February 28, 2019
COR-19-020
Via Electronic

Alaska Department of Environmental Conservation
Division of Water, Compliance Program
555 Cordova Street
Anchorage, AK 99501

Re: **Northern Star (Pogo) LLC 2018 Annual Activity and Monitoring Report**

To whom it may concern:

Enclosed is Northern Star (Pogo) LLC (Pogo's) 2018 Annual Activity and Monitoring Report. This report is prepared to fulfill the requirements of the *Alaska Department of Natural Resources (ADNR) Pogo Mine Millsite Lease ADL416949*, *Alaska Department of Environmental Conservation (ADEC) APDES Permit AK0053341,* and *ADEC Waste Management Permit 2018DB0001*. This report covers the period from January 1, 2018 through December 31, 2018.

If you have any questions, please contact Jeremiah Drewel, Environmental Coordinator at (907) 895-2860 or email him at jdrewel@nsrltd.com. Or you may contact me at 907-895-2879 or jladegard@nsrltd.com.

Sincerely,

Jillian Ladegard, P.E.
Environmental Manager

Enclosure: 2018 Annual Activity and Monitoring Report, Northern Star (Pogo) LLC

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2018 ANNUAL ACTIVITY AND MONITORING REPORT

NORTHERN STAR (POGO) LLC

Submitted To:

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Feb 28, 2018

Table of Contents

1. INTRODUCTION 6

2. 2018 MONITORING 6

2.1 SUMMARY 7

2.2 TREATED EFFLUENT MONITORING 9

2.2.1 Outfall 011 – Treated Effluent from Mine Water Treatment Plant 9

2.2.2 Outfall 001 – Discharge from Off River Treatment Works 10

2.2.3 Outfall 002 – Treated Effluent from Sewage Treatment Plant 11

2.3 SURFACE WATER MONITORING 12

2.4 GROUNDWATER QUALITY MONITORING 14

2.4.1 Downgradient of DSTF 14

2.4.2 Liese Creek Flumes 15

2.4.3 Downgradient of RTP Dam 15

2.4.3.1 MW12-500, 501, 502 Wells 15

2.4.3.2 MW18-SCW and MW18-FL3 16

2.4.4 Downgradient of Ore Zone 16

2.4.4.1 MW04-213 and MW11-216 16

2.4.4.2 MW18-FL4 and MW18-FL4 Deep 16

2.4.5 Downgradient of ORTW 17

2.4.6 Goodpaster River Area 17

2.5 PROCESS CONTROL MONITORING 17

2.5.1 Water Balance 18

2.5.2 Permits to Appropriate Water and Temporary Water Use Permit Summary 18

2.5.3 Carbon-In-Pulp (CIP) Tailings Cyanide Destruction 20

2.5.4 Mineralized Development Rock Geochemistry 21

2.5.5 Flotation Tailings Geochemistry 21

2.5.6 Flotation Tailings Interstitial Water Chemistry 21

2.6 VISUAL MONITORING 22

2.6.1 Facility Inspection 22

2.6.2 Biological Survey 22

2.6.3 Invasive Weed Control *22*
2.7 DEVELOPMENT ROCK SEGREGATION AND STORAGE 24
2.8 WASTE DISPOSAL 25
2.9 SPILL REPORTING 25
2.10 GEOTECHNICAL MONITORING 26
3. AS-BUILT REPORTS AND MAPS 27
4. RECLAMATION AND FINANCIAL RESPONSIBILITY 27
4.1 REVEGETATION STUDY 29
5. PERMIT ACTIVITIES 36
5.1 2018 PERMIT ACTIVITIES 36
5.2 FUTURE PERMIT ACTIVITIES 37

List of Figures

FIGURE 1: 2018 MWTP #3 OUTFALL 011 DISCHARGE TO ORTW 10
FIGURE 2: 2018 OUTFALL 001 DISCHARGE TO GOODPASTER RIVER 11
FIGURE 3: 2018 OUTFALL 002 DISCHARGE TO GOODPASTER RIVER 12
FIGURE 4: 2018 RTP FLUME #1 AND SITE CUMULATIVE RAINFALL 15
FIGURE 5: BIRD VETCH, BEFORE AND AFTER REMOVAL AT MILE 5.1. 23
FIGURE 6: MATERIAL SITE 03 BEFORE AND AFTER REMOVAL OF WHITE SWEET CLOVER, NARROWLEAF HAWKSBEARD, AND SHEPARD'S PURSE 24
FIGURE 7: 2018 POGO SPILL REPORTING 26
FIGURE 8: BROADLEAF FOREST 2014 (BEFORE) AND 2017 (AFTER 3 YEARS OF GROWTH) 30
FIGURE 9: 2017 ALLUVIAL SHRUB PLOTS 32
FIGURE 10: 2017 BROADLEAF FOREST PLOTS 32
FIGURE 11: 2017 WETLAND PLOTS 33
FIGURE 12: 2018 ALPINE MEADOW PLOTS 33
FIGURE 13: CONTROL PLOTS ALPINE SEED MIXES ON DSTF SHELL 2 AUGUST 2018 (AFTER 3 YEARS OF GROWTH). 36

List of Tables

Table 1: Pogo Mine Whole Effluent Toxicity (WET) Testing 2018……13
Table 2: Permits to Appropriate Water 2018 Monthly Total Flows……19
Table 3: Temporary Water Use Permits 2018 Monthly Total Flows……20
Table 4: Miscellaneous Waste Disposal in DSTF and Underground in 2018……25
Table 5: Summary of Pogo Mine Reclamation and Closure Cost……28
Table 6: Summary of Pogo ROW Reclamation and Closure Cost……29
Table 7: Revegetation Plot Seed Mixes Summary……34

Appendices

APPENDIX A – MAPS

Figure 1: General Location Map
Figure 2: Monitoring Stations
Figure 3: Pogo Mine As-Built
Figure 3a: 1525 Portal and Lower Camp As-Built
Figure 3b: Airstrip Area As-Built
Figure 3c: Mill and Permanent Camp Bench As-Built
Figure 3d: RTP and DSTF Area As-Built

APPENDIX B – WASTE ROCK GEOCHEMISTRY AND FLOTATION TAILINGS SOLIDS CHEMISTRY

TABLE 1: WHOLE ROCK GEOCHEMISTRY FOR ROCK PLACED IN DRYSTACK 2018
TABLE 2: GEOCHEMISTRY OF FLOTATION TAILINGS SOLIDS PLACED IN DRYSTACK 2018

APPENDIX C – TIME SERIES GRAPHS OF MONITORING DATA

APPENDIX D – WHOLE EFFLUENT TOXICITY TESTING

APPENDIX E – LABORATORY MDL STUDIES

Electronic Appendices

APPENDIX F – ELECTRONIC MONITORING DATA

[SUBMITTED ELECTRONICALLY VIA ALASKA ZENDTO (STATE OF ALASKA)]

Acronyms

AAC:	Alaska Administrative Code
ADEC:	Alaska Department of Environmental Conservation
ADNR:	Alaska Department of Natural Resources
APDES:	Alaska Pollutant Discharge Elimination System
BOD:	Biological Oxygen Demand
CIP:	Carbon-in-Pulp
DSTF:	Dry Stack Tailings Facility
DMR:	Discharge Monitoring Report
MDL:	Method Detection Limit
ML:	Method Limit
MWTP#3:	Mine Water Treatment Plant #3
ORTW:	Off-River Treatment Works
QAP:	Quality Assurance Plan
RTP:	Recycle Tailings Pond
SCW:	Seepage Collection Wells
STP:	Sewage Treatment Plant
TSS:	Total Suspended Solids
TDS:	Total Dissolved Solids
WAD:	Weak Acid Dissociable
WQS:	Water Quality Standards

1. Introduction

Northern Star (Pogo) LLC prepared this report to fulfill the requirements of the *Alaska Department of Environmental Conservation (ADEC) APDES Permit AK0053341 (7/27/17), Alaska Department of Environmental Conservation (ADEC) Waste Management Permit 2018DB0001 (5/24/2018), Alaska Department of Natural Resources (ADNR) Pogo Mine Millsite Lease ADL416949*, *and ADNR Plan of Operations Approval F20189500 (5/24/2018)*. This report addresses activities executed during the 2018 calendar year from January 1, 2018 through December 31, 2018. A General Location Map can be found in **Figure 1, Appendix A**. Graphs were streamlined and updated to show data plotted on a log-scale axis. This presentation defines individual data sets and their relation to the detection limits and the ADEC Water Quality Standards (WQS). The past six years of data are included in the graphs.

2. 2018 MONITORING

A prescriptive environmental monitoring program is performed in accordance with State of Alaska permits and Pogo's approved *Pogo Mine Monitoring Plan* and *Quality Assurance Plan (QAP).*

The objectives of Pogo's monitoring programs are:

- To monitor the water quality of the effluent discharged from the facility,
- To monitor water quality changes in the Goodpaster River and in the groundwater below the facility that may occur as a result of mining activities or discharges from the facility,
- To monitor the Carbon-in-Pulp (CIP) tailings processes associated with the underground paste backfill, and;
- To monitor the flotation tailings and the materials placed in the Drystack Tailings Facility (DSTF).

Samples collected from the Mine Water Treatment Plant #3 (MWTP#3), groundwater stations, surface water stations, the Sewage Treatment Plant (STP) and the Off-River Treatment Works (ORTW) effluent were submitted to Energy Laboratories, Inc., and

Pollen Environmental. Samples collected from PC002, monitoring mineralized waste rock, and PC003, monitoring floatation tailings, were analyzed by ALS Chemex. Annual Whole Effluent Toxicity (WET) Test samples were submitted to TRE Environmental and Test America Laboratory. Annual fish tissue samples were analyzed by Test America Laboratory, Tacoma. An Annual Verification of Laboratory Specific Method Detection Limit (MDL) Study was required under ADEC Waste Management Permit 2011DB0012 and is included in **Appendix E**. The current ADEC Waste Management Permit 2018DB0001 does not have this requirement, therefore the section will be phased out in the next annual report.

2.1 SUMMARY

A summary of the 2018 monitoring results shows:

APDES Permit:

- **Outfall 011:** Pogo reported no exceedances at Outfall 011 during the year. Refer to **Section 2.2.1** for more detail.
- **Outfall 001:** Pogo reported no exceedances at Outfall 001. All WAD cyanide analytical results for Outfall 001 during the year were less than 10 ug/L. Refer to **Section 2.2.2** for more detail.
- **Outfall 002:** Pogo reported no exceedances at Outfall 002 during the year. Refer to **Section 2.2.3** for more detail.
- **Surface Water:** No adverse trends were observed for the year. Refer to **Section 2.3** for more detail.
- **Whole Effluent Toxicity:** WET testing took place in June. Chronic bioassays were conducted by two laboratories concurrently. All final test results were within the permit limits. Refer to **Section 2.3.2** for more detail.
- **Fish Tissue:** Annual fish tissue sampling was completed in September. No adverse trends were observed. Refer to **Section 2.3.3** for more detail.

Waste Management Permit:

<u>Ground Water</u>

- **2011 Series Wells:** Two wells are located below the Drystack Tailings Facility: MW11-001A and MW11-001B. The wells monitor groundwater downstream of the DSTF and upstream of the Recycled Tailings Pond (RTP). Nitrates and TDS

remain above ADEC WQS in this area and Copper in MW11-001A. Refer to **Section 2.4.1** for more detail.

- **500 Series Wells:** Three wells are located below the RTP Dam: MW12-500, MW12-501, and MW12-502. The wells monitor groundwater downstream of the RTP seepage collection wells(SCW) system. Chloride, nitrate, and sodium levels were detected above trigger limits. Refer to **Section 2.4.2** for more detail.
- **200 Series Wells:** Two wells, MW04-213 and MW11-216, are located downgradient of the ore body to monitor groundwater quality. No adverse trends were observed; however, arsenic remains above ADEC WQS in MW04-213. These wells are sampled semi-annually. Refer to **Section 2.4.3** for more detail.
- **LL Series Wells:** LL04-031 and LL04-032 are located downgradient of the ORTW to monitor groundwater between the ORTW and Goodpaster River. Samples were collected during the 2nd quarter. The wells are sampled annually. No adverse trends were observed. Refer to **Section 2.4.4** for more detail.
- **2012 Series Wells:** To support hydrogeological studies, two wells are located adjacent to the Pogo Airstrip, MW12-001A and MW12-001B. No adverse trends were observed. Refer to **Section 2.4.5** for more detail.
- **2018 Series Wells:** To support a corrective action investigation associated with the seepage collection wells, four new wells were placed next to flumes in Leise Creek. The 2018 Series wells were installed in late October 2018, and are sampled quarterly. One sampling event occurred in 2018. Refer to **Section 2.4.3.2** for wells MW18-SCW, MW18-FL3 and to **Section 2.4.4.2** for wells MW-FL4, MW-FL4 Deep.

Process Control

- **PC001:** PC001 monitors CIP tails prior to use in paste backfill. All samples are within limits and conditions set forth within the permit. Refer to **Section 2.5.2** for more detail.
- **PC002 and PC003 Solids:** PC002 samples monitor mineralized waste rock that is placed within the DSTF. PC003 Solids samples monitor floatation tailings that are placed within the DSTF. No adverse trends were observed. Refer to

Sections 2.5.3 and 2.5.4 for more detail.

- **PC003 Liquid:** PC003 Liquid samples monitor interstitial water pressed from the flotation tailings prior to placement within the DSTF. Mercury remains elevated, and an internal investigation is underway. Refer to **Section 2.5.5** for more detail. A discussion of the results for each sampling program is provided below. Time series graphs of analytes for each monitoring location are provided in **Appendix C**.

2.2 TREATED EFFLUENT MONITORING

ADEC APDES AK0053341 (8/1/17), Appendix A, 3.0

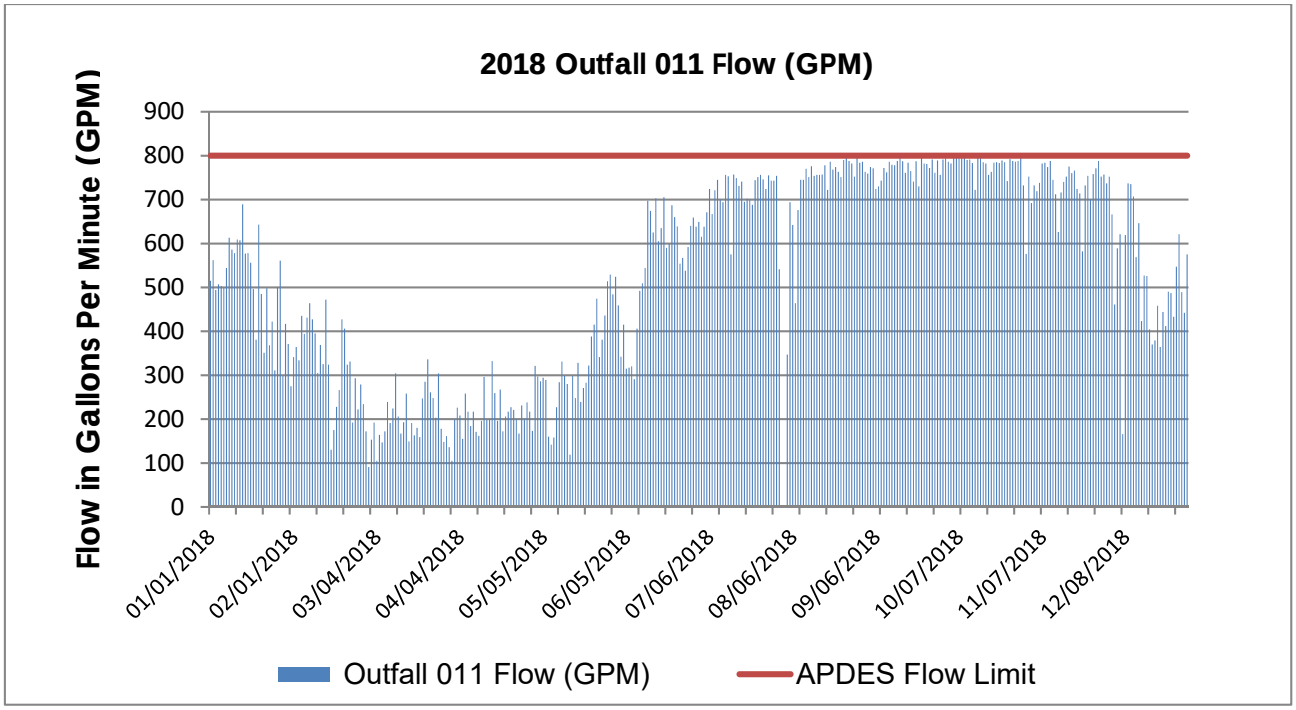
Treated effluent data are submitted to ADEC monthly via the Discharge Monitoring Reports (DMRs) under the APDES Permit. The monitoring locations for treated effluent are shown on **Figure 2 in Appendix A**, as Outfall 011, 001, and 002.

2.2.1 Outfall 011 – Treated Effluent from Mine Water Treatment Plant

ADEC APDES AK0053341 (8/1/17), 1.4

Groundwater and drill water collected from the underground workings are sent to MWTP#3 (located near the 1525 portal). The treated effluent is returned for use underground, sent to the mill to be used as process water, or discharged to the ORTW. Surface runoff and groundwater are collected in the RTP. RTP water and mine water are sent to MWTP#3, treated, and then discharged to the ORTW, or directed to the mill for use as process water. Treated effluent was discharged to the ORTW throughout the year. The volume of water discharged from Outfall 011 during 2018 is shown below in **Figure 1.**

FIGURE 1: 2018 MWTP #3 OUTFALL 011 DISCHARGE TO ORTW



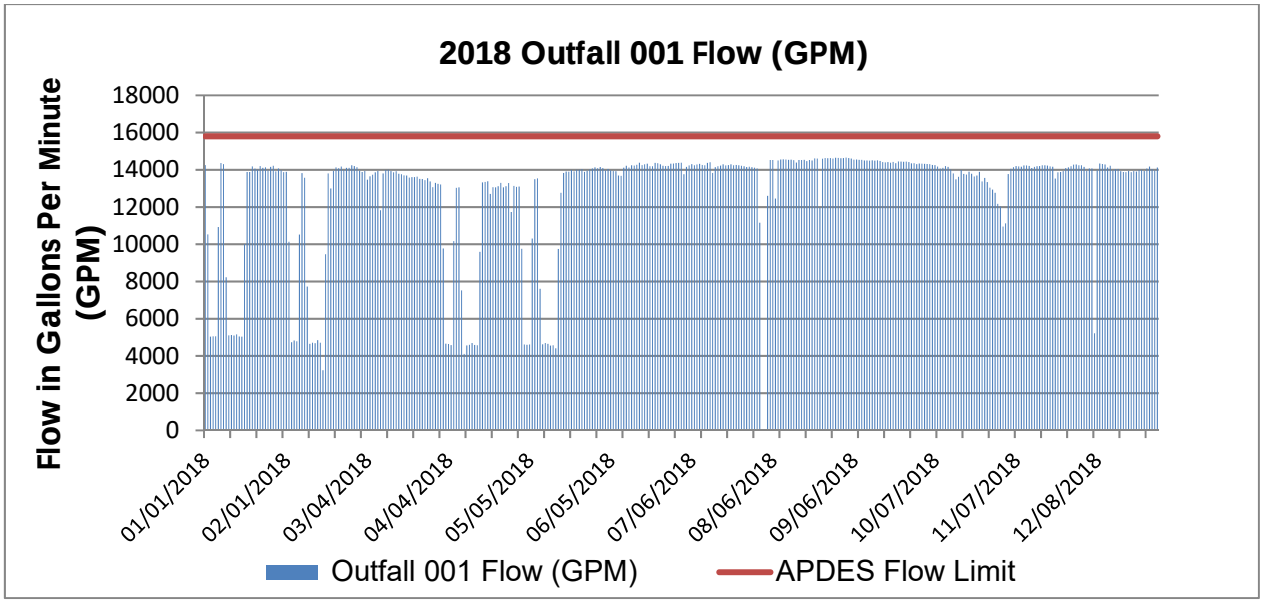
Continuous pH data is collected at Outfall 011 along with weekly laboratory samples of Weak-Acid Dissociable (WAD) cyanide and quarterly laboratory samples for metals (arsenic, cadmium, copper, iron, lead, manganese, mercury, selenium, zinc), total suspended solids (TSS), hardness, and sulfate. All results are within the limits and conditions set forth in the permit. Outfall 011 has a two continuous pH meters; pH readings taken during the year show compliance with permit limits Time series graphs are provided in **Appendix C**. Monitoring data is provided in **Appendix F**.

2.2.2 Outfall 001 – Discharge from Off River Treatment Works

ADEC APDES AK0053341 (8/1/17), 1.3

Treated effluent from MWTP#3 is sent to the ORTW. After mixing in the ORTW, water flows over the weir of Pond 2 (Outfall 001) into the Goodpaster River. The sampling location is at the weir. **Figure 2** presents the gallons per minute flow from Outfall 001 for 2018.

FIGURE 2: 2018 OUTFALL 001 DISCHARGE TO GOODPASTER RIVER



Continuous turbidity data and twice-daily pH readings are collected along with weekly laboratory samples for copper, lead, manganese, WAD cyanide, pH, and temperature at Outfall 001. Monthly samples required by the permit include: cadmium, mercury, zinc, hardness and turbidity. All WAD cyanide analytical results for Outfall 001 during the quarter were less than 10 ug/L. None of the analytical results for WAD cyanide fell between the facility specific method limit (ML) of <20 ug/L and the facility specific method detection limit (MDL) of <10 ug/L.

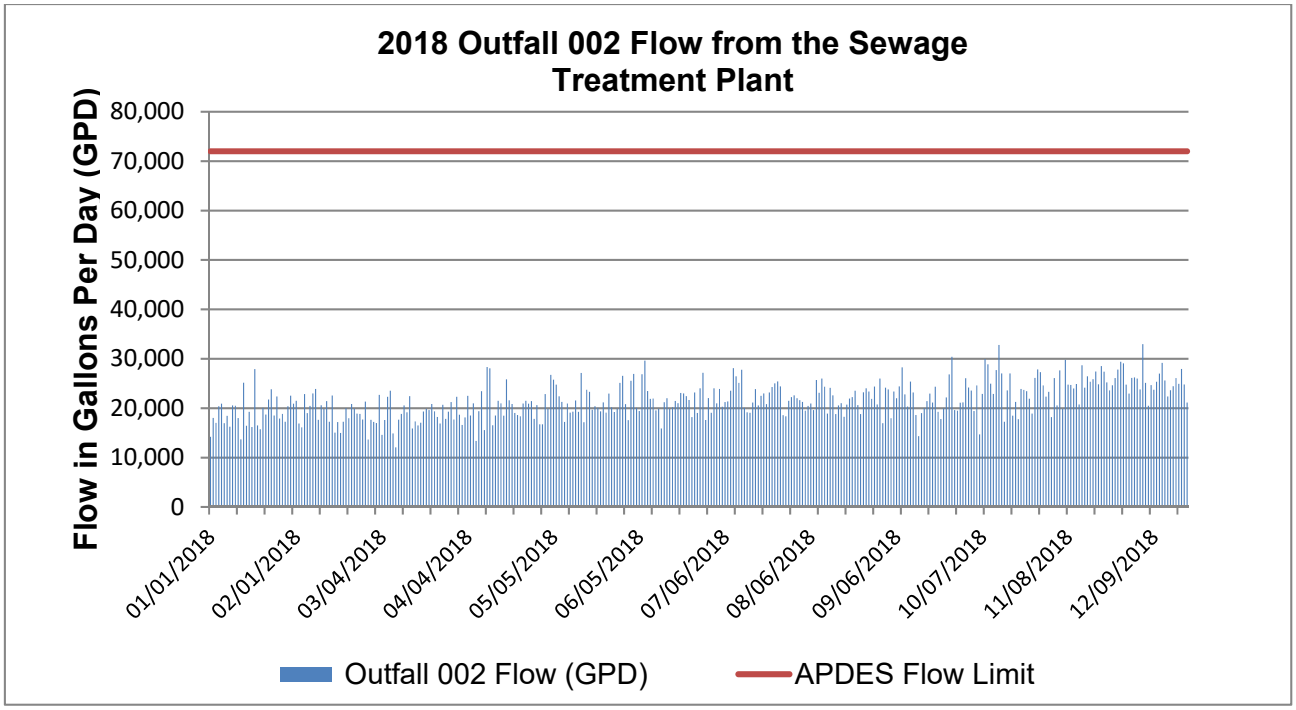
All other results are within the limits and conditions set forth within the permit. Time series graphs are provided in **Appendix C**. Monitoring data is provided in **Appendix F.**

2.2.3 Outfall 002 – Treated Effluent from Sewage Treatment Plant

ADEC APDES AK0053341 (8/1/17), 1.5

The STP operated throughout the year with flows ranging between 12,064 and 32,949 gallons per day. Daily field parameters were collected to assess quality of treated effluent. Monthly samples were also collected for metals (arsenic, cadmium, copper, lead, manganese, mercury, and zinc), biological oxygen demand (BOD_5), total suspended solids (TSS), fecal coliform, and nitrate/nitrite. **Figure 3** presents the gallons per day flow from Outfall 002 for 2018.

FIGURE 3: 2018 OUTFALL 002 DISCHARGE TO GOODPASTER RIVER



Influent data from STP002 were collected for BOD_5 and TSS on a quarterly basis to determine percent removal. All results were within the limits and conditions set forth within the permit. Time series graphs are provided in **Appendix C.** Monitoring data is provided in **Appendix F.**

2.3 SURFACE WATER MONITORING

2.3.1 Goodpaster River

ADEC Waste Management Permit 2018DB0001 (5/24/2018), 1.6.2; ADEC APDES AK0053341 (8/1/17), 1.8; Pogo Mine Monitoring Plan (7/18) 6.0

Six surface water stations are monitored to evaluate water quality along the Goodpaster River: SW01 and SW49 are located upstream of the Pogo Mine, SW41 is located downstream of Outfall 001, SW42 is downstream of Outfall 002, and SW15 and SW12 are located downstream from all Pogo facilities. Surface water samples are analyzed six times a year for total metals (antimony, arsenic, cadmium, copper, iron, lead, manganese, mercury, nickel, selenium, silver, and zinc) and WAD cyanide. Physical and aggregate properties of alkalinity, conductivity, hardness, nitrite plus nitrate, pH, total dissolved solids (TDS), turbidity, and temperature are also

measured.

Surface water samples were collected on March 5th, May 21st, June 19th, August 6th, September 17th, and December 17th, 2018. On May 21st samples were collected while the river was turbid from recent rain events resulting in cadmium, copper, iron, lead, manganese, and silver concentrations above ADEC surface water quality standards at both upstream and downstream sample locations. Copper, iron, and lead concentrations were above the ADEC surface water quality standards at both upstream and downstream sample locations during another high-water sampling event on August 6th.

All other results were within the limits and conditions no other adverse trends were observed. The locations of the surface water monitoring stations are shown in **Appendix A, Figure 2.** Time series graphs are provided in **Appendix C**. Results of the fish tissue sampling are provided in the **Section 2.3.3**. Monitoring and historic data is provided in **Appendix F**.

2.3.2 Whole Effluent Toxicity

ADEC APDES Permit AK0053341 (8/1/17), 1.7

The annual WET test was conducted June 18 through June 25, 2018 by TRE Environmental Strategies in Fort Collins, Colorado. A split of the same sample was also sent to Test America on Corvallis Oregon. Results from both laboratories are presented in **Table 1**. All results were within the limits and conditions set forth within the permit. Laboratory reports are provided in **Appendix D**.

Table 1: Pogo Mine Whole Effluent Toxicity Testing 2018

Laboratory	Species	No Observed Effect Concentration	Low Observed Effect Concentration	Inhibition Concentration 25 %	Toxicity Units Chronic	Was Toxicity Demonstrated TUc value > 2.0
TRE	*Pimephales promelas*	100	>100	>100	<1	No
TEST AMERICA	*Pimephales promelas*	100	>100	>100	<1	No

2.3.3 Fish Tissue

ADEC APDES Permit AK0053341 (8/1/17), 1.8.8

In order to assess long term trends in Goodpaster River quality, annual whole-body analysis of juvenile Chinook Salmon are required at monitoring sites both upstream (SW01) and downstream (SW12) from the project facilities. Juvenile Chinook Salmon were collected from these two stations on September 18, 2018. Metals analysis was conducted on individual Chinook and a composite sample of fish for each location. As required by **Fish Resource Permit SF2018-215** a report of collection activities and a data submission form was submitted to ADF&G on October 4, 2018.

All results are consistent with historical data. Time series graphs are provided in **Appendix C**. Monitoring and historic data are provided in **Appendix F**.

2.4 GROUNDWATER QUALITY MONITORING

Groundwater samples are analyzed for WAD cyanide, major cations and anions, total metals, dissolved metals, physical and aggregate properties of ammonia, conductivity, hardness, nitrates, pH, TDS, TSS, and temperature. The locations of the groundwater monitoring stations are shown in **Appendix A**, **Figure 2**

2.4.1 Downgradient of DSTF

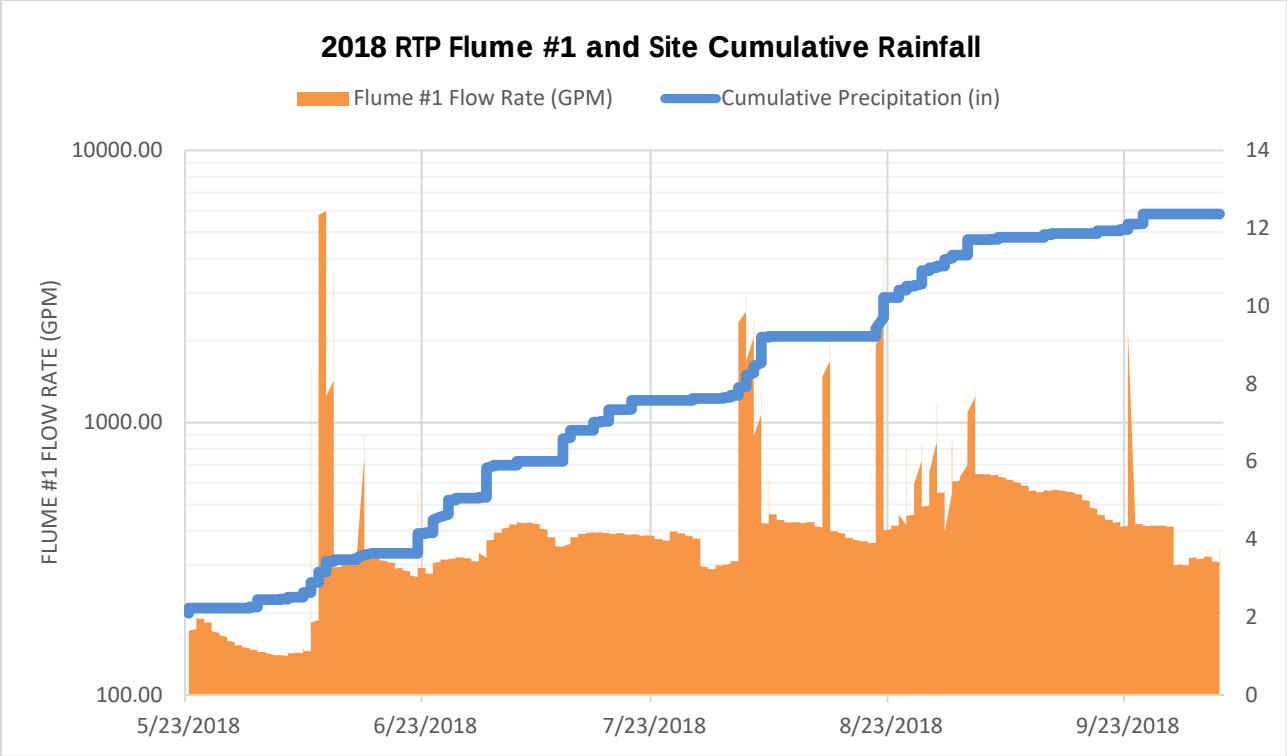
ADEC Waste Management Permit 2018DB0001 (5/24/2018), 1.1.4, 1.2.6, 1.2.7, 1.5.4; Pogo Mine Monitoring Plan (7/18), 7.0

MW11-001A and MW11-001B provide information on water quality trends down-gradient from the DSTF and up-gradient of the RTP. MW11-001A is an alluvial well and MW11-001B is a bedrock well. Samples were collected from both MW11-001A and MW11-001B on October 8, 2018. MW11-001A was dry and no samples were collected the rest of the year. MW11-001B was also sampled on March 11, May 27, June 25, July 15, and August 27, 2018. MW11-001A and MW11-001B are located within a process facility, therefore nitrate concentrations above the WQS are under observation. WQS are shown on the graphs for reference purposes only. Copper and TDS appear elevated above WQS in MW-11-001A. No other adverse trends were observed. Time series graphs are provided in **Appendix C**. Monitoring data is provided in **Appendix F**.

