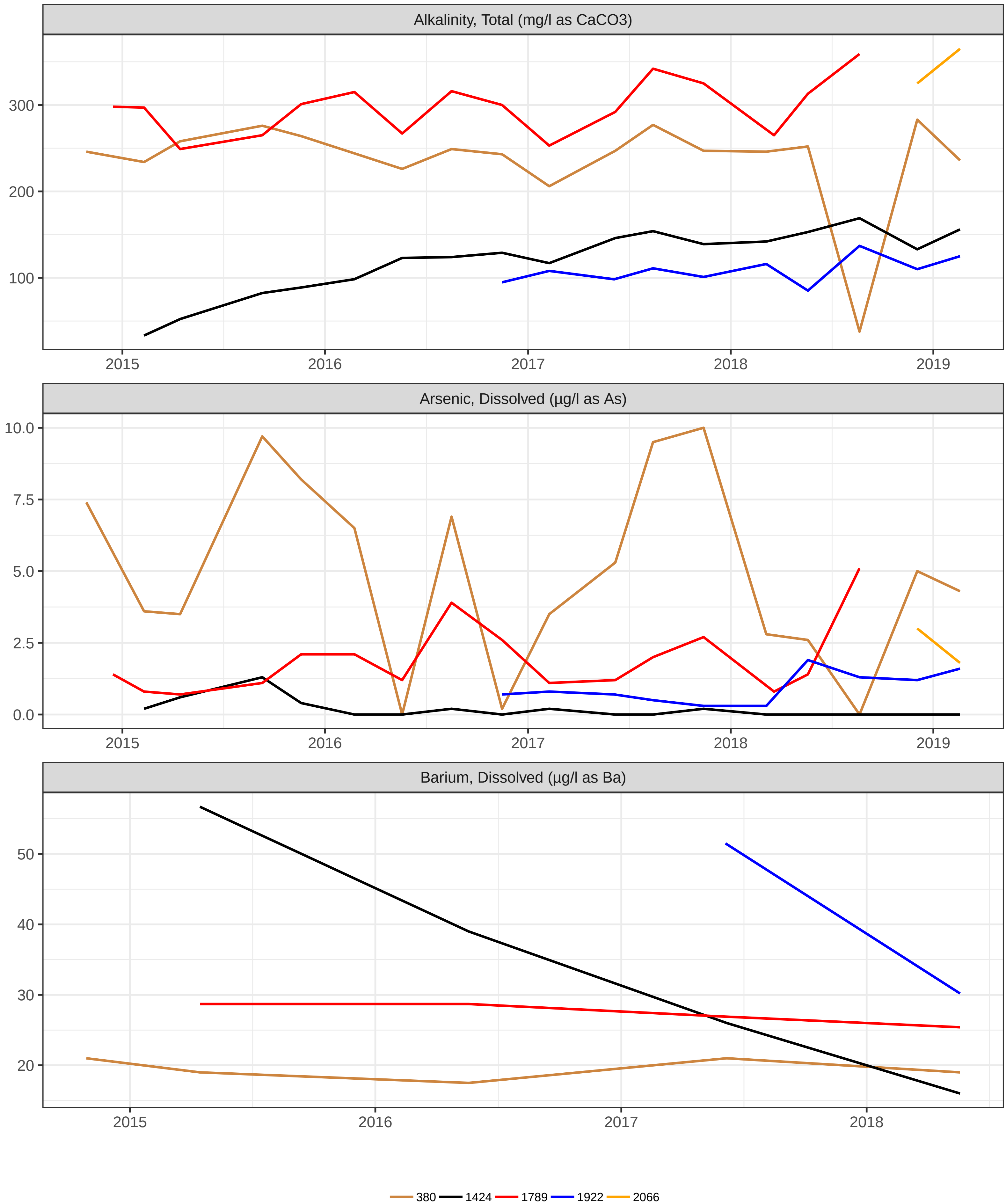
USDA, Forest Service, 2013 Greens Creek Mine Tailings Disposal Facility Expansion, Final Environmental Impact Statement and Record of Decision, Vol 1. September 2013.

Kane, William J., 2018. Aquatic biomonitoring at Greens Creek Mine, 2018. Technical Report No. 19-07. Alaska Department of Fish and Game, Douglas, AK.

Attachment A:

Tailings Area Above Liner Drains

ATTACHMENT A
Tailings Area Above Liner Drains



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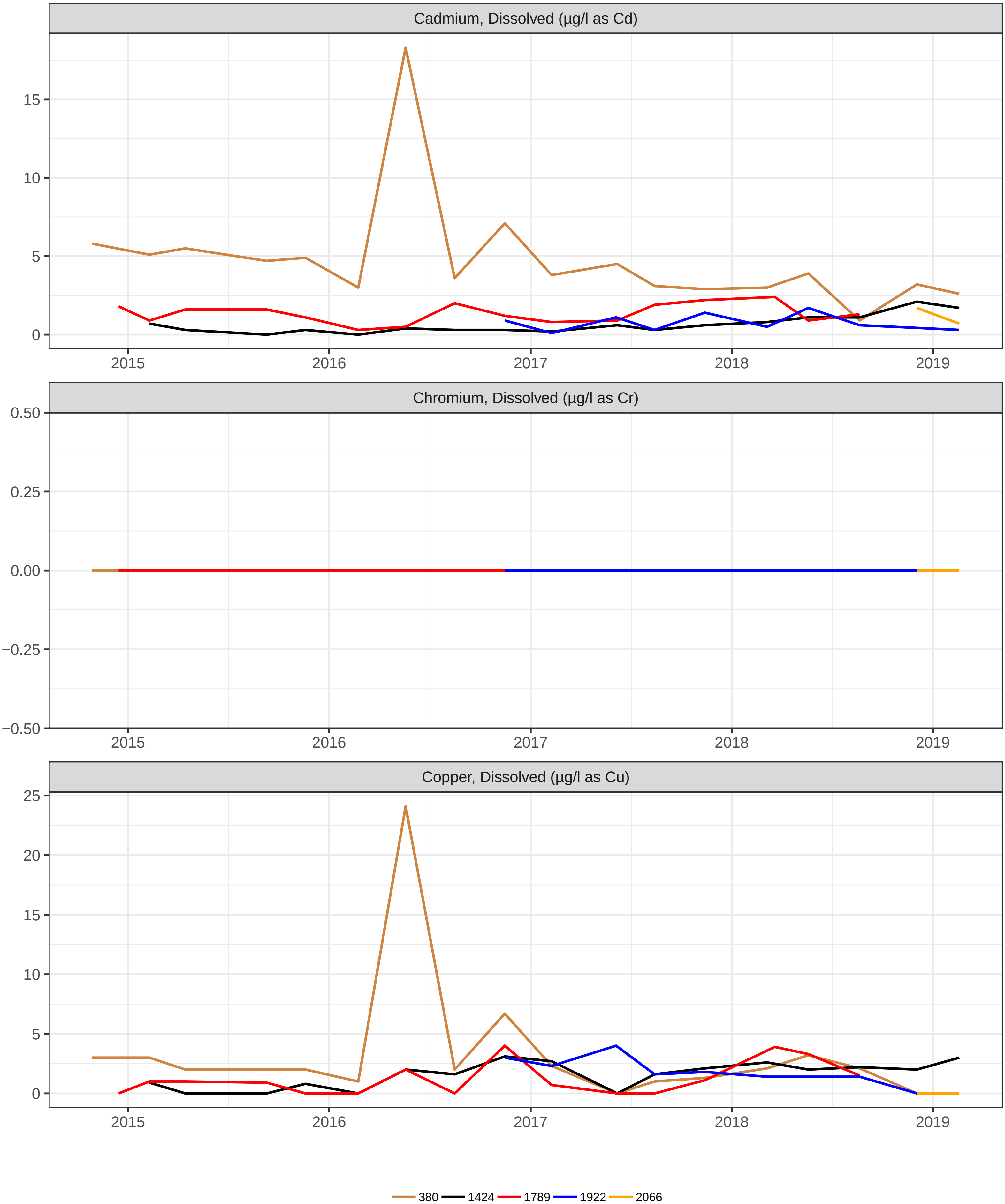
Tailings Area Above Liner Drains



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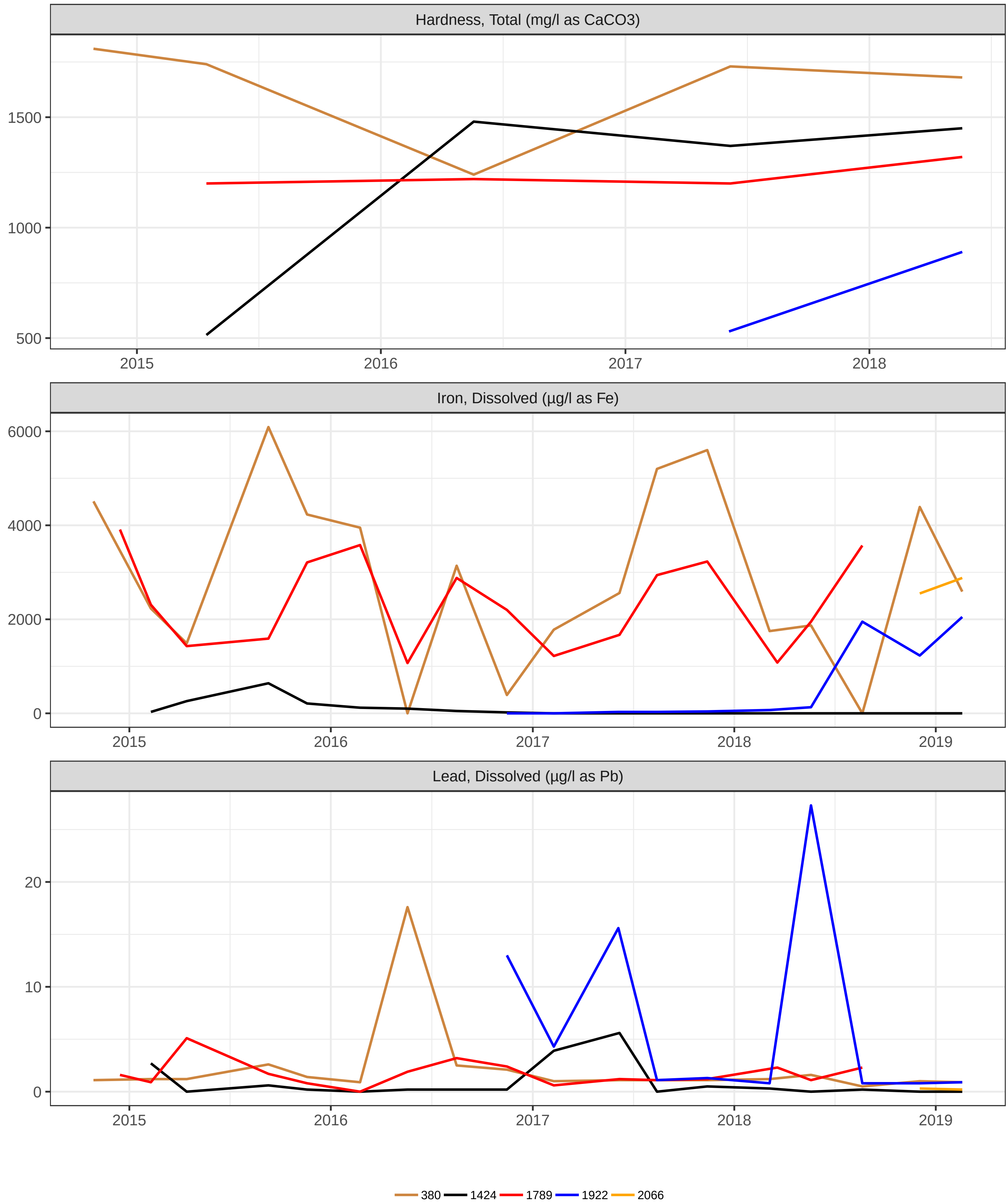

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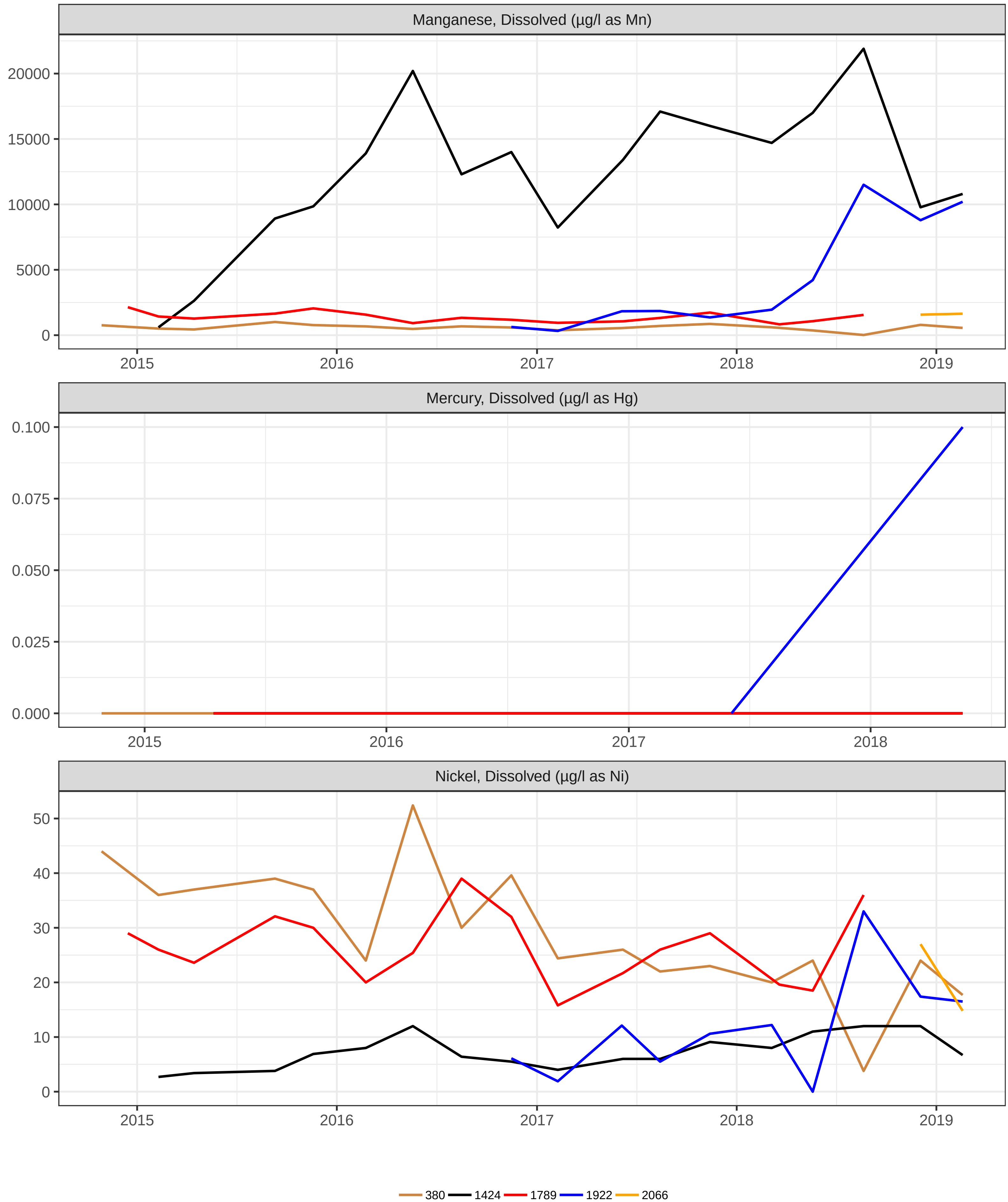

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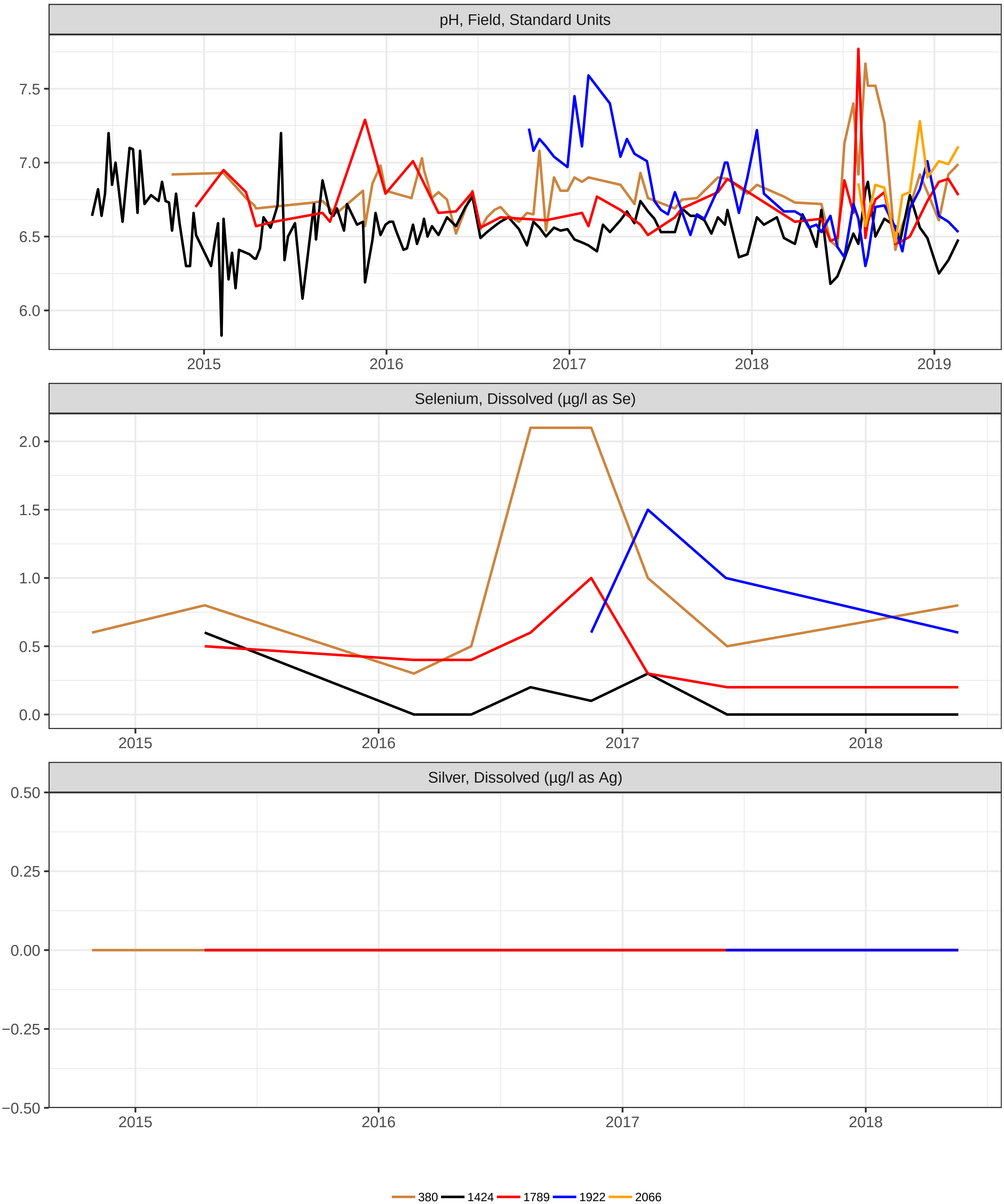

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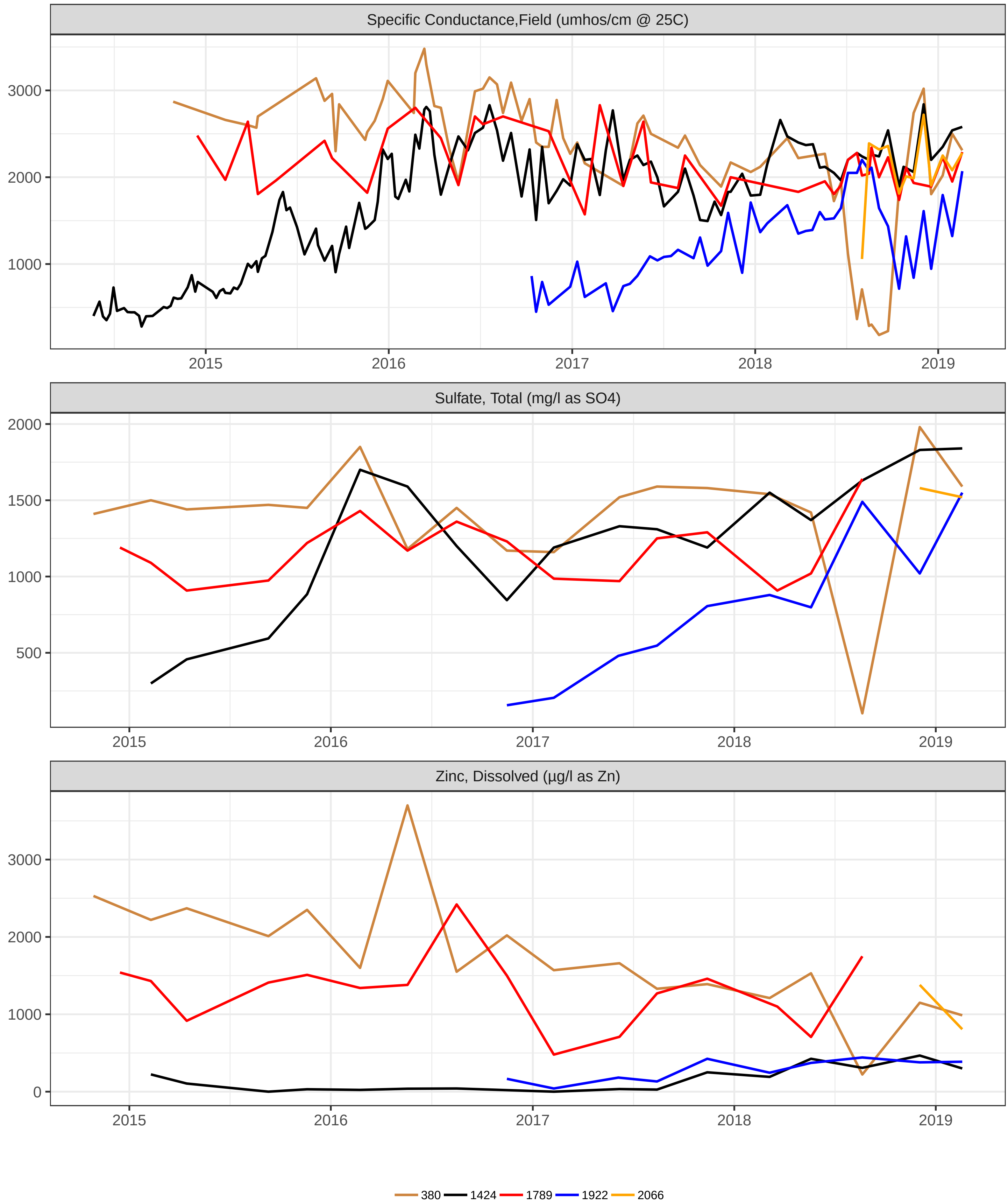

Attachment B:

Tailings Area Underdrains

ATTACHMENT B
Tailings Area Underdrains

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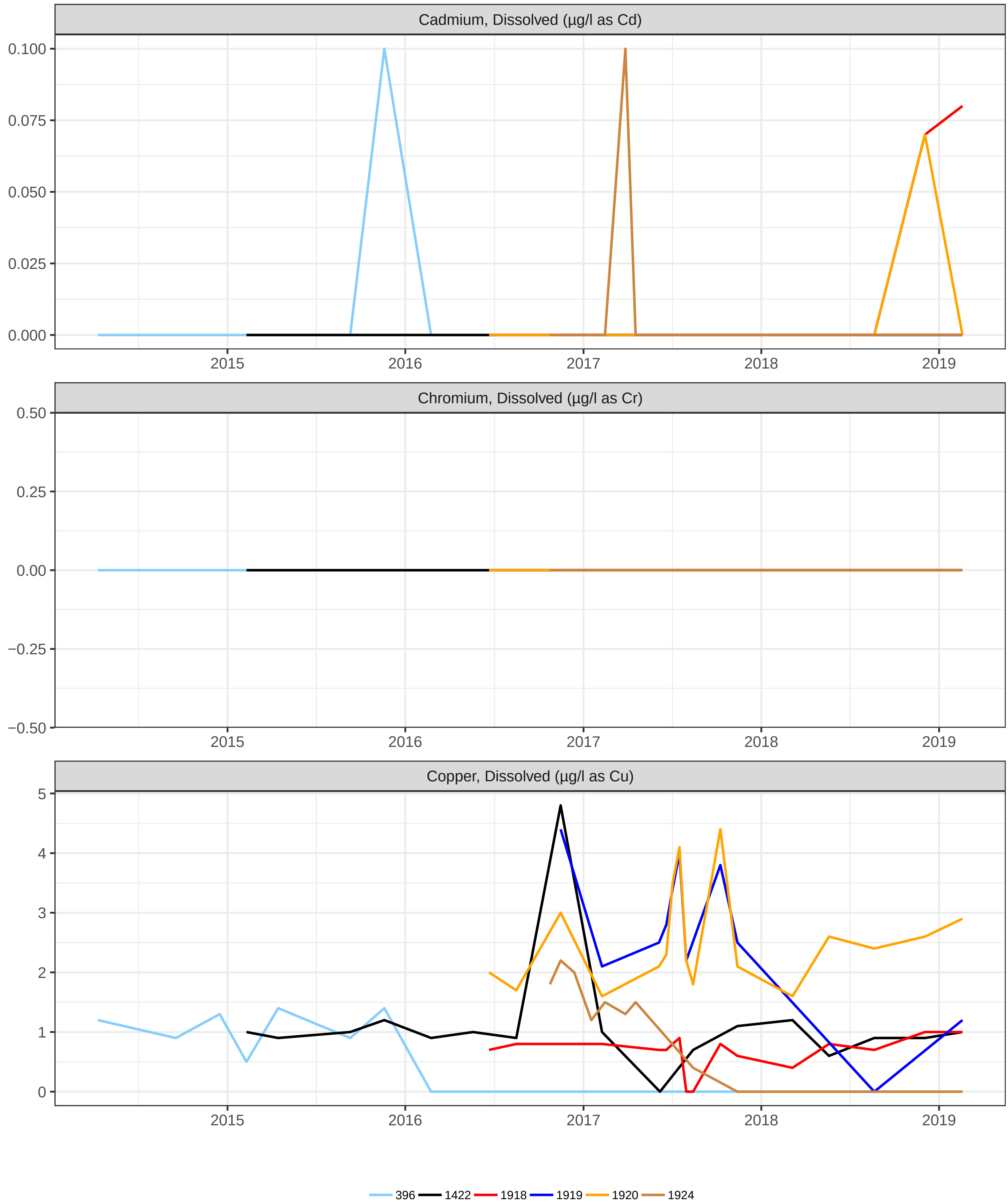
Tailings Area Underdrains



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Tailings Area Underdrains

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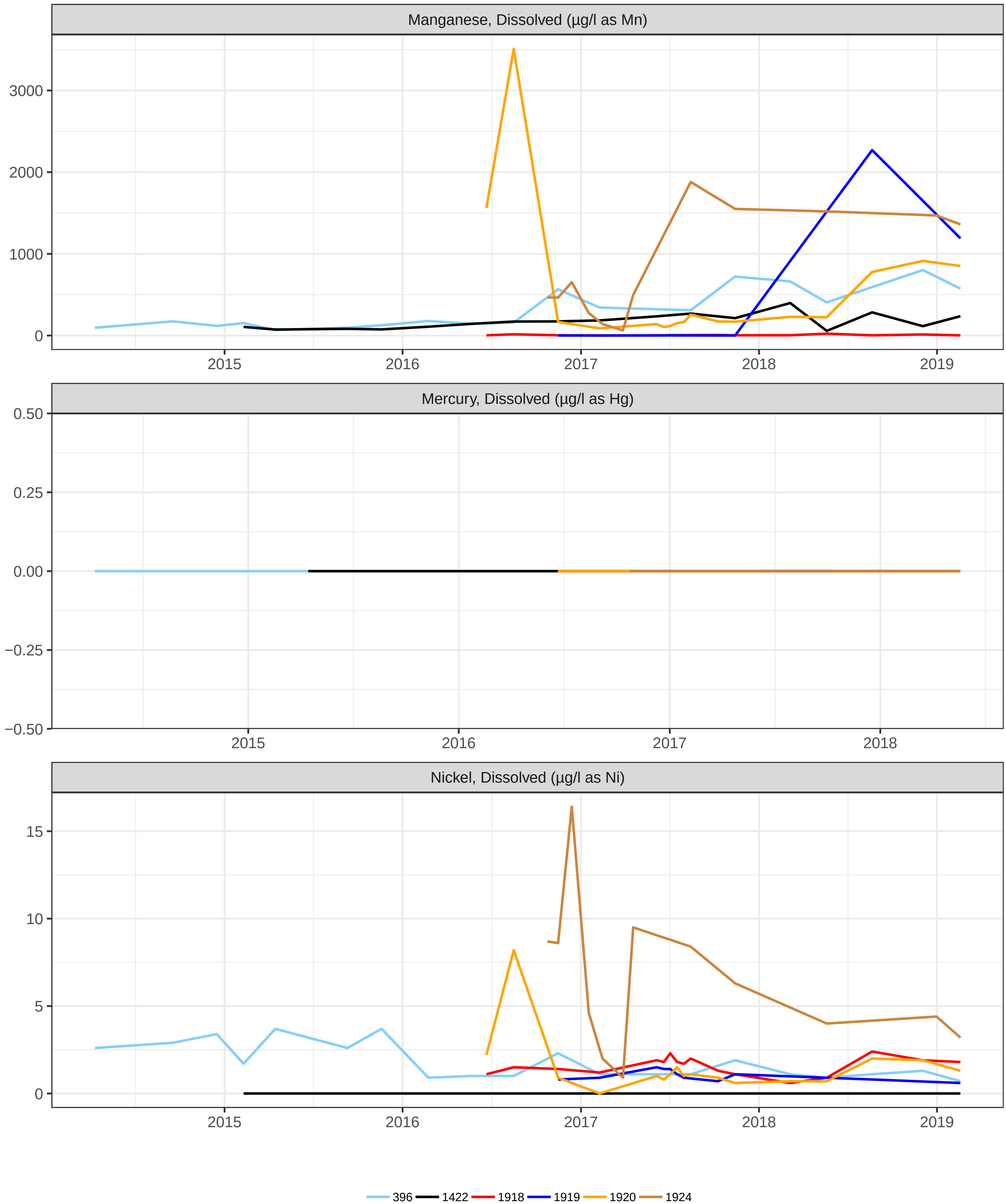

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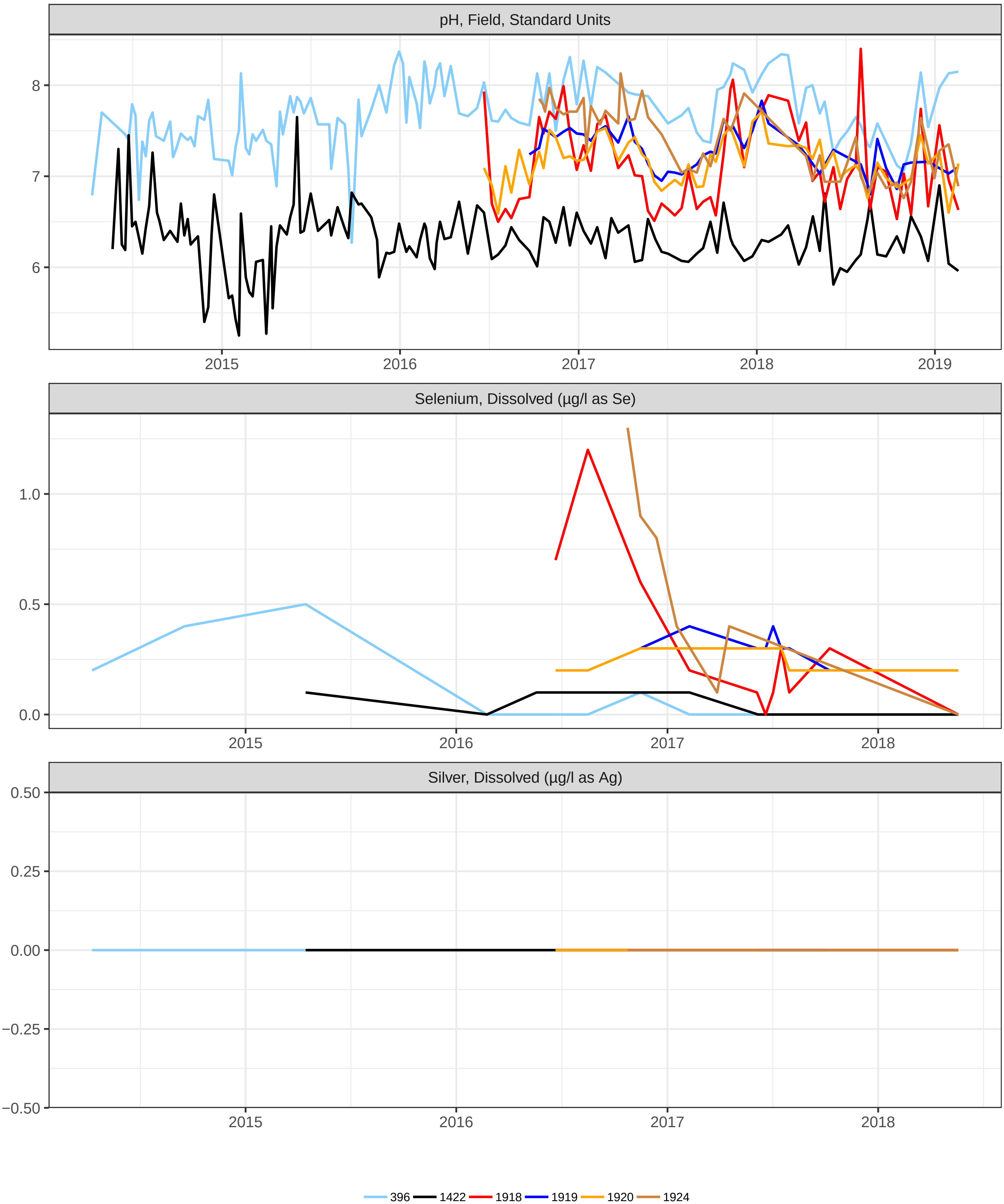

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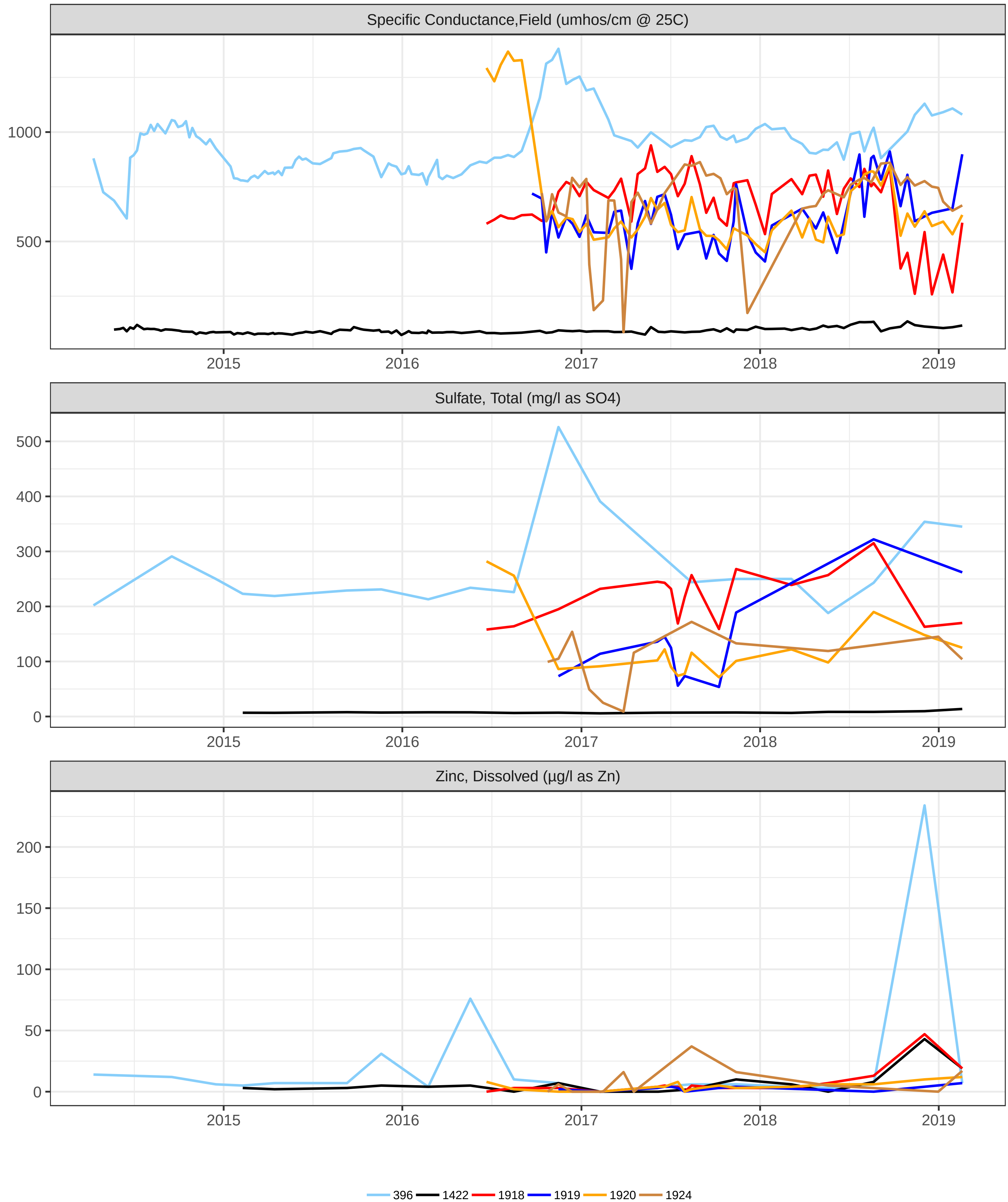

Attachment C:

Site 23 Finger Drains

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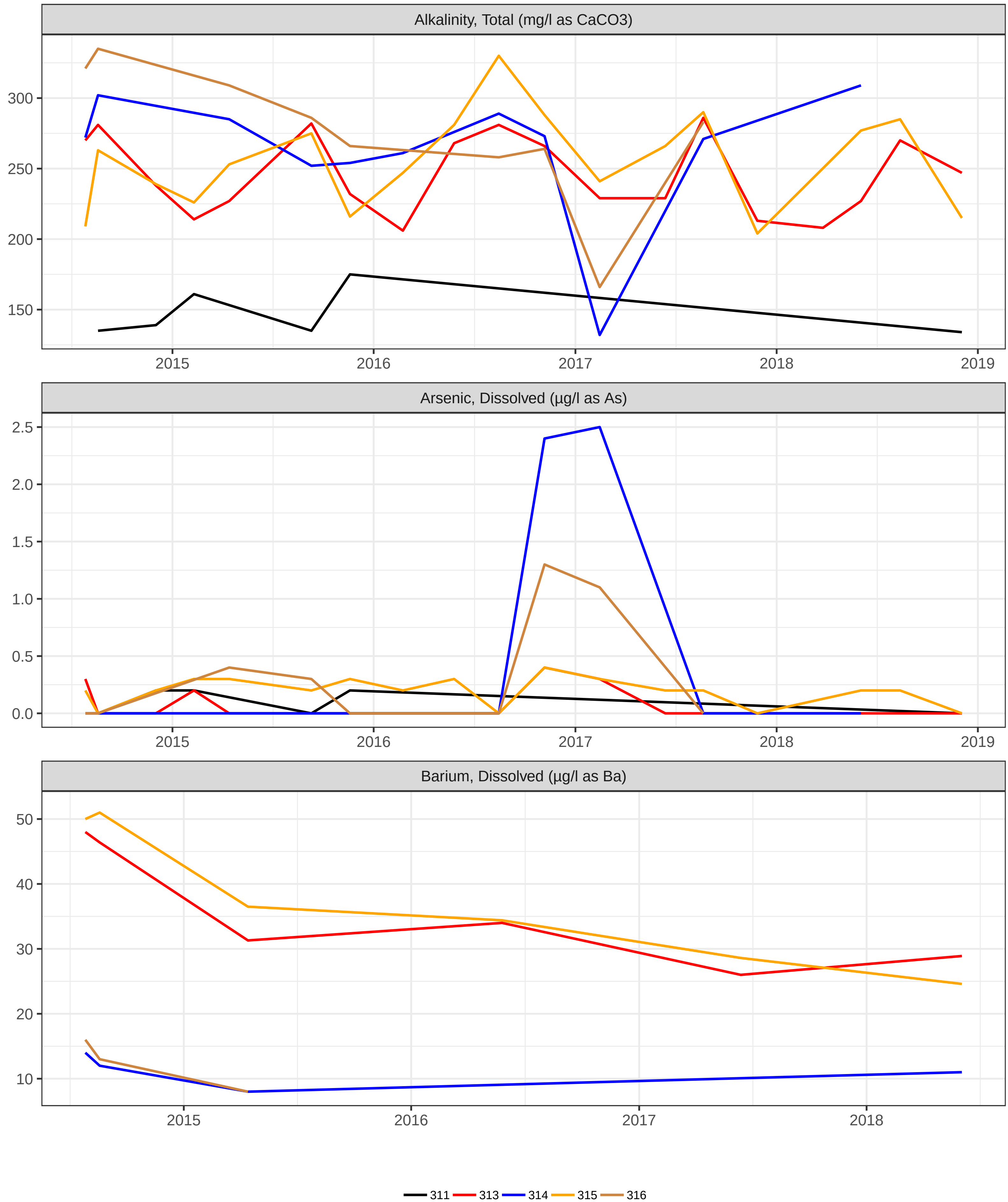
Site 23 Finger Drains



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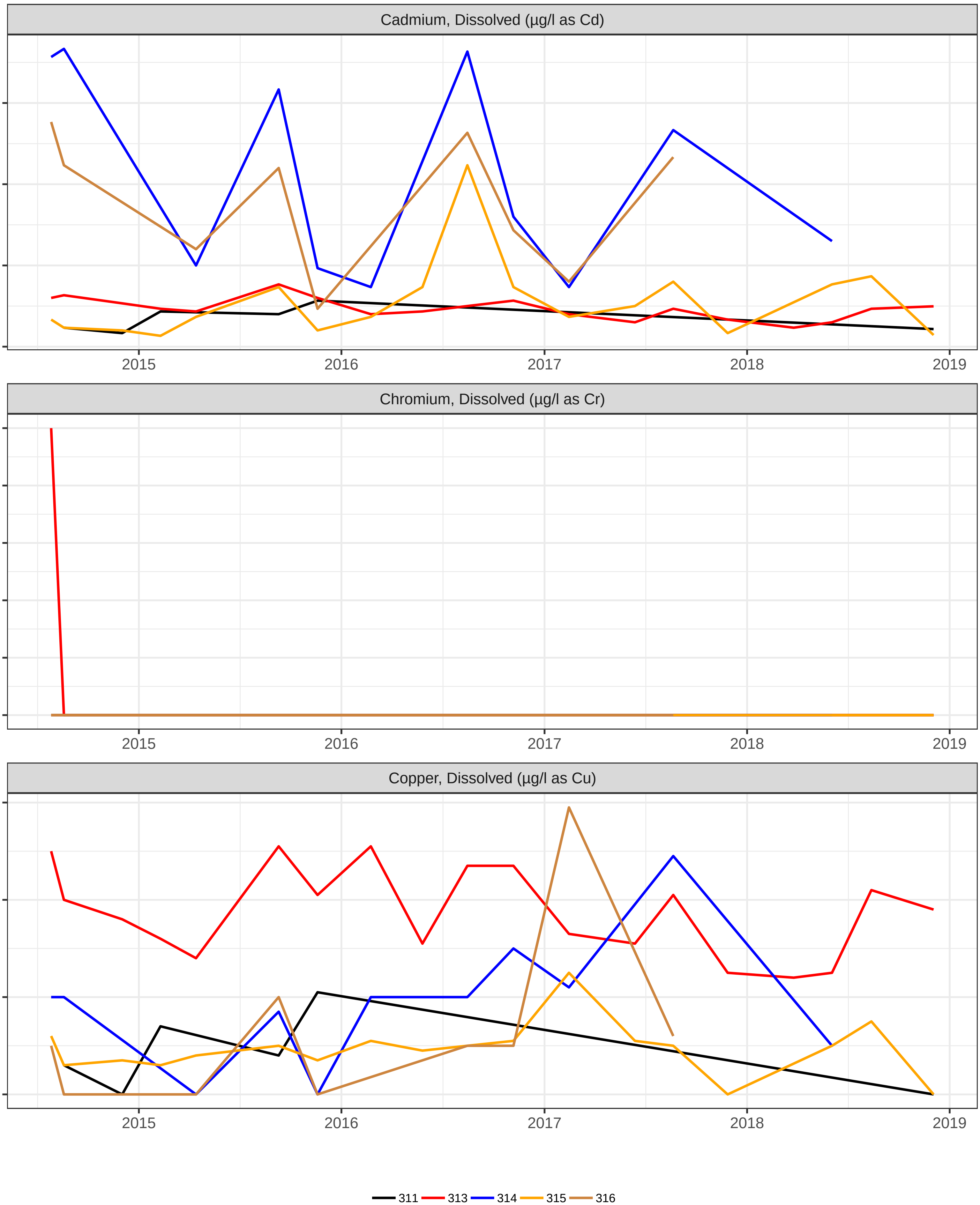