2.4.2 Liese Creek Flumes

Four flumes were installed in Liese Creek in 2012. **Figure 4** provides flow data for Flume #1 (near the toe of the DSTF) versus precipitation rate in 2018.

FIGURE 4: 2018 RTP FLUME #1 AND SITE CUMULATIVE RAINFALL



2.4.3 Downgradient of RTP Dam

2.4.3.1 MW12-500, 501, 502 WELLS

ADEC Waste Management Permit 2018DB0001 (5/24/2018), 1.1.4, 1.2.6, 1.2.7, 1.5.4; Pogo Mine Monitoring Plan (7/18), 7.0

Three wells located below the RTP Dam, MW12-500, MW12-501, and MW12-502, monitor groundwater downstream of the RTP seepage collection system. Samples were collected quarterly throughout 2018 (when there was available water). Trigger limits for groundwater monitoring at these locations are set forth in Pogo's ADEC Waste Management Permit 2018DB0001.

Six sampling events occurred in 2018 for MW12-500. Chloride, nitrate, and sodium levels are detected above the trigger limits.

Five sampling events occurred for MW12-501 and MW12-502. Nitrate and Sodium remain elevated at these two wells. Dam containment of the RTP water is under evaluation as part of a current corrective action investigation with ADEC.

2.4.3.2 MW18-SCW AND MW18-FL3

In October 2018, four new wells were drilled in the Liese Creek Valley, below the RTP Dam, as part of the corrective action investigation. One well, MW18-SCW, was placed adjacent to Flume 2, between the SCW system and the MW12-500 series wells. The second well, MW18-FL3, was placed downstream of the MW12-500 series wells in the immediate vicinity of Flume 3.

Well placement was designed to monitor changes in water quality parameters through the Liese Creek Valley and help identify SCW bypass flow. Both wells were sampled on October 19. MW18-FL3 was above the groundwater WQS in Nitrates. MW18-SCW had elevations above the groundwater WQS in Arsenic, Manganese, and Nitrates. Monitoring data is presented in **Appendix F**.

Except as noted above, all results are within the limits and conditions set forth within the permit. Time series graphs are provided for the MW12-500 series wells in **Appendix C**. Monitoring data is provided in **Appendix F**.

2.4.4 Downgradient of Ore Zone

ADEC Waste Management Permit 2018DB0001 (5/24/2018), 1.1.4, 1.2.6, 1.2.7, 1.5.4; Pogo Mine Monitoring Plan (7/18), 7.0

2.4.4.1 MW04-213 AND MW11-216

Monitoring wells MW04-213 and MW11-216 provide information on water quality trends down-gradient from the ore zones. Samples are collected semi-annually at MW04-213 and MW11-216. MW04-213 was sampled March 11, August 25, and October 9, 2018. MW11-216 was sampled on March 10, and September 24, 2018. Piezometer well MW99-216 is monitored quarterly for water elevation.

2.4.4.2 MW18-FL4 AND MW18-FL4 DEEP

Elevated arsenic levels have been reported in MW04-213 since 2012. This data corresponds to an expansion of the underground mine workings and possible monitoring well communication with mine contacted water.

An investigation into the water quality at MW04-213 found reducing conditions, causing a higher concentration of arsenic, within the borehole. In 2018, two new wells were placed as a nested pair, MW18-FL4 and MW18-FL4 Deep, downstream of Flume 4. Well MW18-FL4 Deep was designed to replace MW04-213 and has a stronger relationship to the groundwater associated with the underground workings. MW04-213 will be sampled through the third quarter, 2019, before abandonment. A sample was collected at MW18-FL4 Deep on October 21, and at MW18-FL4 on October 22. MW18-FL4 was above the groundwater WQS in Manganese, MW18-FL4 Deep was also higher than the WQS in Manganese and Iron.

MW04-213 and MW11-216 time series graphs are provided in **Appendix C**. Monitoring data is provided in **Appendix F**.

2.4.5 Downgradient of ORTW

The following information is supplied as part of an ongoing study and is not required by permit.

Monitoring stations LL04-031 and LL04-032 are sampled annually and provide information on ground water quality trends between the ORTW and the Goodpaster River. Samples were collected on June 17, 2018 from LL04-031 and LL04-032. Time series graphs are provided in **Appendix C**. Monitoring data is provided in **Appendix F**.

2.4.6 Goodpaster River Area

The following information is supplied as part of an ongoing study and is not required by permit.

MW12-001A and MW12-001B were established to support a hydrogeologic study initiated in 2012. Samples were collected on February 19, June 19, September 2, and Dec. 10, 2018 at both wells. No adverse trends were observed. Time series graphs are provided in **Appendix C**. Monitoring data is provided in **Appendix F**.

2.5 PROCESS CONTROL MONITORING

Process facilities are monitored as described below.

2.5.1 Water Balance

ADEC Waste Management Permit 2018DB0001 (5/24/2018), 1.5.2.4; Pogo Plan of Operations (6/18), 8.0; Water Rights LAS 24616

At the beginning of 2018, the RTP reservoir volume was observed at 11.7 million gallons. At the end of 2018, the RTP volume was recorded at 13.0 million gallons.

Water Added to RTP

- 130.0 million gallons of runoff and seepage water was collected in the RTP
- 13.8 million gallons of treated water was recycled to the RTP distribution system

Removed from RTP distribution system

- 21.7 million gallons were pumped from the RTP for underground process water
- 62.4 million gallons were pumped from the RTP to the mill process
- 86.3 million gallons were pumped from the RTP to WTP#3

Recycled Treated Water

- 36.0 million gallons were recycled at the Mill
- 14.0 million gallons were recycled to the RTP distribution system

Discharge to ORTW

- 352.7 million gallons were treated and discharged to the ORTW

2.5.2 Permits to Appropriate Water and Temporary Water Use Permit Summary

ADNR Permits to Appropriate Water, LAS 24616, 24613, 24611, 24612 Condition 6; ADNR Temporary Water Use Authorization TWUP F2011-131, F2011-76, F2011-130, F2013-023, F2013-143, Condition 14. A summary of water usage for Permits to Appropriate Water and Temporary Water Use Permits is provided in **Table 2** and **Table 3**.

Table 2: Permits to Appropriate Water 2018 Monthly Total Flows

Month	LAS 24616 Surface Water Collected in Recycle Tailings Pond (RTP)	LAS 24617 Groundwater from UG Discharged to ORTW and Recycled UG	LAS 24613 Goodpaster River ORTW Influent	LAS 24611 Drinking Water Wells DW02 & DW03	LAS 24612 Gravel Pit Pond*
	(gallons)	(gallons)	(gallons)	(gallons)	(gallons)
January	2,790,126	25,658,844	609,345,799	728,424	0
February	3,093,385	21,276,801	538,514,899	693,856	0
March	2,535,790	17,739,186	595,570,606	725,839	0
April	2,610,397	18,957,906	555,417,683	748,691	0
May	8,213,877	18,896,608	599,410,654	779,177	0
June	15,284,057	19,709,557	587,068,852	806,006	0
July	22,439,723	24,405,495	601,803,620	820,707	0
August	23,022,521	23,931,660	559,411,308	789,635	0
September	23,892,569	25,276,982	552,607,913	719,237	0
October	15,864,911	32,412,749	618,876,746	851,479	0
November	7,028,859	28,071,080	567,138,635	899,924	0
December	3,343,228	27,556,931	591,280,767	838,329	0
Total (gallons)	**130,119,445**	**283,893,800**	**6,976,447,482**	**9,401,305**	**0**
Total in Acre-ft	**399.32**	**871.23**	**21,409.73**	**28.85**	**0.00**
Permit Limit Acre-ft	**387.12**	**1,613.30**	**24,195.11**	**81.77**	**241.95**

*includes water used for Mill make-up and for road dust control

Pogo applied for water rights in 2018 for LAS 24616 Surface Water Collection in the Recycle Tailing Pond. The new permit number is LAS 32225 and the application was initiated on 1/31/2018. An increase in water use, up to 600 acre-feet a year, was requested to accommodate more intensive use of the impoundment. This application is currently awaiting approval. The delayed permit has caused an over use of permit LAS 24616 by 12.2 acre-feet in 2018.

Table 3: Temporary Water Use Permits 2018 Monthly Total Flows

Month	TWUP F2011-131 RTP Seepage Collection System Wells	TWUP F2011-76 Rosa Creek, Caribou Creek, Gilles Creek, Shaw Creek	TWUP F2011-130 Diversion Ditches	TWUP F2013-023 Underground Water Recycle
	(gallons)	(gallons)	(acre-feet)	(gallons)
January	2,537,788	0	Annual Calculated Amount	25,658,844
February	1,550,212	0		21,276,801
March	1,899,503	0		17,739,186
April	1,310,545	15,000		18,957,906
May	1,577,904	596,500		18,896,608
June	1,961,854	729,000		19,709,557
July	2,875,168	679,500		24,405,495
August	3,795,094	94,500		23,931,660
September	4,465,176	0		25,276,982
October	5,763,799	0		32,412,749
November	4,841,738	0		28,071,080
December	4,592,614	0		27,556,931
Total Gallons	**37,171,394**	**2,114,500**	**312,392,064**	**283,893,800**
Total Acre-feet	**114**	**6**	**959**	**871**
Permit Limit	**1,945,000,000 gals**	**14,400,000 gals**	**1460 acre-ft**	**1613.3 acre-ft**

2.5.3 Carbon-In-Pulp (CIP) Tailings Cyanide Destruction

ADEC Waste Management Permit 2018DB0001 (5/24/2018), 1.2.3, 1.5.2.3; Pogo Mine Monitoring Plan (7/18), 5.2

After cyanide destruction, the CIP tailings are stored in the CIP tank prior to being mixed with cement and used as backfill in the mine. Pogo's Mine Monitoring Plan requires grab samples at station PC001 (CIP Stock Tank), which is located directly after the cyanide destruction circuit. Pogo collects a daily sample during each paste pour. The Waste Management Permit 2018DB0001 requires that samples contain less than 10 mg/kg of WAD cyanide as a monthly average and none of the samples can contain more than 20 mg/kg of WAD cyanide. During 2018, 100% of the monthly averages of PC001 sample results were below 10 mg/kg of WAD

cyanide, and none of the sample results detected more than 20 mg/kg WAD cyanide. Time series graphs are provided in **Appendix C**. Monitoring data is provided in **Appendix F**.

2.5.4 Mineralized Development Rock Geochemistry

ADEC Waste Management Permit 2018DB0001 (5/24/2018), 1.2.1, 1.5.2.6; Pogo Mine Monitoring Plan (7/18) 5.0, Appendix C

Samples of whole rock materials placed in the DSTF (PC002) are collected monthly and composited to form a quarterly sample for analysis. Arsenic was elevated during June and September between 1045 mg/kg and 1090 mg/kg in contrast to the 282 mg/kg and 262 mg/kg in January and December respectively. The composite sample showed no adverse trends. **Appendix B**, **Table 1**, shows selected parameters for PC002 whole rock monitoring. Monitoring data is provided in **Appendix F**.

2.5.5 Flotation Tailings Geochemistry

ADEC Waste Management Permit 2018DB0001 (5/24/2018), 1.5.4; Pogo Mine Monitoring Plan (7/18) 5.0

Flotation tailings geochemistry solid samples were collected on January 16, June 28, September 25, and December 17, 2018 at PC003, the underflow of the filter-feed tank at the end of the mill circuit, prior to disposal on the DSTF. No adverse trends were observed. **Appendix B, Table 2**, shows selected parameters for the PC003 Solid, flotation tailings samples. Monitoring and historic data are provided in **Appendix F**.

2.5.6 Flotation Tailings Interstitial Water Chemistry

ADEC Waste Management Permit 2018DB0001 (5/24/2018), 1.5.4; Pogo Mine Monitoring Plan (7/18) 5.0

The interstitial water from the tailings samples was collected at PC003 on February 25, March 26, June 25, September 25, and December 16, 2018. Mercury concentrations remain elevated above the Target Operating Range, presented in Table 5.4 of the *Pogo Mine Monitoring Plan*, and an internal investigation is

underway to determine the cause. Copper and TKN are starting to show an upward trend as well. Time series graphs are provided in **Appendix C**. Monitoring and historic data are provided in **Appendix F**.

2.6 VISUAL MONITORING

2.6.1 Facility Inspection

ADEC Waste Management Permit 2018DB0001 (5/24/2018), 1.5.2.1, 1.5.9.3, 1.5.9.4; Pogo Mine Monitoring Plan (7/18) 3.0, 3.1; Pogo RTP Operating and Maintenance Manual (7/18), 3.0

Weekly visual inspections of the DSTF, RTP Dam, and monitoring wells were completed throughout the year. No cracking, bulging, settlement, geotechnical concerns, erosion or damage was observed. Minor surface erosion on Shell 1 of the DSTF was repaired following a Dam Safety Inspection by ADNR on August 15, 2018. A second site-wide inspection was completed by ADNR on October 3, 2018.

2.6.2 Biological Survey

ADEC Waste Management Permit 2018DB0001 (5/24/2018), 1.5.2.5; Pogo Mine Monitoring Plan (7/18) 3.4

The objective of the visual biological survey program is to monitor wildlife interaction with the surface waste disposal facilities. No wildlife mortalities occurred within the surface waste disposal facilities during the year.

2.6.3 Invasive Weed Control

An invasive weed inventory was performed along the Pogo Access Road and the mine site at the end of June and the beginning of July in 2018.

One noxious weed species, Bird Vetch/Tufted Vetch (*Vicia cracca*), was identified in a small area (approximately 16 ft^2) at Mile 5.1. on the Access Road. On August 4, the Bird Vetch was removed, by the roots, and bagged for disposal at the Pogo incinerator (**Figure 5**). The area will be monitored in 2019 and plant removal will continue as needed.

FIGURE 5: BIRD VETCH, BEFORE AND AFTER REMOVAL AT MILE 5.1.

Several plants of *Vicia cracca* were also identified (and removed) within the Alluvial Shrub Reclamation Trial Plots on the Pogo Mine Site, near the Burn Pit. These will also be monitored for re-occurrence and removed as needed.

The invasive weed inventory also indicated a prevalence of White Sweet Clover on the first 30 miles of the Pogo Access Road. To help combat the spread of the White Sweet Clover, annual road maintenance will include mowing back the road edges by mid-summer, before the clover produces seed in 2019.

In November 2017, at ADNR's request, Pogo committed to the removal of White Sweet Clover (*Melilotus alba*) and Narrowleaf Hawksbeard (*Crepis tectorum*) weed growth along the edge of the road bordering Material Site 03, as the site was closed and returned to the State. On August 11, 2018, both sides of the road, and the area between the road and Material Site 03 (approximately 1,800 ft^2 total) were cleared of White Sweet Clover, Hawksbeard and Shepard's Purse (*Capsella bursa-pastoris*) as seen in **Figure 6**.

FIGURE 6: MATERIAL SITE 03 BEFORE AND AFTER REMOVAL OF WHITE SWEET CLOVER, NARROWLEAF HAWKSBEARD, AND SHEPARD'S PURSE.

2.7 DEVELOPMENT ROCK SEGREGATION AND STORAGE

ADEC Waste Management Permit 2018DB0001 (5/24/2018), 1.2.1, 1.5.2.6; Pogo Mine Monitoring Plan (7/18), 5.1.1, Appendix C

During 2018, 1520 rounds were blasted underground and sampled; 20.1% of the rounds exceeded either the arsenic threshold of 600 mg/l or the sulfide threshold of 0.5% and these were encapsulated in the DSTF. A total of 292 were not sampled due to operational challenges; all were placed internally in the DSTF. Approximately 916 rounds (60.3%) of non-mineralized development rock was used to build drains, shells, line the edge of the DSTF. This material was also used as road surfacing and backfill material.

2.8 WASTE DISPOSAL

ADEC Waste Management Permit 2018DB0001 (5/24/2018), 1.2.1, 1.4.4

During 2018, 550,470 dry tons of flotation tailings, 274,415 tons of mineralized rock, and 91,905 tons of non-mineralized rock, were placed in the DSTF. Approximately, 119,168 dry tons of flotation tails and 150,871 dry tons of CIP tailing were placed underground as paste backfill in 2018. Site survey using a Maptek SR3 Laser scanner on July 9, 2018 indicated 12.5 M tons of material were contained in the DSTF representing 63% of the 20 M ton design capacity. Based on truck load counts, a total of 13 M tons was placed in the DSTF through 2018 filling 65% of the available capacity. Approximately 7 M tons of capacity remains in the DSTF. The approximate quantities of miscellaneous waste materials placed either into the DSTF or underground during the year are shown in **Table 4.**

Table 4: Miscellaneous Waste Disposal in DSTF and Underground in 2018

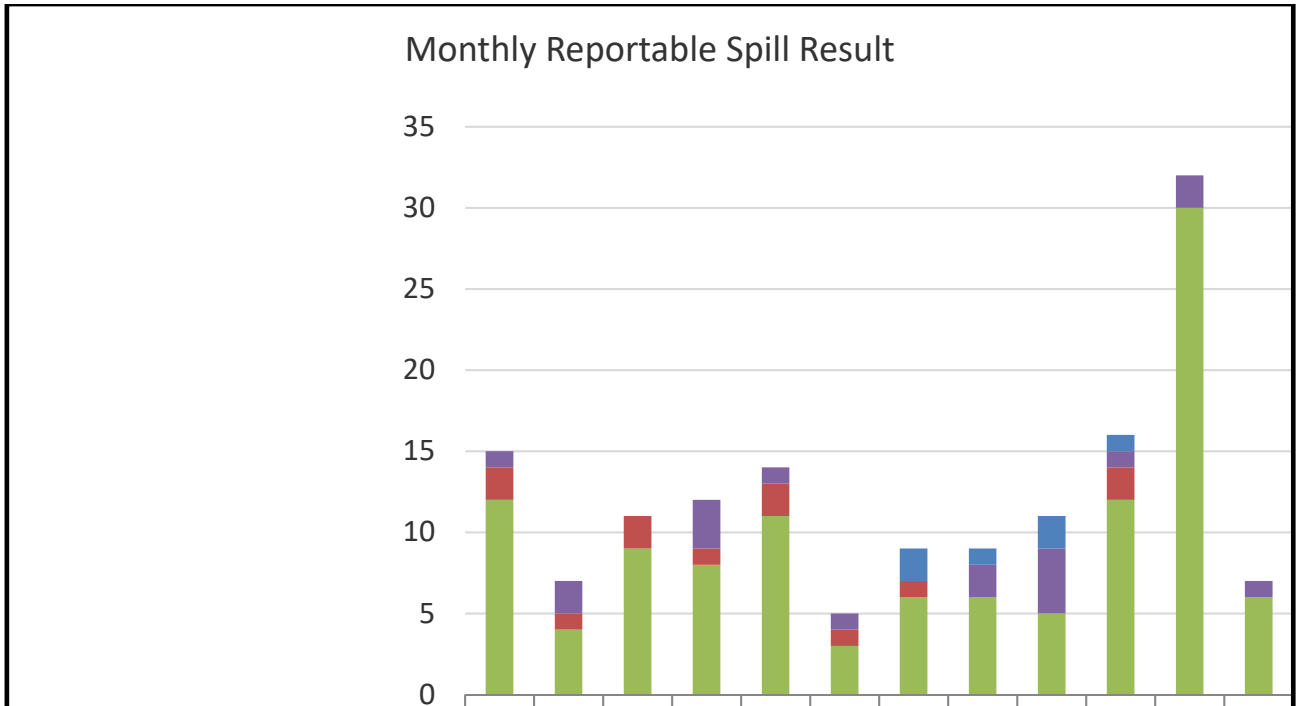
Material	Disposal Location	Approximate Quantity	Unit
Assay Lab Ore Samples (XRF Wafers)	DSTF	104	lbs
Cyanide Contacted/Reagent Bay Residue	UG Paste Stope	43	tons
Grinding/Flotation Debris Screen Residue	DSTF	112	tons
LAROK Filter Clothes	DSTF	68	each
Water Treatment Plant Filter Press Waste	UG Paste Stope	301	Yds
Conveyor Belt – ore feed	DSTF	1	each

2.9 SPILL REPORTING

ADEC APDES AK0053341 (8/1/17), Appendix A, 1.14; ADEC Waste Management Permit 2018DB0001 (5/24/2018), 1.4.10

During 2018, there were a total of 148 spills reported, refer to **Figure 7**, 2018 Pogo Spill Reporting.

FIGURE 7: 2018 POGO SPILL REPORTING



	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Contractor Surface Spill	0	0	0	0	0	0	2	1	2	1	0	0
Contractor Underground Spill	1	2	0	3	1	1	0	2	4	1	2	1
Pogo Surface Spill	2	1	2	1	2	1	1	0	0	2	0	0
Pogo Underground Spill	12	4	9	8	11	3	6	6	5	12	30	6

2.10 GEOTECHNICAL MONITORING

ADEC Waste Management Permit 2018DB0001 (5/24/2018), 1.4.3, 1.4.3.4; Pogo Mine Plan of Operations (6/18) Appendix F: Pogo DSTF Construction and Maintenance Plan (7/18)

A survey was conducted as noted in **Section 2.8** to determine the available capacity of the DSTF. Piezometers were downloaded at regularly scheduled intervals and data was reviewed. There are no plans to add more monitoring equipment in 2019.

3. AS-BUILT REPORTS AND MAPS

Pogo Mine Site 2016 as-built maps are in **Appendix A. Figure 2** provides an overview of all facilities within the Pogo Millsite lease boundary at the end of 2016. **Figures 3a** through **3d Appendix A** provide additional detail for the major areas of the mine.

4. RECLAMATION AND FINANCIAL RESPONSIBILITY

ADEC Waste Management Permit 2018DB0001 (5/24/18), 1.11, 3. ADNR Plan of Operations Approval F20189500 (5/24/2018), pg. 3, 9; ADNR Pogo Mine Millsite Lease ADL416949 (3/9/04), Section 8

The Pogo Mine reclamation and closure bond including the road/transmission line is currently $71.91 million (refer to **Table 5**). The road/transmission line reclamation and closure cost estimate is currently at $7.08 million (**Table 6**).

In 2016, SRK consulting was contracted to convert the current bond to a Standardized Reclamation Cost Estimator (SRCE) model for the renewal of the previous *ADEC Waste Management Permit 2011DB0012* and *ADNR Plan of Operations Approval F20129500*. The SRCE model was submitted with the renewal applications in 2018 with no changes made.

Table 5: Summary of Mine Reclamation and Closure Cost Estimates as of 2017

Summary of Estimated Reclamation and Closure Costs	
Item Description	
Earthwork/Recontouring	
Subtotal	8,526,670
Revegetation/Stabilization	
Subtotal	3,694,623
Detoxification/Water Treatment/Disposal of Waste Water	
Subtotal	5,669,769
Structure, Equipment and Facility Removal	
Subtotal	10,402,219
Monitoring	
Subtotal	2,369,650
Construction Management and Support	
Subtotal	1,093,448
Closure Planning	
Subtotal	16,663,398
Subtotal Operational and Maintenance Costs	
Subtotal	**48,419,777**
Indirect Costs	
Subtotal	18,161,463
Total Direct and Indirect	**66,581,240**
Inflation Proofing	5,326,499
Grand Total	**71,907,739**

Table 6: Summary of Pogo Access Road/Transmission Line Reclamation and Closure Cost Estimates as of 2017

Summary of Estimated Right of Way Closure Costs	
Item Description	
Earthwork/Recountouring	
Subtotal	646,544
Revegetation/Stabilization	
Subtotal	1,554,352
Detoxification/Water Treatment/Disposal of Waste Water	
Subtotal	0
Structure, Equiptment and Facility Removal	
Subtotal	1,451,958
Monitoring	
Subtotal	0
Construction Management and Support	
Subtotal	400,440
Closure Planning	
Subtotal	726,229
Subtotal Operational and Maintenance Costs	
Subtotal	**4,779,523**
Indirect Costs	
Subtotal	1,784,132
Total Direct and Indirect	**6,563,655**
Inflation Proofing	525,092
Grand Total	**7,088,747**

4.1 REVEGETATION STUDY

The purpose of this study was to fulfill the requirements set forth in the Pogo Mine Plan of Operations Approval (F20189500) Project-Specific Stipulations under the Pogo Reclamation and Closure Plan Stipulation 3 (page 9). The program of revegetation test trials, based on the outline described in the Pogo Mine Reclamation and Closure Plan, was established to determine the best, most cost-effective, use of material and resources to achieve the stated reclamation goals. **Figure 8** is an example of vegetation establishment over three years.

FIGURE 8: BROADLEAF FOREST 2014 (BEFORE) AND 2017 (AFTER 3 YEARS OF GROWTH)

Revegetation test trials were evaluated after three years of growth to compare the use of material and resources for meeting the coverage goals set forth in the Pogo Mine Reclamation and Closure Plan. The Plan defined the revegetation goals as:

- Diverse species cover of at least 70% three years after seeding.
- Vegetation will flourish with no additional seeding or fertilizing after three years and still flourishing after five years.
- At least 30% cover after the first three years or reassess methods.
- No single species of grass more than 70% of cover.
- No tree or shrub more than 95% of cover.
- Discourage the invasion of non-native weeds.

Alluvial Shrub, Broadleaf, and Wetland test plots were established in 2015; 2017 graphs (**Figure 9** through **Figure 11**) represent three growing seasons. Alpine test plots on the Dry Stack Tailings Facility Shell 2 were established in 2016, the 2018 Alpine Meadow graph (**Figure 12**) also represents three growing seasons of data. Agrotain, a urea inhibitor that prevents the rapid volatilization of nitrogen, was included in all the 10-10-10 fertilizer mixtures. Seed mixes used for each plot type are described in **Table 7: Revegetation Plot Seed Mixes Summary**. The small size of the revegetation trial program precludes statistical analysis, as not enough data is available to support this type of analysis.

An overview of the data indicates that the total cover goal of 70% have been met in almost every trial variation of media/fertilizer/seed application. 100% cover is apparent in many of the trial plots, more than is actually desirable to encourage the pioneering of native species. Plant establishment appears to be responding most strongly to fertilizer rates and the application/type of seed than to the presence of, or particular depth of, growth media. Zero application of growth media produced a lower percentage of cover in some instances, though most were very close to the required 70% cover or exceeded the 70% cover. Overall, it seems the application of fertilizer and seed produced sufficient cover whether topsoil (growth media) was present or not. Three inches of growth media appears to be just as effective as six inches of growth media in establishing the required cover in all four of the different ecotype studies: the broadleaf forest, wetlands, alluvial shrubs and alpine meadow. The Broadleaf Forest plots appear to be the most sensitive to the amount of growth media.

In some cases, a reduction in fertilizer and seeding rates may be advised. A reduction in grass coverage would allow more colonization of native species. A reduction in fertilizer, especially when not needed to meet cover requirements, can help discourage invasive weeds as they are faster growing and more opportunistic than most native plant species. **Figure 13** shows an overall photo of the Alpine Seed Mixes with no growth media (and variable rates of fertilizer) exhibiting higher densities of native plant establishment.

It seems some seed mixes lead to better growth/coverage than other seed mixes. In most cases, zero application of seed was sufficient for meeting the 70% cover.

Willow cuttings were added to some of the alluvial shrub plots. The addition of the willow cuttings does not appear to significantly impact the total coverage; the required 70% coverage was met in all alluvial shrub plots.

In summary, it appears that minimal to medium material and resource input is sufficient for meeting coverage requirements. Most plots met the 70% coverage goal, and all plots met the required 30% cover. Moreover, many of the plots reached 100% cover. Recommendations to achieve the reclamation goals while reducing the amount of material and resources used include minimal to medium growth media depths and reduction of fertilizer and/or seeding rates to certain ecotypes.

FIGURE 9: 2017 ALLUVIAL SHRUB PLOTS

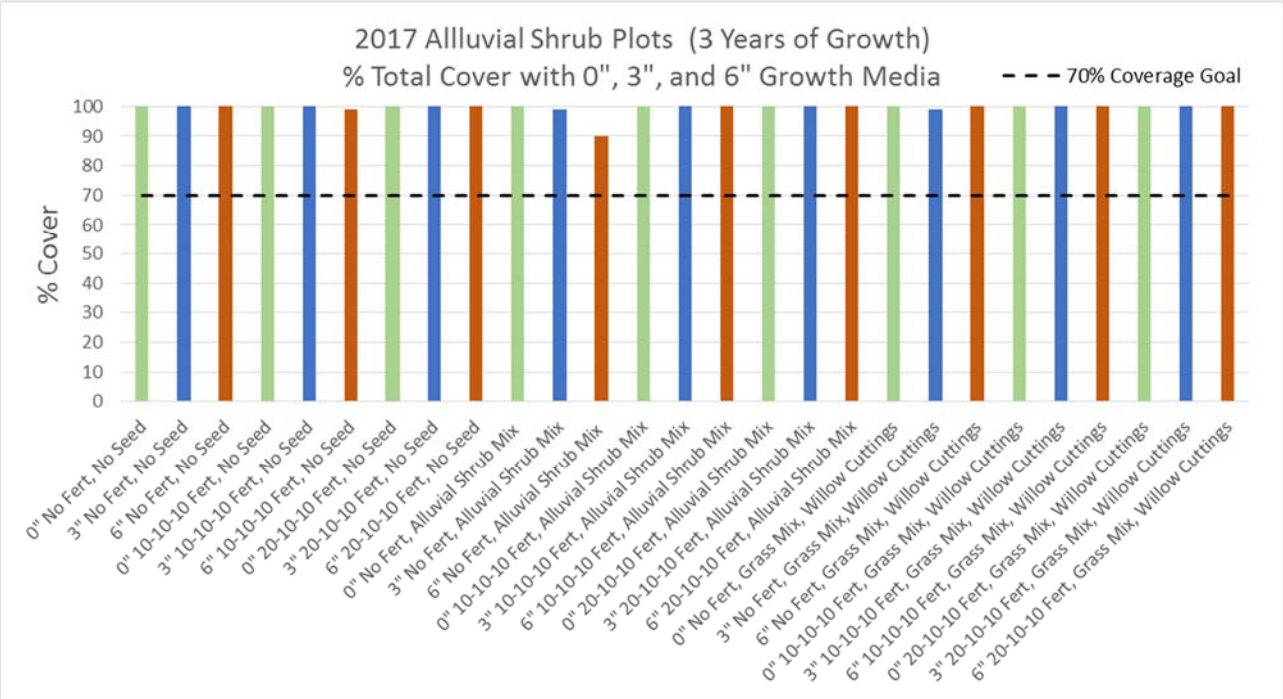


FIGURE 10: 2017 BROADLEAF FOREST PLOTS

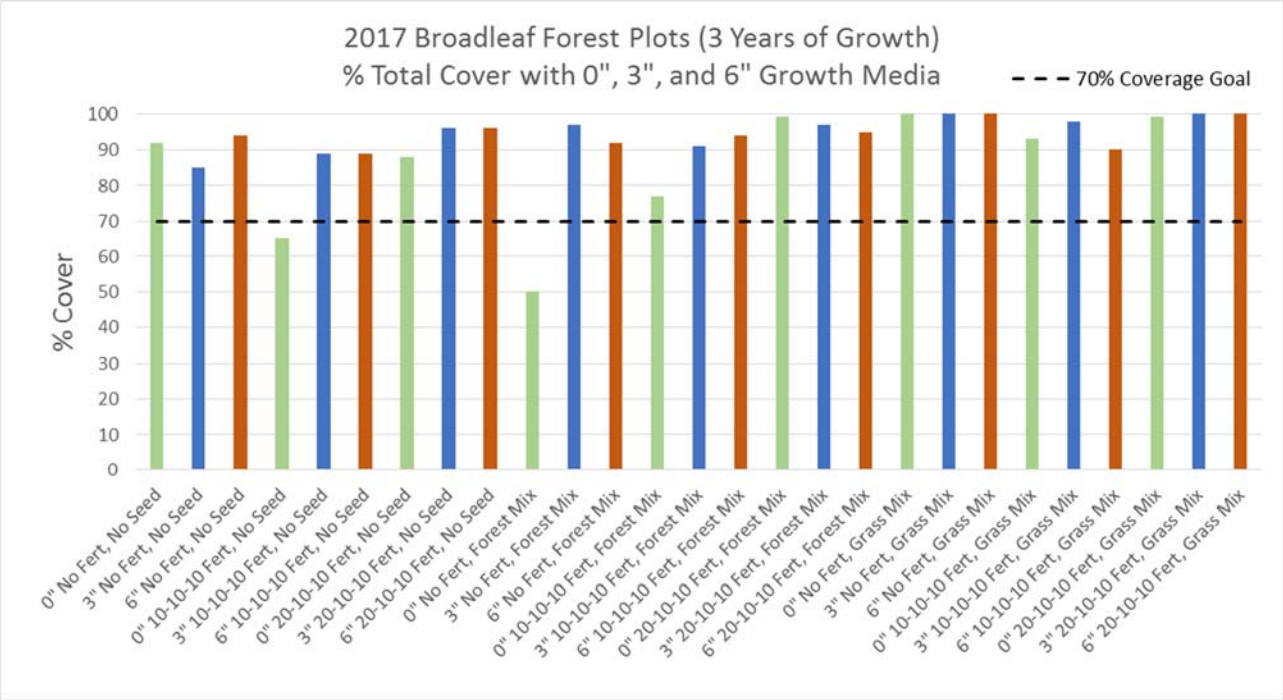


FIGURE 11: 2017 WETLAND PLOTS

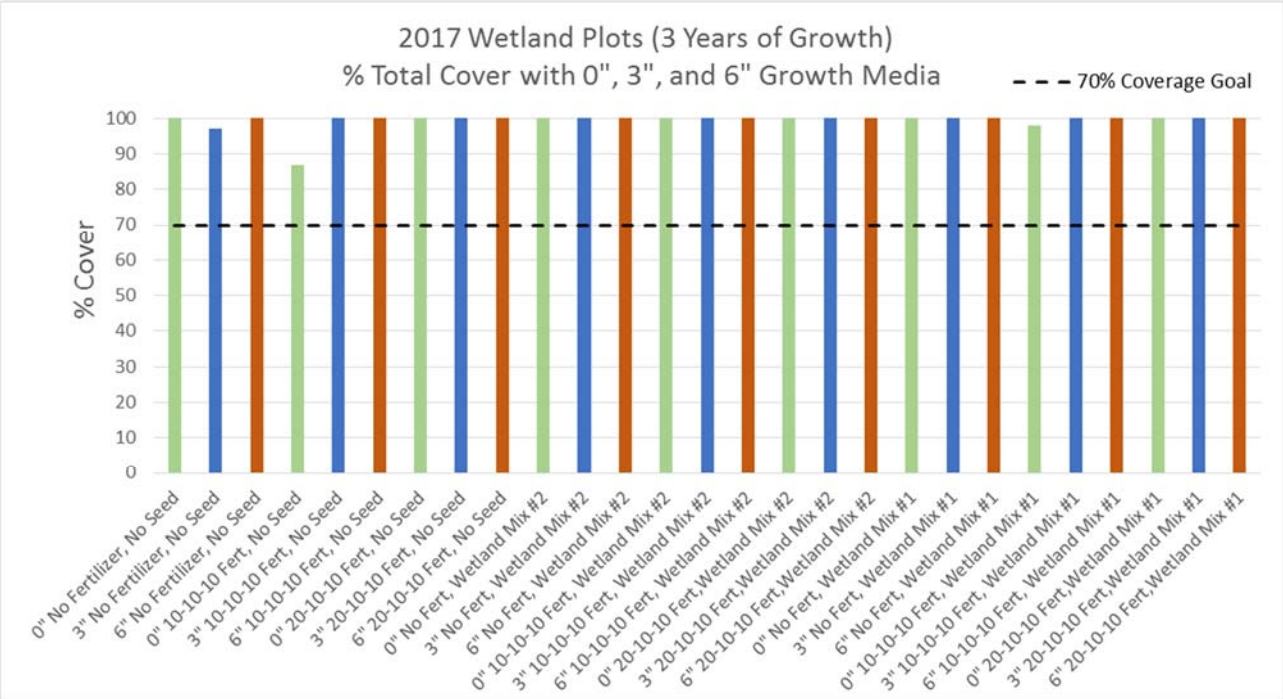


FIGURE 12: 2018 ALPINE MEADOW PLOTS

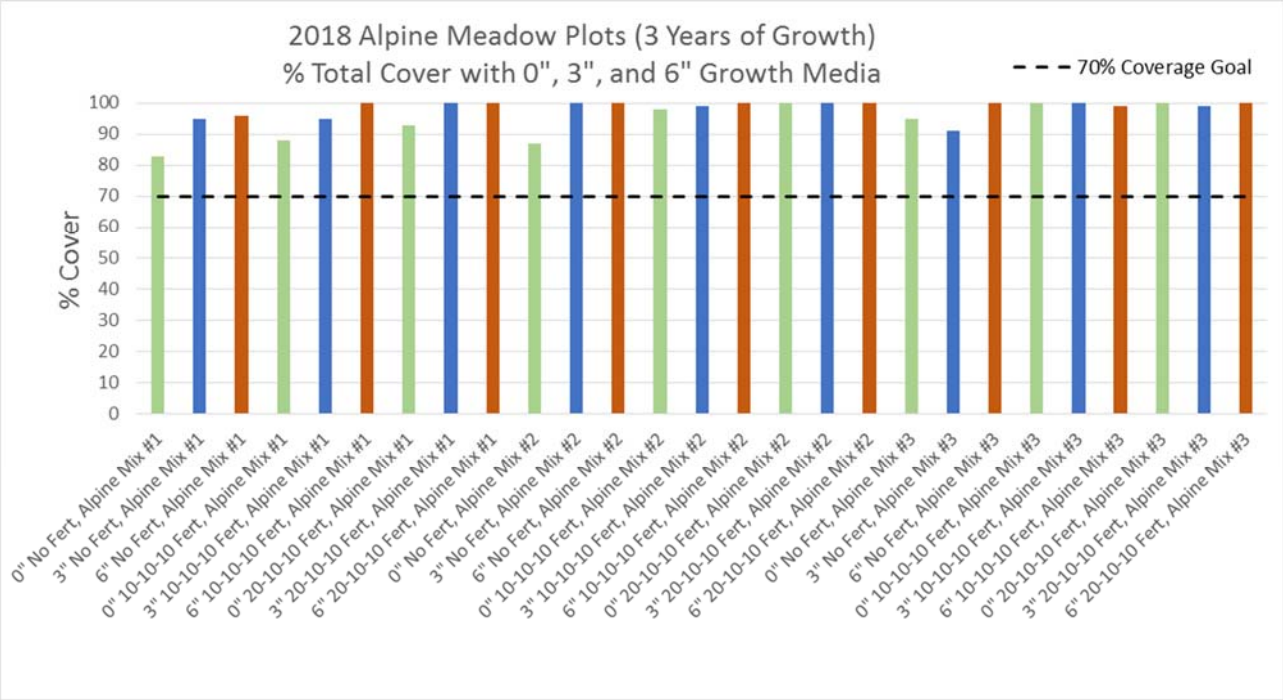


Table 7: Revegetation Plot Seed Mixes Summary

Species	Scientific Name	Percent of mixture
Alluvial Shrub Seed Mix		
Annual Ryegrass	*Lolium multiflorum*	10
Wainwright Slender Wheatgrass	*Elymus trachycaulus*	30
Alder	*Alnus sinuata*	15
Various Willow Species	*Salix ssp.*	45
Willow Cuttings Grass Seed Mix		
Annual Ryegrass	*Lolium multiflorum*	10
Wainwright Slender Wheatgrass	*Elymus trachycaulus*	90
Broadleaf Forest Seed Mix		
Annual Ryegrass	*Lolium multiflorum*	5
Wainwright Slender Wheatgrass	*Elymus trachycaulus*	5
Birch	*Betula papyrifera*	25
Aspen	*Populus tremuloides*	20
Alder	*Alnus sinuata*	25
White Spruce	*Picea glauca*	20
Grass/Natural Invasion Seed Mix		
Annual Ryegrass	*Lolium multiflorum*	10
Wainwright Slender Wheatgrass	*Elymus trachycaulus*	45
Alpine Bluegrass 'Gruening'	*Poa alpina*	45
Wetland Seed Mix #1		
Egan American Slough Grass	Beckmannia syzigachne	30
Polar Grass 'Alyeska' or 'Kenai'	*Arctagrostis latifolia*	30
Bering Hairgrass 'Norcoast"	*Deschampsia beringensis*	30
Wild Iris	*Iris setosa*	5
Northwest Territory Sedge	*Carex utriculata*	5
Wetland Seed Mix #2		
Wild Iris	*Iris setosa*	50
Northwest Territory Sedge	*Carex utriculata*	50

Species	Scientific Name	Percent of mixture
Alpine Seed Mix #1		
Annual Ryegrass	*Lolium multiflorum*	10
Red Fescue 'Arctared'	*Festuca rubra*	50
Wainwright Slender Wheatgrass	*Elymus trachycaulus*	40
Alpine Seed Mix #2		
Annual Ryegrass	*Lolium multiflorum*	10
Tufted Hairgrass 'Nortran'	*Deschampsia caespitosa*	30
Wainwright Slender Wheatgrass	*Elymus trachycaulus*	20
Alpine Bluegrass 'Gruening'	*Poa alpina*	20
Alpine Sweetvetch/ Eskimo Potato	*Hedysarum alpinum*	5
Field Oxytrope	*Oxytropis compestris*	5
Snow Parsley	*Cnidium cnidifolium*	1
Yarrow	*Achillea millefolium var borealis*	1
Silverberry	*Elaeagnus commutata*	5
Pasque Flower	*Pulsatilla vulgaris*	1
Pale Corydalis	*Corydalis sempervirens*	2
Alpine Seed Mix #3		
Annual Rye Grass	*Lolium multiflorum*	10
Red Fescue 'Arctared'	*Festuca rubra*	30
Wainwright Slender Wheatgrass	*Elymus trachycaulus*	20
Alpine Bluegrass 'Gruening'	*Poa alpina*	20
Alpine Sweetvetch or Eskimo Potato	*Hedysarum alpinum*	5
Field Oxytrope	*Oxytropis compestris*	5
Snow Parsley	*Cnidium cnidifolium*	1
Yarrow	*Achillea millefolium var borealis*	1
Silverberry	*Elaeagnus commutata*	5
Fleabane	*Erigeron*	1
Siberian Aster	*Eurybia sibirica*	2
Hairy Scorpion Weed	*Phacelia mollis*	1
Arctic Poppy	*Papaver radicatum*	2

FIGURE 13: CONTROL PLOTS ALPINE SEED MIXES ON DSTF SHELL 2 AUGUST 2018 (AFTER 3 YEARS OF GROWTH).

5. PERMIT ACTIVITIES

5.1 2018 PERMIT ACTIVITIES

The following permit activities were completed during 2018.

- **Waste Management Permit Renewal**: Pogo received the waste management permit *ADEC 2018DB0001*, on May 24, 2018.
- **USACE NWP 18 Exemption:** Pogo received an NWP 18 exemption to disturb wetlands for the helipad expansion on July 3, 2018.
- **Toxic Release Inventory (TRI) Report** was submitted under the Emergency Planning and Community Right to Know Act on June 26, 2018.
- **Plan of Operations Approval:** Pogo submitted an updated Plan of Operations

and supporting documents to ADNR and ADEC as required by the permits (Plan of Operations Approval F20189500 and Waste Management Permit 2018DB0001) on July 21, 2018.

- ***Minor Modification:*** Pogo submitted a Minor Modification to the Plan of Operations for exploration of Strip Veins on 12/19/2018 and was subsequently approved on 1/7/2019.

5.2 FUTURE PERMIT ACTIVITIES

- **APDES Discharge Permit Minor Modification:** Pogo is planning to increase the APDES Individual Discharge Permit limits from 800 gpm to 1,000 gpm. This minor modification is for permit number AK0053341.

APPENDIX A – MAPS

FIGURE 1: GENERAL LOCATION MAP

FIGURE 2: MONITORING STATIONS FIGURE

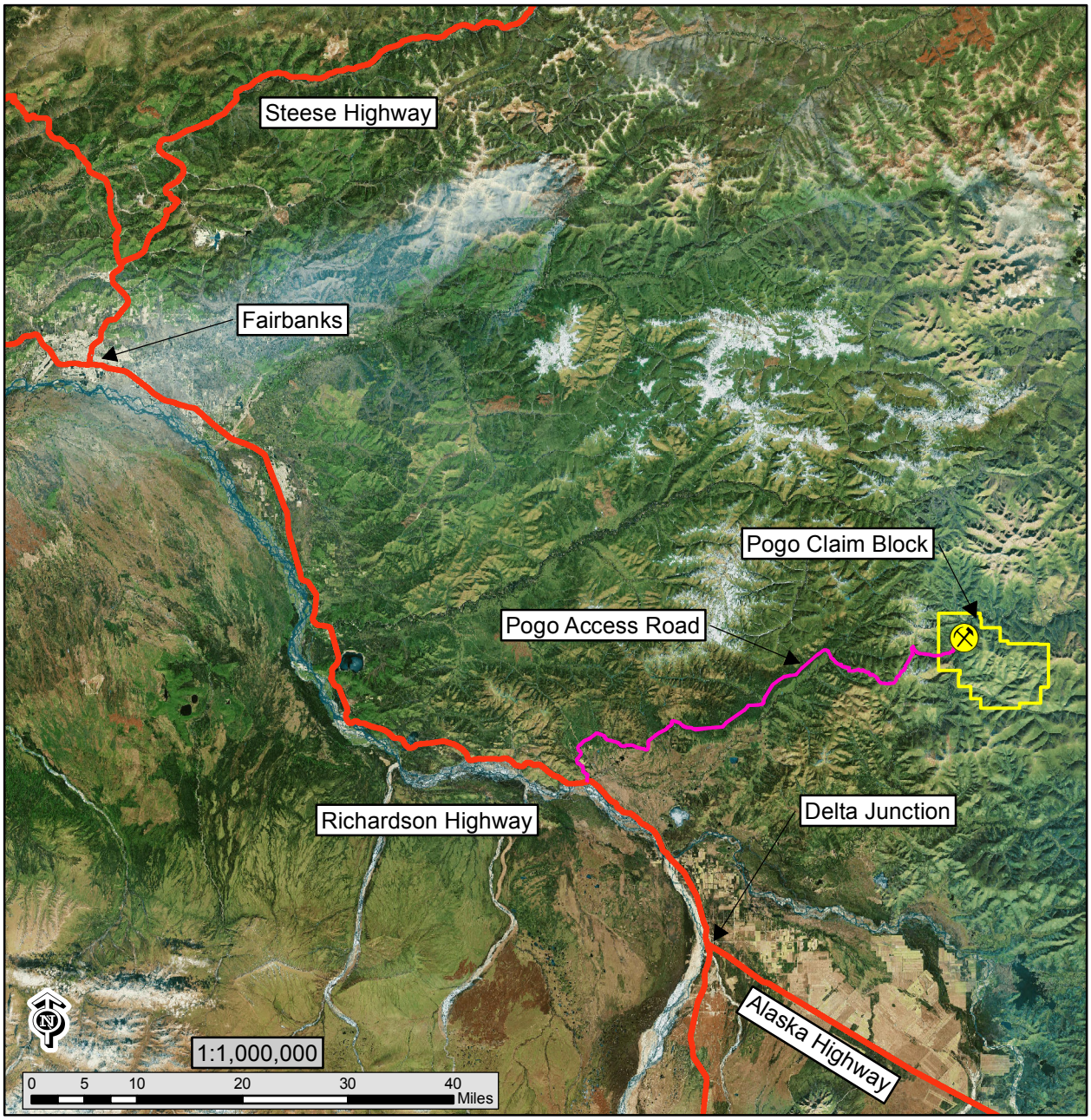
FIGURE 3: Pogo Mine

FIGURE 3a: 1525 Portal and Lower Camp

FIGURE 3b: Airstrip

FIGURE 3c: Mill Camp Bench

FIGURE 3d: RTP and DSTF



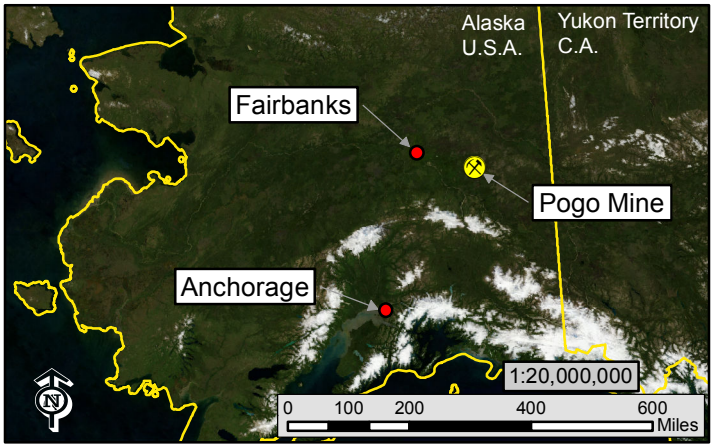


Figure 1
Pogo Mine
General Location

NORTHERN STAR
RESOURCES LIMITED

Basemap: GINA BDL WMS
Coordinate System: NAD 1983 StatePlane Alaska 3 FIPS 5003 Feet
Projection: Transverse Mercator
False Easting: 1,640,416.67
Central Meridian: -146.00
Latitude of Origin: 54.00

Author: Pogo Environmental
File Location: P:\Geology\Environmental\Maps

NORTHERN STAR
RESOURCES LIMITED

Figure 2
2019 Pogo Mine Monitoring Locations

Coordinate Sytem: NAD 1983 StatePlane Alaska 3 FIPS 5003 Feet
Projection: Transverse Mercator
Datum: North American 1983
False Easting: 1,640,416.67
False Northing: 0.00
Central Meridian: -146.00
Latitude of Origin: 54.00
Author: Martin Weiser, Environmental Specialist

Monitoring Locations

- MET Station
- LL Wells
- Surface Water Sites
- Monitoring Wells
- Flume
- OUTFALL

1:25,000

N
W E
S

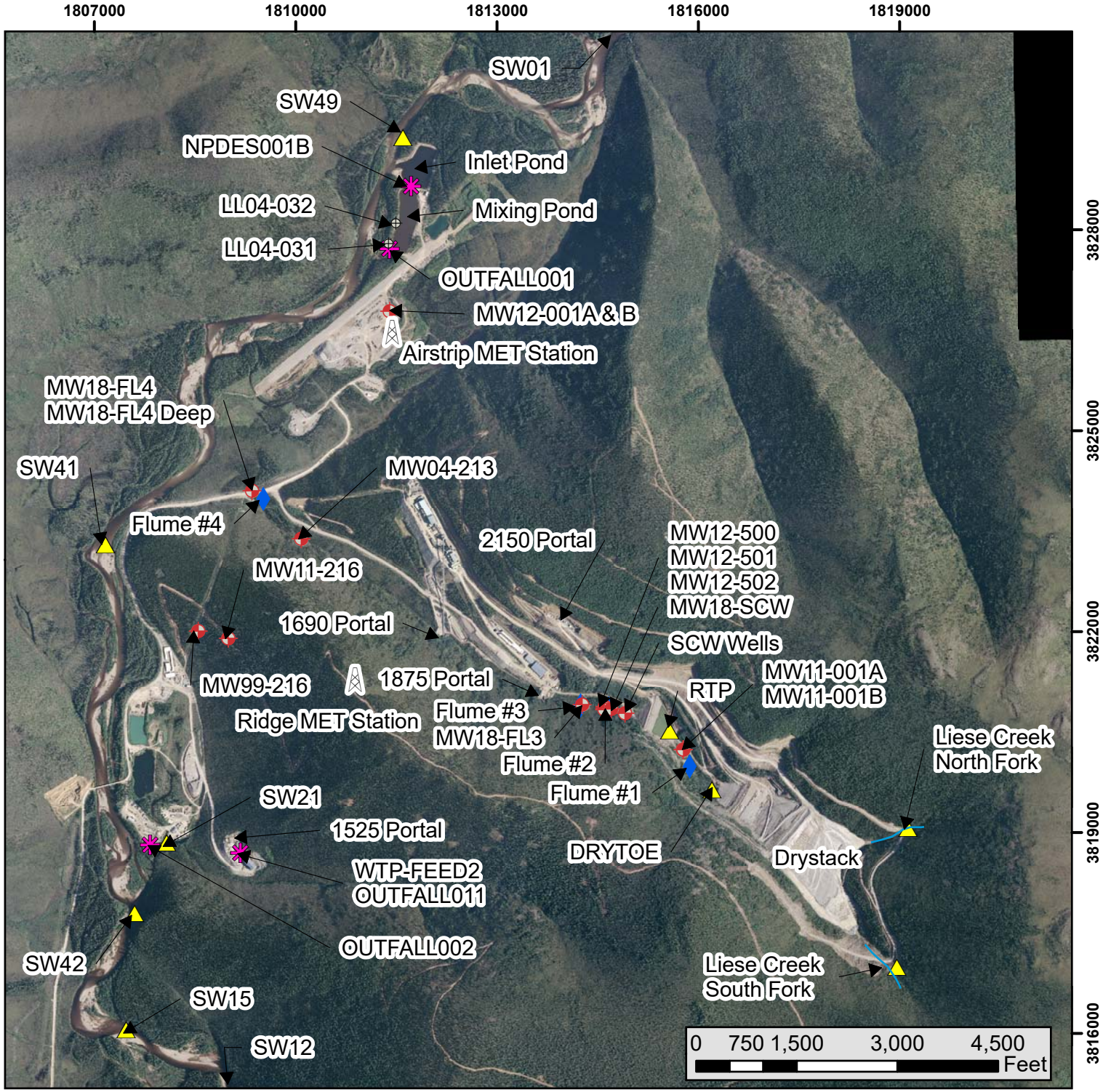


Figure 3
Pogo Mine As-built
January 2018

NORTHERN STAR RESOURCES LIMITED

Coordinate Sytem: NAD 1983 StatePlane Alaska 3 FIPS 5003 Feet
Projection: Transverse Mercator
Datum: North American 1983
False Easting: 1,640,416.67
False Northing: 0.00
Central Meridian: -146.00
Latitude of Origin: 54.00
Author: Martin Weiser, Environmental Specialist

File Location: G:\Enviro\Private\0_GIS\Maps\As-built_Maps

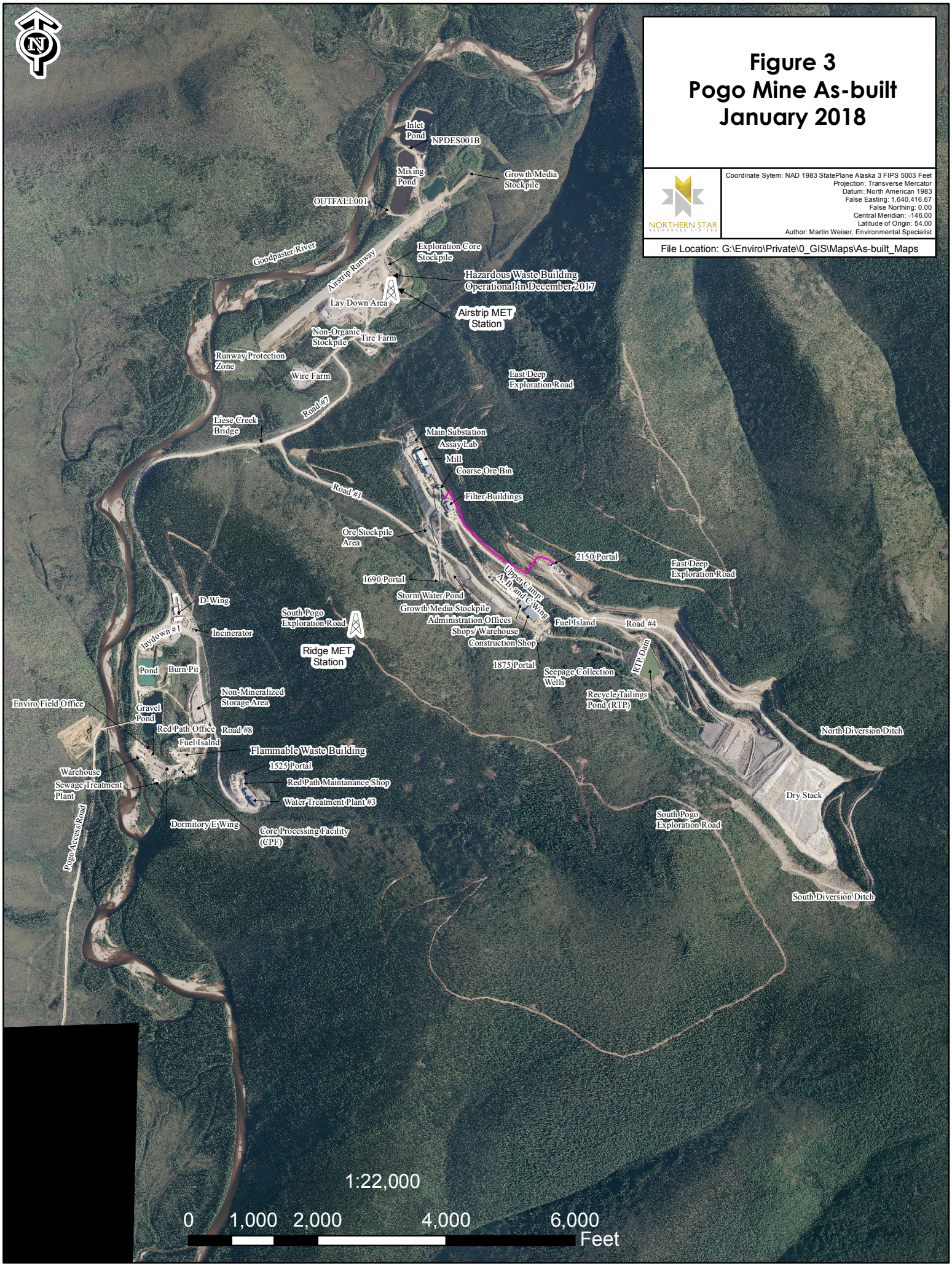


Figure 3a
1525 Portal Area and
Lower Camp As-built
January 2018
NORTHERN STAR RESOURCES LIMITED
Coordinate Sytem: NAD 1983 StatePlane Alaska 3 FIPS 5003 Feet
Projection: Transverse Mercator
Datum: North American 1983
False Easting: 1,640,416.67
False Northing: 0.00
Central Meridian: -146.00
Latitude of Origin: 54.00
Author: Martin Weiser, Environmental Specialist
File Location: G:\Enviro\Private\0_GIS\Maps\As-built_Maps
0 250 500 1,000 1,500 Feet
1:5,000
South Pogo Exploration Road
Powerline
Water Treatment Plant #3
Redpath Warehouse and Maintenance Shop
1525 Portal
Vaporizer Shack & Propane Tank
Road #8
Incinerator
Dormitory D-Wing
Mineralized Storage Area
Burn Pit
Laydown #1
Helipad
Fuel Island
Red Path Office
Flammable Waste Building
Ruen Drilling Office
Core Processing Facility
Dormitory E-Wing
Sewage Treatment Plant (STP)
Enviro Field Office
Warehouse
Gravel Pond
Pond
To Airstrip and Upper Camp
Potable Water Treatment Plant
Goodpaster River
Material Site #23
Pogo Access Road to Richardson Highway

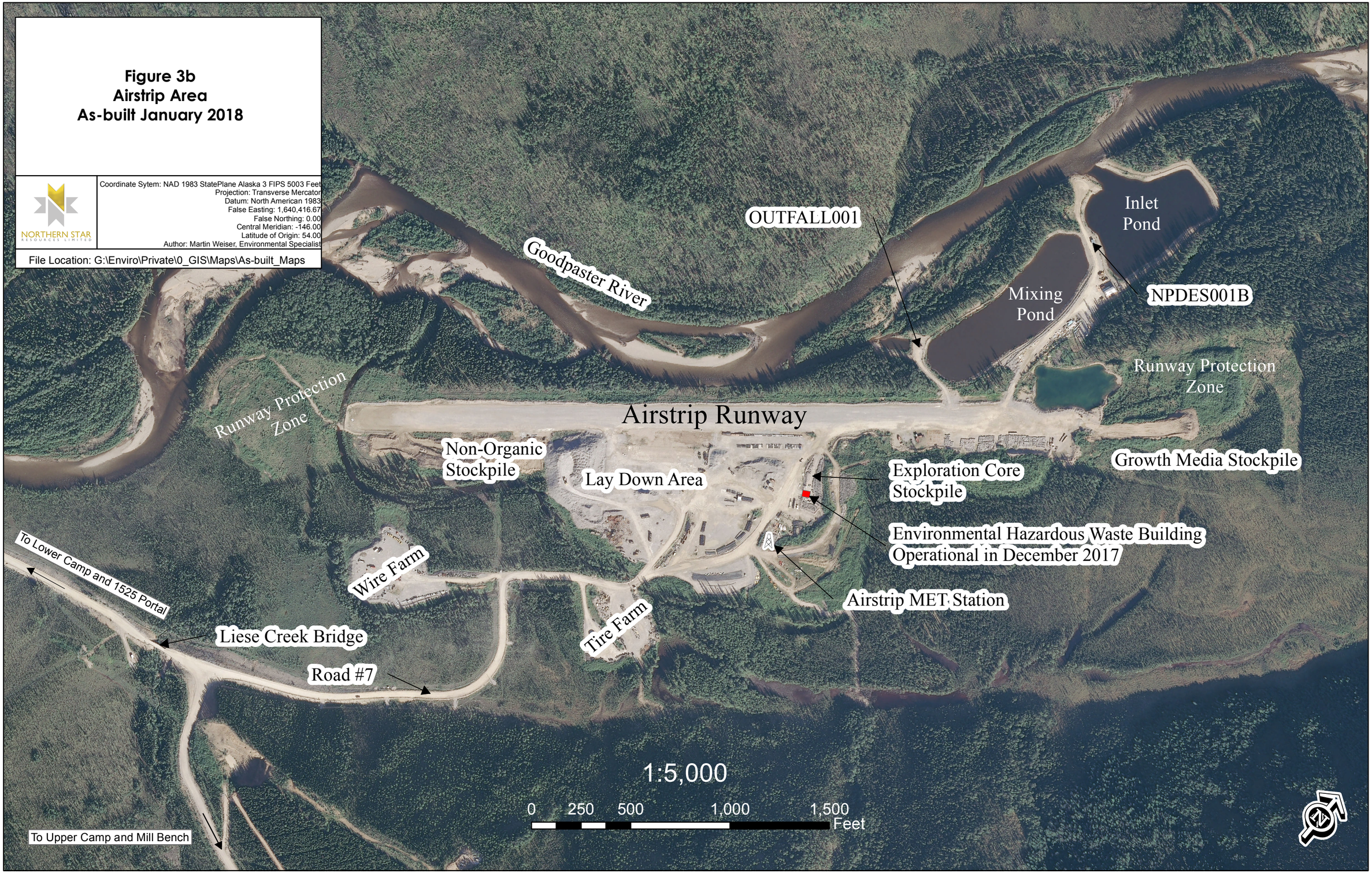


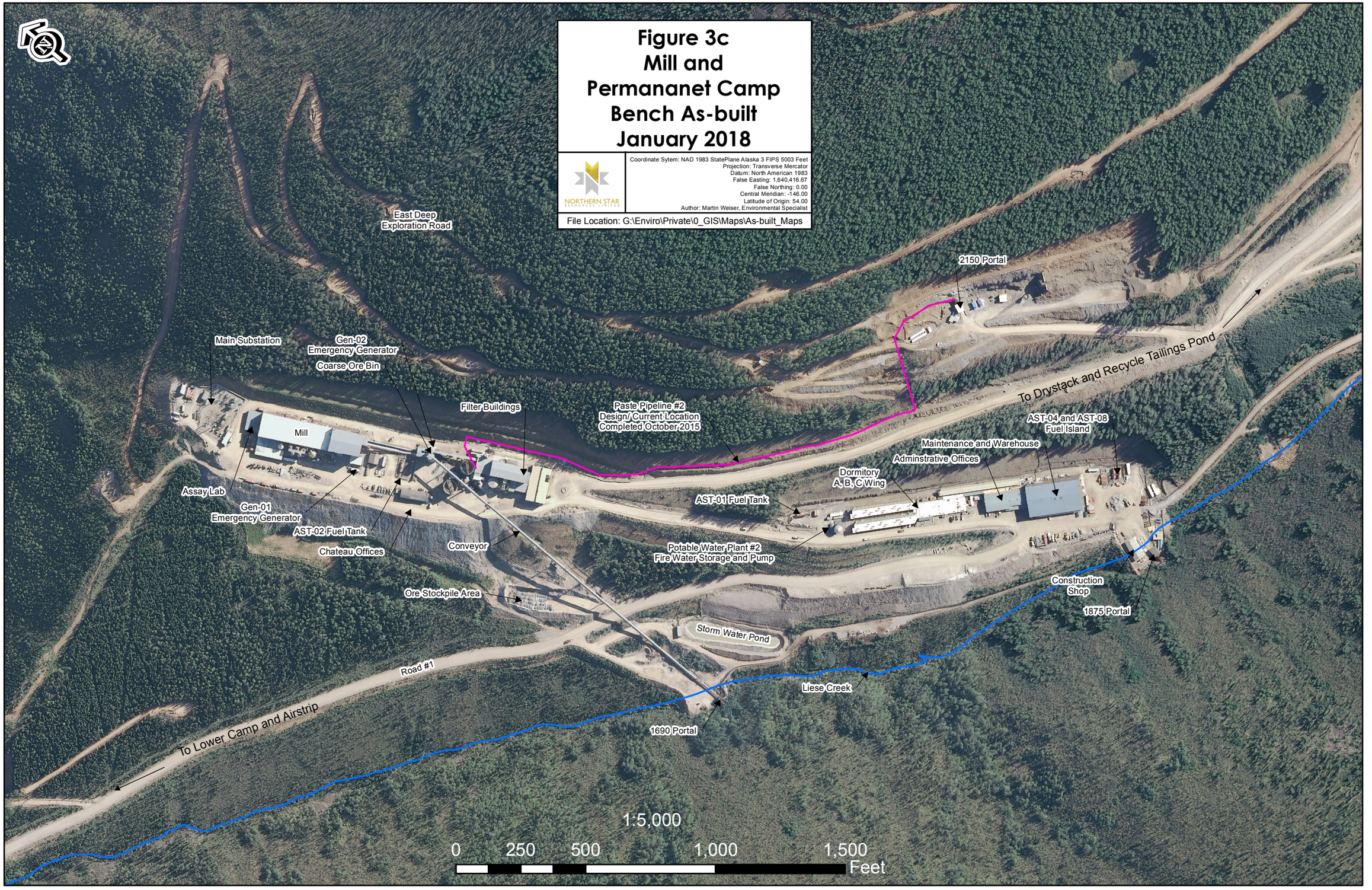
Figure 3b
Airstrip Area
As-built January 2018
NORTHERN STAR
RESOURCES LIMITED
Coordinate Sytem: NAD 1983 StatePlane Alaska 3 FIPS 5003 Feet
Projection: Transverse Mercator
Datum: North American 1983
False Easting: 1,640,416.67
False Northing: 0.00
Central Meridian: -146.00
Latitude of Origin: 54.00
Author: Martin Weiser, Environmental Specialist
File Location: G:\Enviro\Private\0_GIS\Maps\As-built_Maps
OUTFALL001
Goodpaster River
Inlet Pond
Mixing Pond
NPDES001B
Runway Protection Zone
Runway Protection Zone
Airstrip Runway
Non-Organic Stockpile
Lay Down Area
Exploration Core Stockpile
Growth Media Stockpile
Environmental Hazardous Waste Building Operational in December 2017
Airstrip MET Station
Wire Farm
Tire Farm
To Lower Camp and 1525 Portal
Liese Creek Bridge
Road #7
To Upper Camp and Mill Bench
1:5,000
0 250 500 1,000 1,500
Feet