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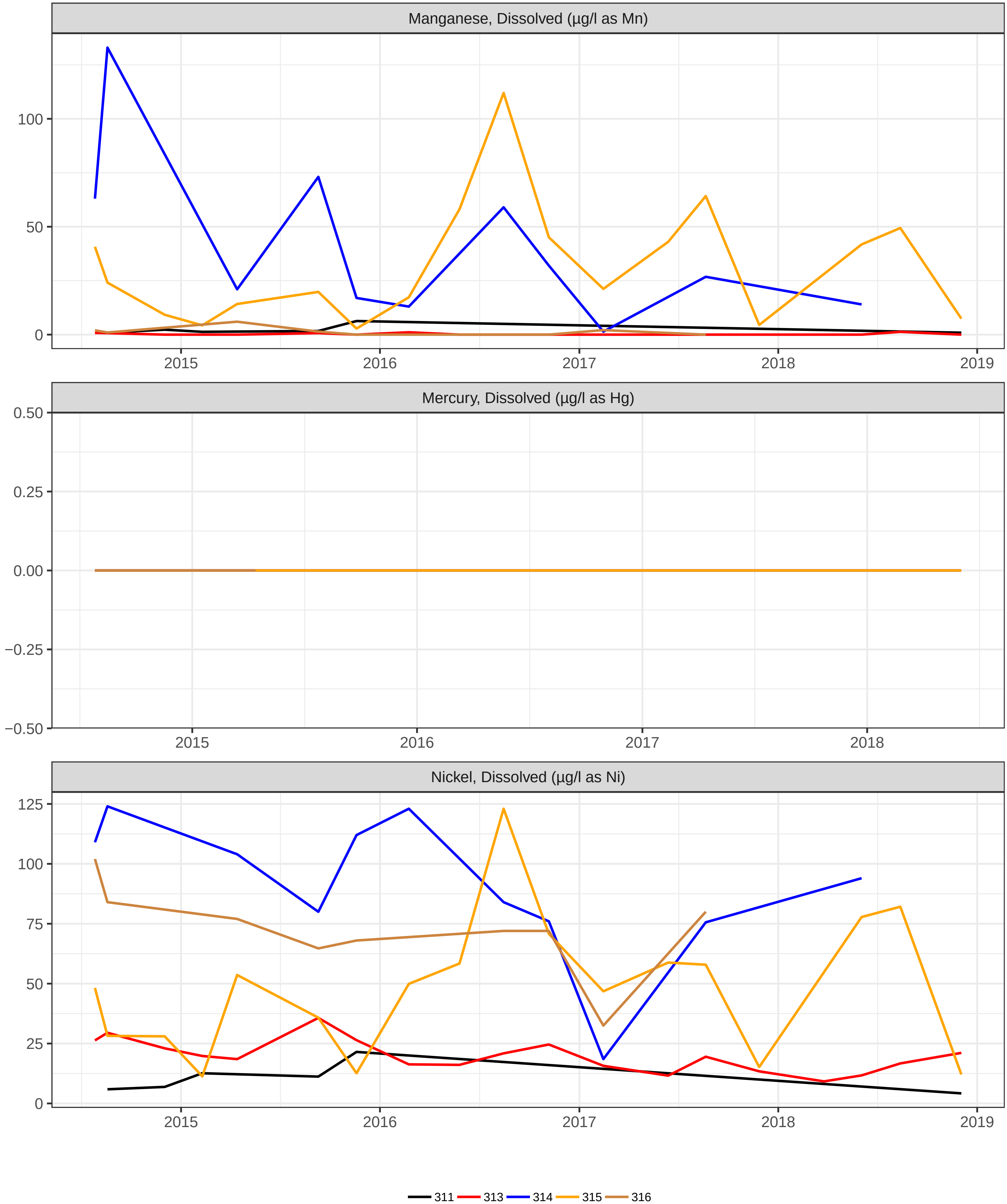

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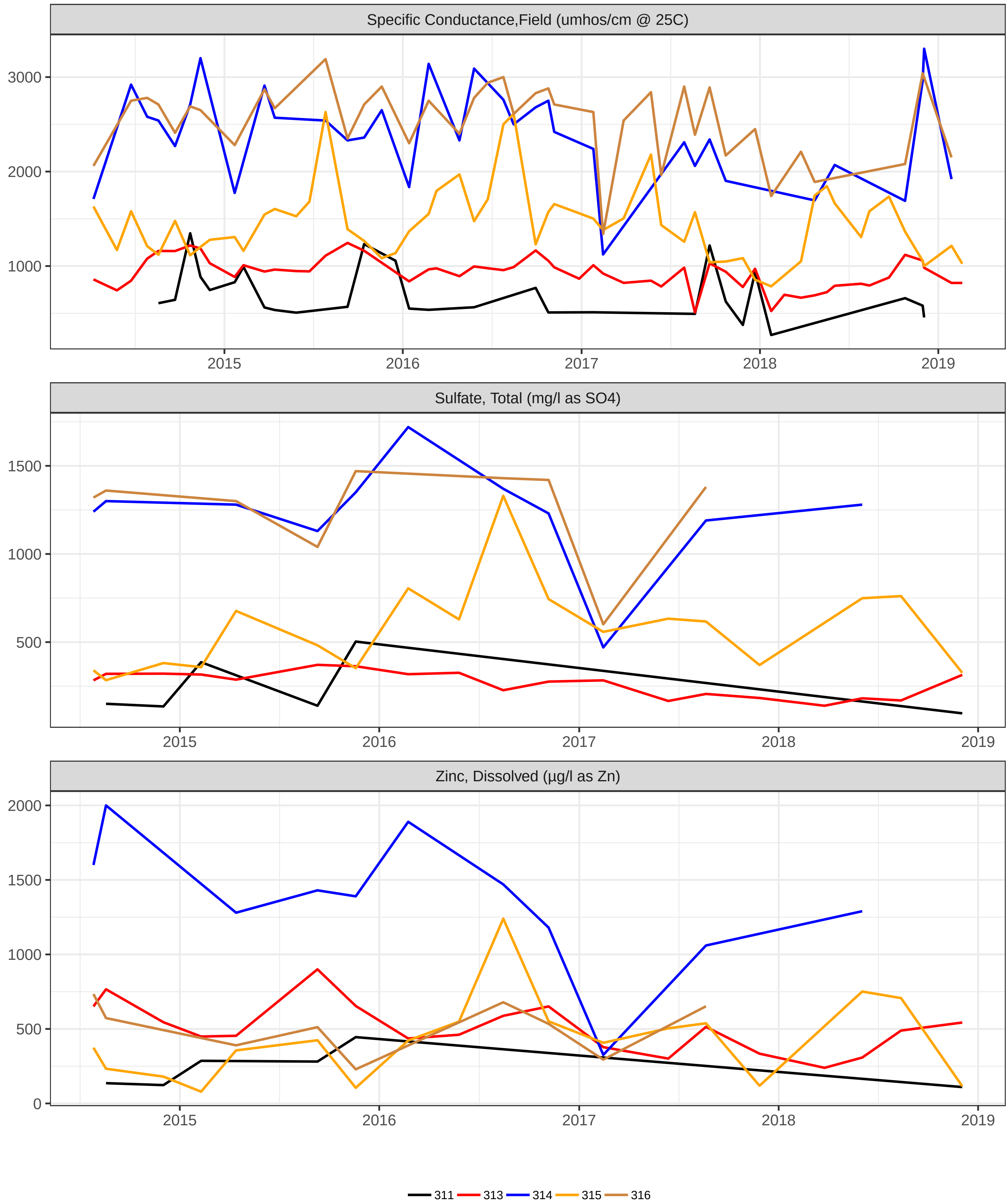

Attachment D:

Site 23/D Curtain Drains

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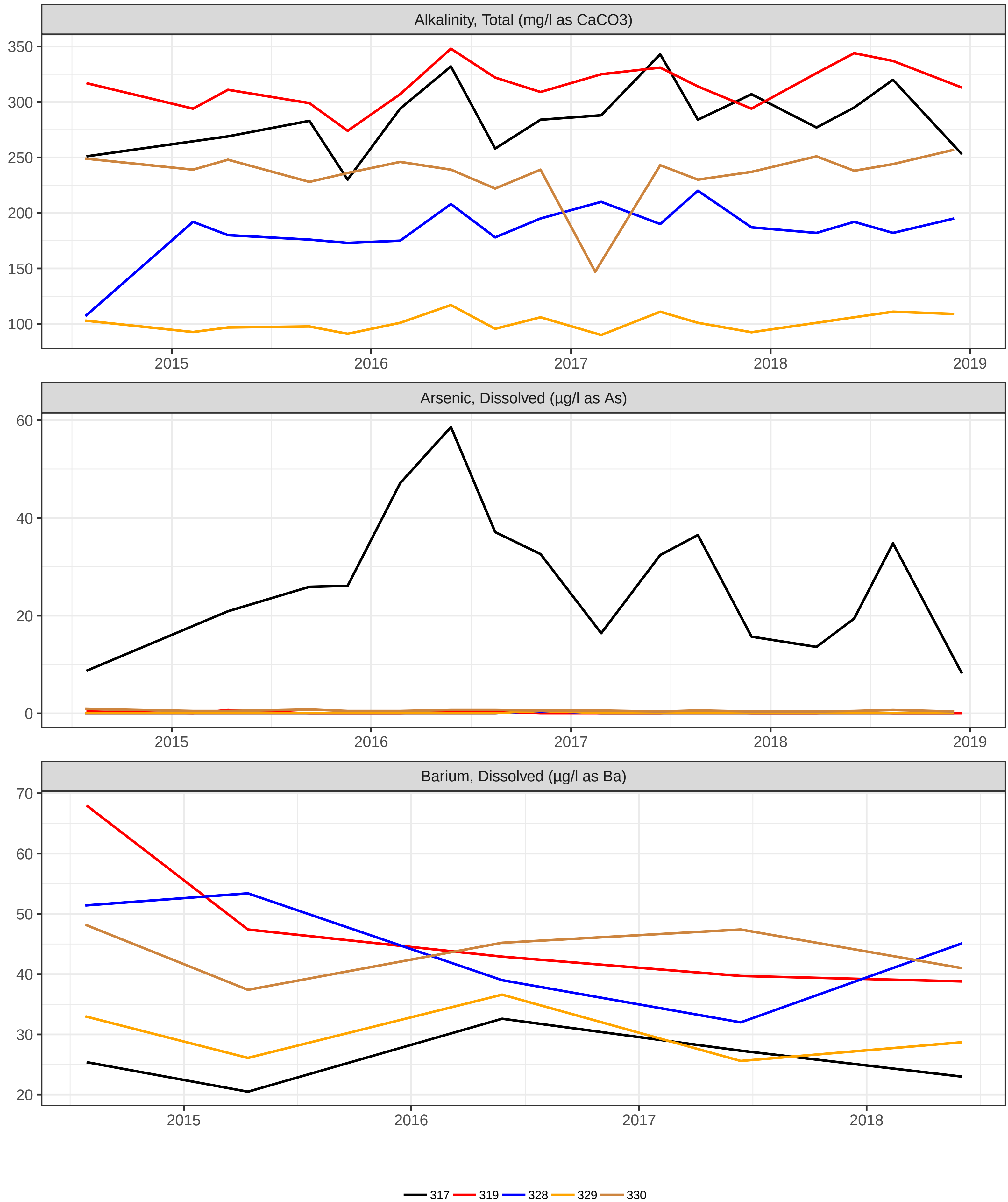
Site 23/D Curtain Drains



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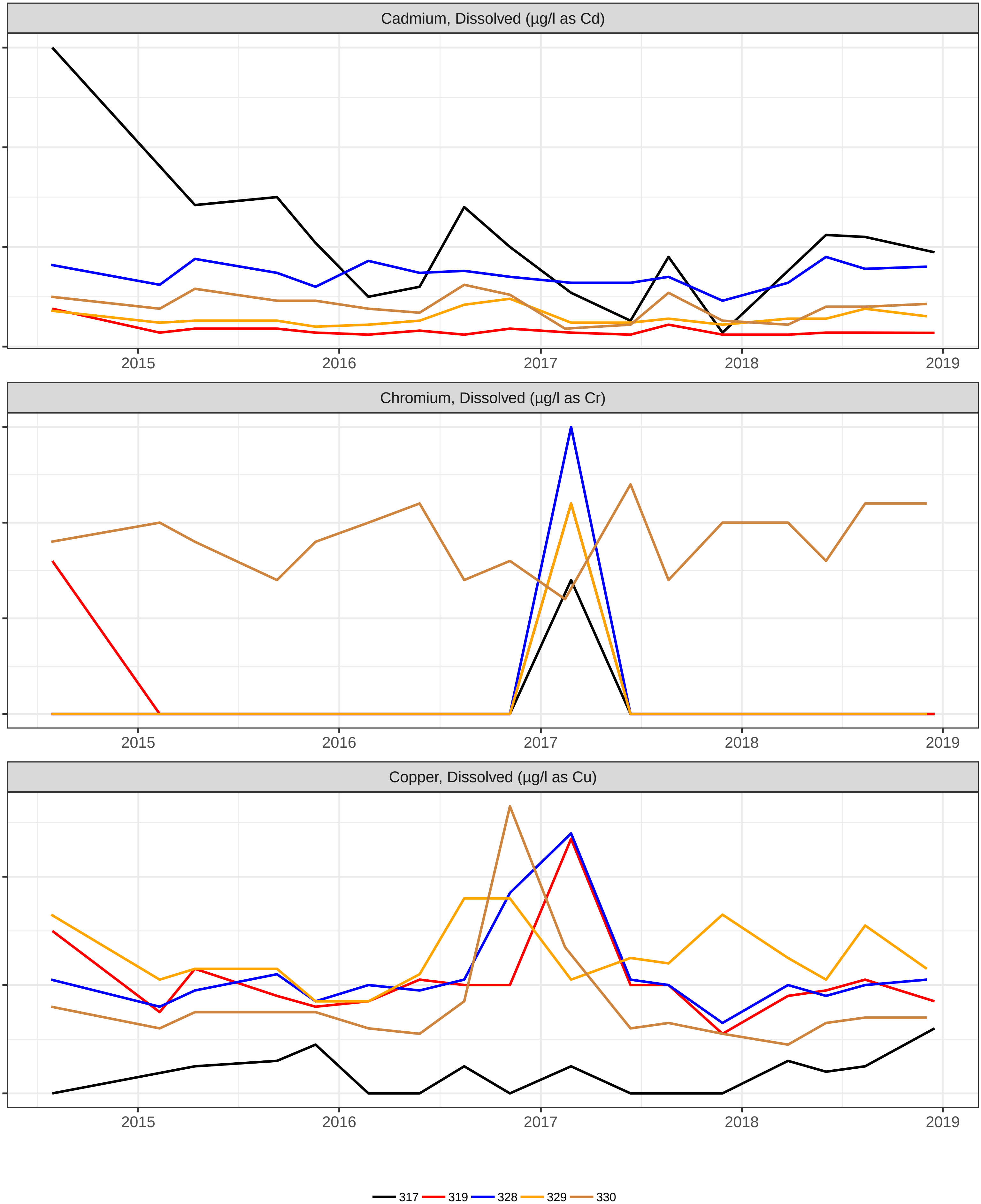

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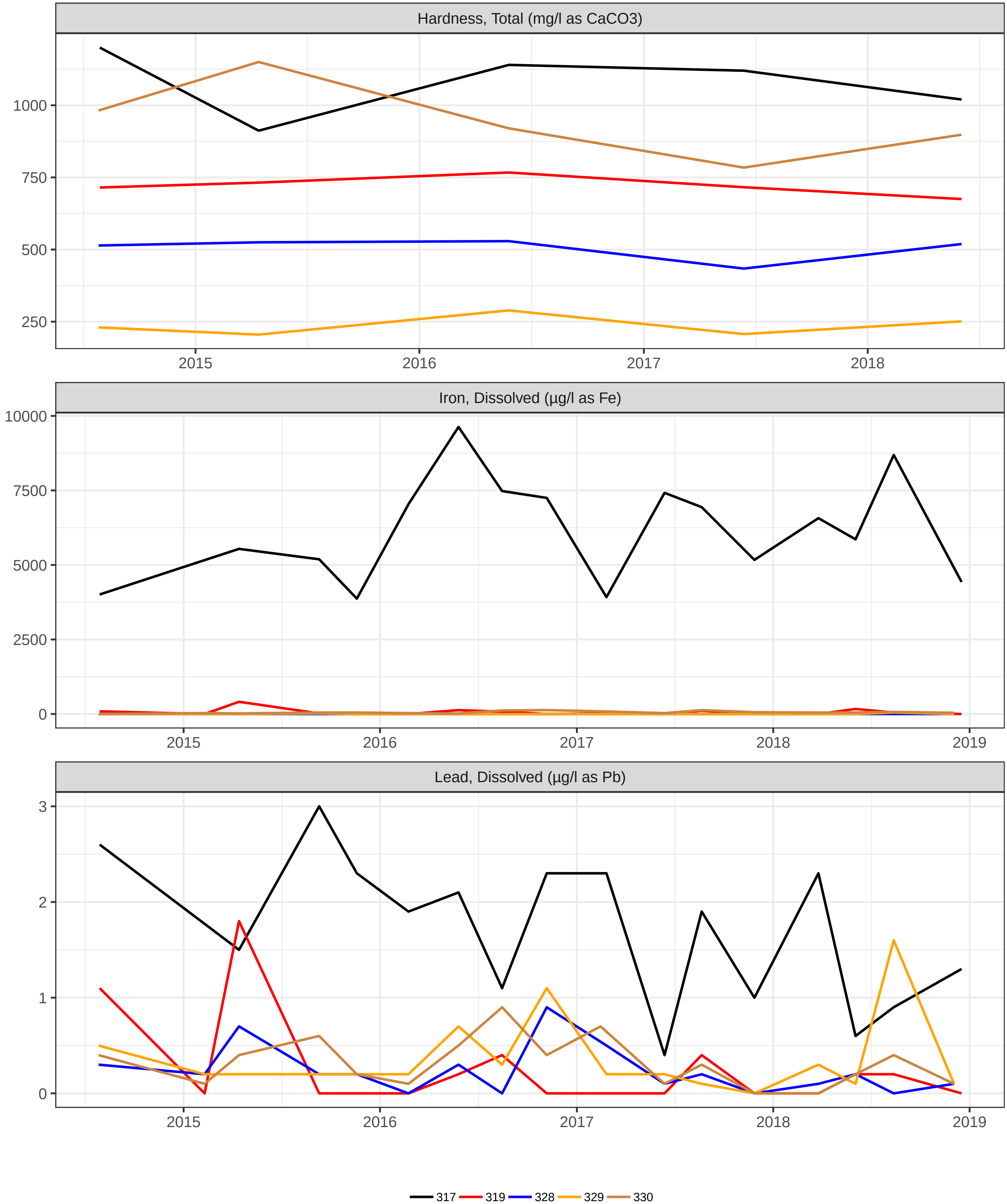