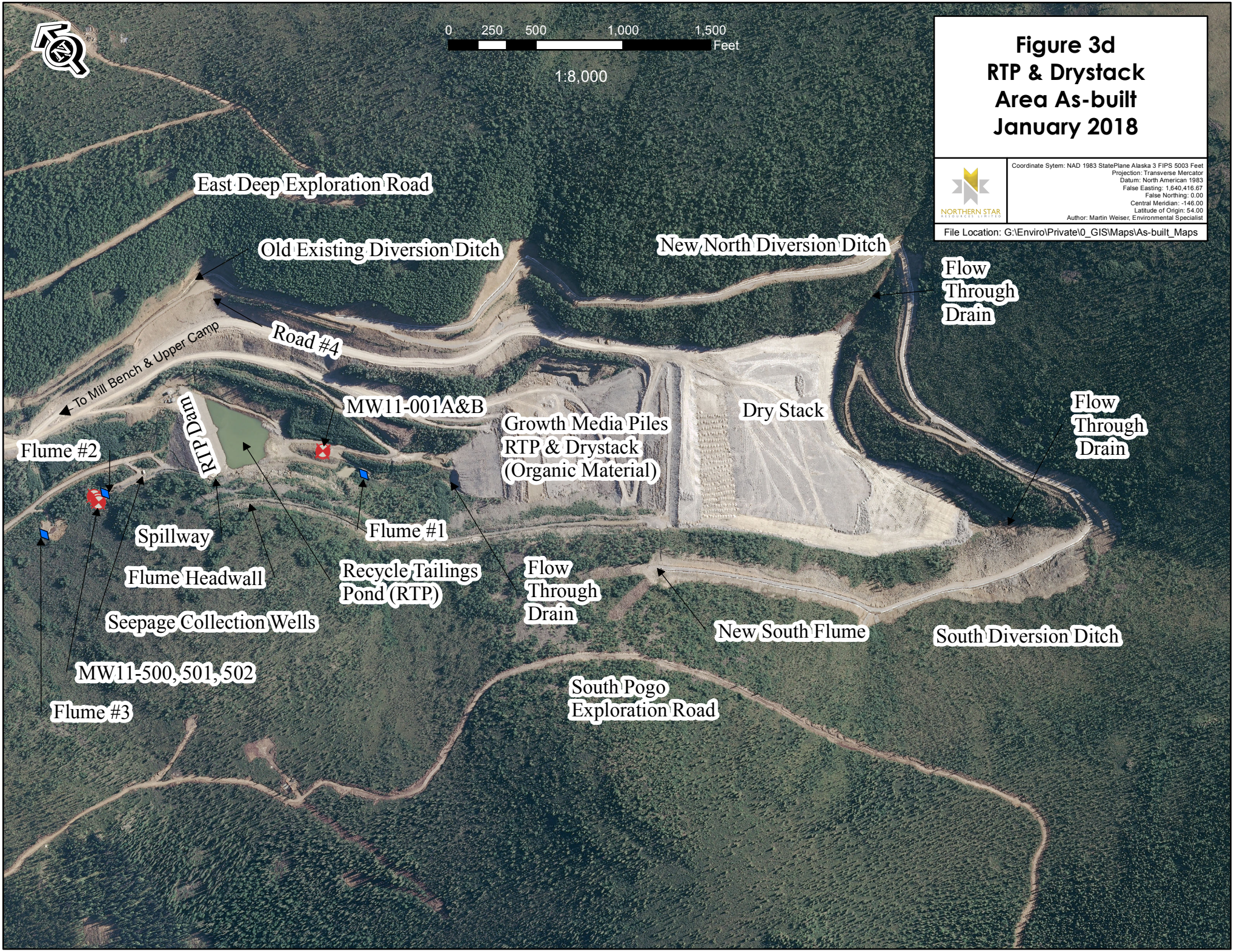
Figure 3c
Mill and Permananet Camp Bench As-built January 2018

NORTHERN STAR RESOURCES LIMITED

Coordinate Sytem: NAD 1983 StatePlane Alaska 3 FIPS 5003 Feet
Projection: Transverse Mercator
Datum: North American 1983
False Easting: 1,640,416.67
False Northing: 0.00
Central Meridian: -146.00
Latitude of Origin: 54.00
Author: Martin Weiser, Environmental Specialist

File Location: G:\Enviro\Private\0_GIS\Maps\As-built_Maps




0 250 500 1,000 1,500
Feet
1:8,000
Figure 3d
RTP & Drystack
Area As-built
January 2018
NORTHERN STAR RESOURCES LIMITED
Coordinate Sytem: NAD 1983 StatePlane Alaska 3 FIPS 5003 Feet
Projection: Transverse Mercator
Datum: North American 1983
False Easting: 1,640,416.67
False Northing: 0.00
Central Meridian: -146.00
Latitude of Origin: 54.00
Author: Martin Weiser, Environmental Specialist
File Location: G:\Enviro\Private\0_GIS\Maps\As-built_Maps
East Deep Exploration Road
Old Existing Diversion Ditch
New North Diversion Ditch
Flow Through Drain
Road #4
To Mill Bench & Upper Camp
RTP Dam
MW11-001A&B
Growth Media Piles
RTP & Drystack
(Organic Material)
Dry Stack
Flow Through Drain
Flume #2
Flume #1
Spillway
Flume Headwall
Recycle Tailings Pond (RTP)
Flow Through Drain
Seepage Collection Wells
New South Flume
South Diversion Ditch
MW11-500, 501, 502
Flume #3
South Pogo Exploration Road

APPENDIX B –

WASTE ROCK GEOCHEMISTRY AND FLOTATION TAILINGS SOLIDS CHEMISTRY DATA

TABLE 1: WHOLE ROCK GEOCHEMISTRY FOR ROCK PLACED IN DRYSTACK 2018

TABLE 2: GEOCHEMISTRY OF FLOTATION TAILINS SOLIDS PLACED IN DRYSTACK 2018

Appendix B. Table 1. Whole Rock Geochemistry for Rock placed into Drystack 2018

PC002	units	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter
Antimony, Total	mg/kg	1.13	1.82	3.92	1.43
Arsenic, Total	mg/kg	282	1090	1045	269
Carbon	%	45	0.34	0.54	0.29
Copper, Total	mg/kg	38	28.7	33.6	18.3
Inorganic Carbon	%	1.7	1.30	2	1.10
Iron, Total	mg/kg	38,400	42,900	45,200	48,900
Lead, Total	mg/kg	15.4	16.9	42	20.9
Maximum Potential Acidity	tCaCO3/1000t	21.9	13.8	15.3	5.3
Net Neutralization Potential	tCaCO3/1000t	29	28	41	24
pH, Paste	pH units	8.8	8.3	8.4	8.5
Potassium, Total	mg/kg	23,100	27,000	23,400	31,300
Ratio (NP/MPA)	su	2.33	3.05	3.66	5.46
Selenium, Total	mg/kg	1	1	1	1
Sodium, Total	mg/kg	9,000	11,800	7,900	13,600
Sulfate Sulfur (CO_3 Leach)	%	<0.01	0.02	<0.01	<0.01
Sulfate Sulfur (HCL Leach)	%	0.04	0.01	<0.01	0.04
Sulfide Sulfur (Calculated)	%	0.7	0.42	0.49	0.16
Sulfur, Total (LECO)	%	0.7	0.044	0.49	0.17
Zinc, Total	mg/kg	63	69	112	90

Appendix B. Table 2. Geochemistry of Flotation Tailings Solids placed into Drystack 2018

PC003 Solid	units	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter
Antimony, Total	mg/kg	2.12	1.91	3.5	1.27
Arsenic, Total	mg/kg	838	736	1500	473
Carbon	%	0.41	0.46	0.36	0.43
Copper, Total	mg/kg	40.8	46.3	81.2	53.3
Inorganic Carbon	%	1.5	1.70	1.3	1.6
Iron, Total	mg/kg	21,300	23,400	23,500	28,200
Lead, Total	mg/kg	8.7	13.6	25.6	11.9
Maximum Potential Acidity	tCaCO3/1000t	3.1	4.1	8.4	2.5
Net Neutralization Potential	tCaCO3/1000t	39	37	25	34
pH, Paste	pH units	8.3	8.2	7.7	8.1
Potassium, Total	mg/kg	22,400	20,400	23,400	19,800
Ratio (NP/MPA)	su	13.44	10.09	3.91	14.40
Selenium, Total	mg/kg	1	1	1	1
Sodium, Total	mg/kg	4,200	4,600	4,500	8,700
Sulfate Sulfur (CO_3 Leach)	%	0.03	0.03	0.03	0.04
Sulfate Sulfur (HCL Leach)	%	0.02	0.02	0.03	0.03
Sulfide Sulfur (Calculated)	%	0.07	0.1	0.24	0.04
Sulfur, Total (LECO)	%	0.1	0.13	0.27	0.08
Zinc, Total	mg/kg	14	19	27	25

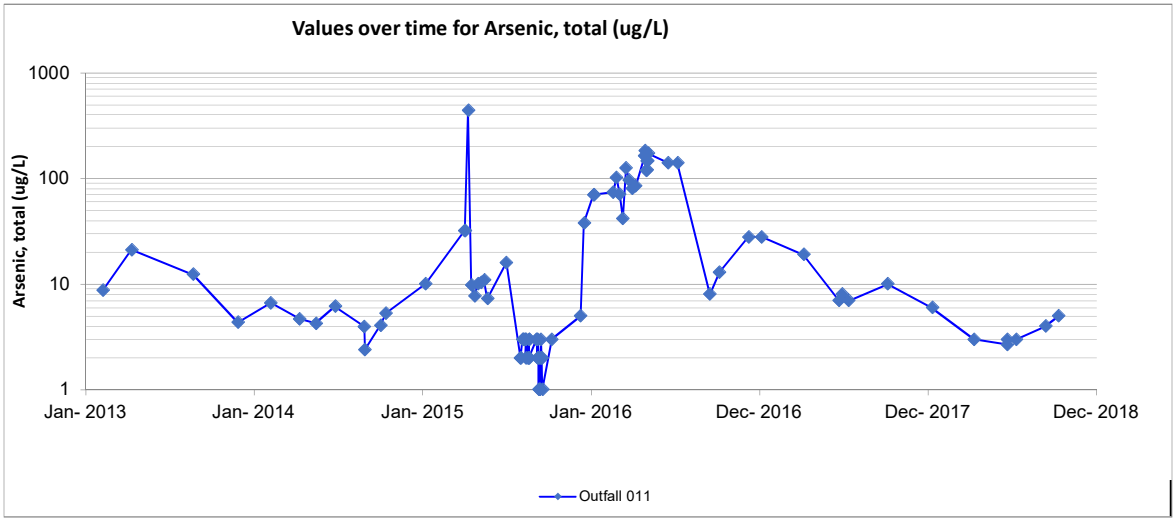
Note: 2017 PC002 and PC003 Solids Data can be found in the 2017 Pogo Annual Activity and Monitoring Report.

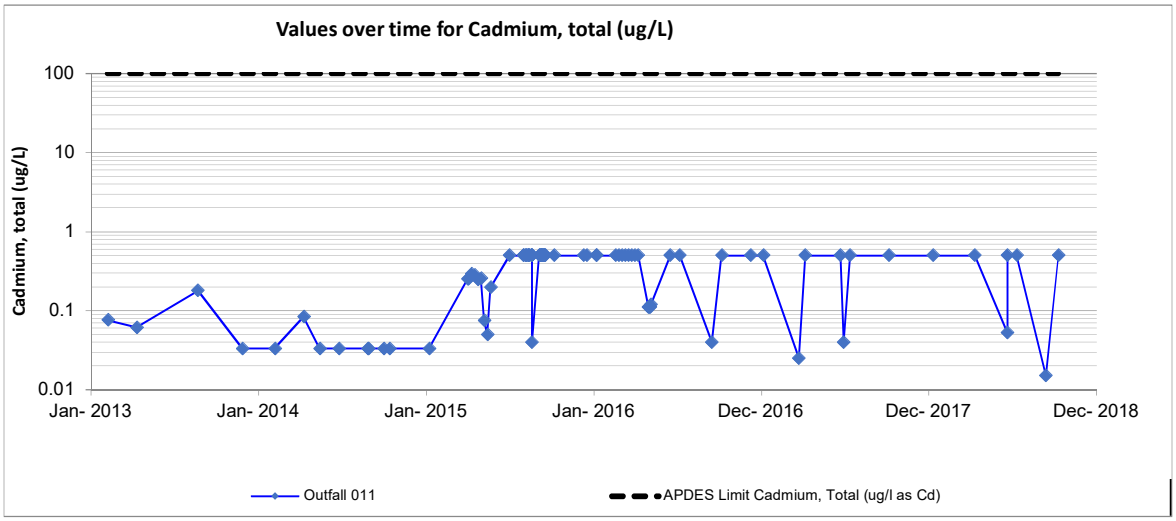
APPENDIX C –

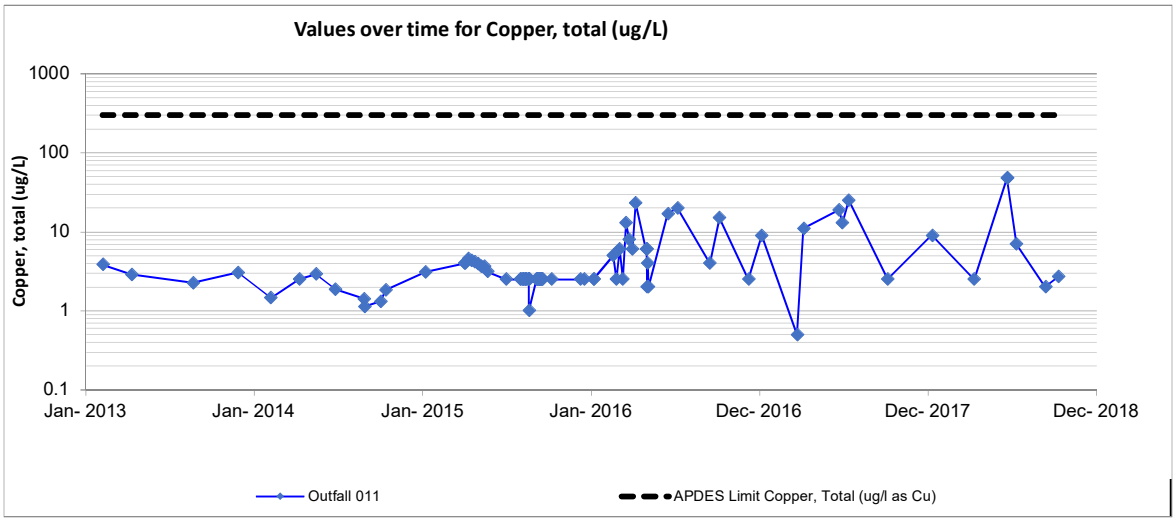
TIME SERIES GRAPHS OF MONITORING DATA

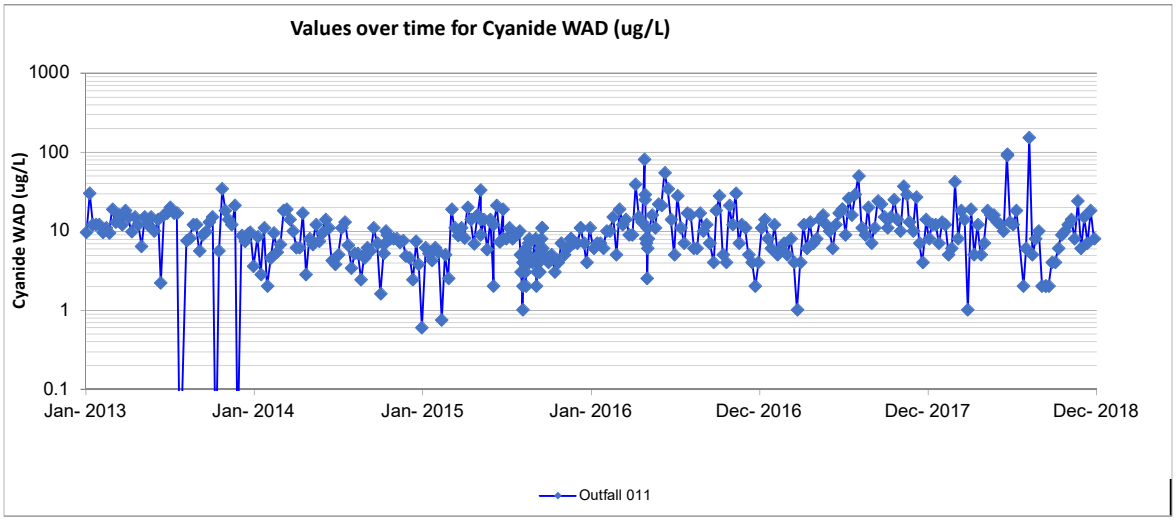
APPENDIX C –

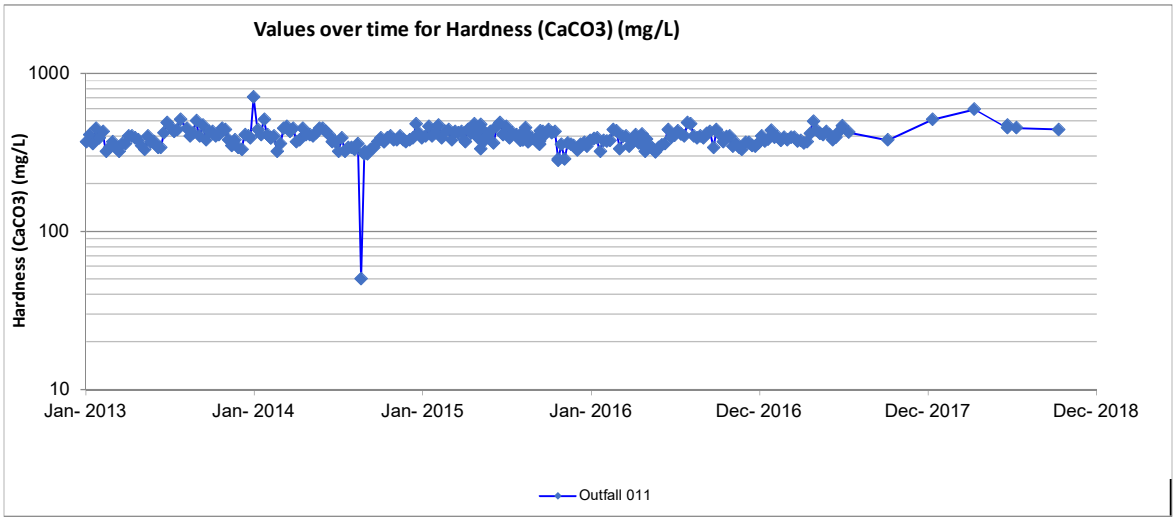
Outfall011 Graphs

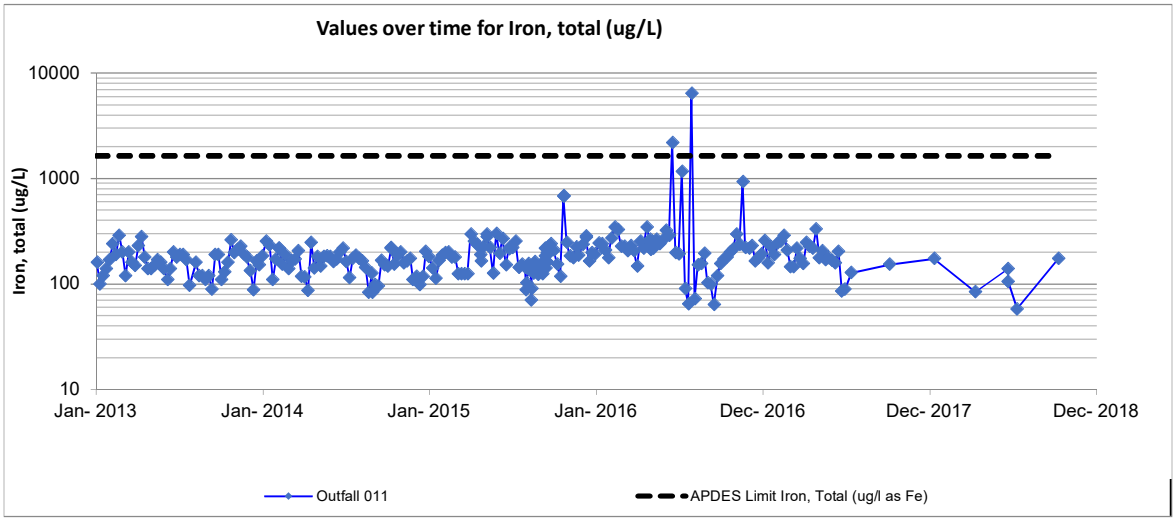

Values over time for Arsenic, total (ug/L)
Arsenic, total (ug/L)
1000
100
10
1
Jan- 2013
Jan- 2014
Jan- 2015
Jan- 2016
Dec- 2016
Dec- 2017
Dec- 2018
Outfall 011

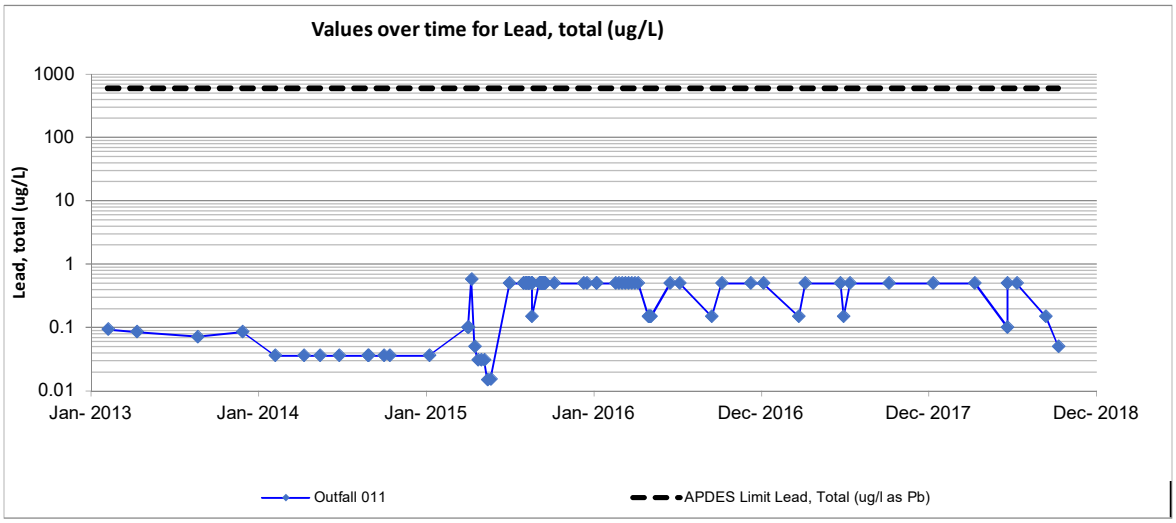

Values over time for Cadmium, total (ug/L)
Cadmium, total (ug/L)
100
10
1
0.1
0.01
Jan- 2013
Jan- 2014
Jan- 2015
Jan- 2016
Dec- 2016
Dec- 2017
Dec- 2018
Outfall 011
APDES Limit Cadmium, Total (ug/l as Cd)

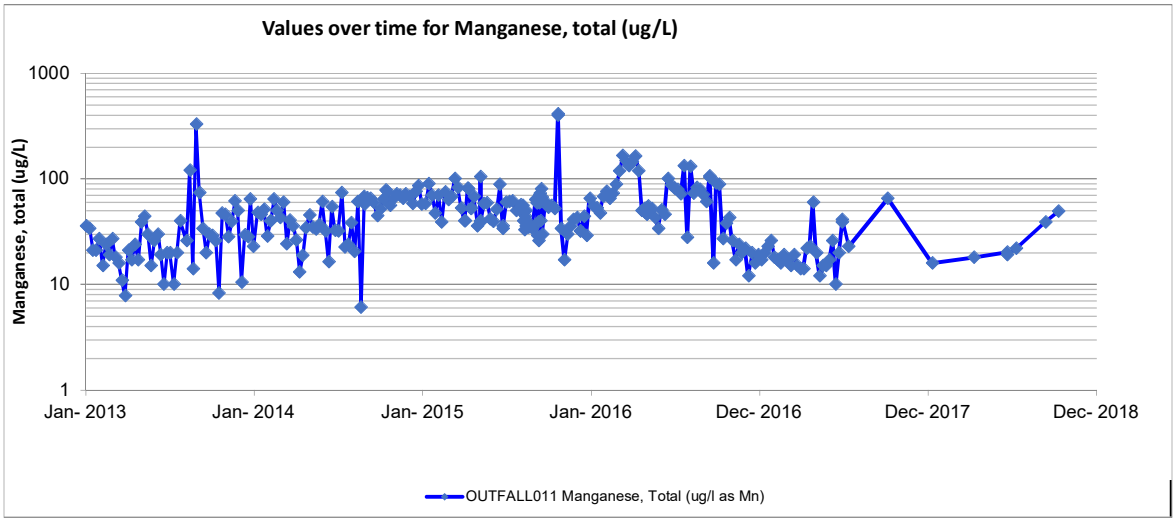

Values over time for Copper, total (ug/L)
Copper, total (ug/L)
1000
100
10
1
0.1
Jan- 2013
Jan- 2014
Jan- 2015
Jan- 2016
Dec- 2016
Dec- 2017
Dec- 2018
Outfall 011
APDES Limit Copper, Total (ug/l as Cu)

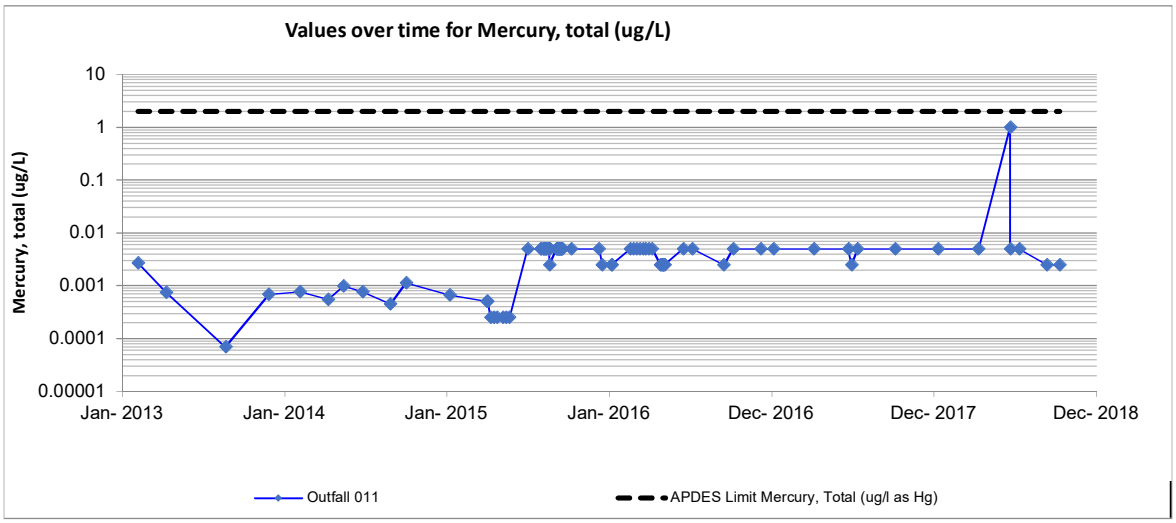

Values over time for Cyanide WAD (ug/L)
Cyanide WAD (ug/L)
1000
100
10
1
0.1
Jan- 2013
Jan- 2014
Jan- 2015
Jan- 2016
Dec- 2016
Dec- 2017
Dec- 2018
Outfall 011

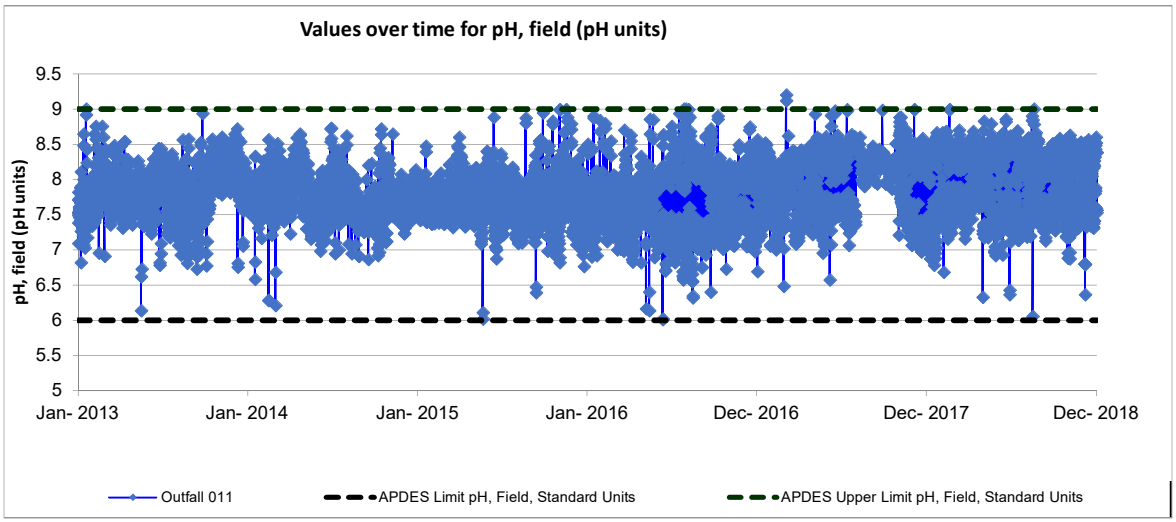

Values over time for Hardness (CaCO3) (mg/L)
Hardness (CaCO3) (mg/L)
1000
100
10
Jan- 2013
Jan- 2014
Jan- 2015
Jan- 2016
Dec- 2016
Dec- 2017
Dec- 2018
Outfall 011