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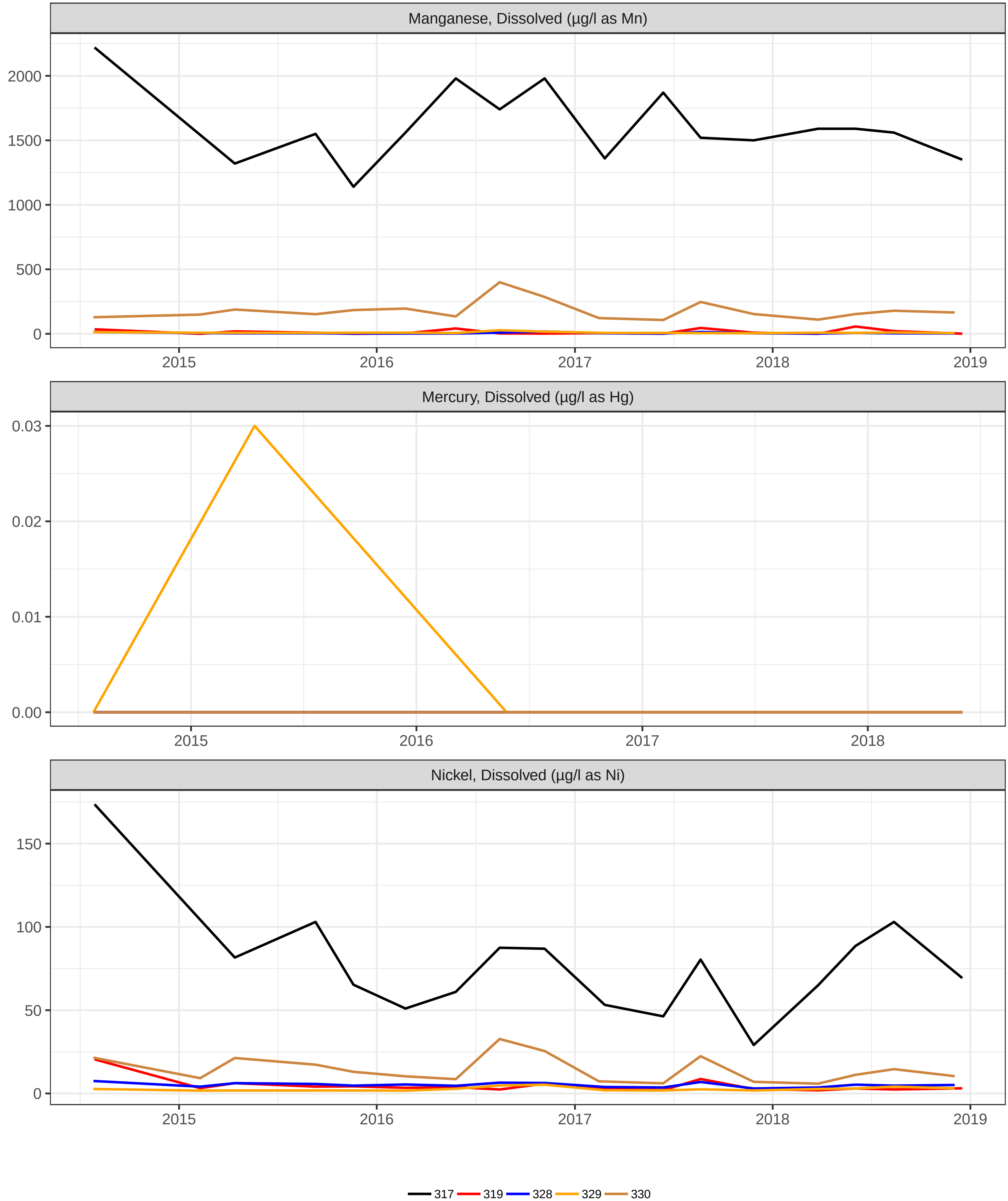
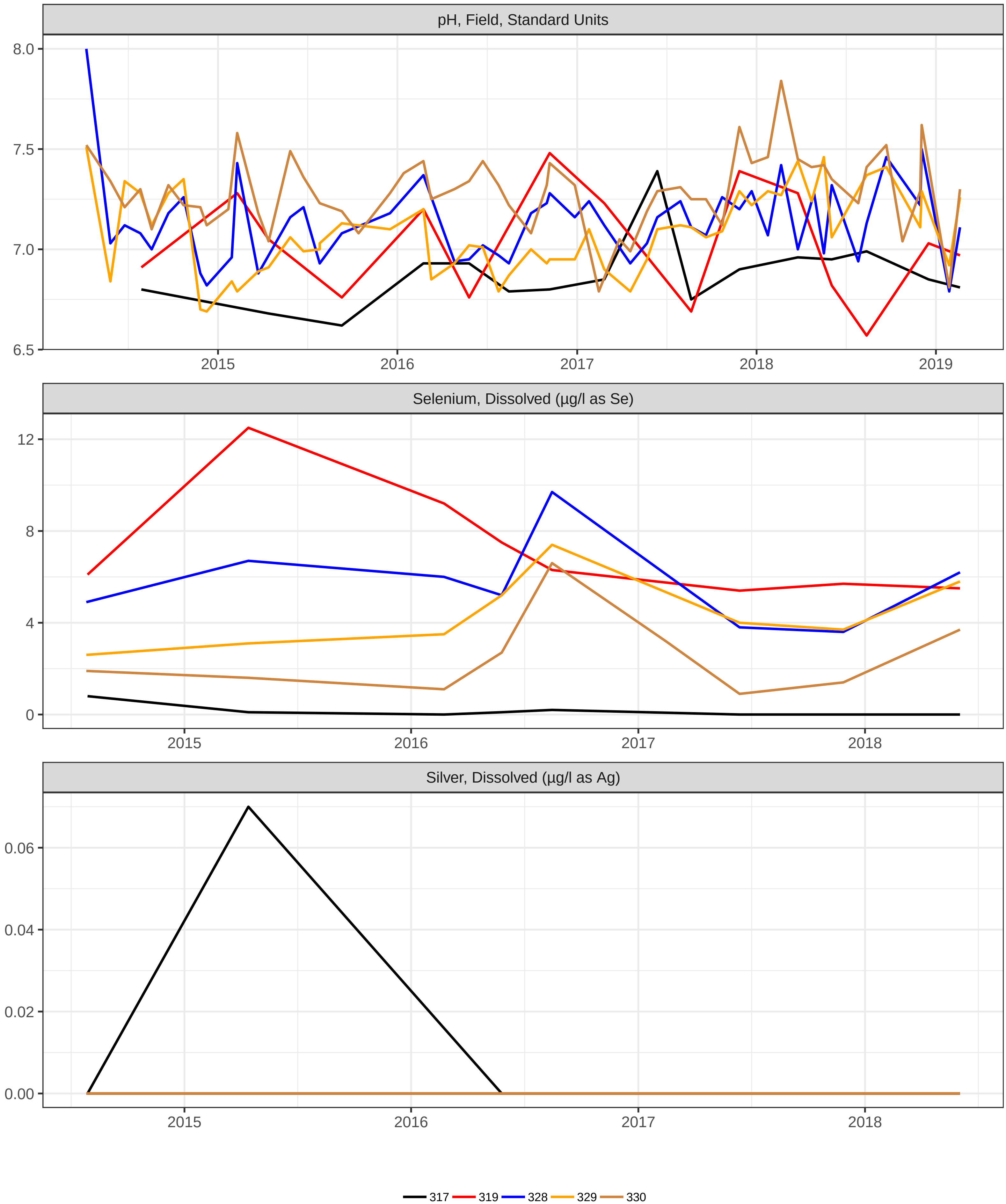
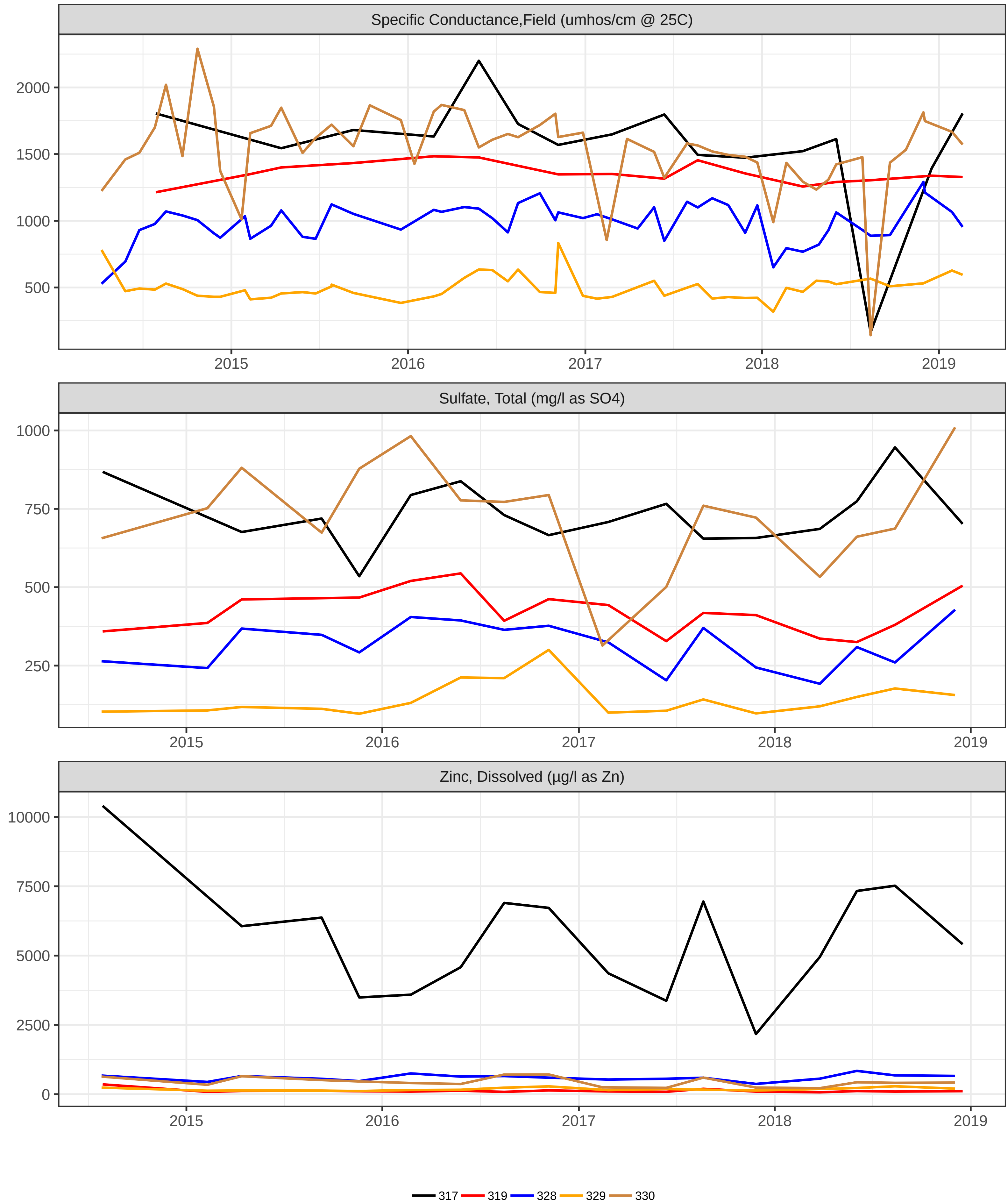


ATTACHMENT D
Site 23/D Curtain Drains



ATTACHMENT D
Site 23/D Curtain Drains

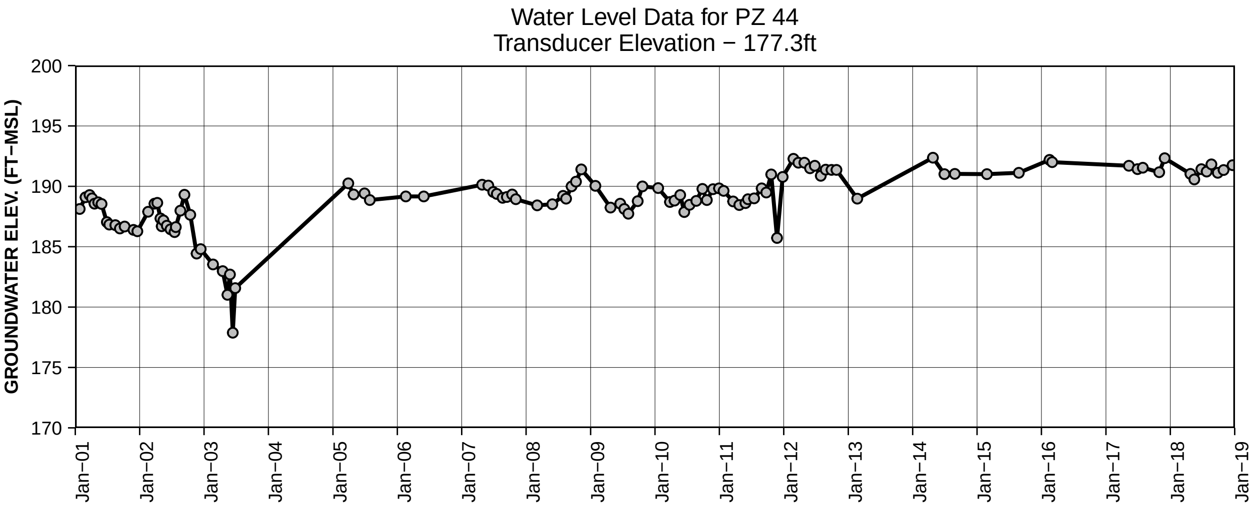


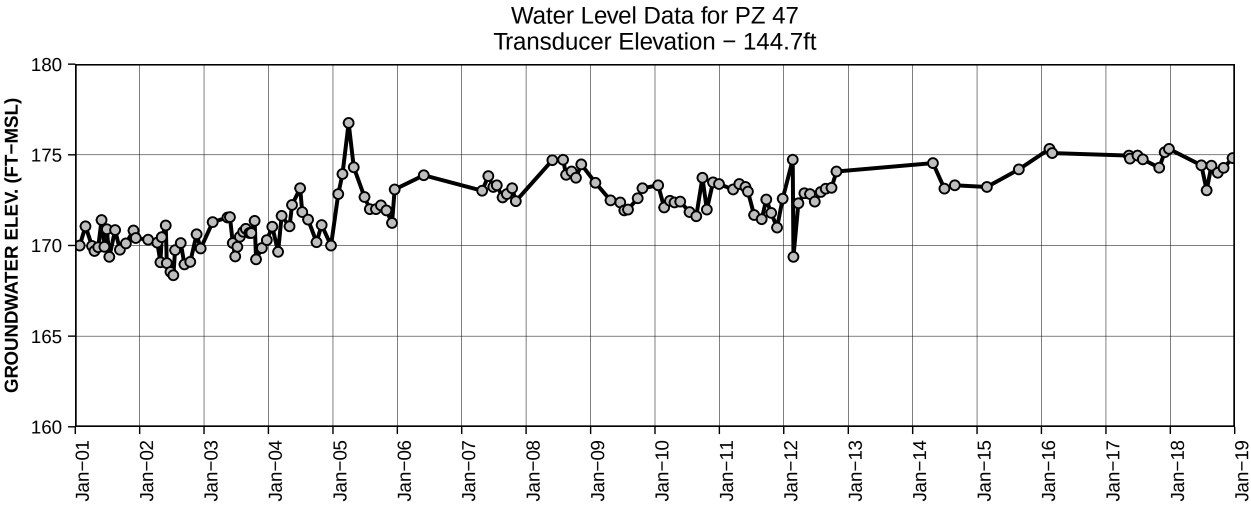
Attachment E:

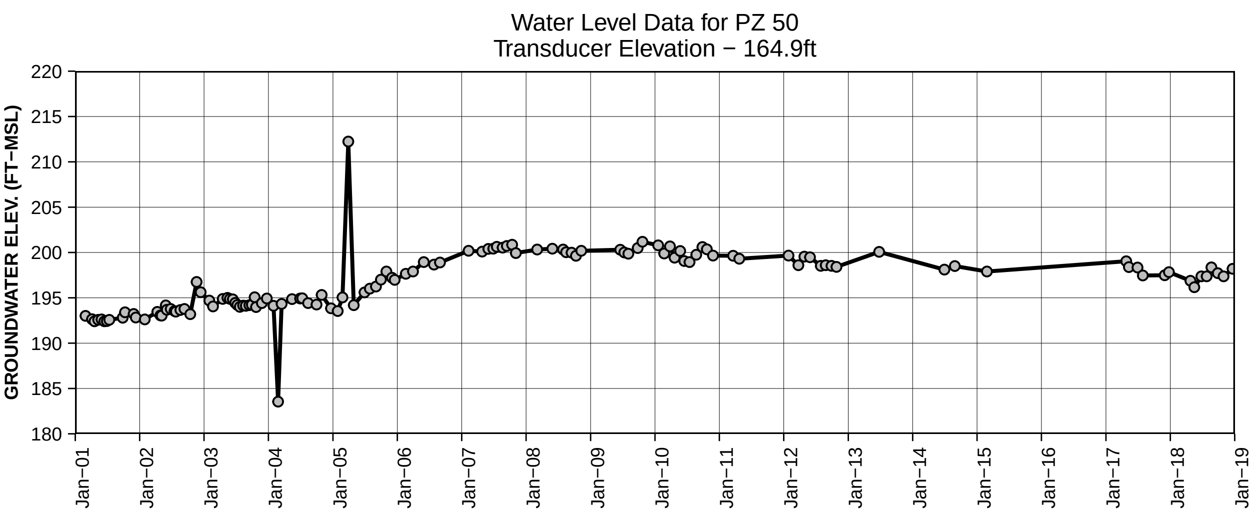
TDF Water Level Data

Attachment E

Piezometer Data at the TDF

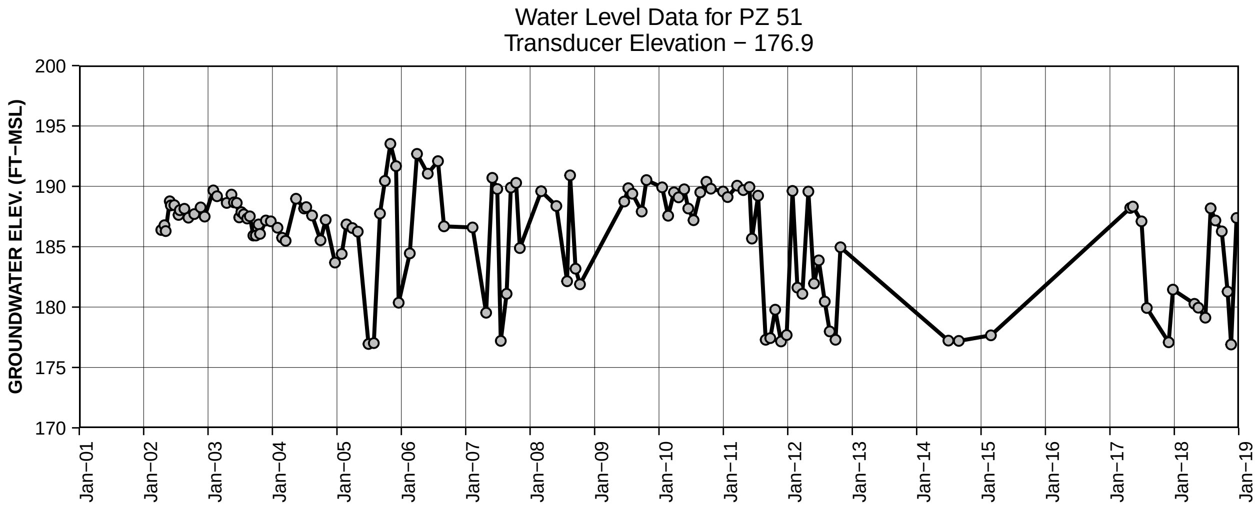


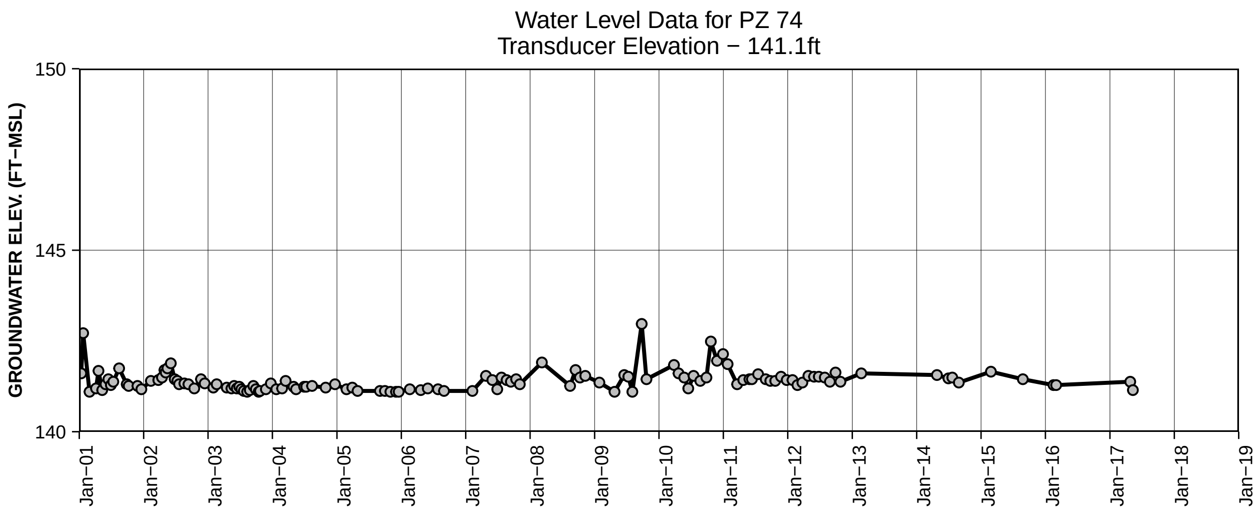


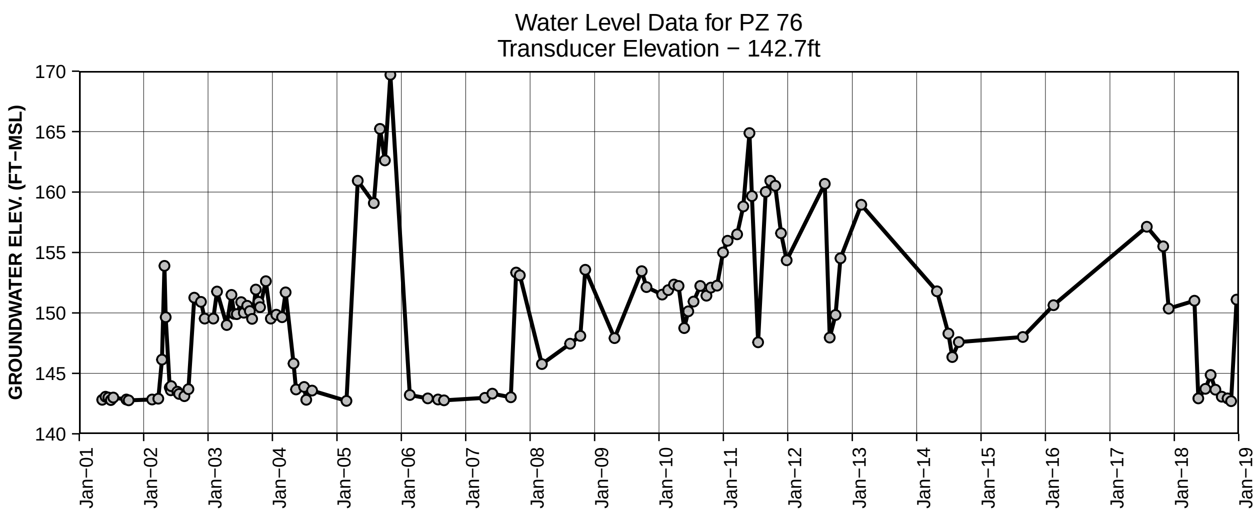


Attachment E

Piezometer Data at the TDF







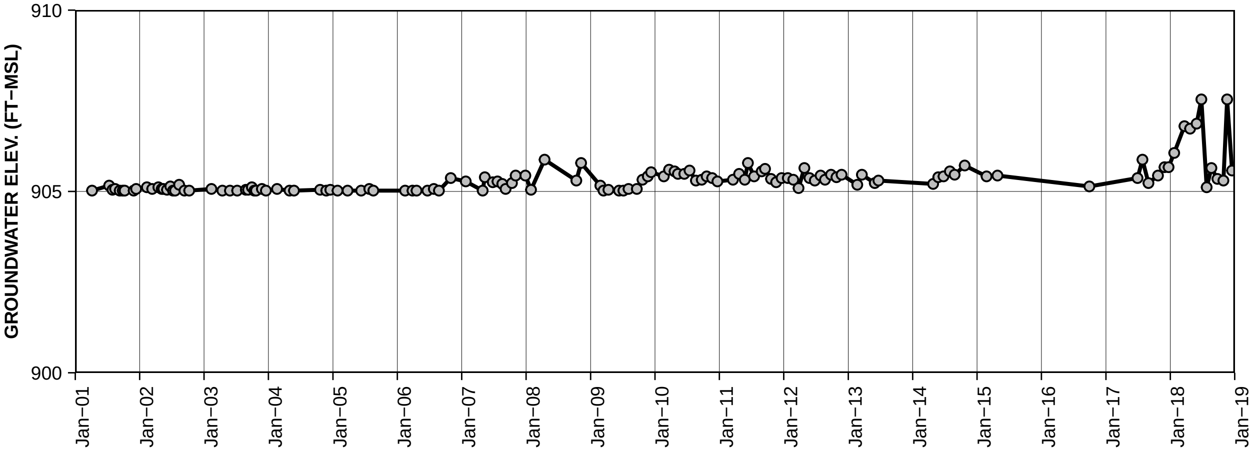
Attachment F:

Site 23/D Water Level Data

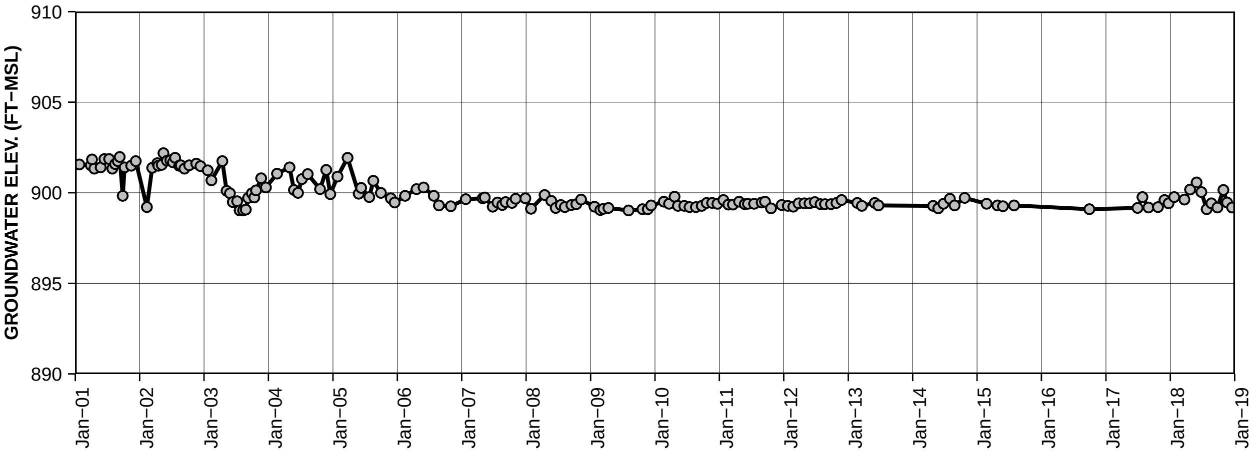
ATTACHMENT F

Piezometer Data at Site 23/D

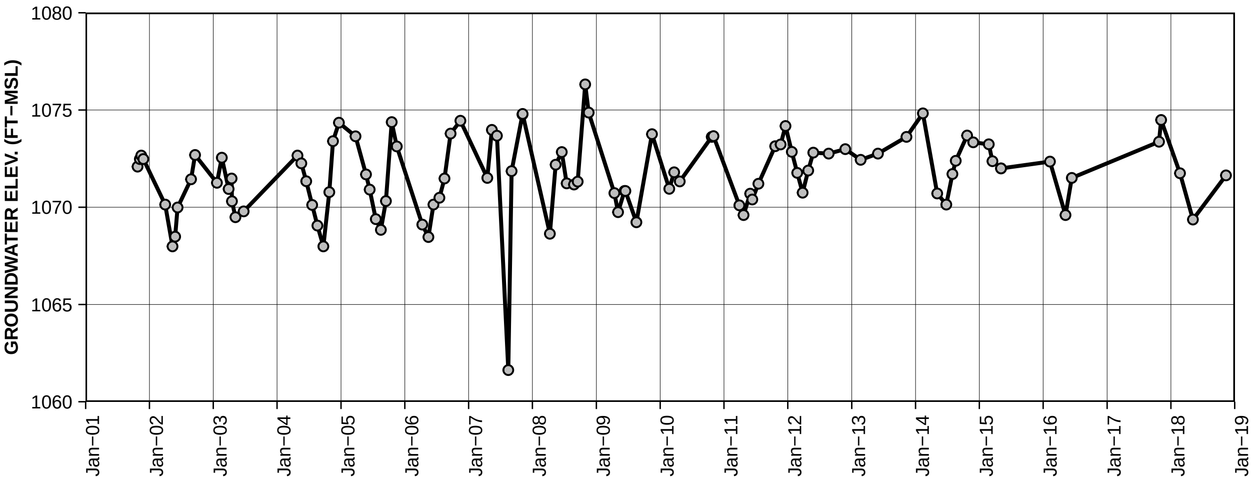
Water Level Data for PZ 52
Transducer Elevation − 905



Water Level Data for PZ 53
Transducer Elevation − 899

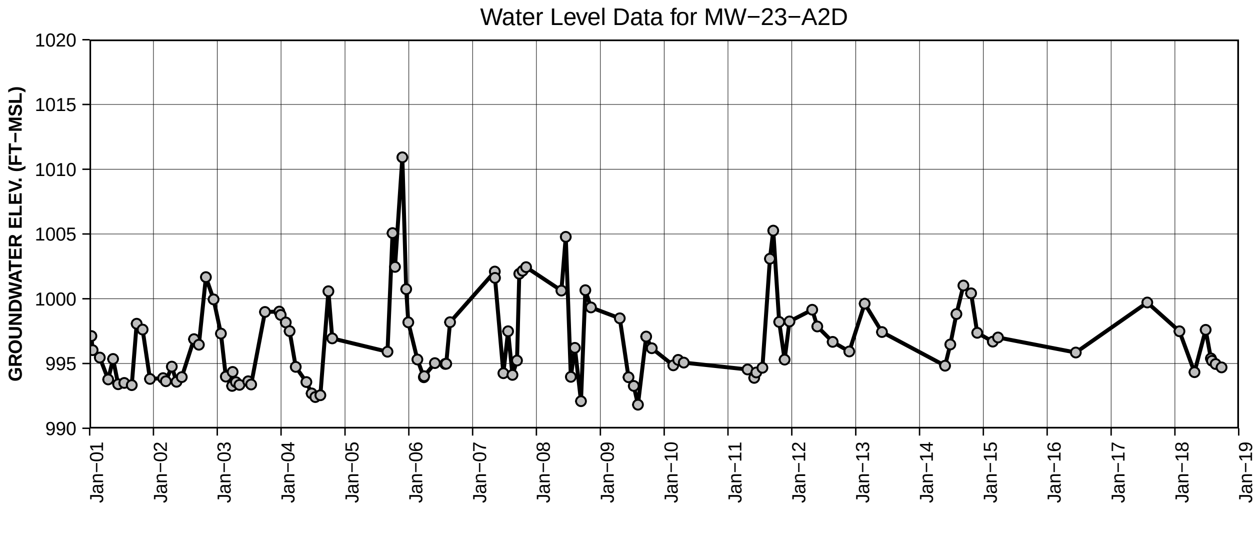


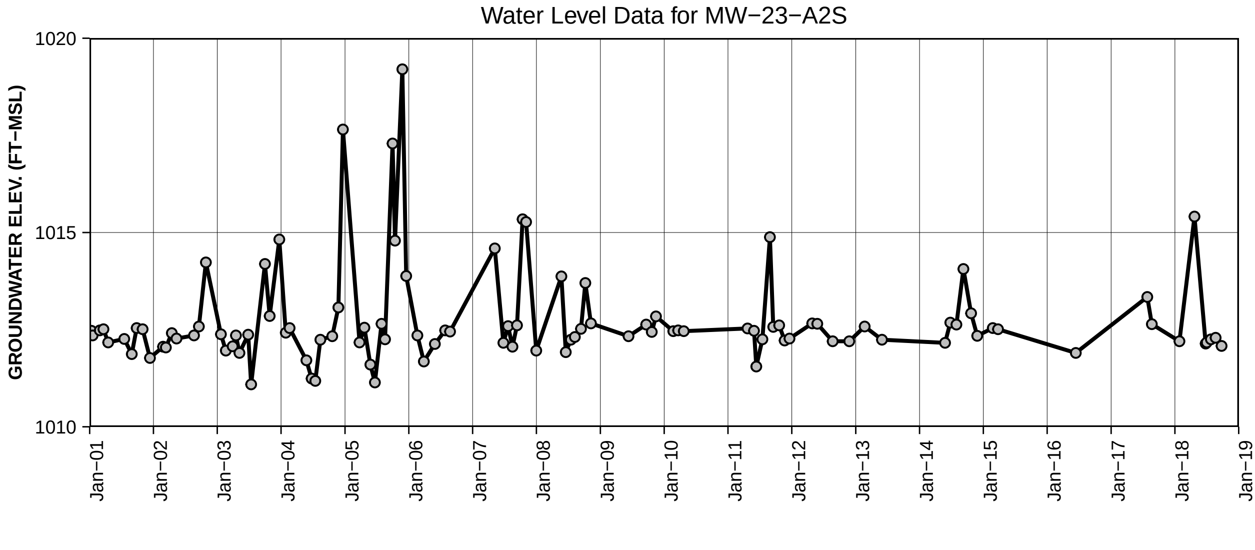
Water Level Data for MW−23/D−00−03

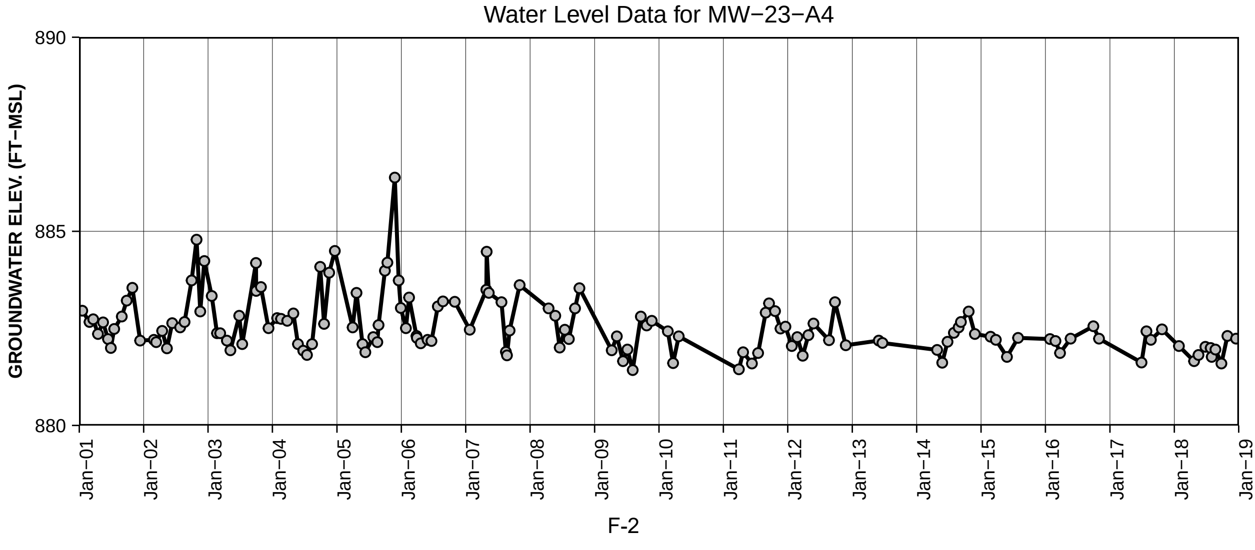


ATTACHMENT F

Piezometer Data at Site 23/D

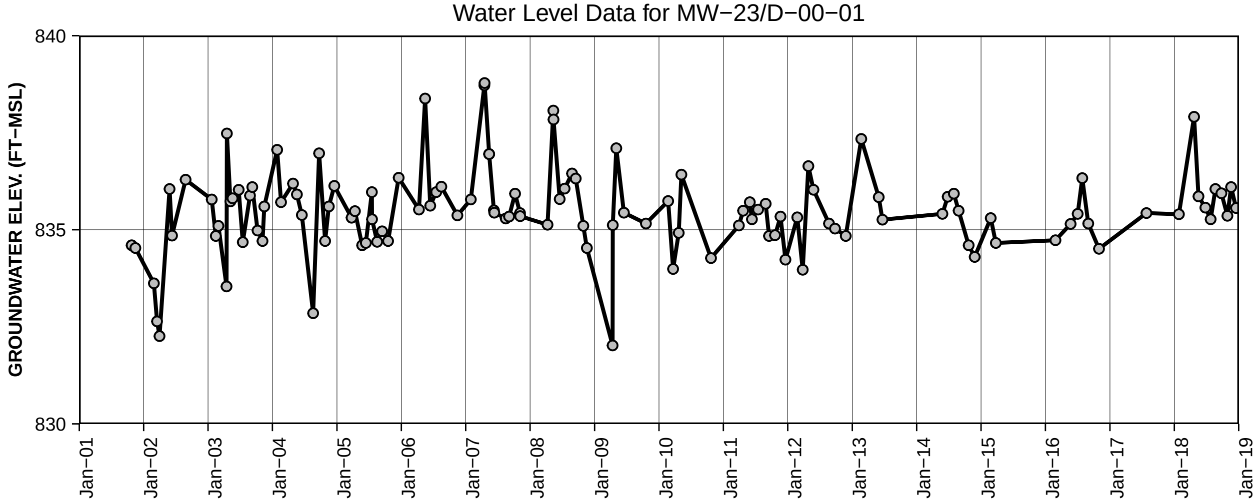


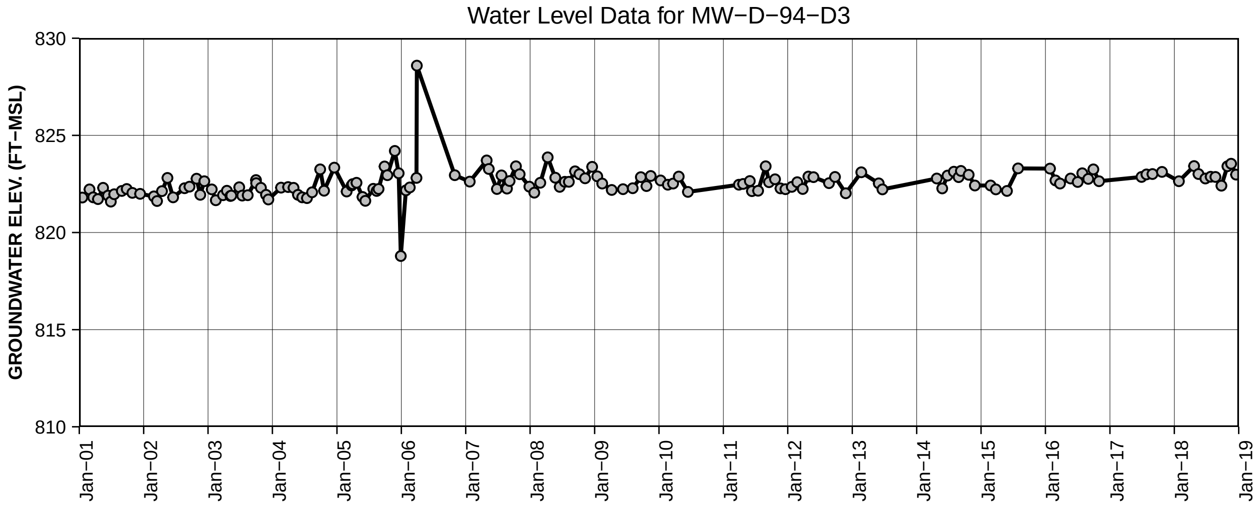


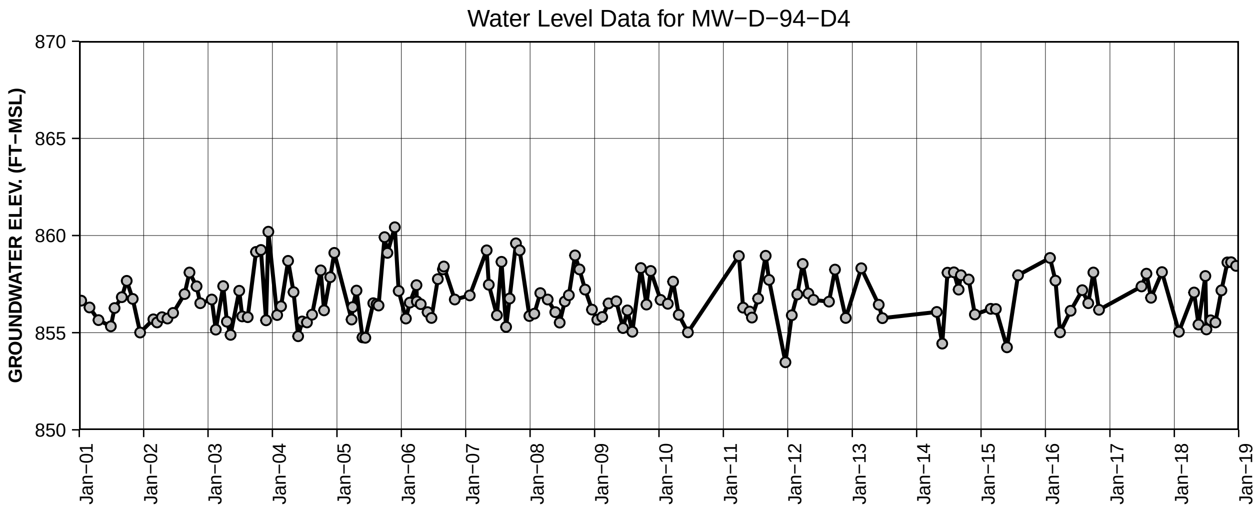


ATTACHMENT F

Piezometer Data at Site 23/D

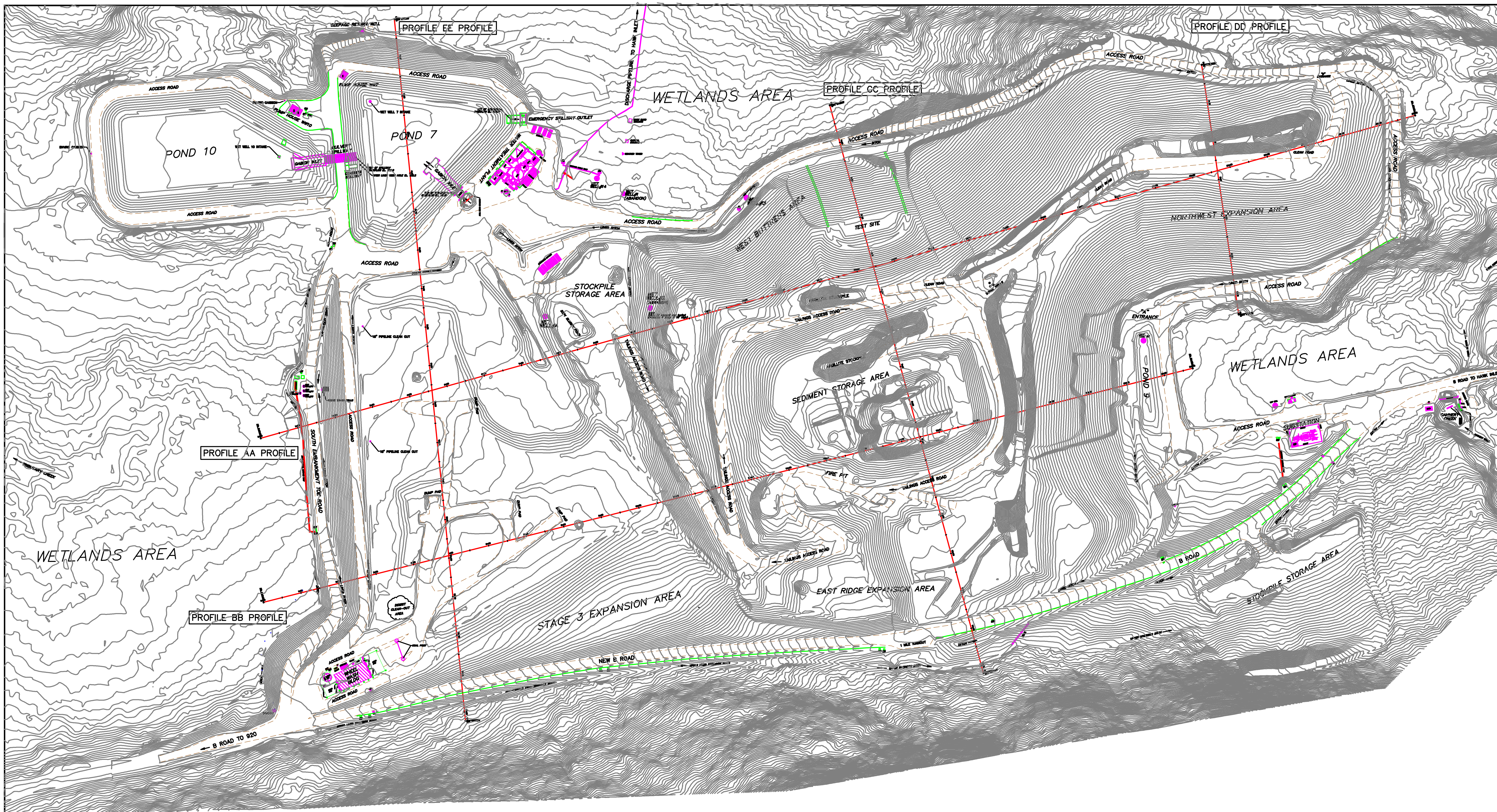






Attachment G:

TDF Building Layout



HECLA GREENS CREEK MINING CO.