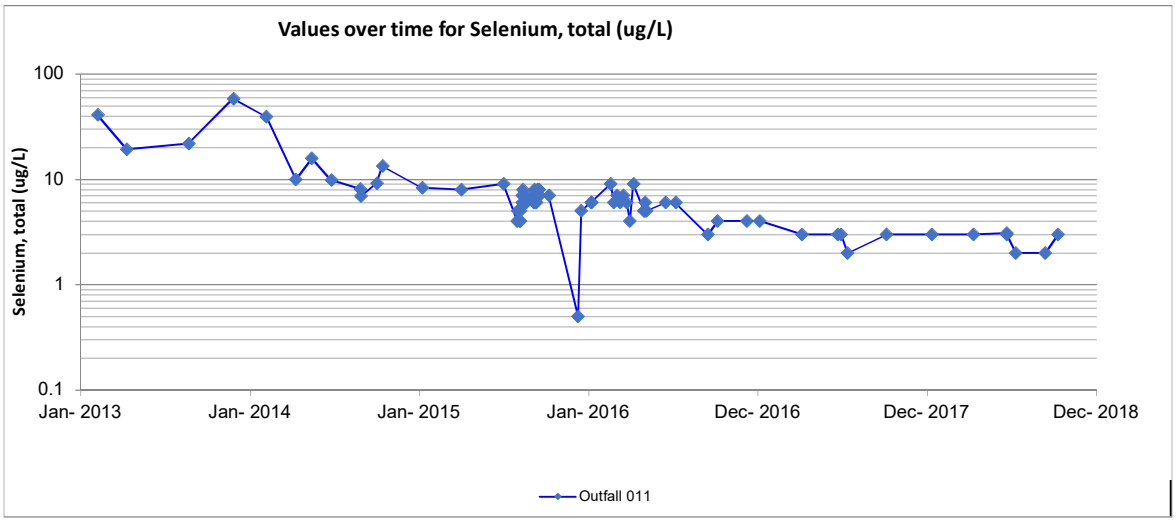

Values over time for Iron, total (ug/L)
Iron, total (ug/L)
10000
1000
100
10
Jan- 2013
Jan- 2014
Jan- 2015
Jan- 2016
Dec- 2016
Dec- 2017
Dec- 2018
Outfall 011
APDES Limit Iron, Total (ug/l as Fe)

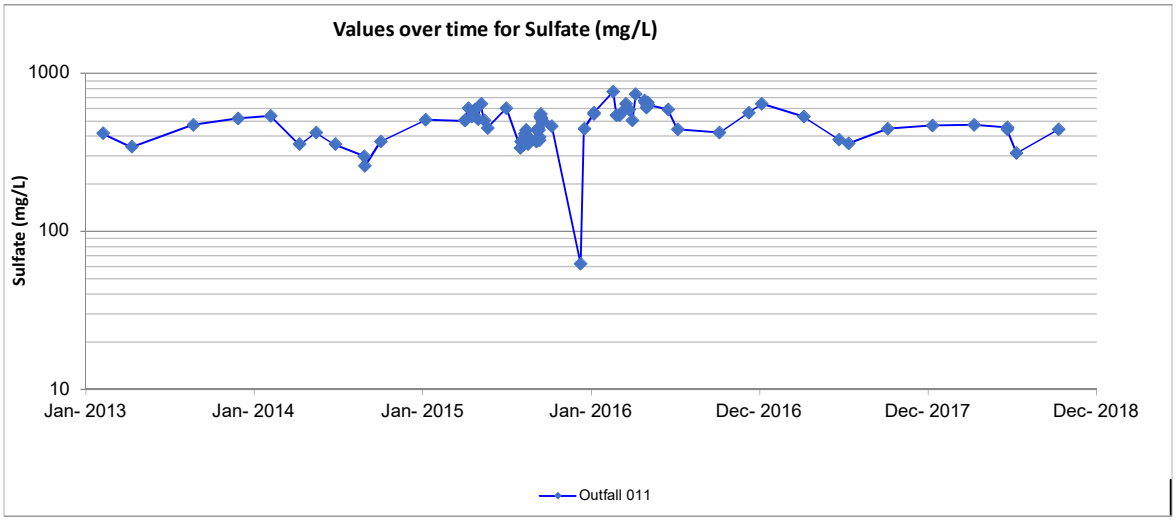

Values over time for Lead, total (ug/L)
Lead, total (ug/L)
1000
100
10
1
0.1
0.01
Jan- 2013
Jan- 2014
Jan- 2015
Jan- 2016
Dec- 2016
Dec- 2017
Dec- 2018
Outfall 011
APDES Limit Lead, Total (ug/l as Pb)

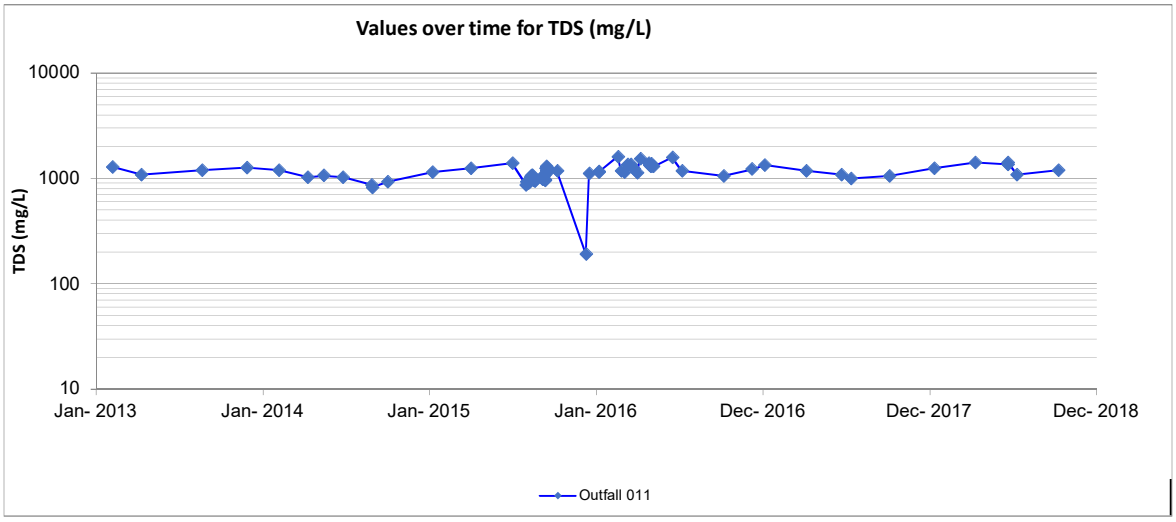

Values over time for Manganese, total (ug/L)
Manganese, total (ug/L)
1000
100
10
1
Jan- 2013
Jan- 2014
Jan- 2015
Jan- 2016
Dec- 2016
Dec- 2017
Dec- 2018
OUTFALL011 Manganese, Total (ug/l as Mn)

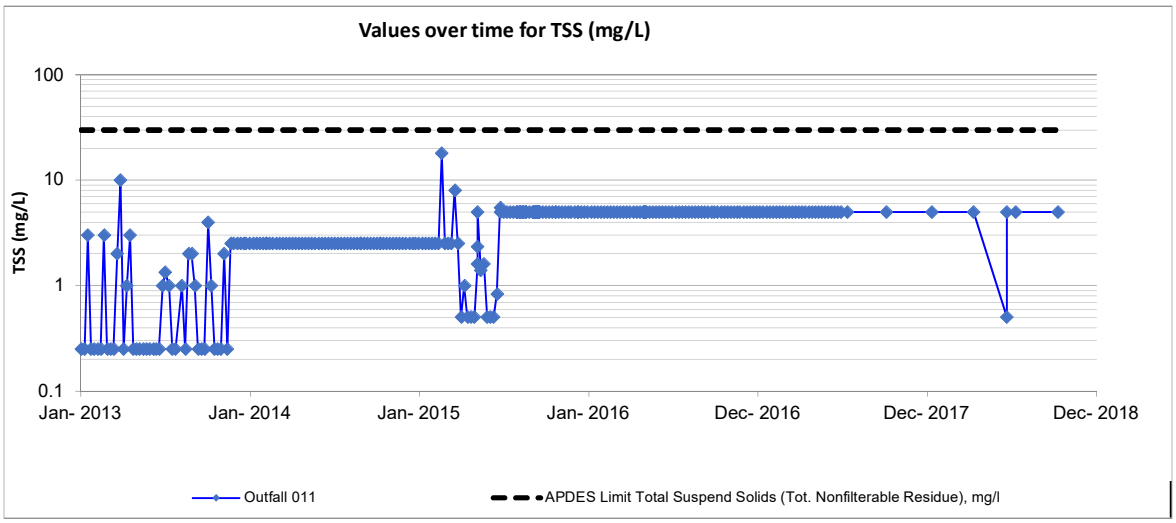

Values over time for Mercury, total (ug/L)
Mercury, total (ug/L)
10
1
0.1
0.01
0.001
0.0001
0.00001
Jan- 2013
Jan- 2014
Jan- 2015
Jan- 2016
Dec- 2016
Dec- 2017
Dec- 2018
Outfall 011
APDES Limit Mercury, Total (ug/l as Hg)

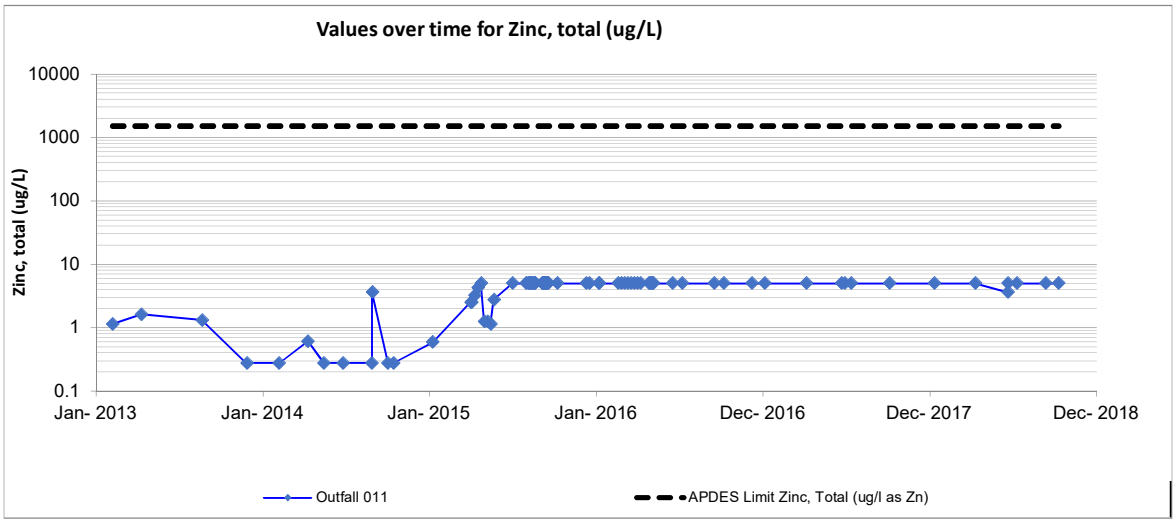

Values over time for pH, field (pH units)
pH, field (pH units)
9.5
9
8.5
8
7.5
7
6.5
6
5.5
5
Jan- 2013
Jan- 2014
Jan- 2015
Jan- 2016
Dec- 2016
Dec- 2017
Dec- 2018
Outfall 011
APDES Limit pH, Field, Standard Units
APDES Upper Limit pH, Field, Standard Units


Values over time for Selenium, total (ug/L)
Selenium, total (ug/L)
100
10
1
0.1
Jan- 2013
Jan- 2014
Jan- 2015
Jan- 2016
Dec- 2016
Dec- 2017
Dec- 2018
Outfall 011


Values over time for Sulfate (mg/L)
Sulfate (mg/L)
1000
100
10
Jan- 2013
Jan- 2014
Jan- 2015
Jan- 2016
Dec- 2016
Dec- 2017
Dec- 2018
Outfall 011

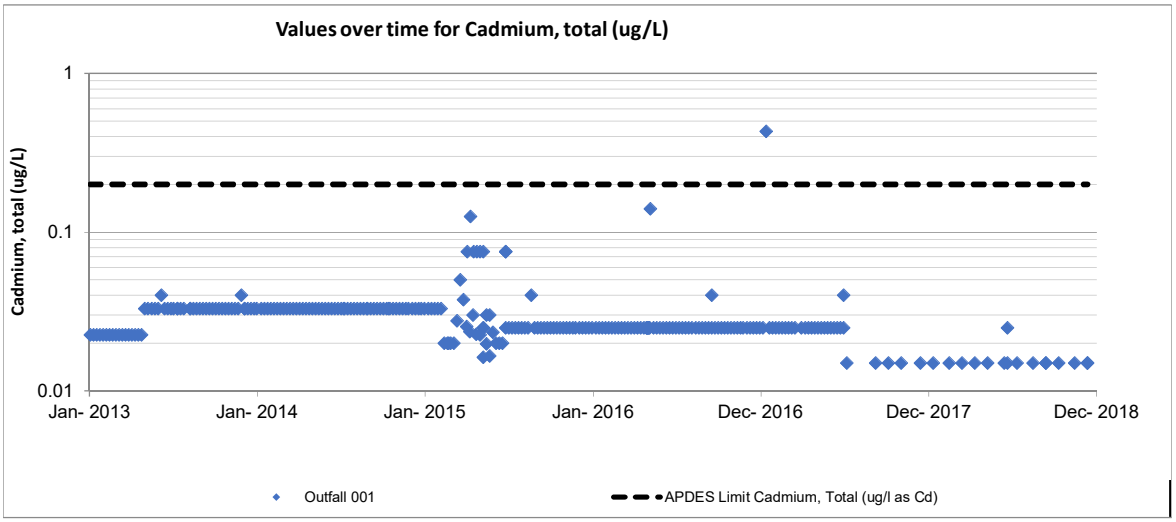

Values over time for TDS (mg/L)
TDS (mg/L)
10000
1000
100
10
Jan- 2013
Jan- 2014
Jan- 2015
Jan- 2016
Dec- 2016
Dec- 2017
Dec- 2018
Outfall 011

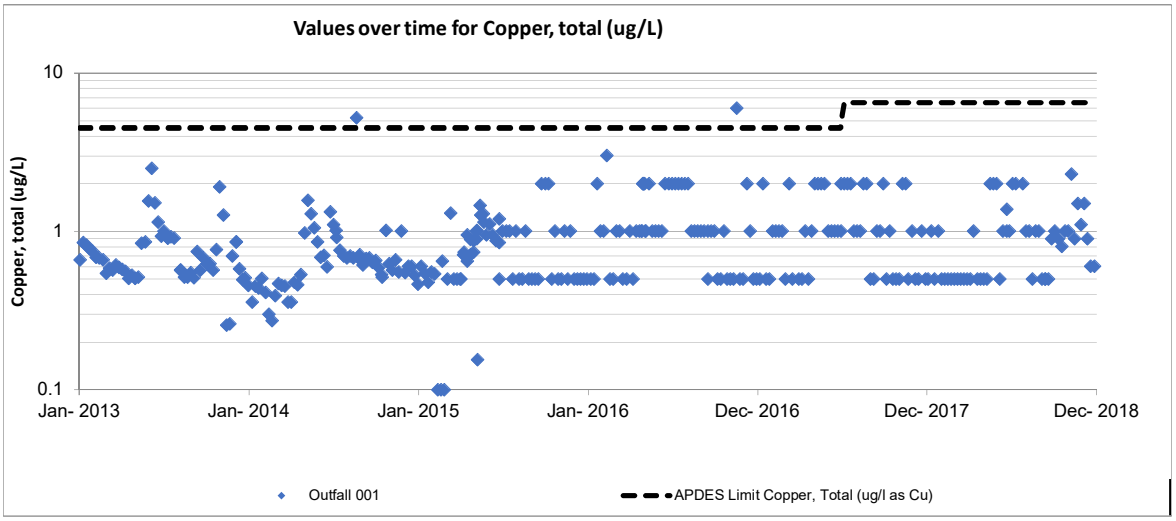

Values over time for TSS (mg/L)
TSS (mg/L)
100
10
1
0.1
Jan- 2013
Jan- 2014
Jan- 2015
Jan- 2016
Dec- 2016
Dec- 2017
Dec- 2018
Outfall 011
APDES Limit Total Suspend Solids (Tot. Nonfilterable Residue), mg/l

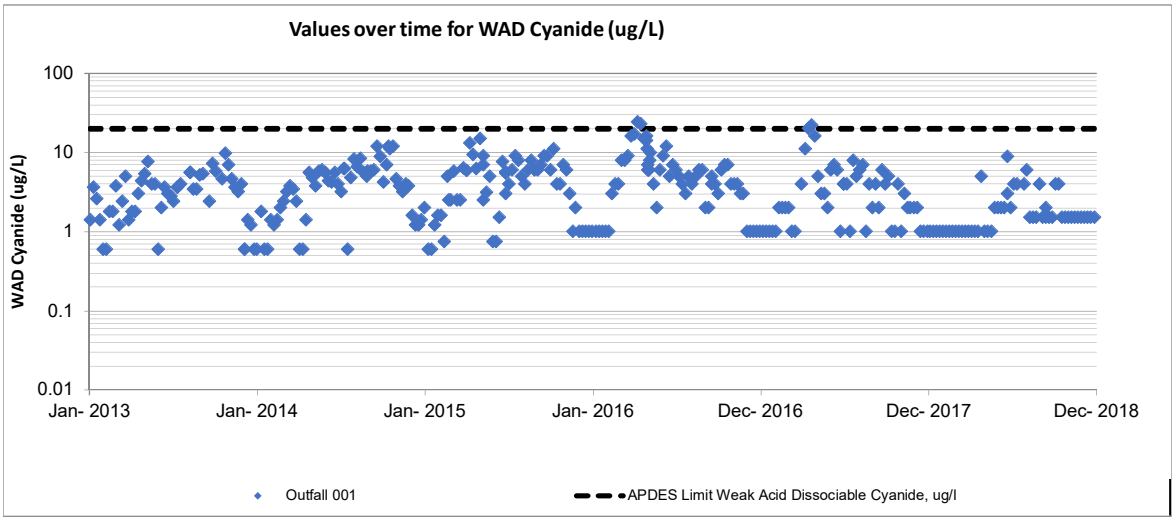

Values over time for Zinc, total (ug/L)
Zinc, total (ug/L)
10000
1000
100
10
1
0.1
Jan- 2013
Jan- 2014
Jan- 2015
Jan- 2016
Dec- 2016
Dec- 2017
Dec- 2018
Outfall 011
APDES Limit Zinc, Total (ug/l as Zn)

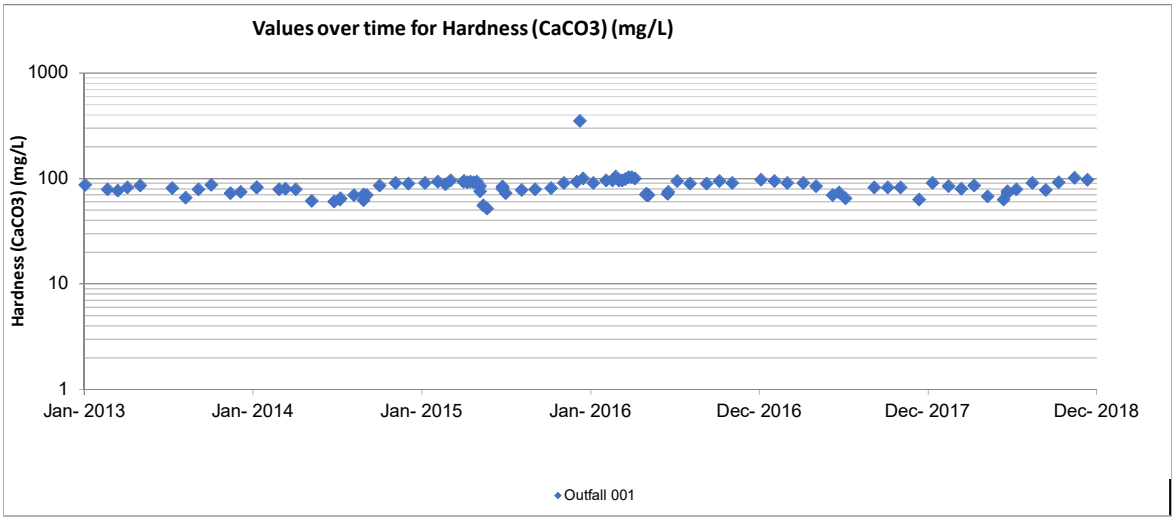
APPENDIX C –

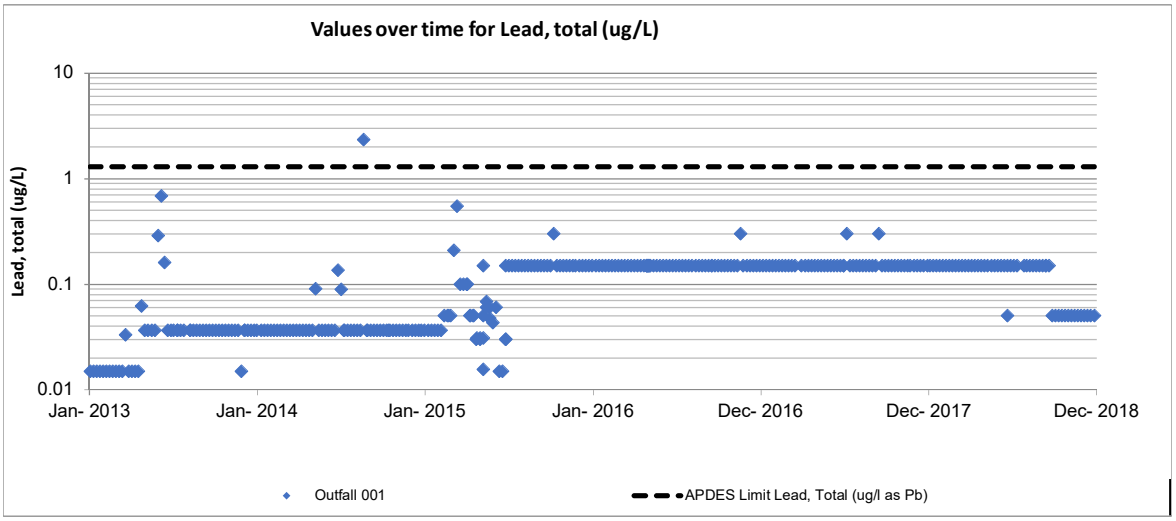
Outfall 001 Graphs

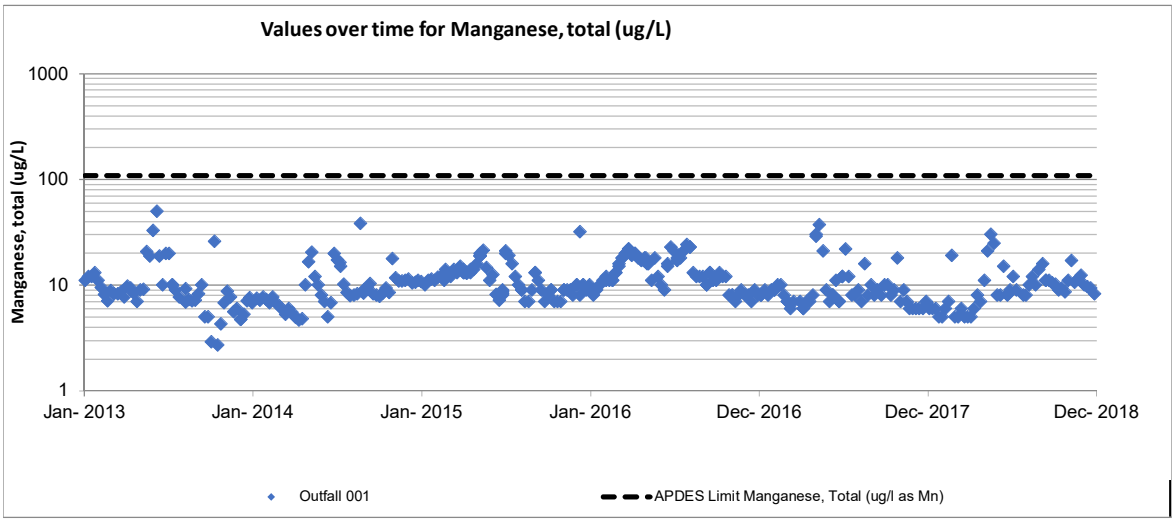

Values over time for Cadmium, total (ug/L)
Cadmium, total (ug/L)
1
0.1
0.01
Jan- 2013
Jan- 2014
Jan- 2015
Jan- 2016
Dec- 2016
Dec- 2017
Dec- 2018
Outfall 001
APDES Limit Cadmium, Total (ug/l as Cd)

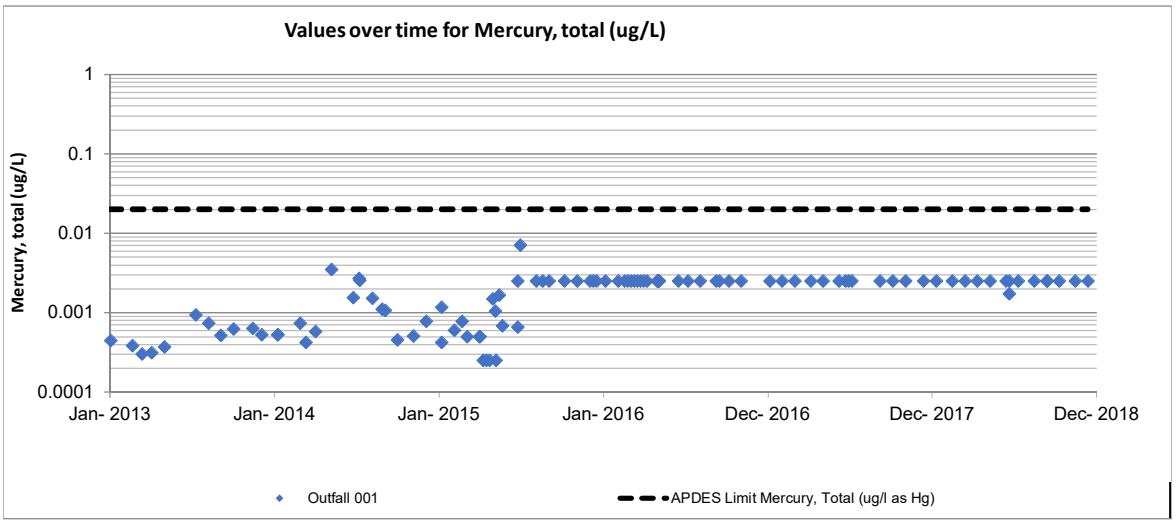

Values over time for Copper, total (ug/L)
Copper, total (ug/L)
10
1
0.1
Jan- 2013
Jan- 2014
Jan- 2015
Jan- 2016
Dec- 2016
Dec- 2017
Dec- 2018
Outfall 001
APDES Limit Copper, Total (ug/l as Cu)

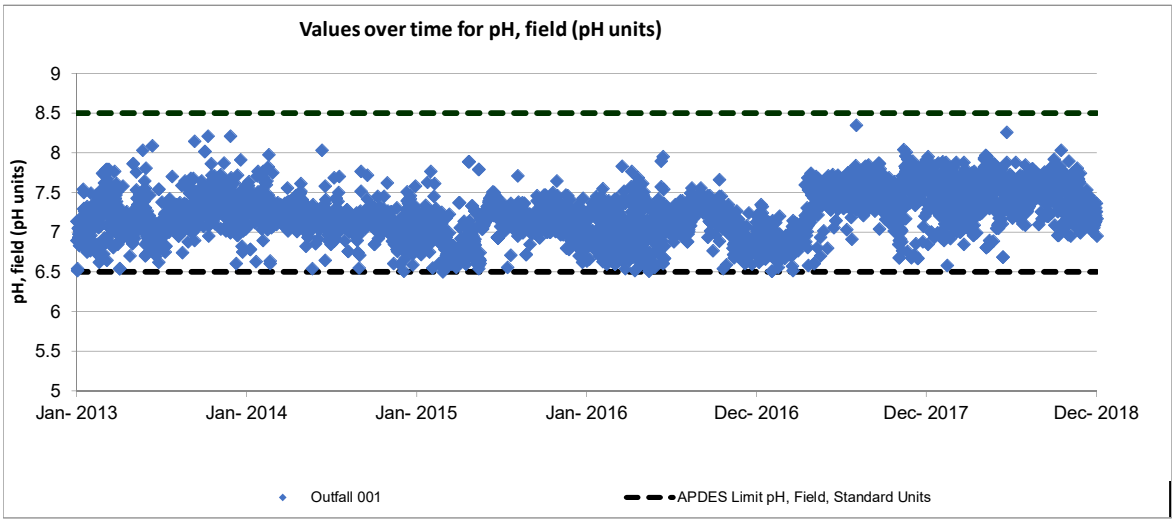

Values over time for WAD Cyanide (ug/L)
WAD Cyanide (ug/L)
100
10
1
0.1
0.01
Jan- 2013
Jan- 2014
Jan- 2015
Jan- 2016
Dec- 2016
Dec- 2017
Dec- 2018
Outfall 001
APDES Limit Weak Acid Dissociable Cyanide, ug/l

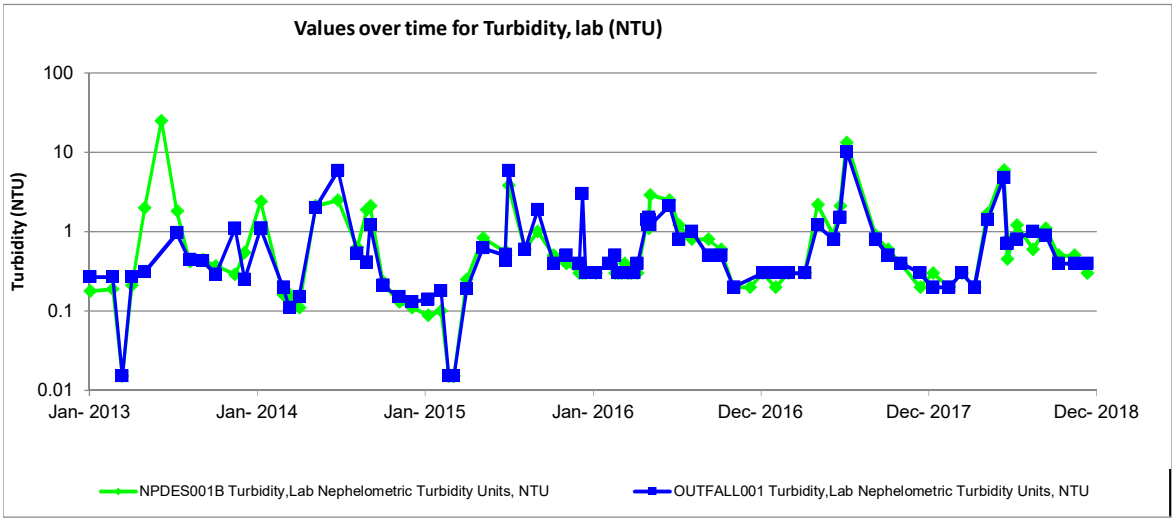

Values over time for Hardness (CaCO3) (mg/L)
Hardness (CaCO3) (mg/L)
1000
100
10
1
Jan- 2013
Jan- 2014
Jan- 2015
Jan- 2016
Dec- 2016
Dec- 2017
Dec- 2018
Outfall 001