P.O. BOX 32199 JUNEAU, ALASKA 99803

PHONE: (907)790-8441 FAX: (907)790-8448

LEGEND:

- BUILDINGS
- WATER UTILS
- ROADS
- ELECT UTILS
- FUEL UTILS
- LINED DITCHES & CONCRETE

SYMBOLS:

- FIRE HYDRANT
- BOLLARDS
- WATER VALVE
- MONITORING POINT
- POWER POLES
- CATCH BASIN

GRAPHIC SCALE:

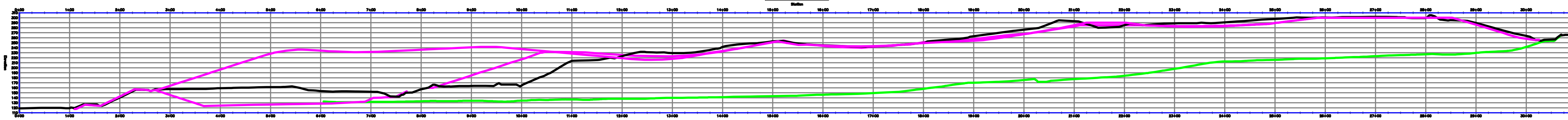
DRAWING BY: Shelby Edwards
DESIGN BY: ----
REVIEWED BY: ----
PROJ OR REF. ----

TRUE

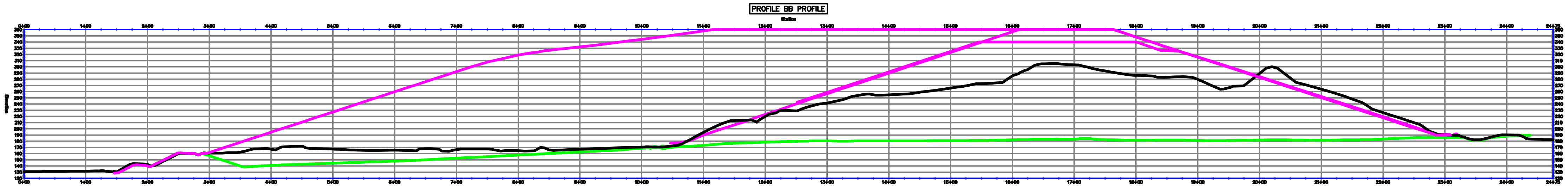
TITLE: Tailings Asbuilt

SHEET: 12/31/18 SHEET: 1 OF 1

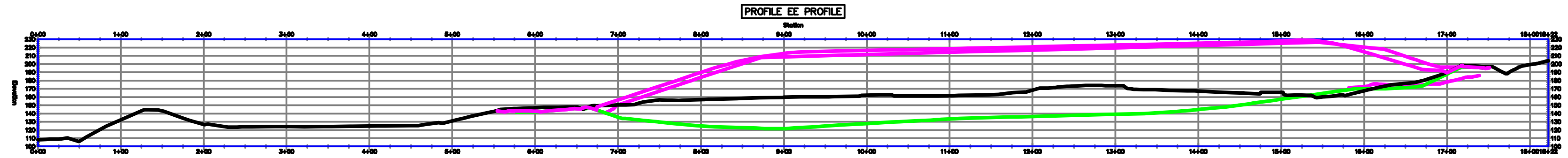
PROFILE AA PROFILE



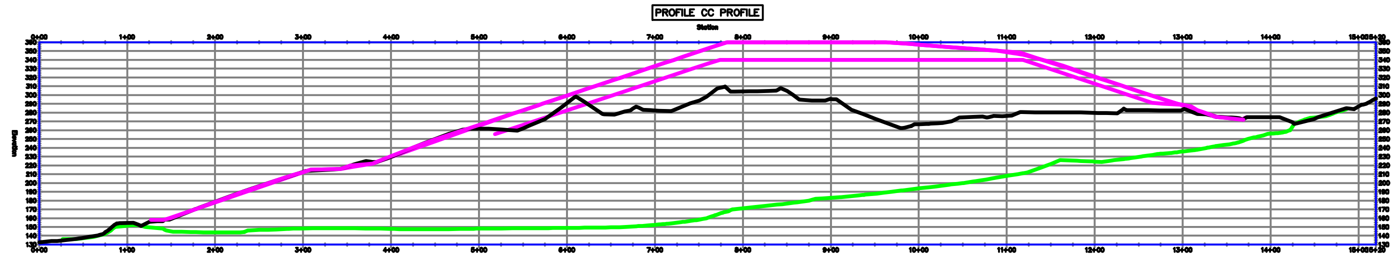
PROFILE BB PROFILE



PROFILE EE PROFILE



PROFILE CC PROFILE



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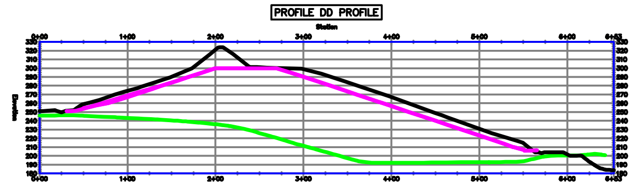


HECLA GREENS CREEK MINING CO.

P.O. BOX 32199 JUNEAU, ALASKA 99803

PHONE: (907)790-8441 FAX: (907)790-8448

LEDGEND:

- ORIGINAL GROUND
- EXISTING GROUND
- STAGE 2&3 DESIGN

SYMBOLS:

FIRE HYDRANT	MONITORING POINT
BOLLARDS	POWER POLES
WATER VALVE	CATCH BASIN

GRAPHIC SCALE: 0 40 100 200

DRAWING BY: Shelby Edwards

DESIGN BY: ----

REVIEWED BY: ----

PROJ OR REF. ----

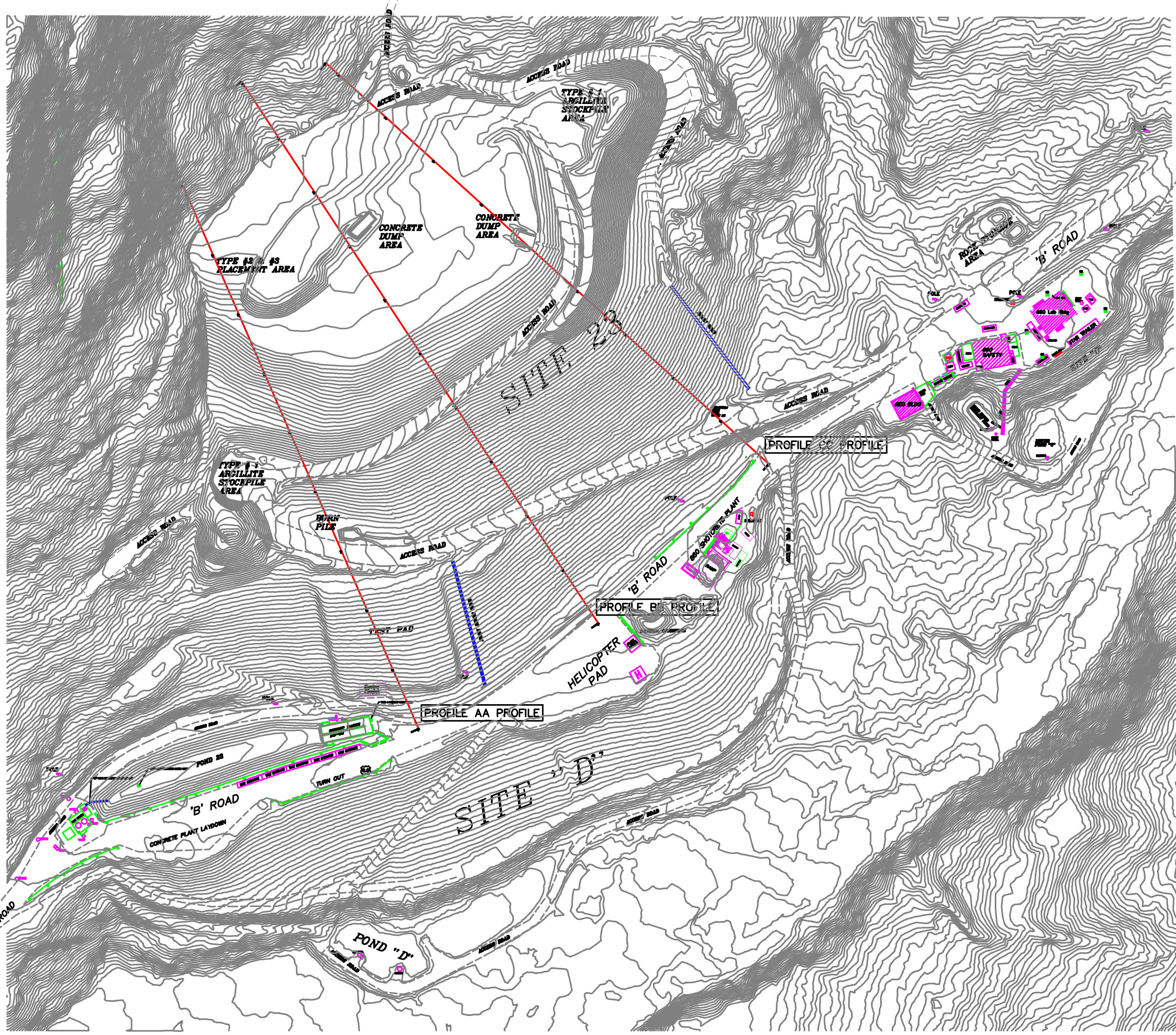
TITLE: 2017 TAILINGS YEAR END PROFILE VIEWS

SHEET: 12/31/18

SHEET: 1 OF 1

Attachment H:

Site 23 Building Layout

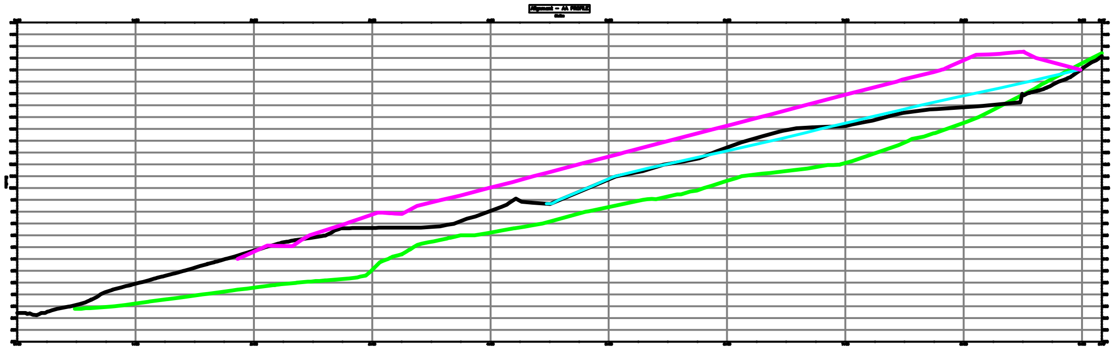


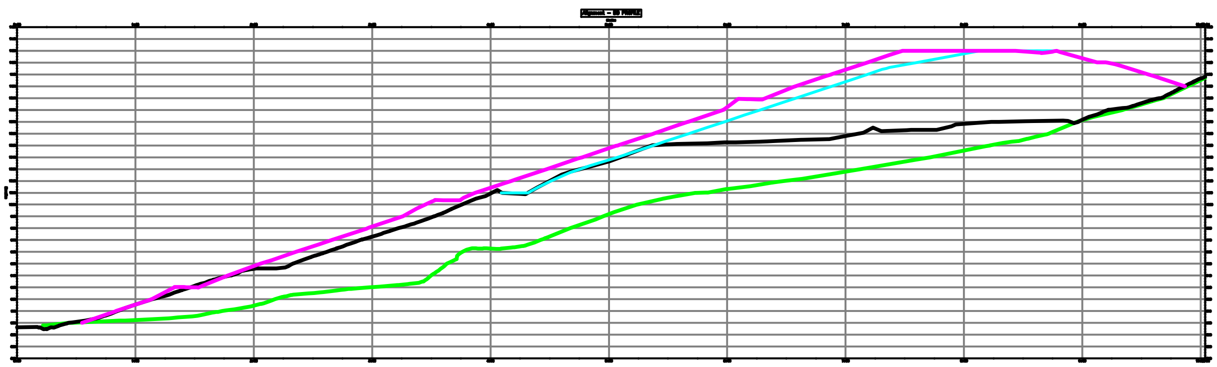
HECLA GREENS CREEK MINE ADMIRALTY ISLAND, ALASKA	**LEGEND** (A) CHEMICAL TANK (24) PETROLEUM TANK TO- TRANSFORMER (SC) SPILL RESPONSE	SITE 23 Asbuilt 12/31/18 SHEET: 1 OF 1

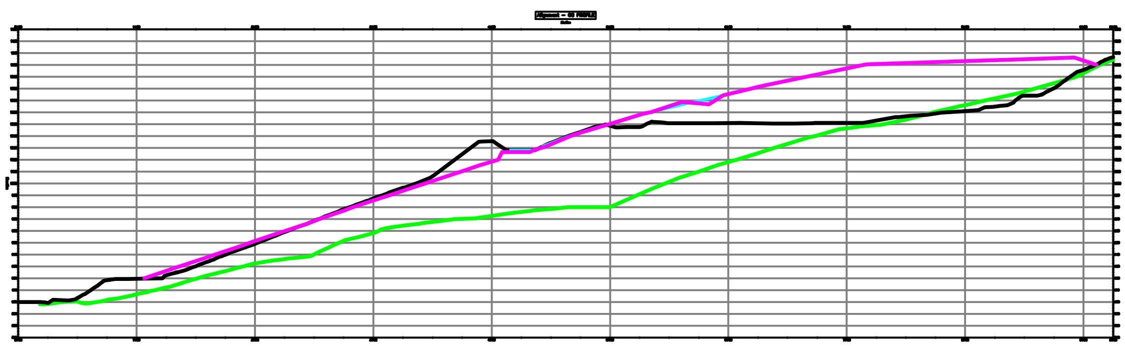
LEGEND: ROADS/DITCHES, SEWER, WATER UTILS, ELECT UTILS, BUILDINGS, CONCRETE CURBS

SYMBOLS: FIRE HYDRANT, BOLLARDS, WATER VALVE, MONITORING POINT, POWER POLES, CATCH BASIN

PREPARED BY:
HECLA GREENS CREEK MINE
P.O. BOX 32199
JUNEAU, ALASKA 99801
PHONE: (907)790-8441 FAX: (907)790-8448
DRAWING BY: Shelby Edwards
DESIGN BY:
REVIEWED BY:
PROJ OR REF.







AS A MUTUAL PROTECTION TO OUR CLIENT, THE PUBLIC AND OURSELVES, ALL REPORTS AND DRAWINGS ARE SUBMITTED FOR THE CONFIDENTIAL INFORMATION OF OUR CLIENT FOR A SPECIFIC PROJECT AND AUTHORIZATION FOR USE AND/OR PUBLICATION OF DATA, STATEMENTS, CONCLUSIONS OR ABSTRACTS FROM OR REGARDING OUR REPORTS AND DRAWINGS IS RESERVED PENDING OUR WRITTEN APPROVAL.

LEDGEND:

- ORIGINAL GROUND
- EXISTING GROUND
- 3:1 DESIGN

SYMBOLS:

- FIRE HYDRANT
- BOLLARDS
- WATER VALVE
- MONITORING POINT
- POWER POLES
- CATCH BASIN

Hecla MINING COMPANY

DATE: 12-31-18
DRAWING BY: Shelby Edwards
DESIGN BY: ----
REVIEWED BY: ----
PROJ OR REF. ----

HECLA GREENS CREEK MINING CO.
P.O. BOX 32199 JUNEAU, ALASKA 99803
PHONE: (907)790-8441 FAX: (907)790-8448

TITLE:

2018 SITE 23 YEAR END PROFILE VIEWS

0 20 50 100

SHEET: 1 OF 1

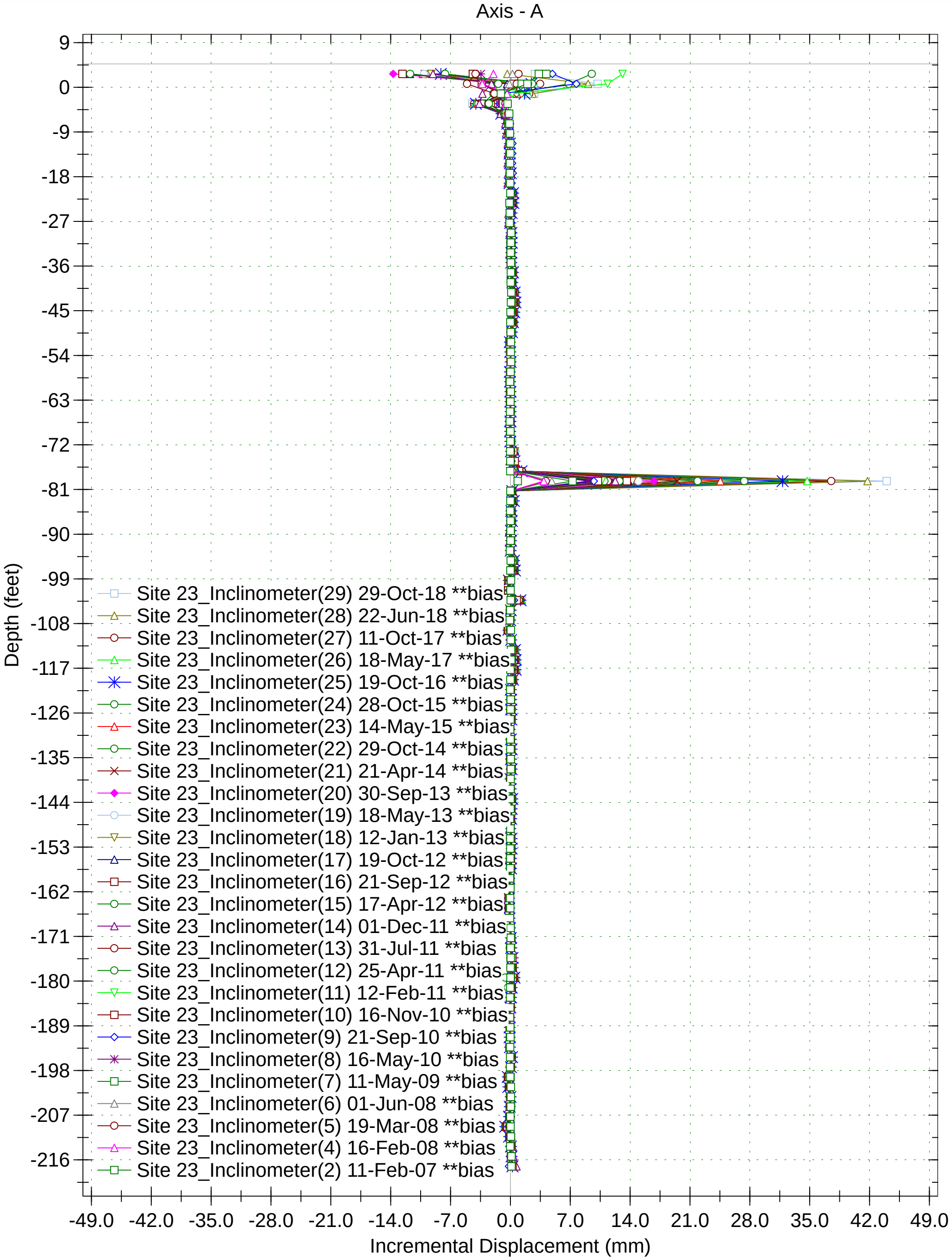
Attachment I:

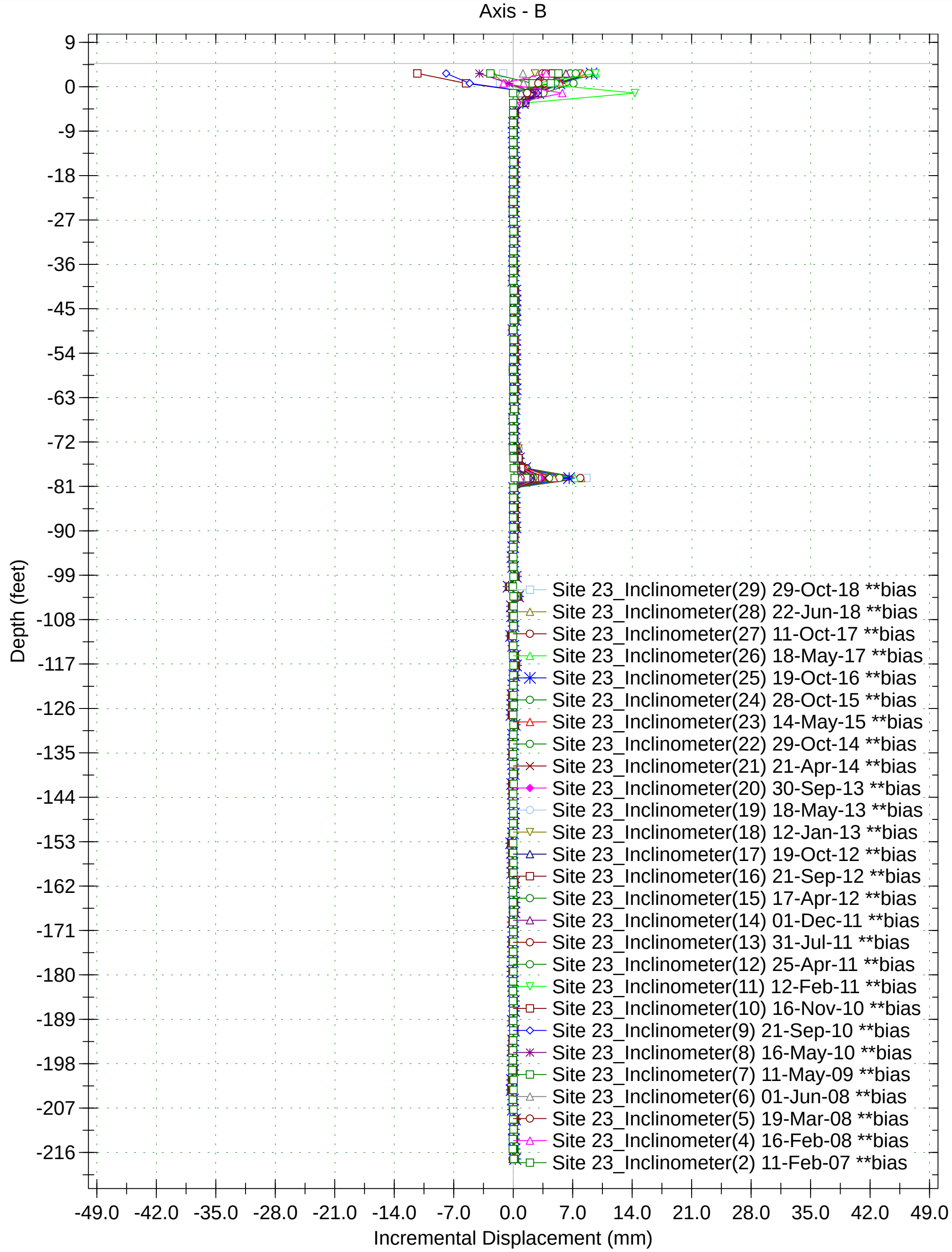
Site 23 Inclinometer Displacement

RST Instruments Ltd. — INCREMENTAL DISPLACEMENT — Inclinalysis v. 2.47.5

Borehole : Inclinometer
Project : Site 23
Location : IN-23-05-01
Northing : 20671.45 ft
Easting : 17186.42 ft
Collar : 948.84 ft

Spiral Correction : N/A
Collar Elevation : 4.7 feet
Borehole Total Depth : 222.0 feet
A+ Groove Azimuth : 135 degrees
Base Reading : 2006 Oct 07 10:28
Applied Azimuth : 0.0 degrees





RST Instruments Ltd.

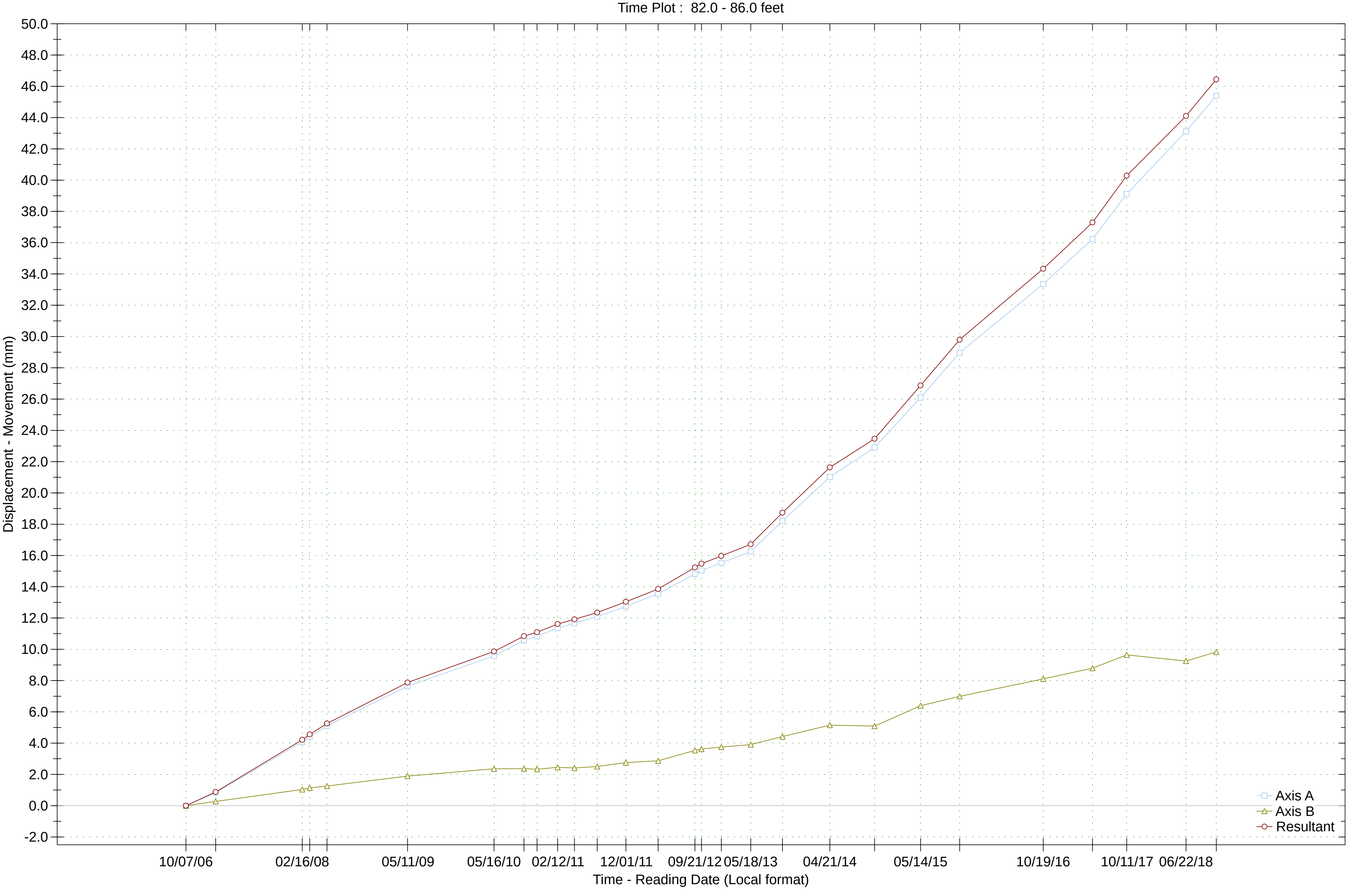
TIME PLOT

Displacement vs. Time

Inclinalysis v. 2.47.5

Borehole : Inclinometer
Project : Site 23
Location : IN-23-05-01
Northing : 20671.45 ft
Easting : 17186.42 ft
Collar : 948.84' Top of Casing
Collar Elev : 4.7 feet

Spiral Correction : N/A
Movement Depth : 82.0 - 86.0 feet
Borehole Total Depth : 222.0 feet
A+ Groove Azimuth : 135 degrees
Latest Reading : 2018 Oct 29 14:54
Initial Reading : 2006 Oct 07 10:28
Applied Azimuth : 0.0 degrees



Attachment J:

Monitoring Site Location Maps

Hecla GREENS CREEK

Tailings Disposal Facility
Monitoring Location Map

Hecla Greens Creek Mining Company
Admiralty Island, Alaska

0 200 400 600 800
Feet

Tailings Disposal Facility
Monitoring Location Map

Hecla Greens Creek Mining Company
Admiralty Island, Alaska

0 200 400 600 800
Feet

Hecla GREENS CREEK

Tailings Disposal Facility Monitoring Location Map

Hecla Greens Creek Mining Company
Admiralty Island, Alaska

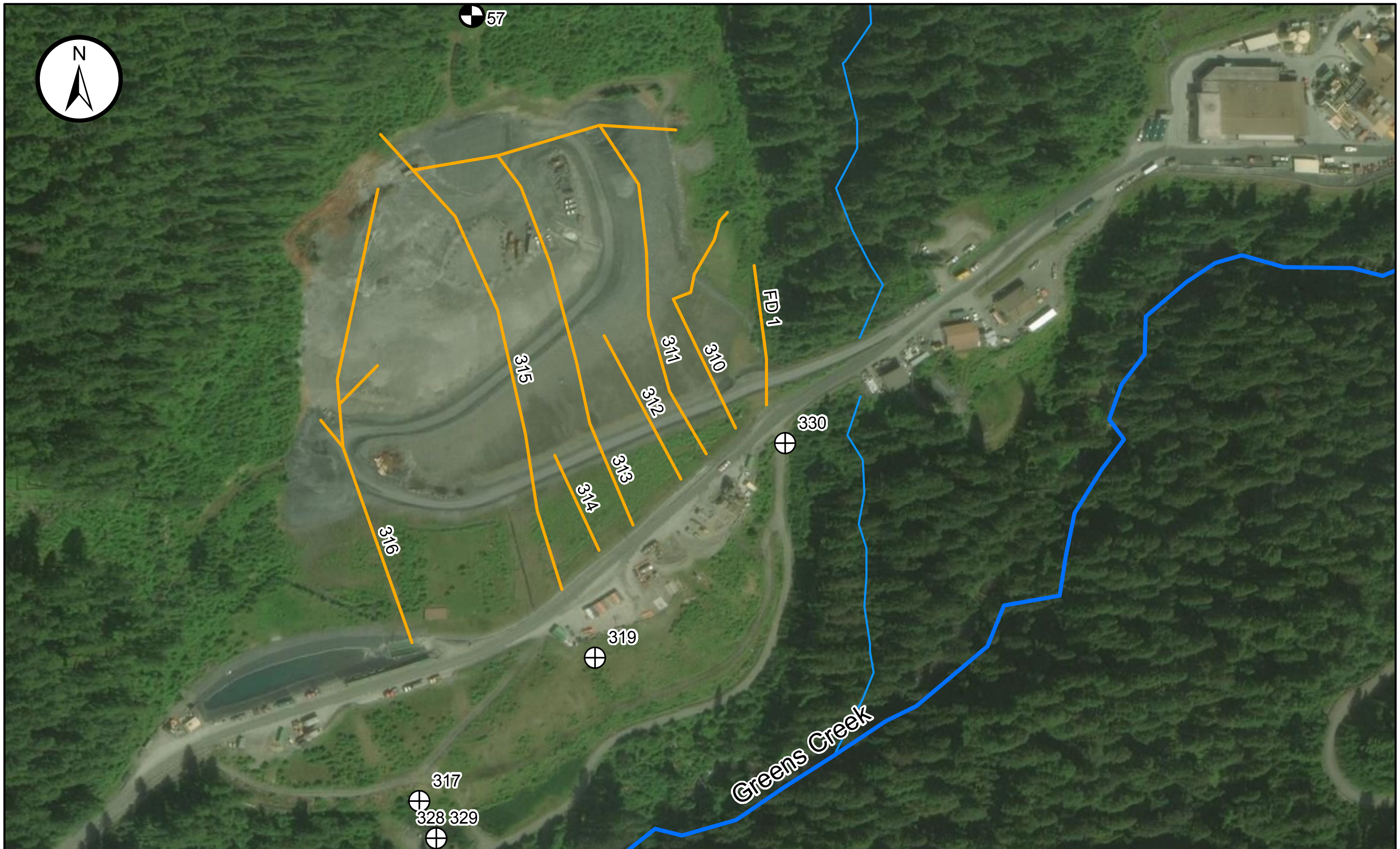
0 200 400 600 800
Feet

Hecla
GREENS CREEK

Tailings Disposal Facility
Monitoring Location Map

Hecla Greens Creek Mining Company
Admiralty Island, Alaska

0 200 400 600 800
Feet



Hecla GREENS CREEK

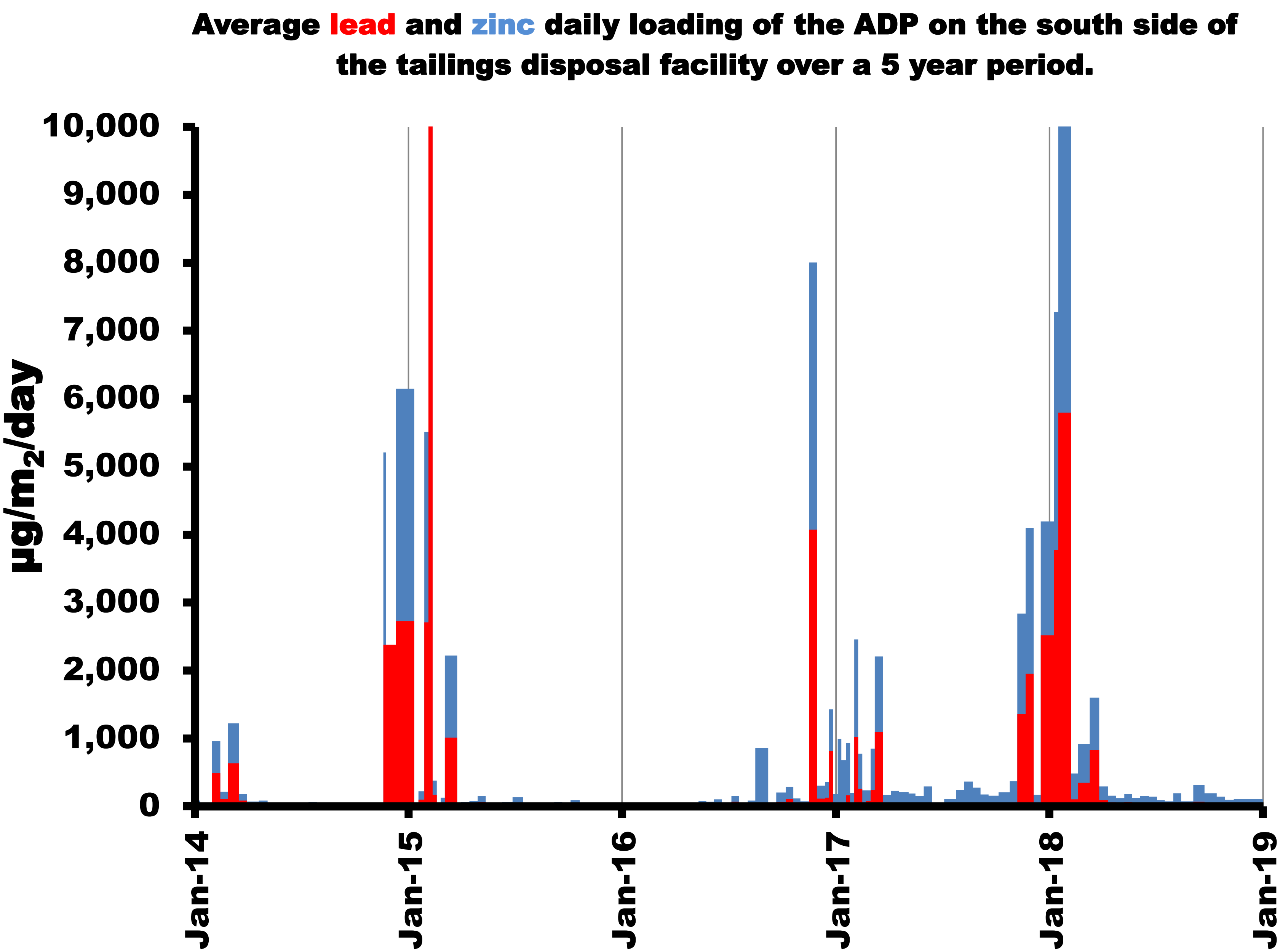
Site 23
Monitoring Location Map

Greens Creek Mining Company
Admiralty Island, Alaska

0 200 400 600 800
Feet

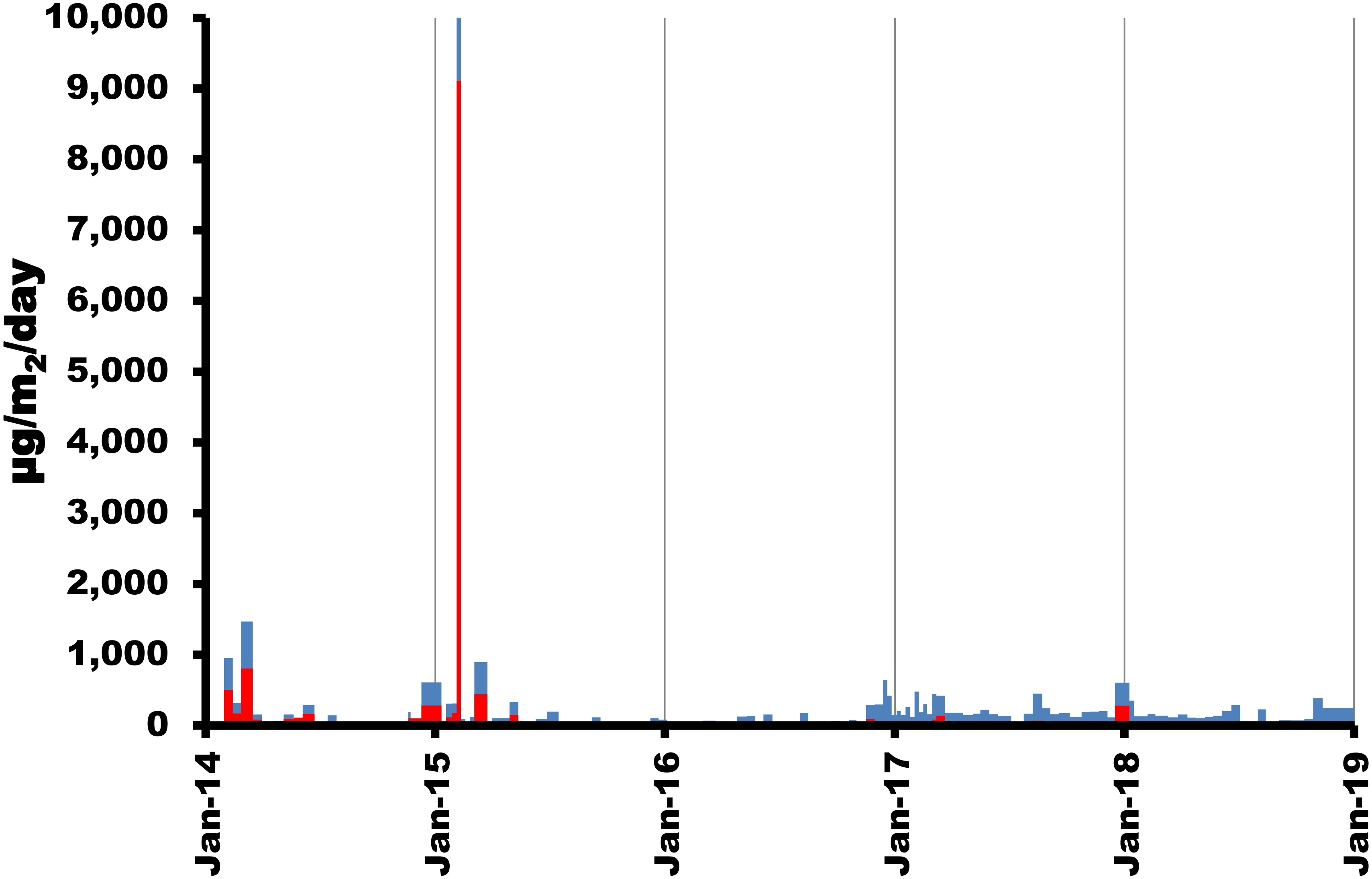
Attachment K:

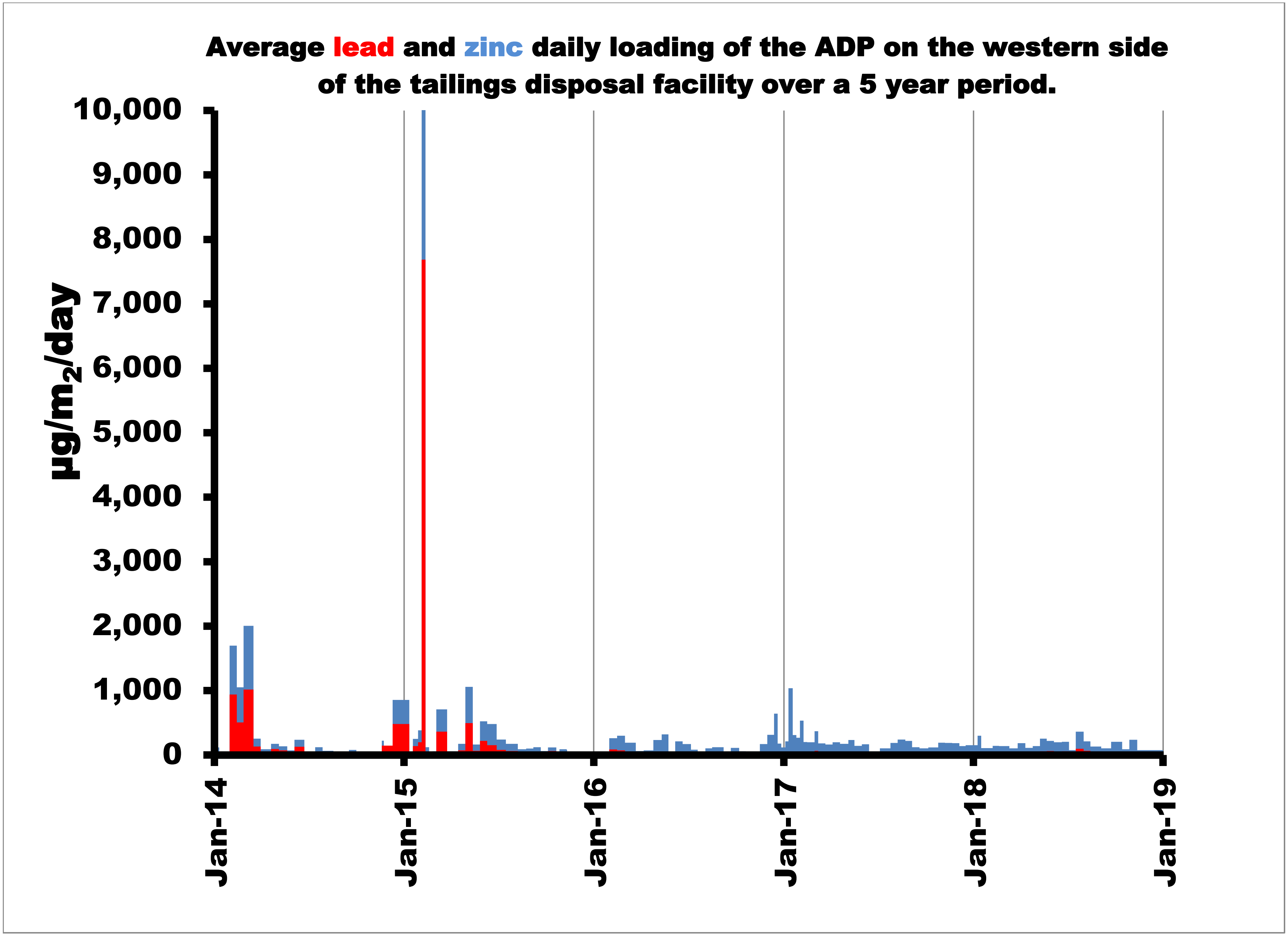
TDF Dust Loading



Average lead and zinc daily loading of the ADP on the south side of the tailings disposal facility over a 5 year period.
µg/m2/day
10,000
9,000
8,000
7,000
6,000
5,000
4,000
3,000
2,000
1,000
0
Jan-14
Jan-15
Jan-16
Jan-17
Jan-18
Jan-19

Average lead and zinc daily loading of the ADP on the southwest side of the tailings disposal facility over a 5 year period.