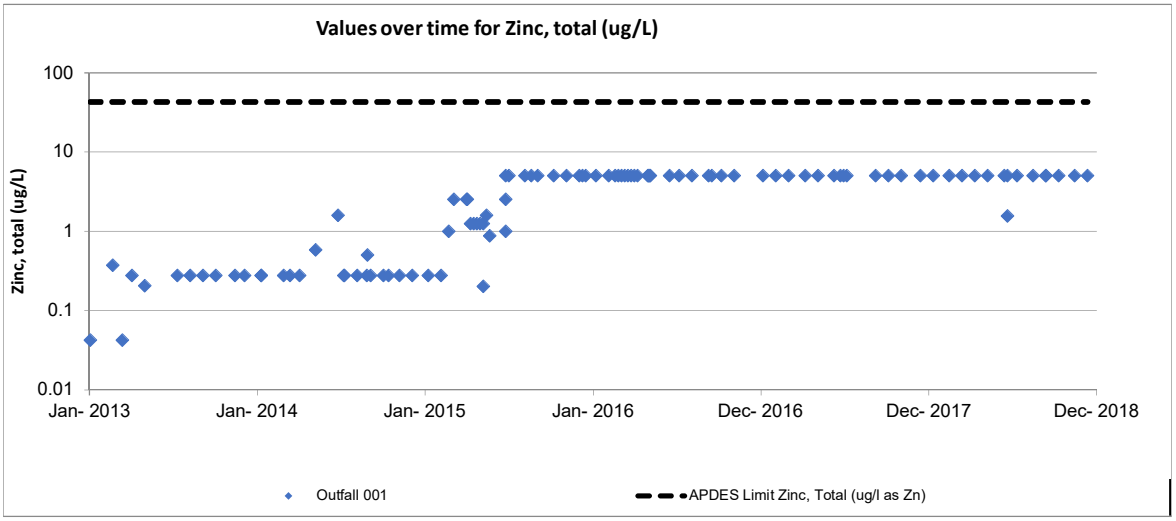

Values over time for Lead, total (ug/L)
Lead, total (ug/L)
10
1
0.1
0.01
Jan- 2013
Jan- 2014
Jan- 2015
Jan- 2016
Dec- 2016
Dec- 2017
Dec- 2018
Outfall 001
APDES Limit Lead, Total (ug/l as Pb)


Values over time for Manganese, total (ug/L)
Manganese, total (ug/L)
1000
100
10
1
Jan- 2013
Jan- 2014
Jan- 2015
Jan- 2016
Dec- 2016
Dec- 2017
Dec- 2018
Outfall 001
APDES Limit Manganese, Total (ug/l as Mn)


Values over time for Mercury, total (ug/L)
Mercury, total (ug/L)
1
0.1
0.01
0.001
0.0001
Jan- 2013
Jan- 2014
Jan- 2015
Jan- 2016
Dec- 2016
Dec- 2017
Dec- 2018
Outfall 001
APDES Limit Mercury, Total (ug/l as Hg)

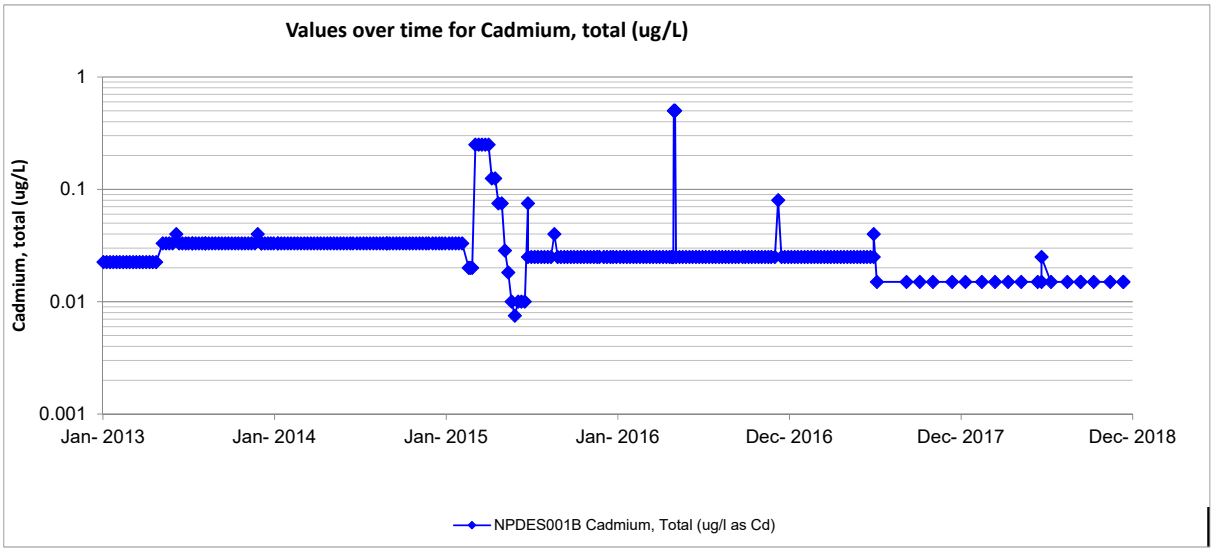

Values over time for pH, field (pH units)
pH, field (pH units)
9
8.5
8
7.5
7
6.5
6
5.5
5
Jan- 2013
Jan- 2014
Jan- 2015
Jan- 2016
Dec- 2016
Dec- 2017
Dec- 2018
Outfall 001
APDES Limit pH, Field, Standard Units

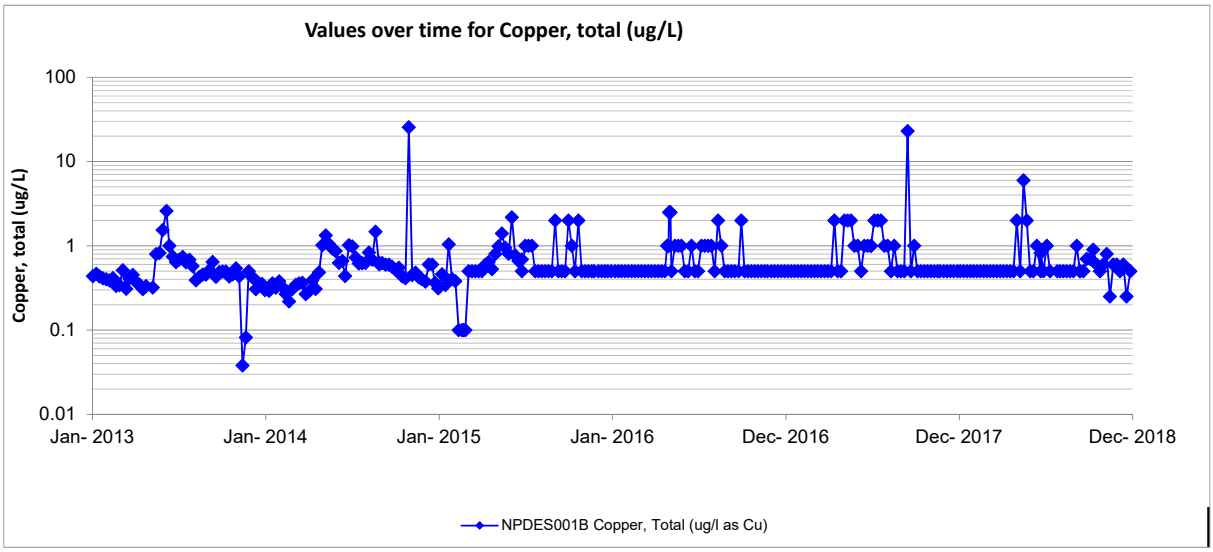

Values over time for Turbidity, lab (NTU)
Turbidity (NTU)
100
10
1
0.1
0.01
Jan- 2013
Jan- 2014
Jan- 2015
Jan- 2016
Dec- 2016
Dec- 2017
Dec- 2018
NPDES001B Turbidity,Lab Nephelometric Turbidity Units, NTU
OUTFALL001 Turbidity,Lab Nephelometric Turbidity Units, NTU

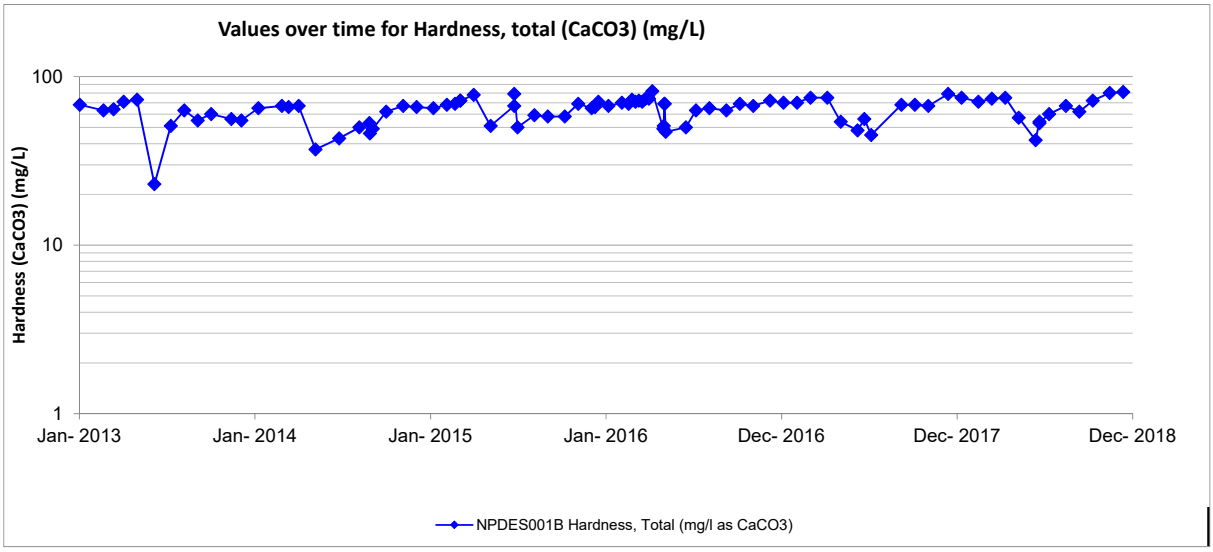

Values over time for Zinc, total (ug/L)
Zinc, total (ug/L)
100
10
1
0.1
0.01
Jan- 2013
Jan- 2014
Jan- 2015
Jan- 2016
Dec- 2016
Dec- 2017
Dec- 2018
Outfall 001
APDES Limit Zinc, Total (ug/l as Zn)

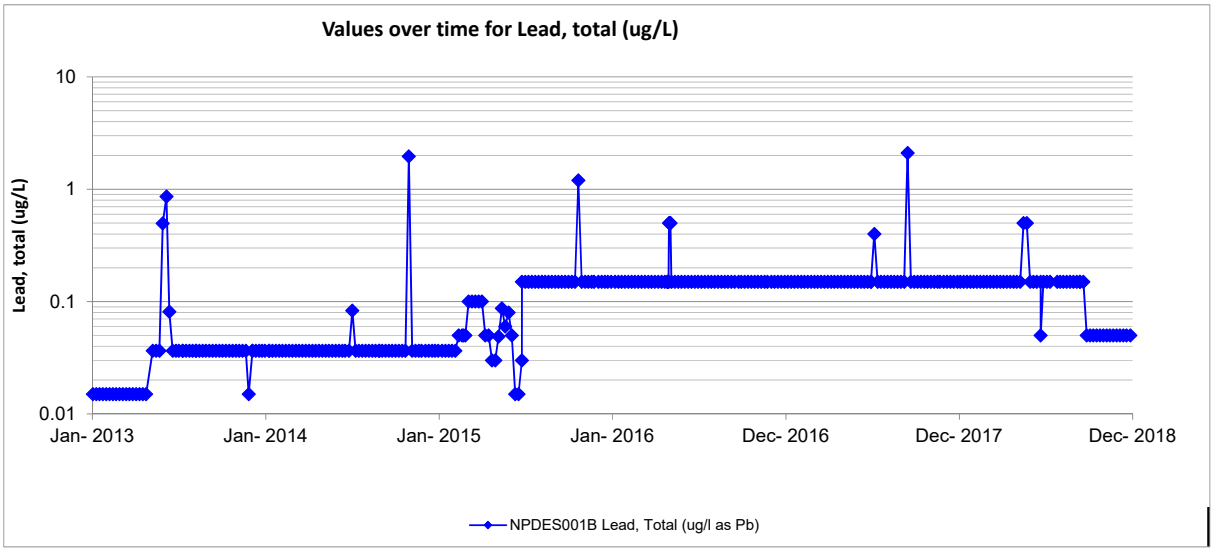
APPENDIX C –

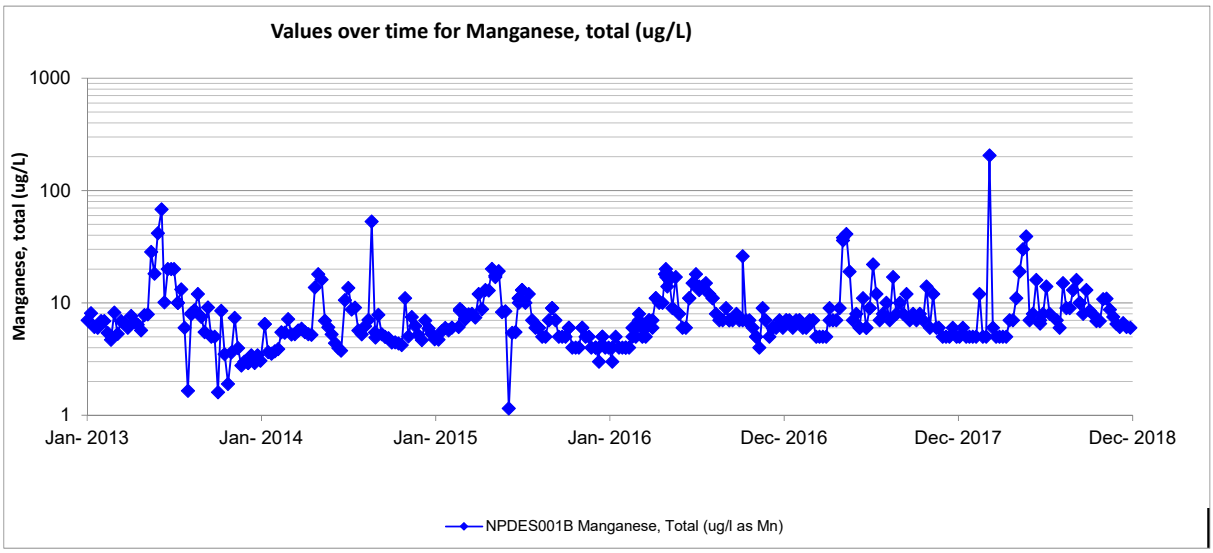
NPDES001B Graphs

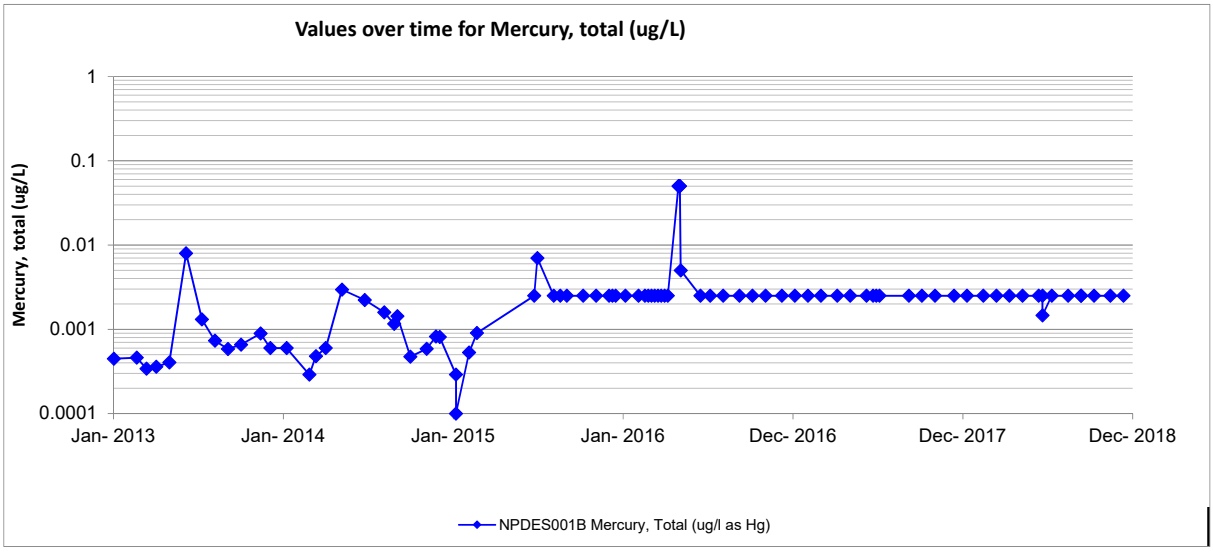

Values over time for Cadmium, total (ug/L)
Cadmium, total (ug/L)
1
0.1
0.01
0.001
Jan- 2013
Jan- 2014
Jan- 2015
Jan- 2016
Dec- 2016
Dec- 2017
Dec- 2018
NPDES001B Cadmium, Total (ug/l as Cd)

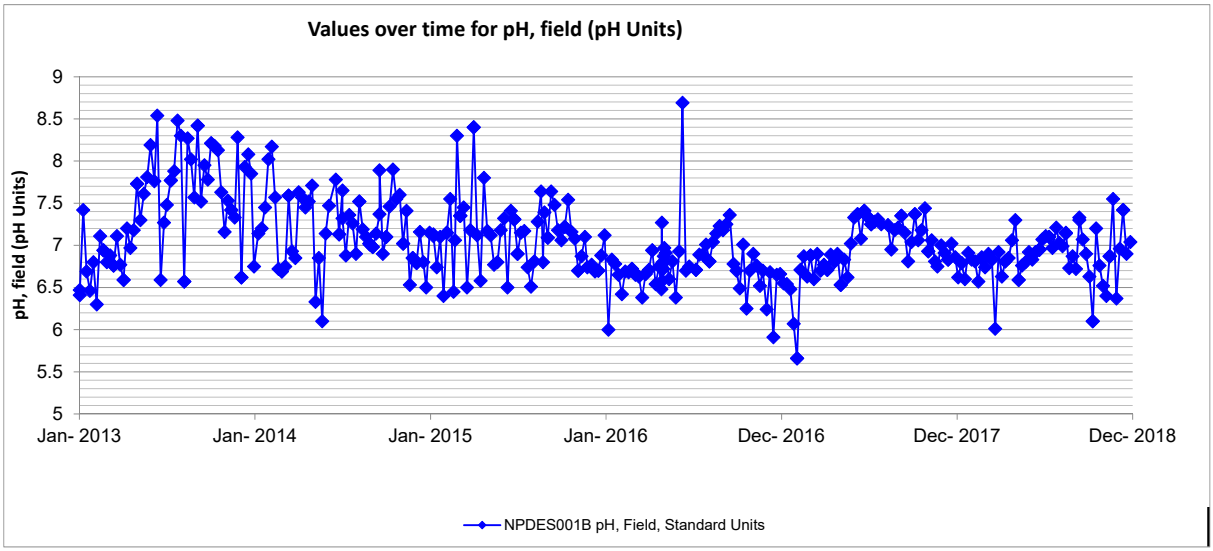

Values over time for Copper, total (ug/L)
Copper, total (ug/L)
100
10
1
0.1
0.01
Jan- 2013
Jan- 2014
Jan- 2015
Jan- 2016
Dec- 2016
Dec- 2017
Dec- 2018
NPDES001B Copper, Total (ug/l as Cu)

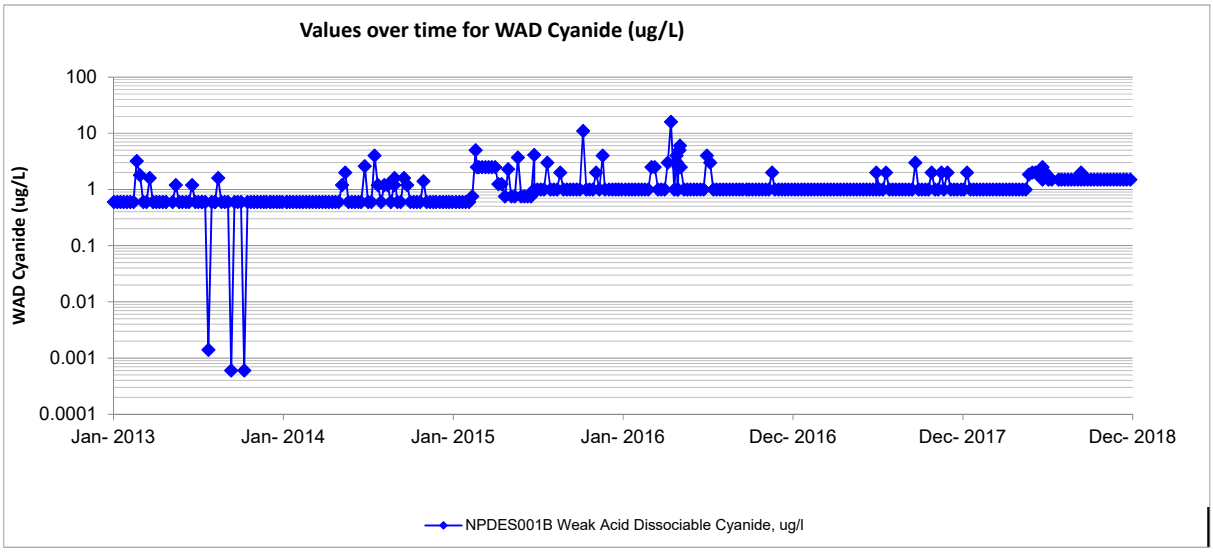

Values over time for Hardness, total (CaCO3) (mg/L)
Hardness (CaCO3) (mg/L)
100
10
1
Jan- 2013
Jan- 2014
Jan- 2015
Jan- 2016
Dec- 2016
Dec- 2017
Dec- 2018
NPDES001B Hardness, Total (mg/l as CaCO3)

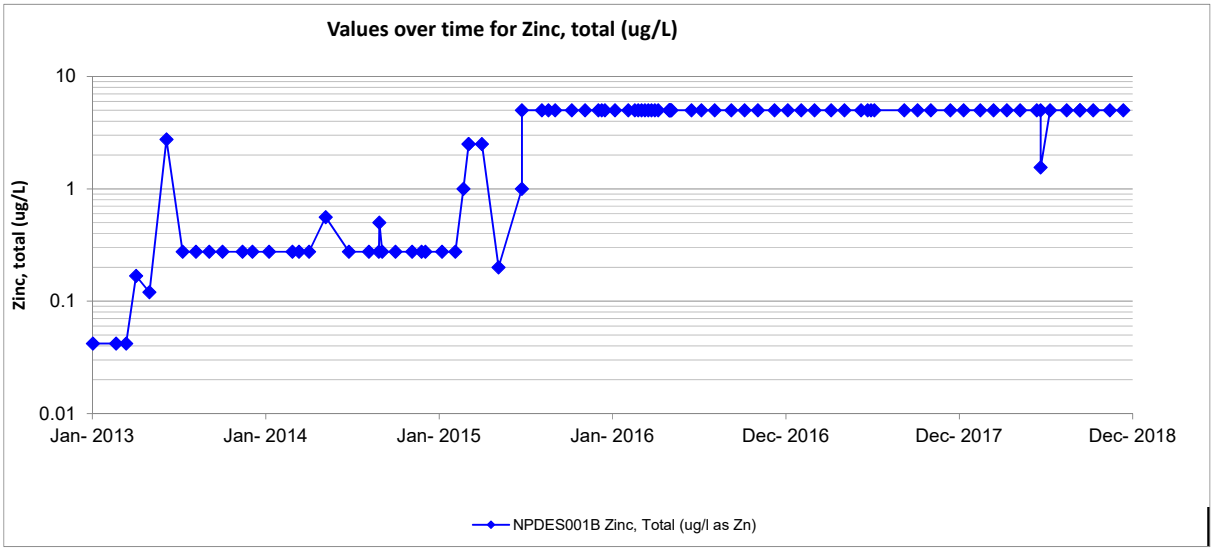

Values over time for Lead, total (ug/L)
Lead, total (ug/L)
10
1
0.1
0.01
Jan- 2013
Jan- 2014
Jan- 2015
Jan- 2016
Dec- 2016
Dec- 2017
Dec- 2018
NPDES001B Lead, Total (ug/l as Pb)


Values over time for Manganese, total (ug/L)
Manganese, total (ug/L)
1000
100
10
1
Jan- 2013
Jan- 2014
Jan- 2015
Jan- 2016
Dec- 2016
Dec- 2017
Dec- 2018
NPDES001B Manganese, Total (ug/l as Mn)


Values over time for Mercury, total (ug/L)
Mercury, total (ug/L)
1
0.1
0.01
0.001
0.0001
Jan- 2013
Jan- 2014
Jan- 2015
Jan- 2016
Dec- 2016
Dec- 2017
Dec- 2018
NPDES001B Mercury, Total (ug/l as Hg)

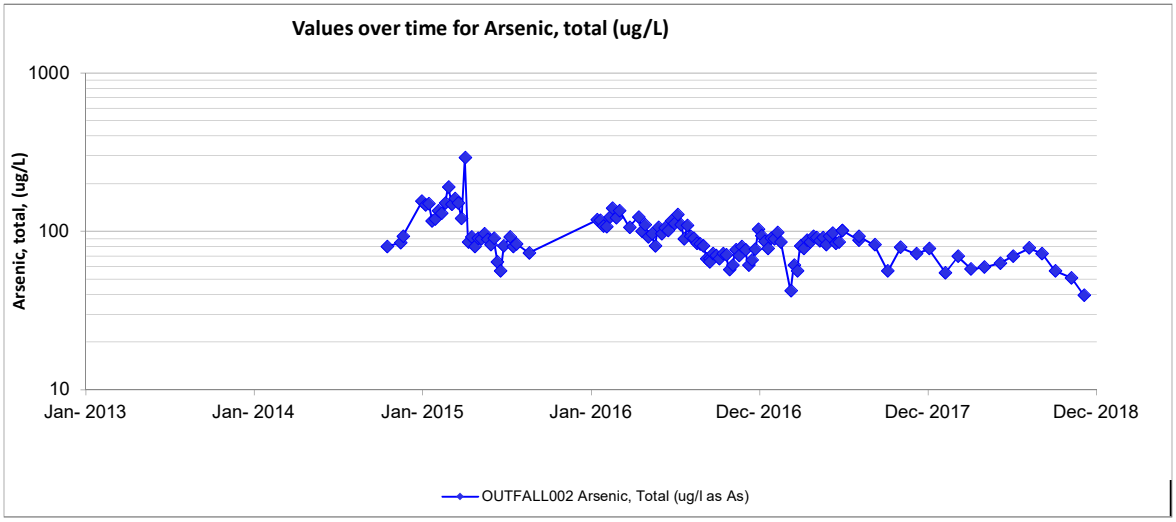

Values over time for pH, field (pH Units)
pH, field (pH Units)
9
8.5
8
7.5
7
6.5
6
5.5
5
Jan- 2013
Jan- 2014
Jan- 2015
Jan- 2016
Dec- 2016
Dec- 2017
Dec- 2018
NPDES001B pH, Field, Standard Units

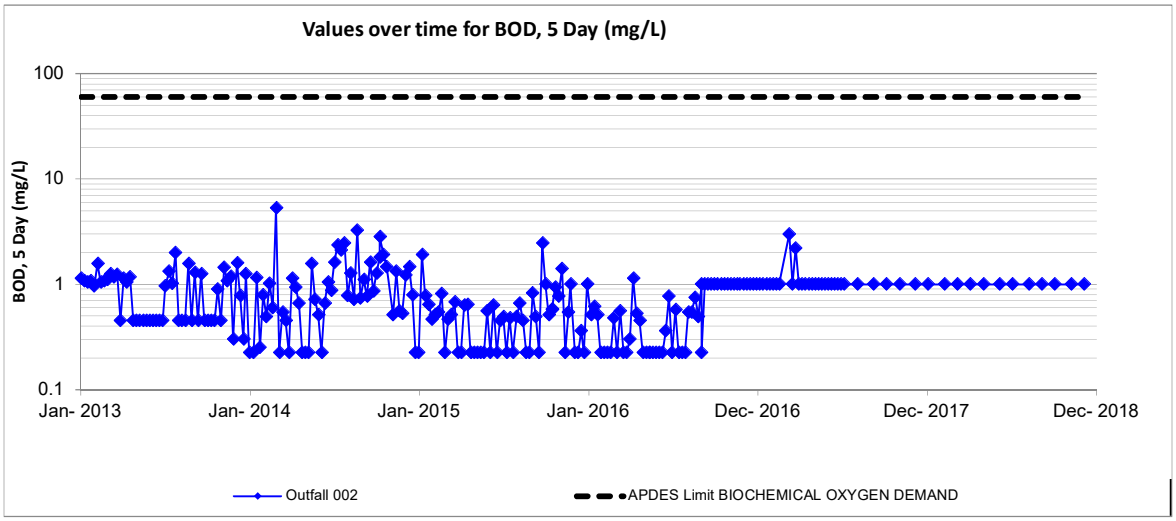

Values over time for WAD Cyanide (ug/L)
WAD Cyanide (ug/L)
100
10
1
0.1
0.01
0.001
0.0001
Jan- 2013
Jan- 2014
Jan- 2015
Jan- 2016
Dec- 2016
Dec- 2017
Dec- 2018
NPDES001B Weak Acid Dissociable Cyanide, ug/l

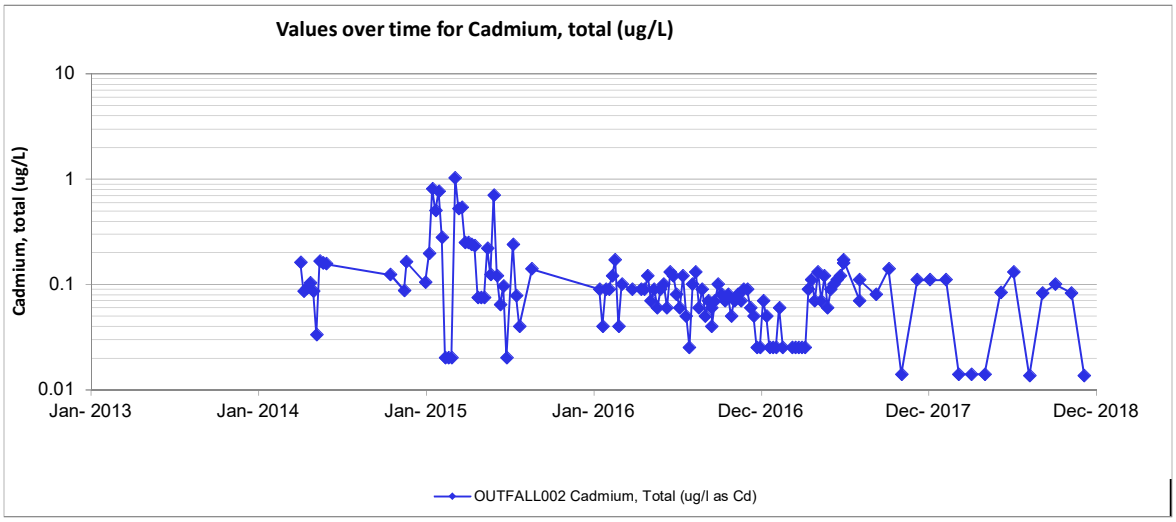

Values over time for Zinc, total (ug/L)
Zinc, total (ug/L)
10
1
0.1
0.01
Jan- 2013
Jan- 2014
Jan- 2015
Jan- 2016
Dec- 2016
Dec- 2017
Dec- 2018
NPDES001B Zinc, Total (ug/l as Zn)

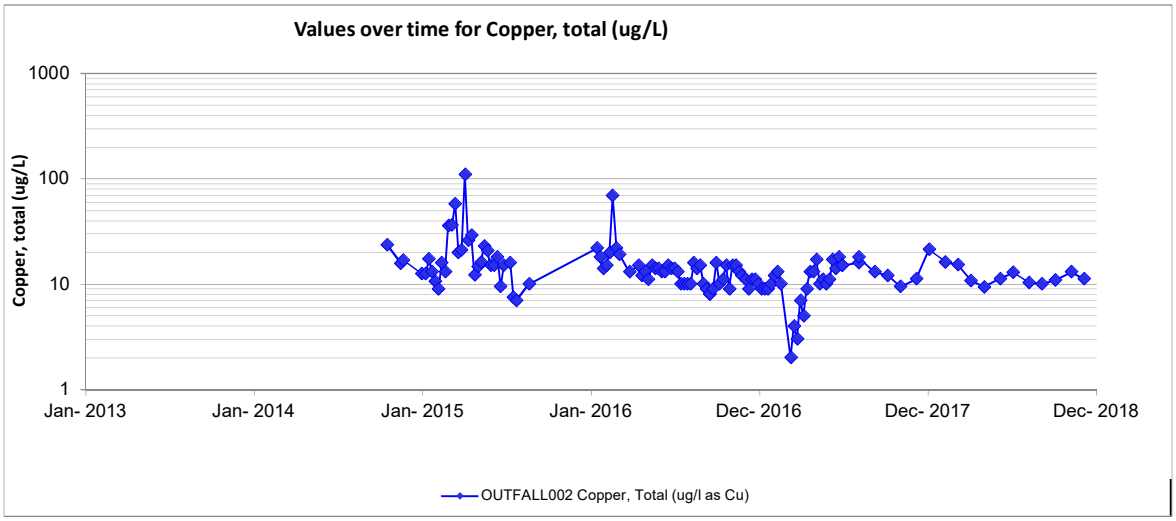
APPENDIX C –

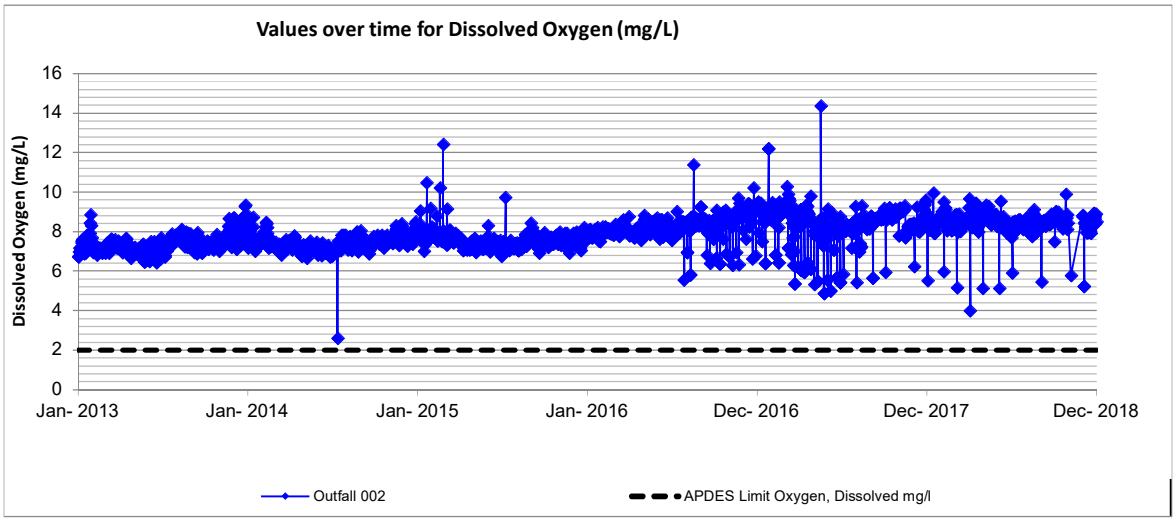
Outfal002 Graphs

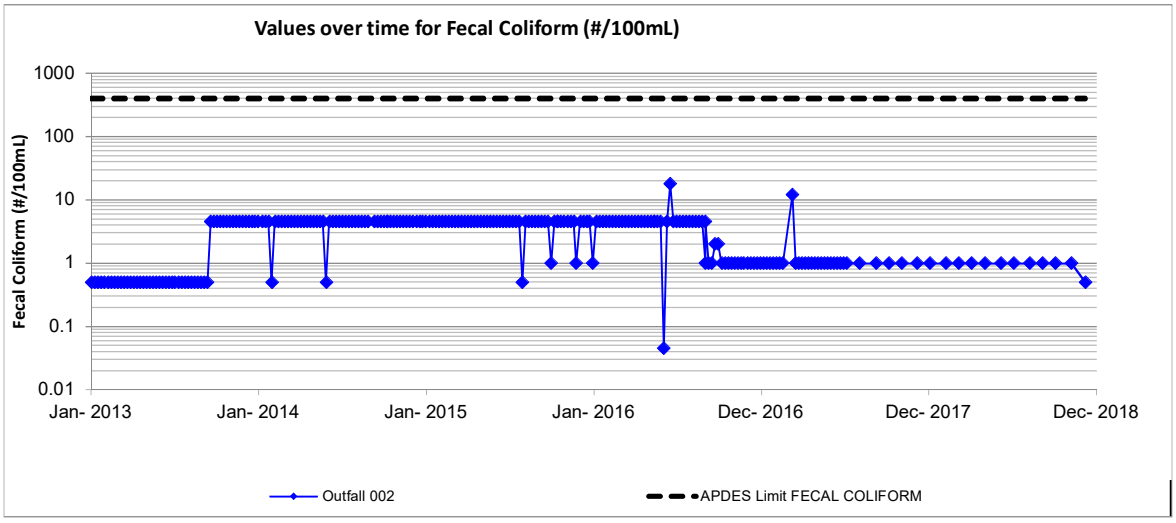

Values over time for Arsenic, total (ug/L)
Arsenic, total, (ug/L)
1000
100
10
Jan- 2013
Jan- 2014
Jan- 2015
Jan- 2016
Dec- 2016
Dec- 2017
Dec- 2018
OUTFALL002 Arsenic, Total (ug/l as As)

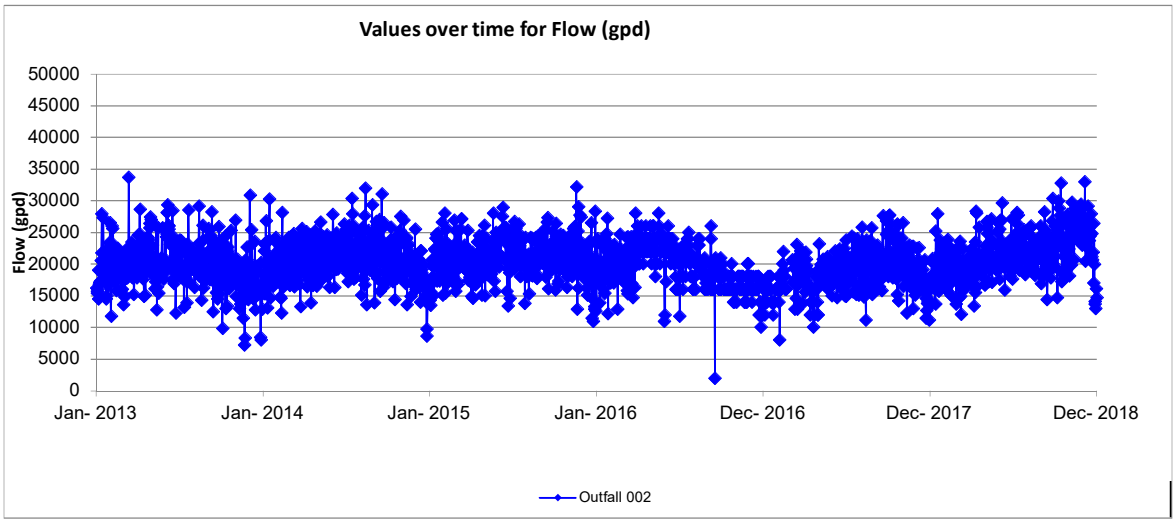

Values over time for BOD, 5 Day (mg/L)
BOD, 5 Day (mg/L)
100
10
1
0.1
Jan- 2013
Jan- 2014
Jan- 2015
Jan- 2016
Dec- 2016
Dec- 2017
Dec- 2018
Outfall 002
APDES Limit BIOCHEMICAL OXYGEN DEMAND

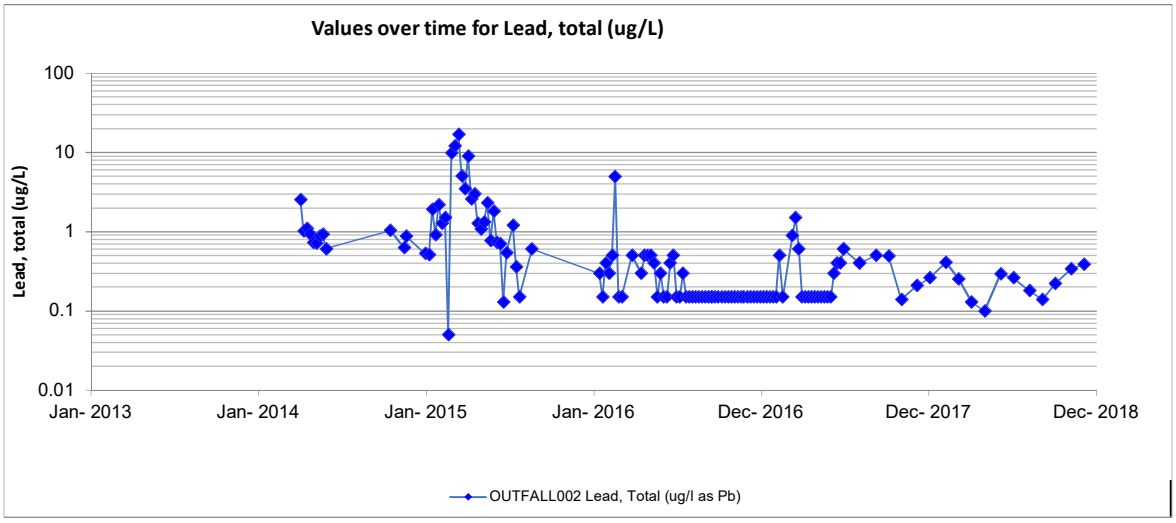

Values over time for Cadmium, total (ug/L)
Cadmium, total (ug/L)
10
1
0.1
0.01
Jan- 2013
Jan- 2014
Jan- 2015
Jan- 2016
Dec- 2016
Dec- 2017
Dec- 2018
OUTFALL002 Cadmium, Total (ug/l as Cd)

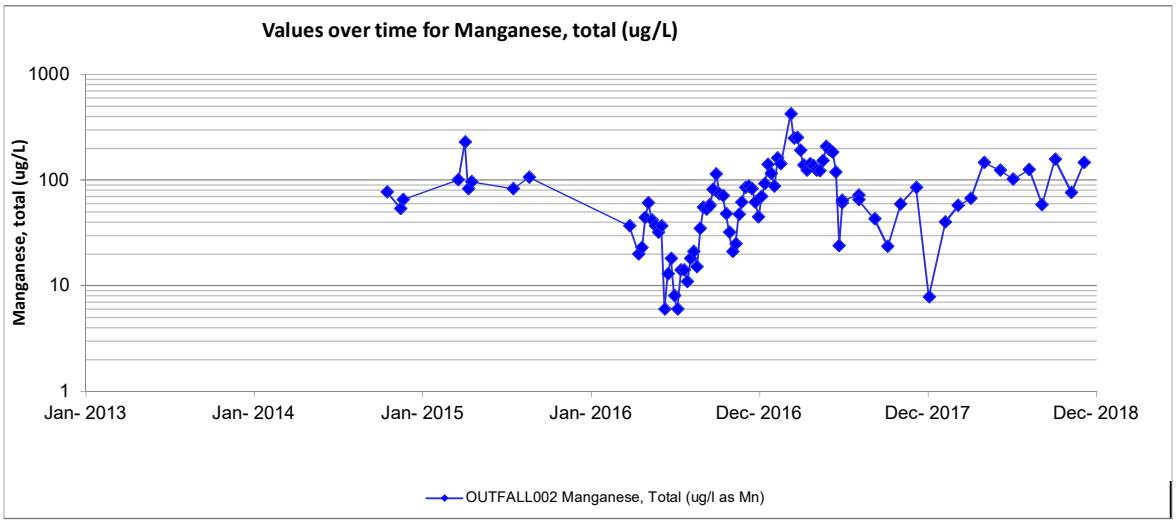

Values over time for Copper, total (ug/L)
Copper, total (ug/L)
1000
100
10
1
Jan- 2013
Jan- 2014
Jan- 2015
Jan- 2016
Dec- 2016
Dec- 2017
Dec- 2018
OUTFALL002 Copper, Total (ug/l as Cu)

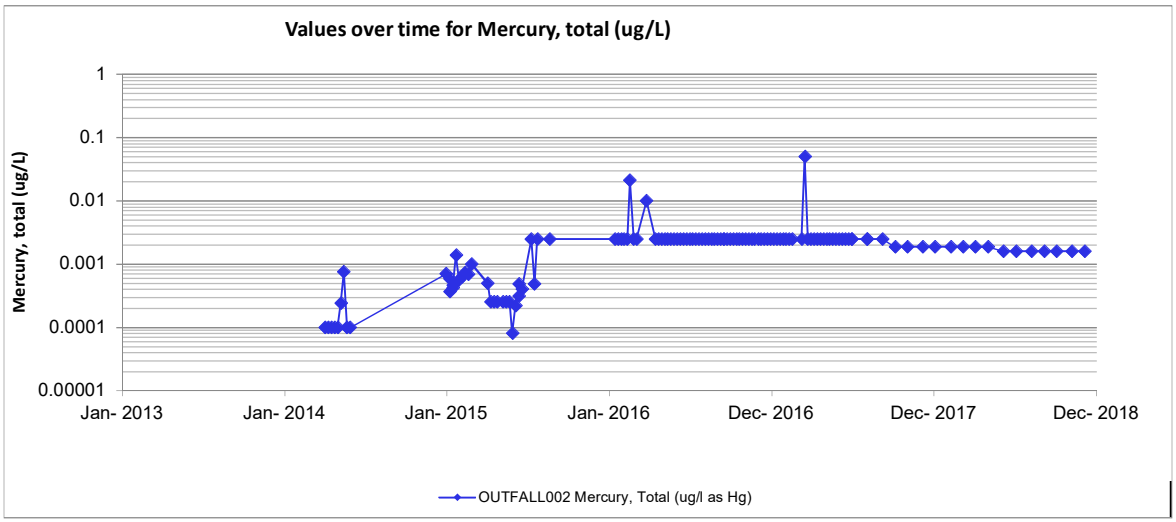

Values over time for Dissolved Oxygen (mg/L)
Dissolved Oxygen (mg/L)
16
14
12
10
8
6
4
2
0
Jan- 2013
Jan- 2014
Jan- 2015
Jan- 2016
Dec- 2016
Dec- 2017
Dec- 2018
Outfall 002
APDES Limit Oxygen, Dissolved mg/l

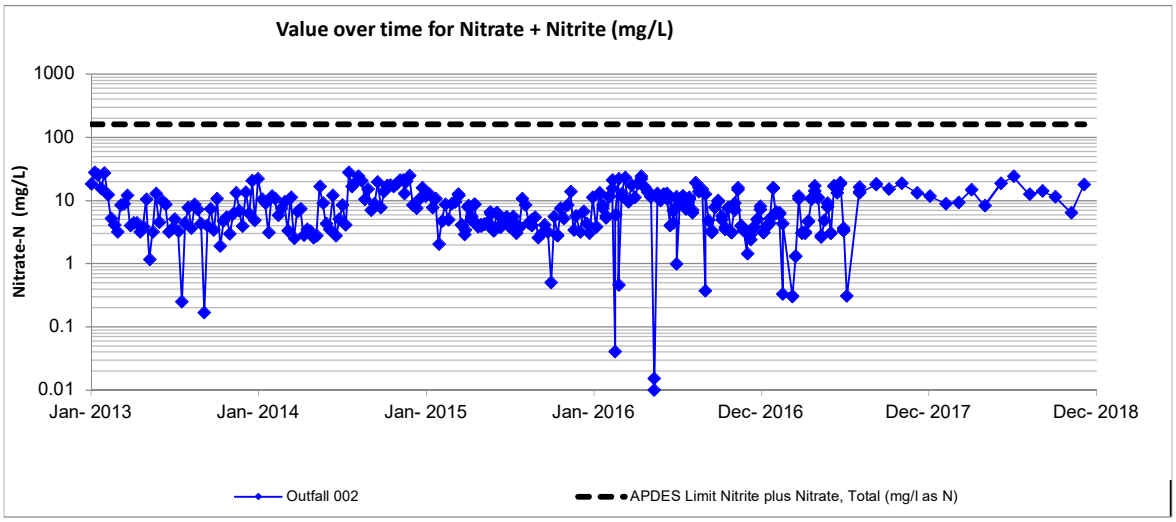

Values over time for Fecal Coliform (#/100mL)
Fecal Coliform (#/100mL)
1000
100
10
1
0.1
0.01
Jan- 2013
Jan- 2014
Jan- 2015
Jan- 2016
Dec- 2016
Dec- 2017
Dec- 2018
Outfall 002
APDES Limit FECAL COLIFORM

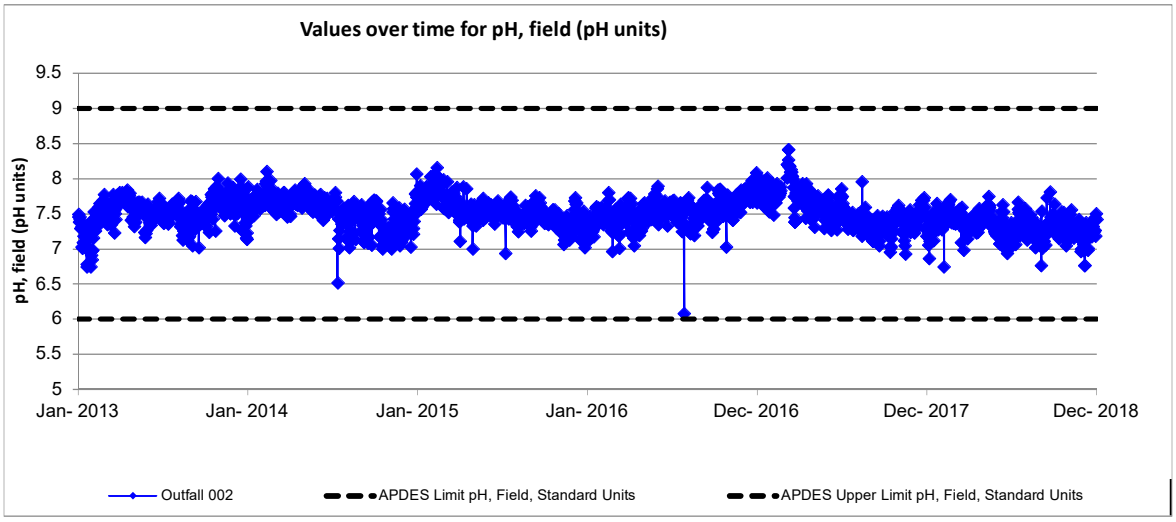

Values over time for Flow (gpd)
Flow (gpd)
50000
45000
40000
35000
30000
25000
20000
15000
10000
5000
0
Jan- 2013
Jan- 2014
Jan- 2015
Jan- 2016
Dec- 2016
Dec- 2017
Dec- 2018
Outfall 002

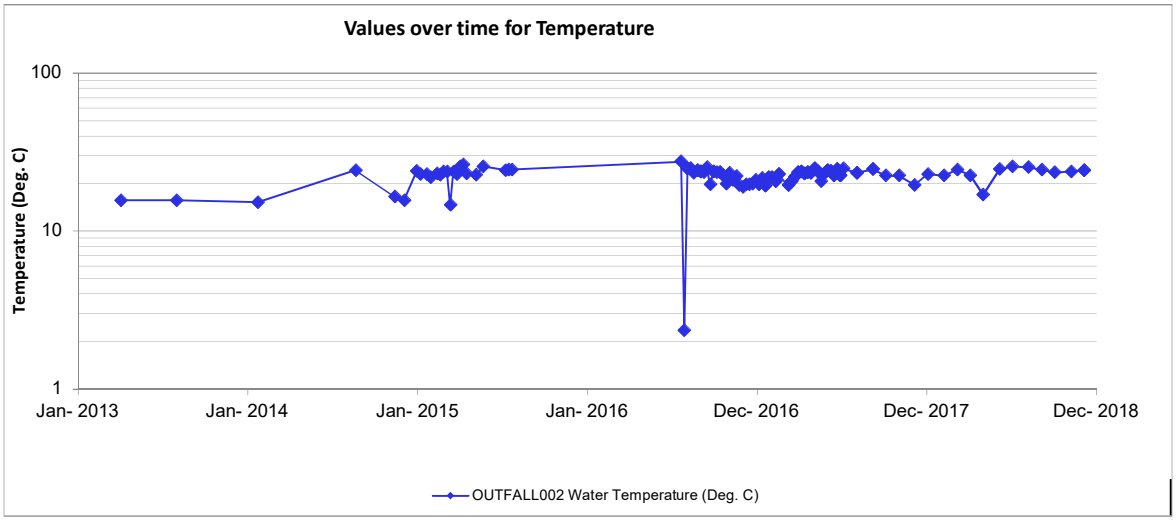

Values over time for Lead, total (ug/L)
Lead, total (ug/L)
100
10
1
0.1
0.01
Jan- 2013
Jan- 2014
Jan- 2015
Jan- 2016
Dec- 2016
Dec- 2017
Dec- 2018
OUTFALL002 Lead, Total (ug/l as Pb)

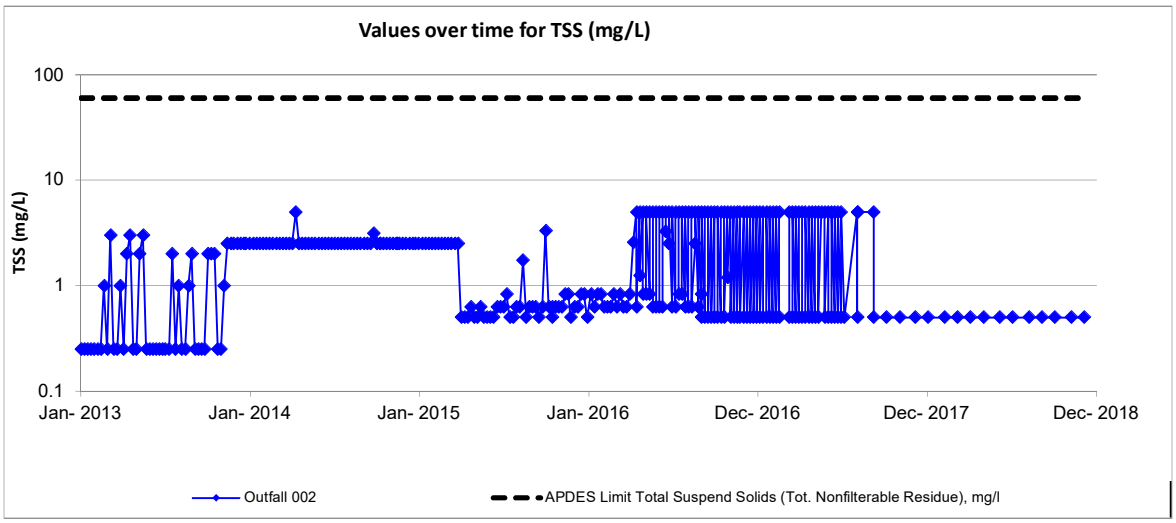

Values over time for Manganese, total (ug/L)
Manganese, total (ug/L)
1000
100
10
1
Jan- 2013
Jan- 2014
Jan- 2015
Jan- 2016
Dec- 2016
Dec- 2017
Dec- 2018
OUTFALL002 Manganese, Total (ug/l as Mn)

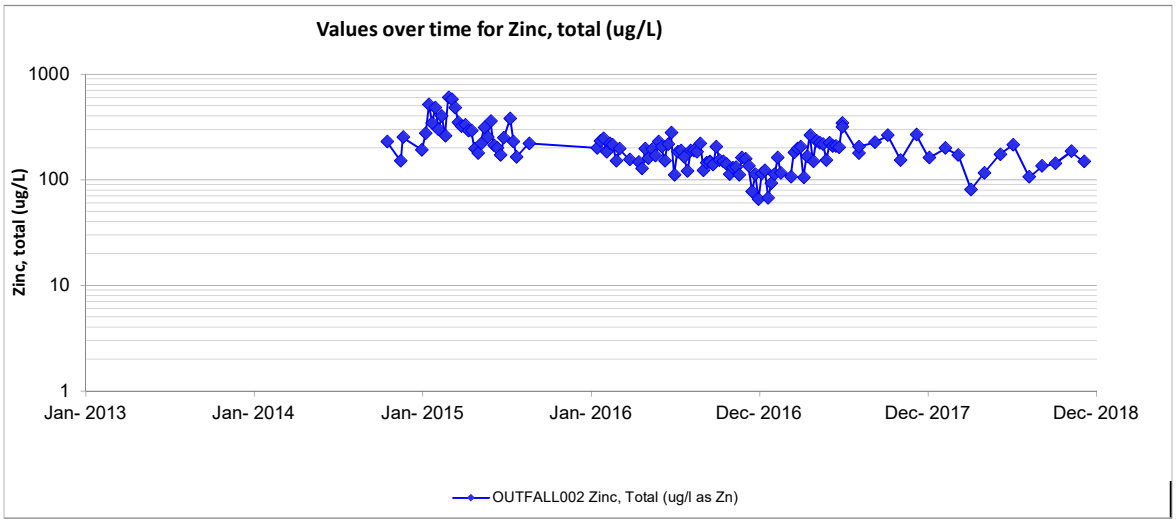

Values over time for Mercury, total (ug/L)
Mercury, total (ug/L)
1
0.1
0.01
0.001
0.0001
0.00001
Jan- 2013
Jan- 2014
Jan- 2015
Jan- 2016
Dec- 2016
Dec- 2017
Dec- 2018
OUTFALL002 Mercury, Total (ug/l as Hg)


Value over time for Nitrate + Nitrite (mg/L)
Nitrate-N (mg/L)
1000
100
10
1
0.1
0.01
Jan- 2013
Jan- 2014
Jan- 2015
Jan- 2016
Dec- 2016
Dec- 2017
Dec- 2018
Outfall 002
APDES Limit Nitrite plus Nitrate, Total (mg/l as N)


Values over time for pH, field (pH units)
pH, field (pH units)
9.5
9
8.5
8
7.5
7
6.5
6
5.5
5
Jan- 2013
Jan- 2014
Jan- 2015
Jan- 2016
Dec- 2016
Dec- 2017
Dec- 2018
Outfall 002
APDES Limit pH, Field, Standard Units
APDES Upper Limit pH, Field, Standard Units

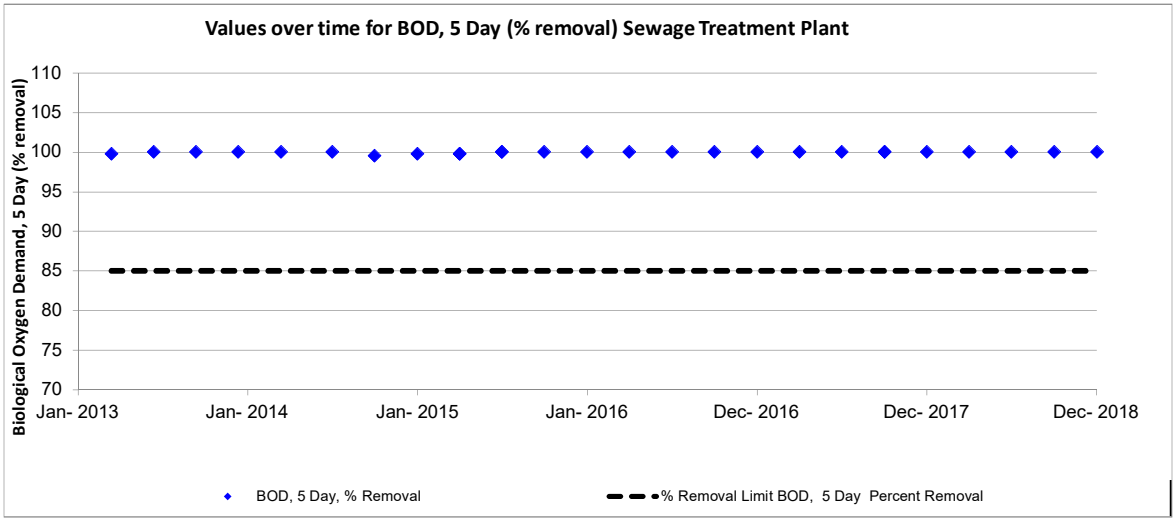

Values over time for Temperature
Temperature (Deg. C)
100
10
1
Jan- 2013
Jan- 2014
Jan- 2015
Jan- 2016
Dec- 2016
Dec- 2017
Dec- 2018
OUTFALL002 Water Temperature (Deg. C)

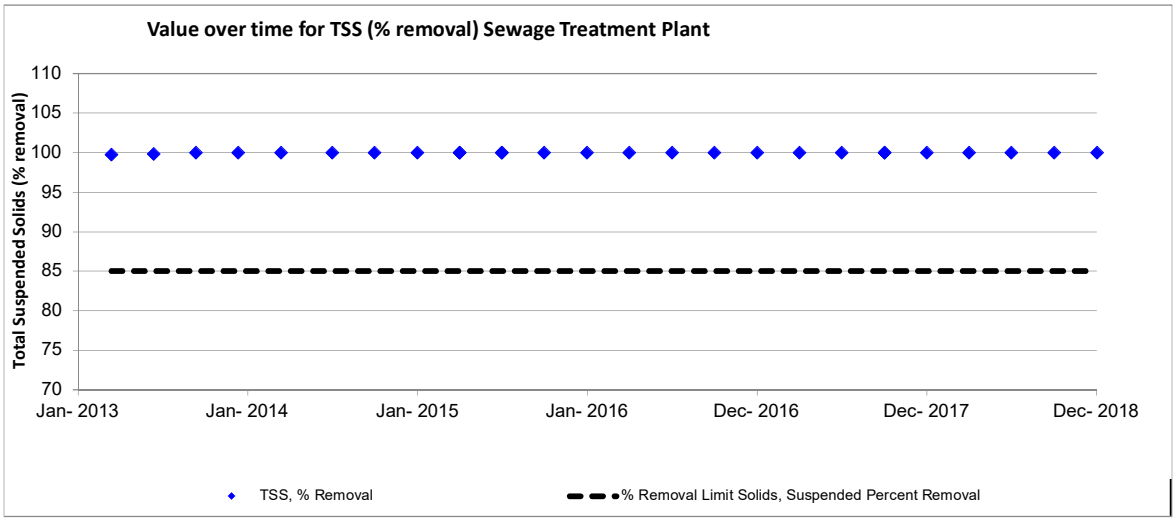

Values over time for TSS (mg/L)
TSS (mg/L)
100
10
1
0.1
Jan- 2013
Jan- 2014
Jan- 2015
Jan- 2016
Dec- 2016
Dec- 2017
Dec- 2018
Outfall 002
APDES Limit Total Suspend Solids (Tot. Nonfilterable Residue), mg/l


Values over time for Zinc, total (ug/L)
Zinc, total (ug/L)
1000
100
10
1
Jan- 2013
Jan- 2014
Jan- 2015
Jan- 2016
Dec- 2016
Dec- 2017
Dec- 2018
OUTFALL002 Zinc, Total (ug/l as Zn)

APPENDIX C –

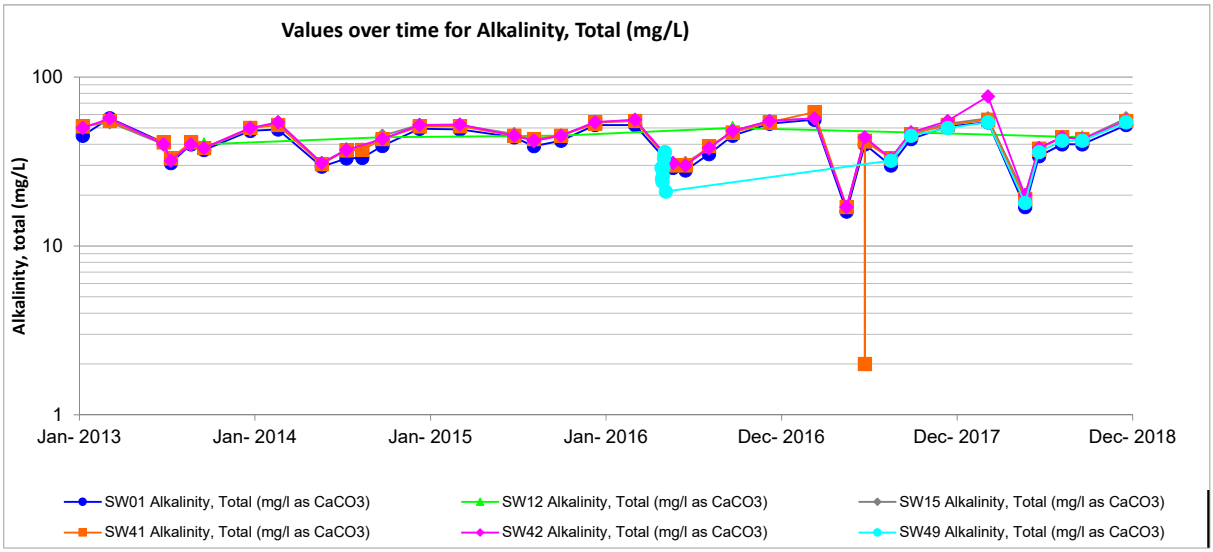
STP Graphs

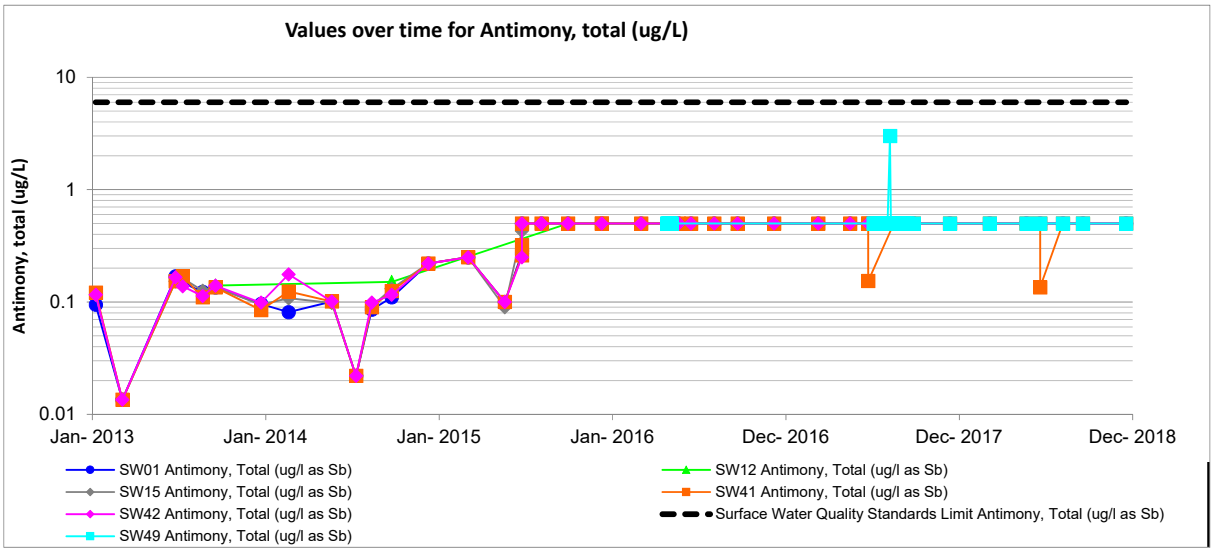

Values over time for BOD, 5 Day (% removal) Sewage Treatment Plant
Biological Oxygen Demand, 5 Day (% removal)
110
105
100
95
90
85
80
75
70
Jan- 2013
Jan- 2014
Jan- 2015
Jan- 2016
Dec- 2016
Dec- 2017
Dec- 2018
BOD, 5 Day, % Removal
% Removal Limit BOD, 5 Day Percent Removal