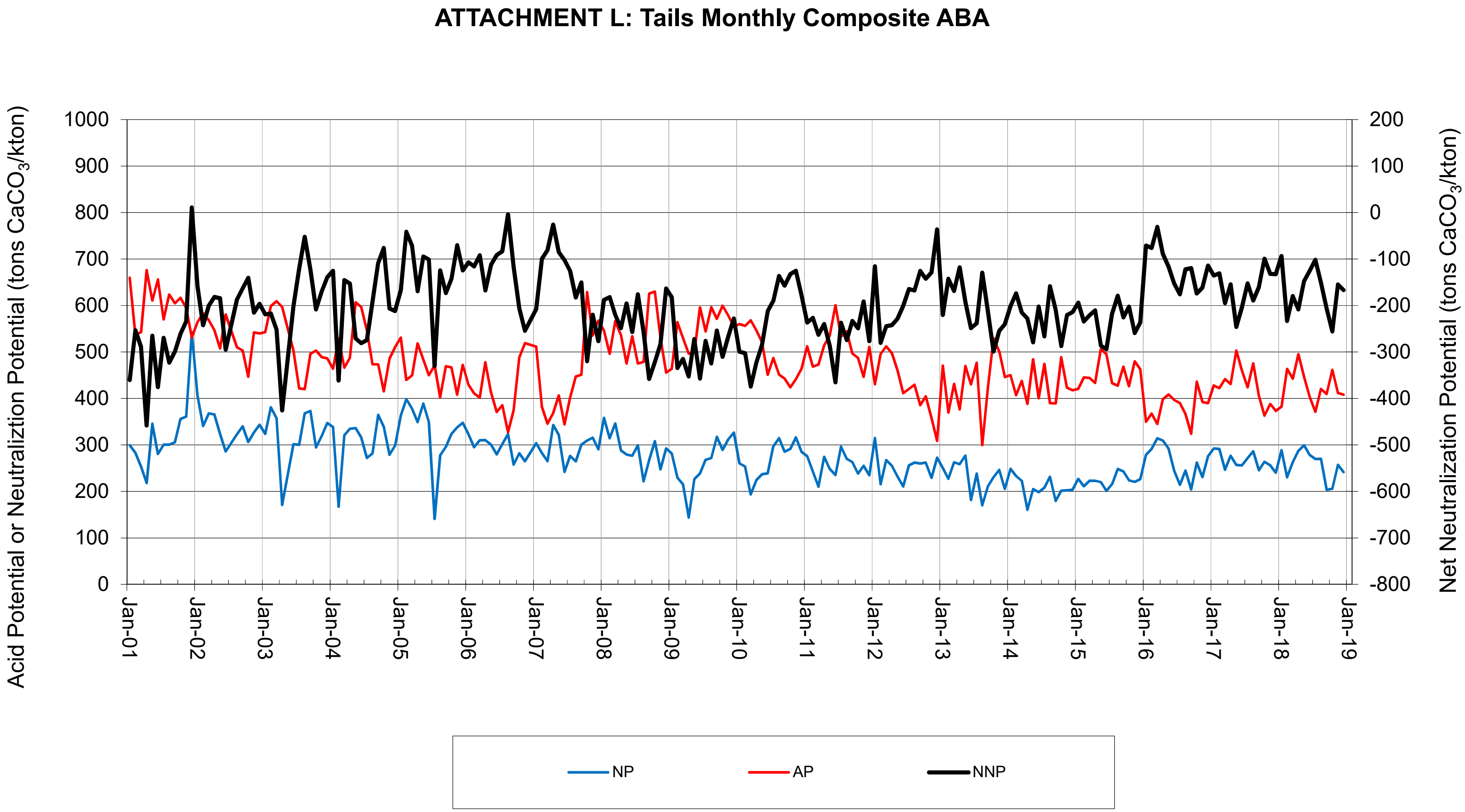


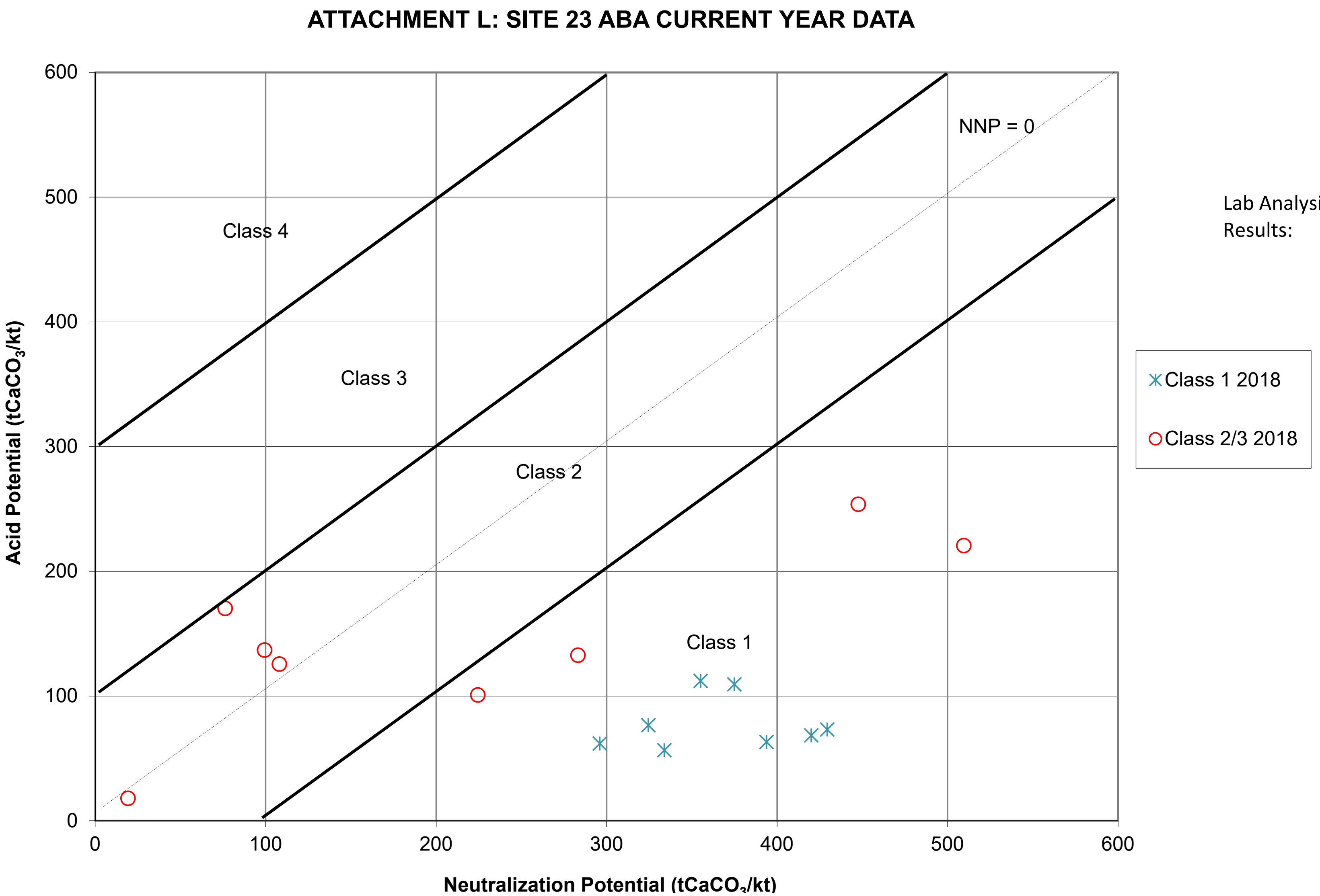


Average lead and zinc daily loading of the ADP on the western side of the tailings disposal facility over a 5 year period.
10,000
9,000
8,000
7,000
6,000
5,000
4,000
3,000
2,000
1,000
0
μg/m2/day
Jan-14
Jan-15
Jan-16
Jan-17
Jan-18
Jan-19

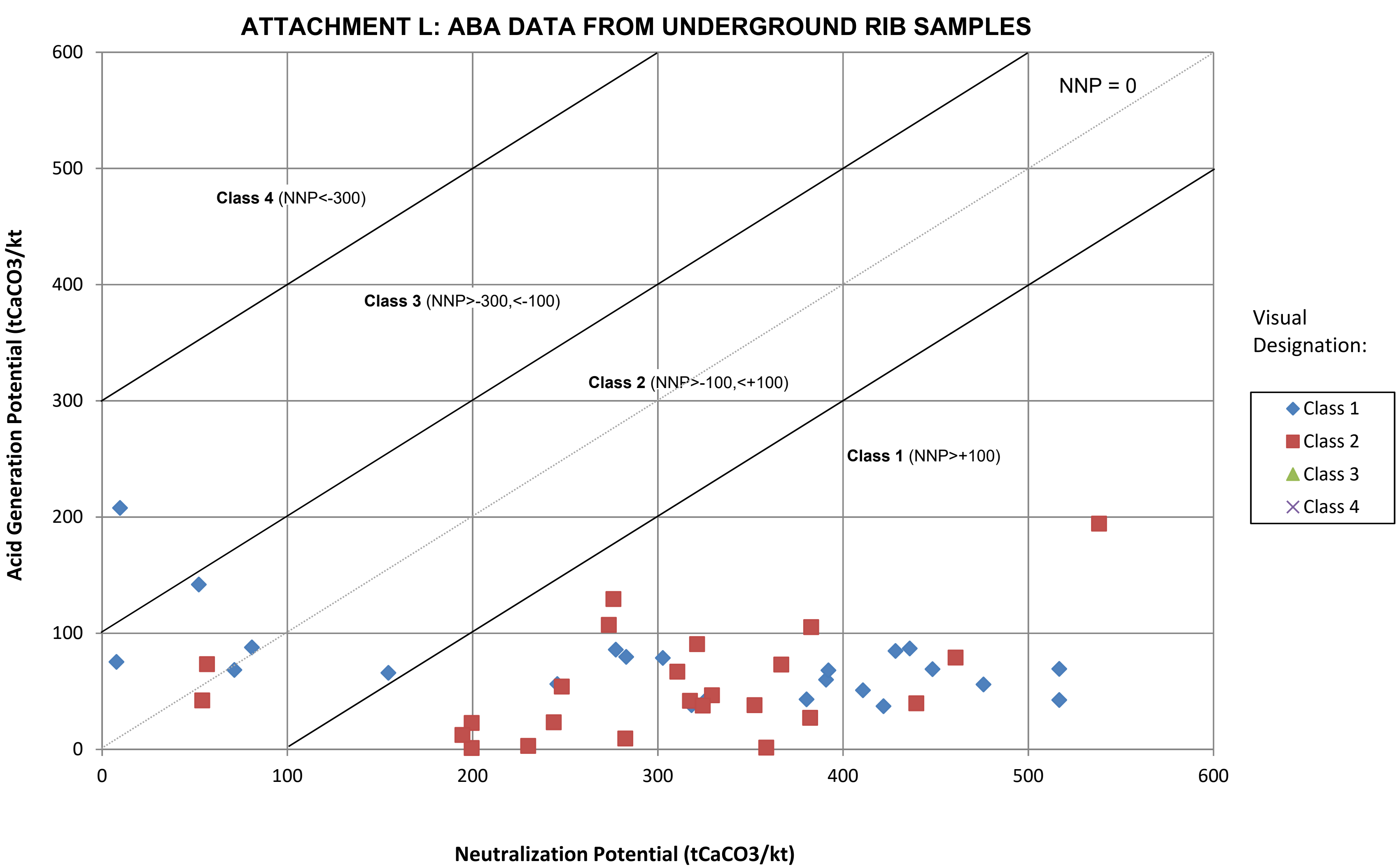
Attachment L:

Acid-Base Accounting Graphs


ATTACHMENT L: Tails Monthly Composite ABA
Acid Potential or Neutraliztion Potential (tons CaCO3/kton)
Net Neutralization Potential (tons CaCO3/kton)
1000
900
800
700
600
500
400
300
200
100
0
200
100
0
-100
-200
-300
-400
-500
-600
-700
-800
Jan-01
Jan-02
Jan-03
Jan-04
Jan-05
Jan-06
Jan-07
Jan-08
Jan-09
Jan-10
Jan-11
Jan-12
Jan-13
Jan-14
Jan-15
Jan-16
Jan-17
Jan-18
Jan-19
NP
AP
NNP



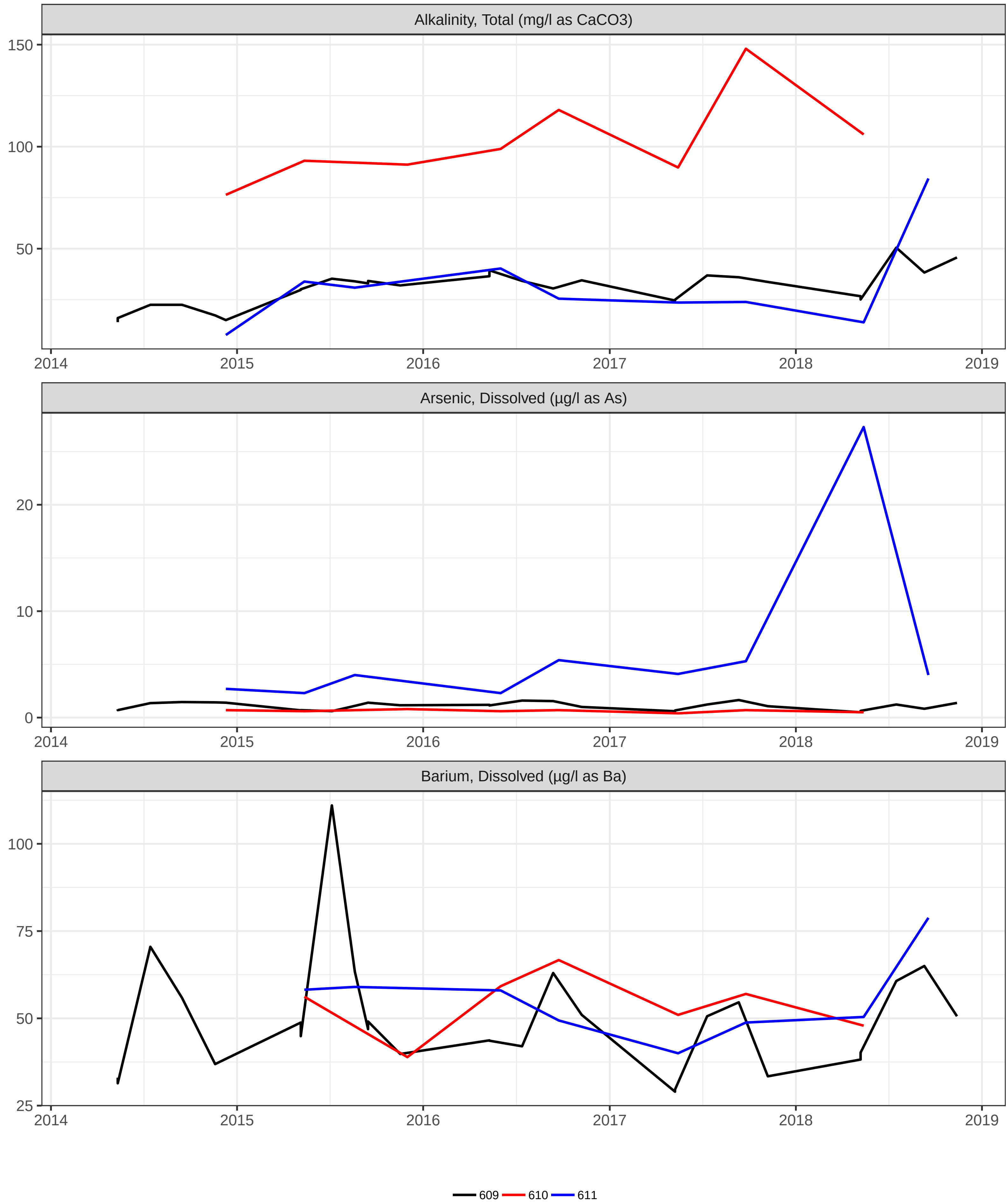
Lab Analysis
Results:


ATTACHMENT L: ABA DATA FROM UNDERGROUND RIB SAMPLES
Acid Generation Potential (tCaCO3/kt
Neutralization Potential (tCaCO3/kt)
NNP = 0
Class 4 (NNP<-300)
Class 3 (NNP>-300,<-100)
Class 2 (NNP>-100,<+100)
Class 1 (NNP>+100)
Visual Designation:
Class 1
Class 2
Class 3
Class 4
0
100
200
300
400
500
600

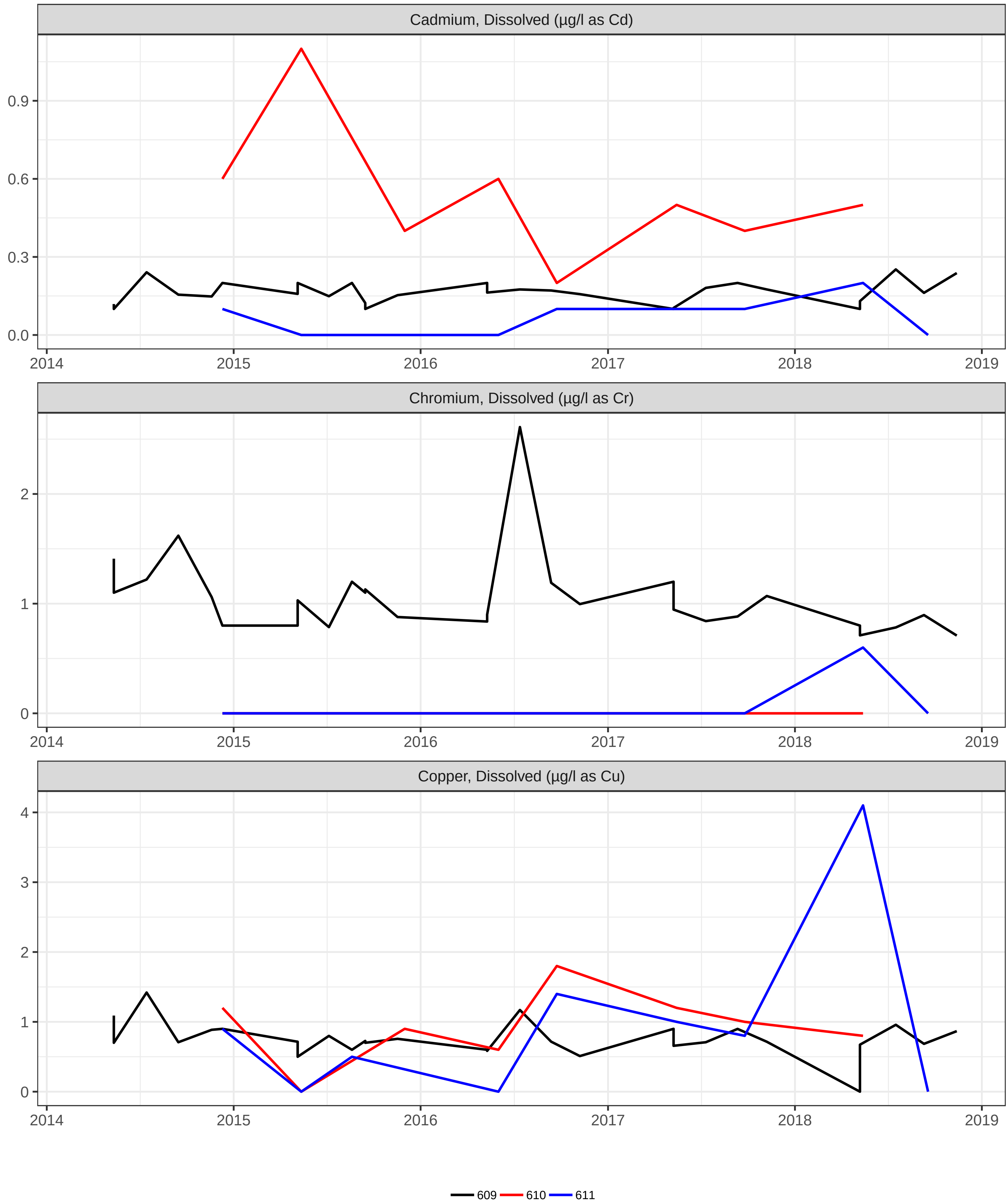
Attachment M:

West Tails Drainage

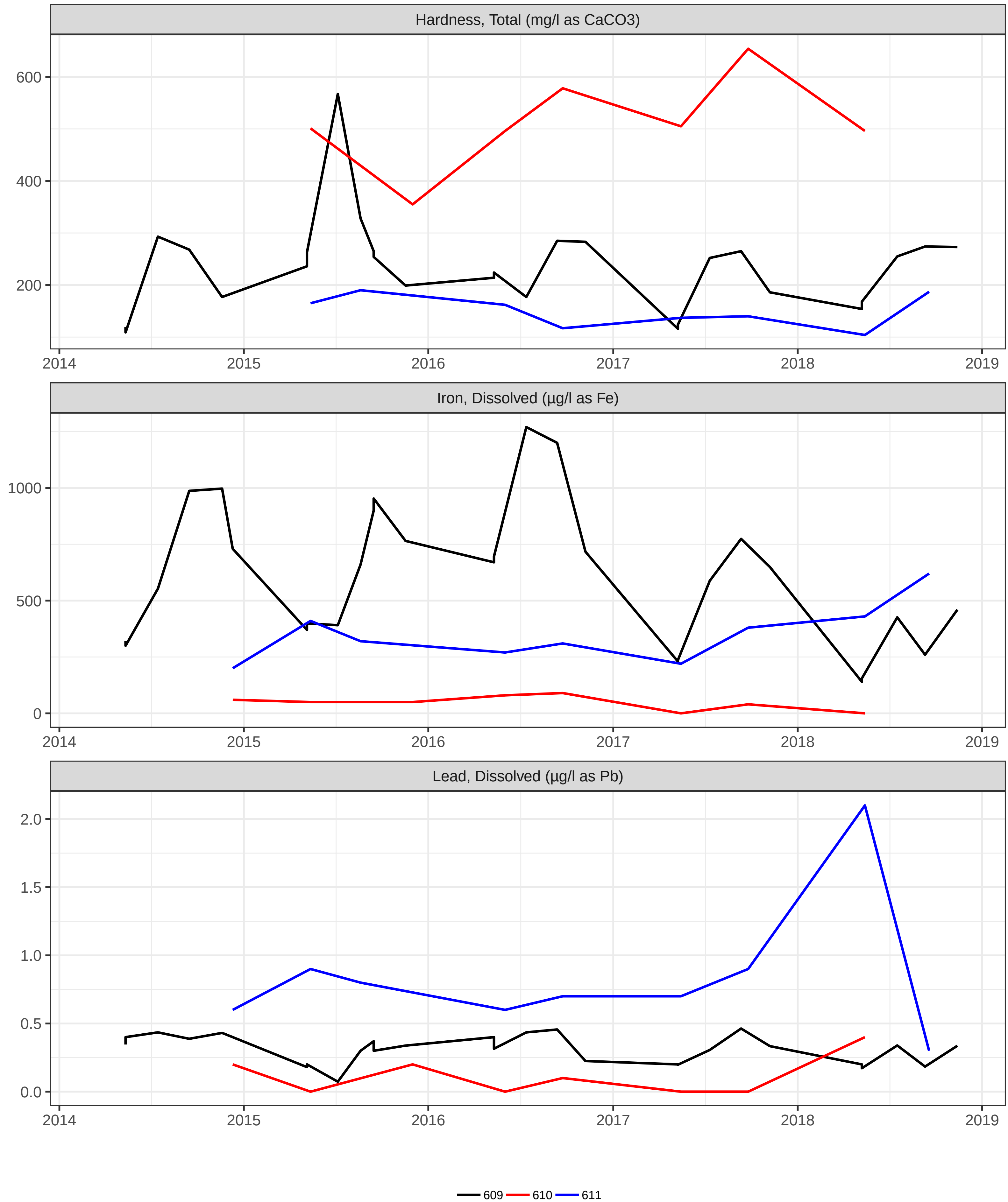
ATTACHMENT M
West Tailings Drainages



ATTACHMENT M
West Tailings Drainages



ATTACHMENT M
West Tailings Drainages



ATTACHMENT M
West Tailings Drainages

ATTACHMENT M
West Tailings Drainages

ATTACHMENT M
West Tailings Drainages