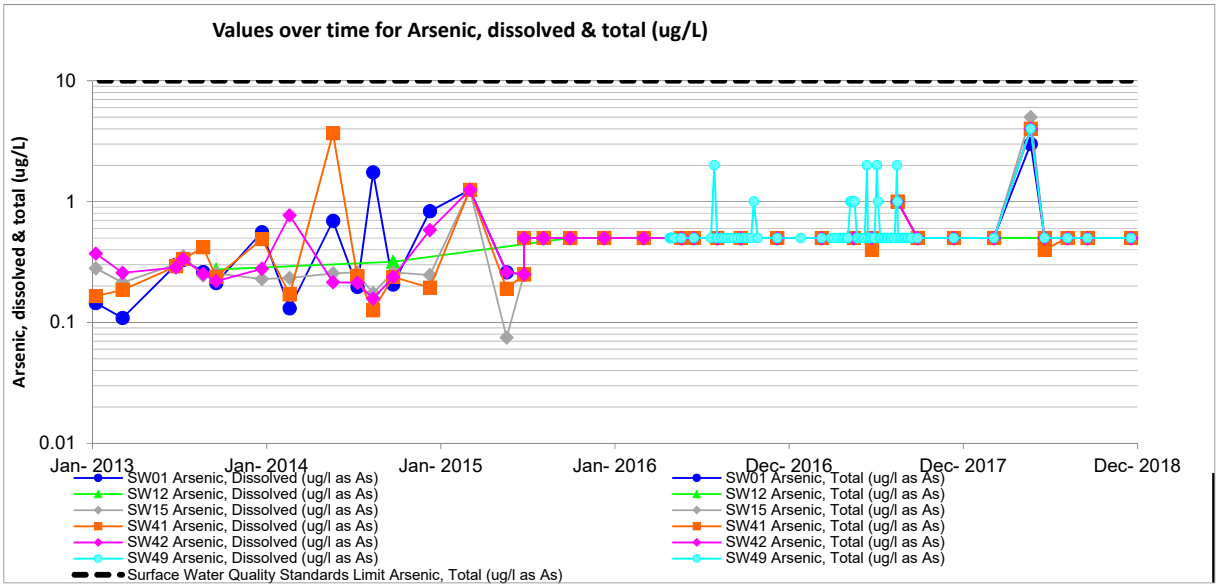

Value over time for TSS (% removal) Sewage Treatment Plant
Total Suspended Solids (% removal)
110
105
100
95
90
85
80
75
70
Jan- 2013
Jan- 2014
Jan- 2015
Jan- 2016
Dec- 2016
Dec- 2017
Dec- 2018
TSS, % Removal
% Removal Limit Solids, Suspended Percent Removal

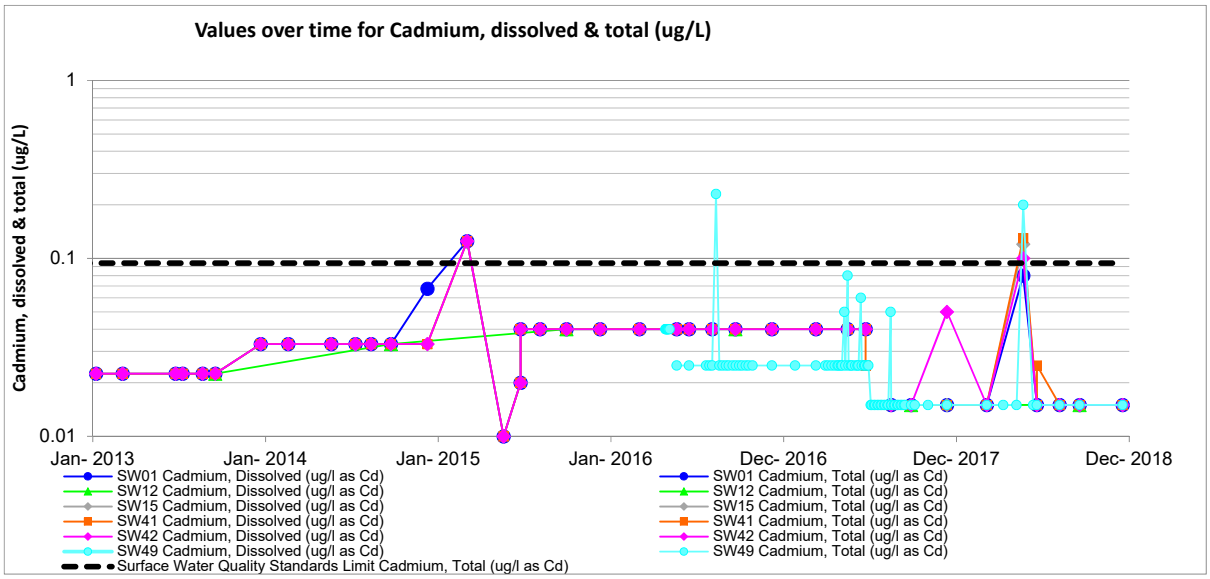
APPENDIX C –

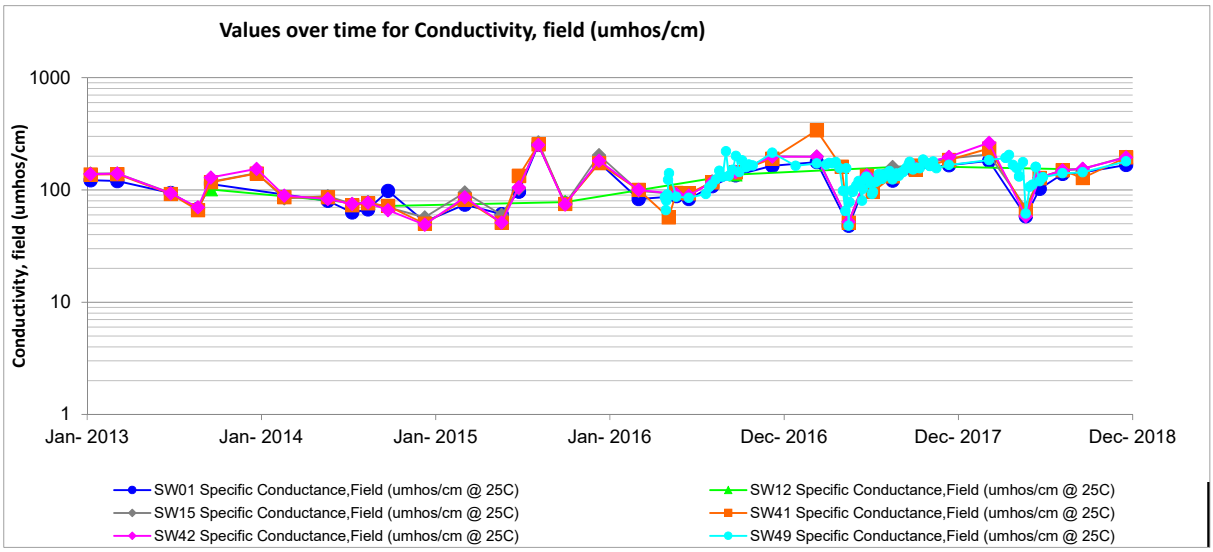
Surface Water Graphs

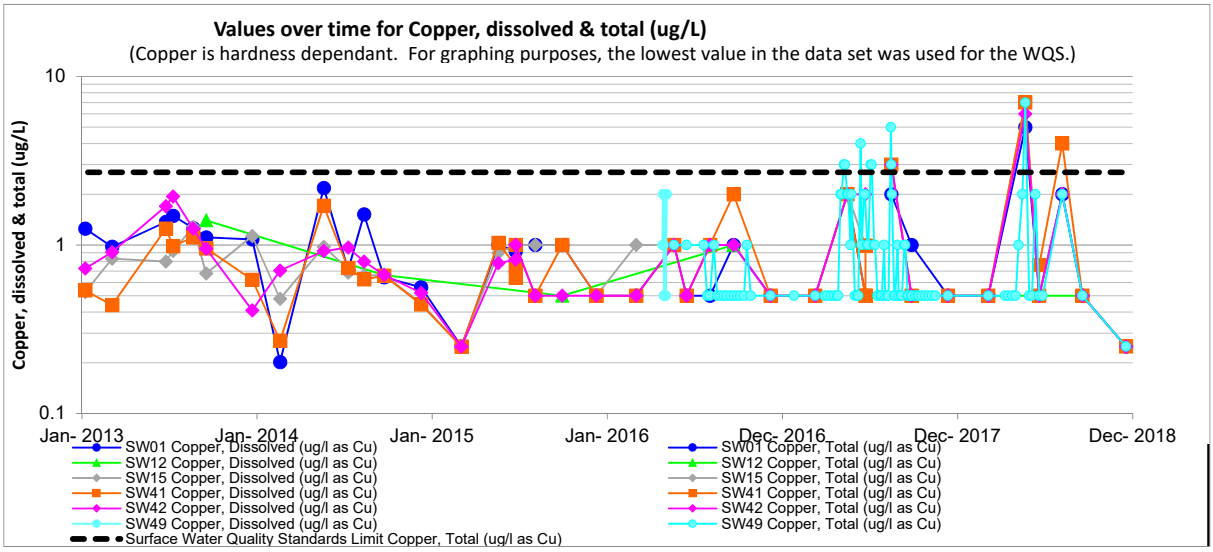

Values over time for Alkalinity, Total (mg/L)
Alkalinity, total (mg/L)
100
10
1
Jan- 2013
Jan- 2014
Jan- 2015
Jan- 2016
Dec- 2016
Dec- 2017
Dec- 2018
SW01 Alkalinity, Total (mg/l as CaCO3)
SW12 Alkalinity, Total (mg/l as CaCO3)
SW15 Alkalinity, Total (mg/l as CaCO3)
SW41 Alkalinity, Total (mg/l as CaCO3)
SW42 Alkalinity, Total (mg/l as CaCO3)
SW49 Alkalinity, Total (mg/l as CaCO3)

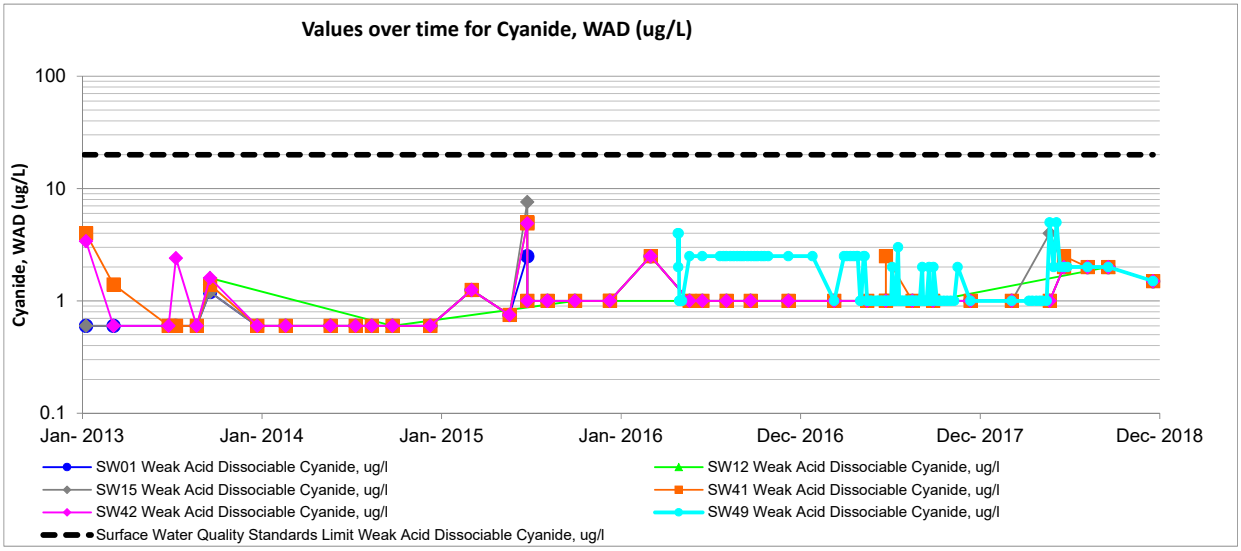

Values over time for Antimony, total (ug/L)
Antimony, total (ug/L)
10
1
0.1
0.01
Jan- 2013
Jan- 2014
Jan- 2015
Jan- 2016
Dec- 2016
Dec- 2017
Dec- 2018
SW01 Antimony, Total (ug/l as Sb)
SW12 Antimony, Total (ug/l as Sb)
SW15 Antimony, Total (ug/l as Sb)
SW41 Antimony, Total (ug/l as Sb)
SW42 Antimony, Total (ug/l as Sb)
Surface Water Quality Standards Limit Antimony, Total (ug/l as Sb)
SW49 Antimony, Total (ug/l as Sb)

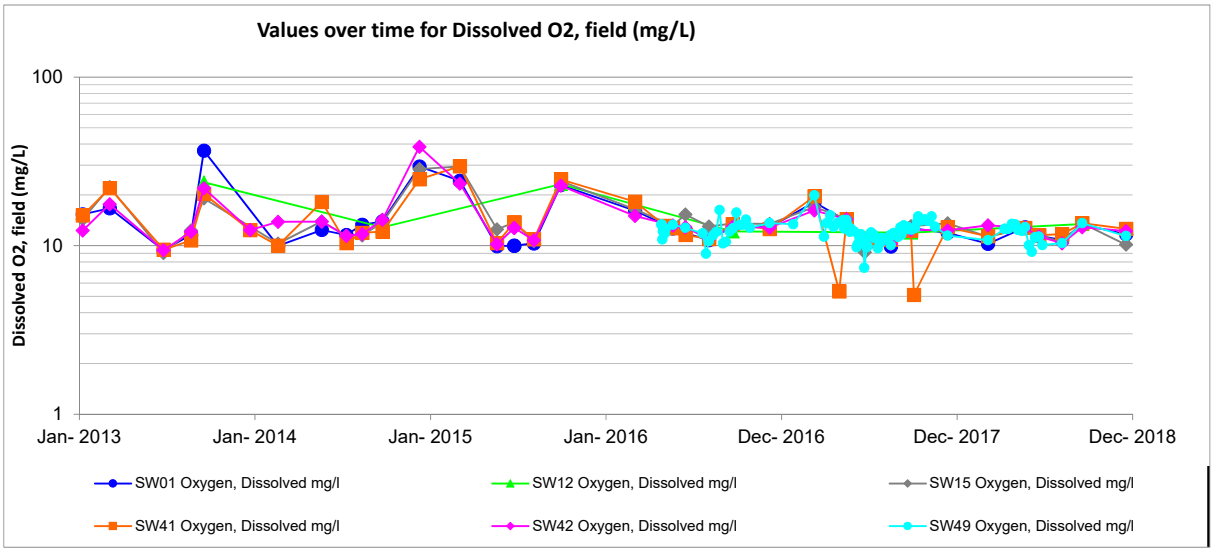

Values over time for Arsenic, dissolved & total (ug/L)
Arsenic, dissolved & total (ug/L)
10
1
0.1
0.01
Jan- 2013
Jan- 2014
Jan- 2015
Jan- 2016
Dec- 2016
Dec- 2017
Dec- 2018
SW01 Arsenic, Dissolved (ug/l as As)
SW01 Arsenic, Total (ug/l as As)
SW12 Arsenic, Dissolved (ug/l as As)
SW12 Arsenic, Total (ug/l as As)
SW15 Arsenic, Dissolved (ug/l as As)
SW15 Arsenic, Total (ug/l as As)
SW41 Arsenic, Dissolved (ug/l as As)
SW41 Arsenic, Total (ug/l as As)
SW42 Arsenic, Dissolved (ug/l as As)
SW42 Arsenic, Total (ug/l as As)
SW49 Arsenic, Dissolved (ug/l as As)
SW49 Arsenic, Total (ug/l as As)
Surface Water Quality Standards Limit Arsenic, Total (ug/l as As)

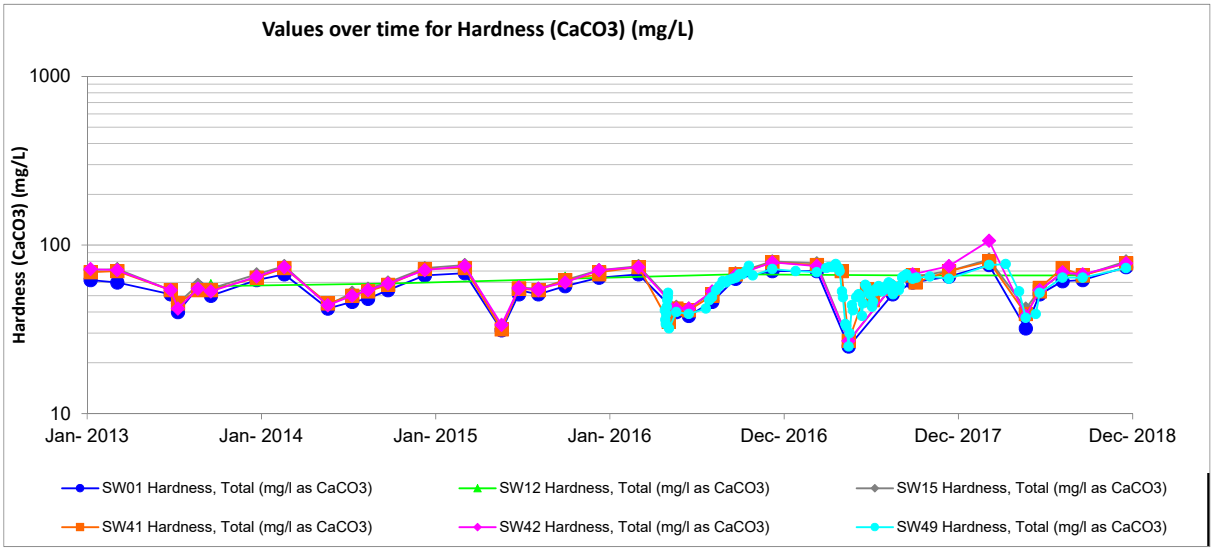

Values over time for Cadmium, dissolved & total (ug/L)
Cadmium, dissolved & total (ug/L)
1
0.1
0.01
Jan- 2013
Jan- 2014
Jan- 2015
Jan- 2016
Dec- 2016
Dec- 2017
Dec- 2018
SW01 Cadmium, Dissolved (ug/l as Cd)
SW12 Cadmium, Dissolved (ug/l as Cd)
SW15 Cadmium, Dissolved (ug/l as Cd)
SW41 Cadmium, Dissolved (ug/l as Cd)
SW42 Cadmium, Dissolved (ug/l as Cd)
SW49 Cadmium, Dissolved (ug/l as Cd)
SW01 Cadmium, Total (ug/l as Cd)
SW12 Cadmium, Total (ug/l as Cd)
SW15 Cadmium, Total (ug/l as Cd)
SW41 Cadmium, Total (ug/l as Cd)
SW42 Cadmium, Total (ug/l as Cd)
SW49 Cadmium, Total (ug/l as Cd)
Surface Water Quality Standards Limit Cadmium, Total (ug/l as Cd)

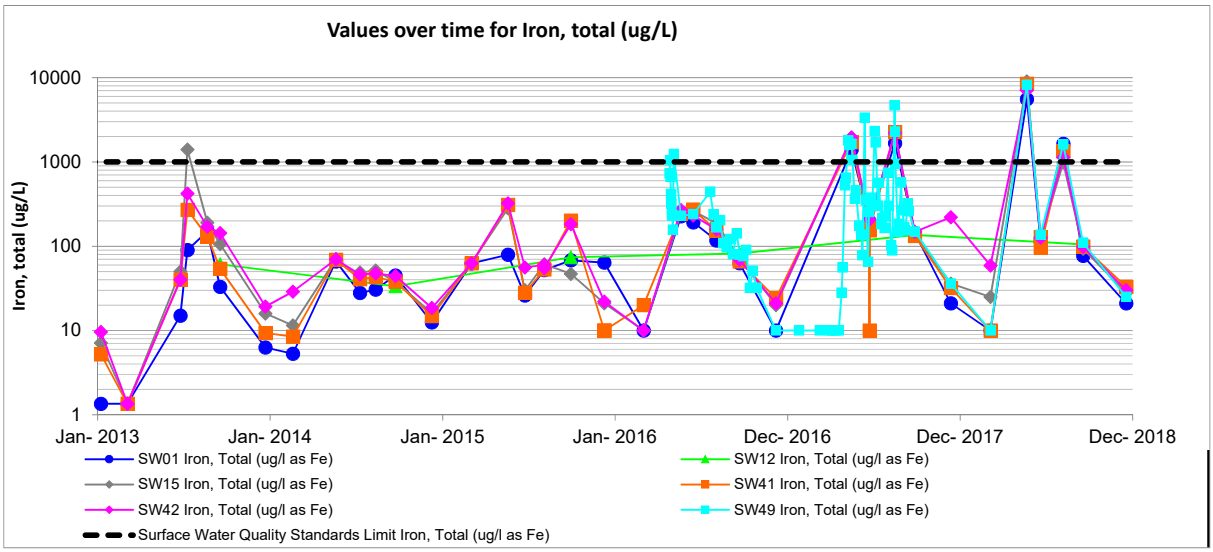

Values over time for Conductivity, field (umhos/cm)
Conductivity, field (umhos/cm)
1000
100
10
1
Jan- 2013
Jan- 2014
Jan- 2015
Jan- 2016
Dec- 2016
Dec- 2017
Dec- 2018
SW01 Specific Conductance,Field (umhos/cm @ 25C)
SW12 Specific Conductance,Field (umhos/cm @ 25C)
SW15 Specific Conductance,Field (umhos/cm @ 25C)
SW41 Specific Conductance,Field (umhos/cm @ 25C)
SW42 Specific Conductance,Field (umhos/cm @ 25C)
SW49 Specific Conductance,Field (umhos/cm @ 25C)

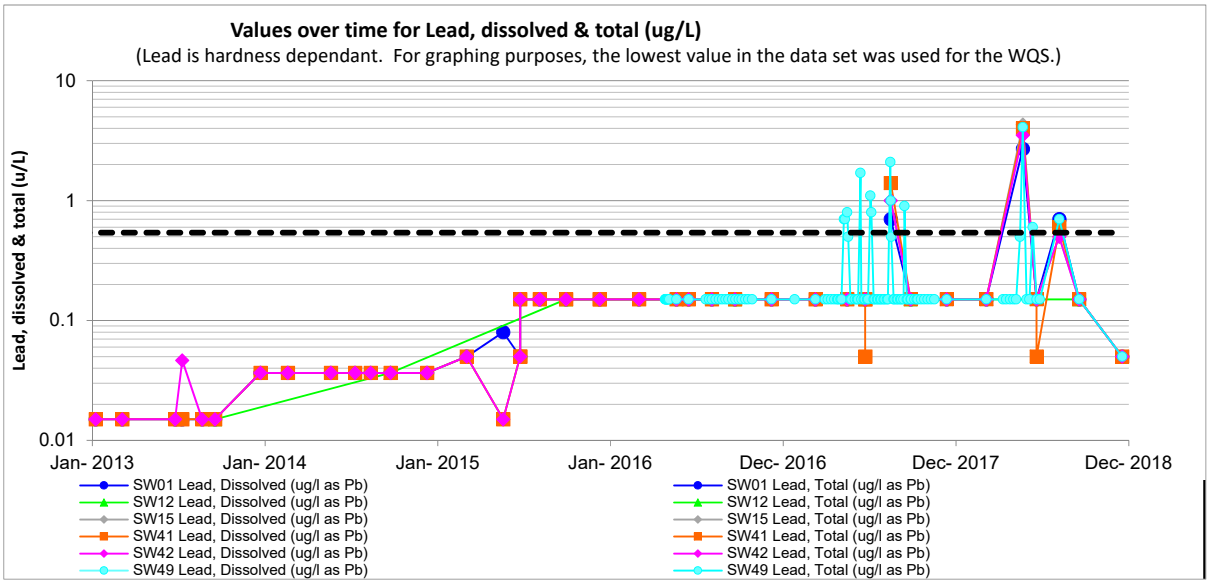

Values over time for Copper, dissolved & total (ug/L)
(Copper is hardness dependant. For graphing purposes, the lowest value in the data set was used for the WQS.)
Copper, dissolved & total (ug/L)
10
1
0.1
Jan- 2013
Jan- 2014
Jan- 2015
Jan- 2016
Dec- 2016
Dec- 2017
Dec- 2018
SW01 Copper, Dissolved (ug/l as Cu)
SW12 Copper, Dissolved (ug/l as Cu)
SW15 Copper, Dissolved (ug/l as Cu)
SW41 Copper, Dissolved (ug/l as Cu)
SW42 Copper, Dissolved (ug/l as Cu)
SW49 Copper, Dissolved (ug/l as Cu)
SW01 Copper, Total (ug/l as Cu)
SW12 Copper, Total (ug/l as Cu)
SW15 Copper, Total (ug/l as Cu)
SW41 Copper, Total (ug/l as Cu)
SW42 Copper, Total (ug/l as Cu)
SW49 Copper, Total (ug/l as Cu)
Surface Water Quality Standards Limit Copper, Total (ug/l as Cu)

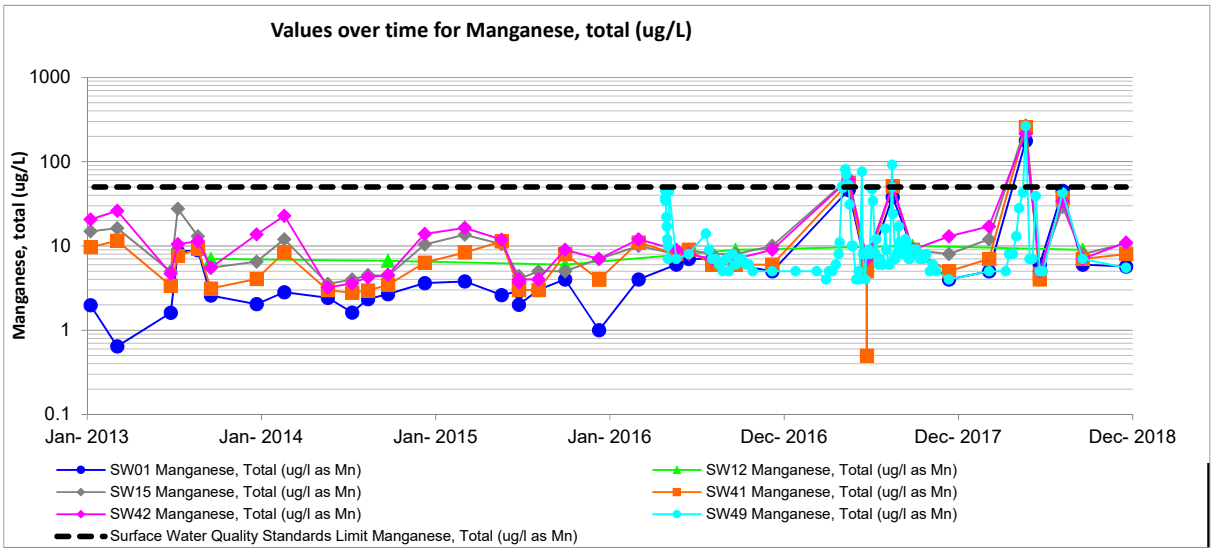

Values over time for Cyanide, WAD (ug/L)
Cyanide, WAD (ug/L)
100
10
1
0.1
Jan- 2013
Jan- 2014
Jan- 2015
Jan- 2016
Dec- 2016
Dec- 2017
Dec- 2018
SW01 Weak Acid Dissociable Cyanide, ug/l
SW12 Weak Acid Dissociable Cyanide, ug/l
SW15 Weak Acid Dissociable Cyanide, ug/l
SW41 Weak Acid Dissociable Cyanide, ug/l
SW42 Weak Acid Dissociable Cyanide, ug/l
SW49 Weak Acid Dissociable Cyanide, ug/l
Surface Water Quality Standards Limit Weak Acid Dissociable Cyanide, ug/l

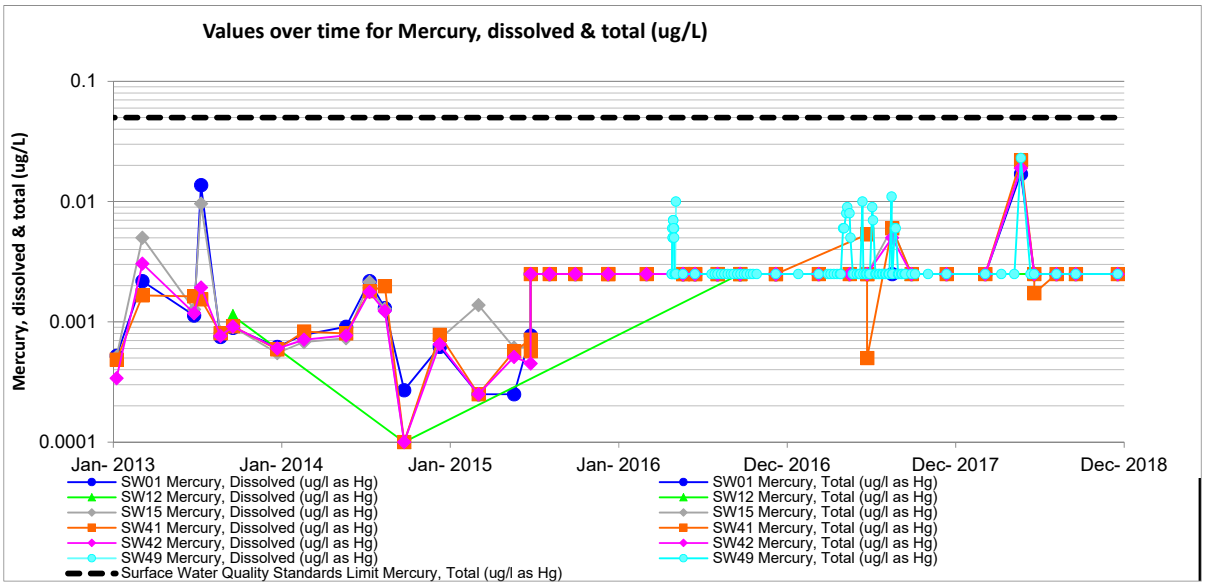

Values over time for Dissolved O2, field (mg/L)
Dissolved O2, field (mg/L)
100
10
1
Jan- 2013
Jan- 2014
Jan- 2015
Jan- 2016
Dec- 2016
Dec- 2017
Dec- 2018
SW01 Oxygen, Dissolved mg/l
SW12 Oxygen, Dissolved mg/l
SW15 Oxygen, Dissolved mg/l
SW41 Oxygen, Dissolved mg/l
SW42 Oxygen, Dissolved mg/l
SW49 Oxygen, Dissolved mg/l

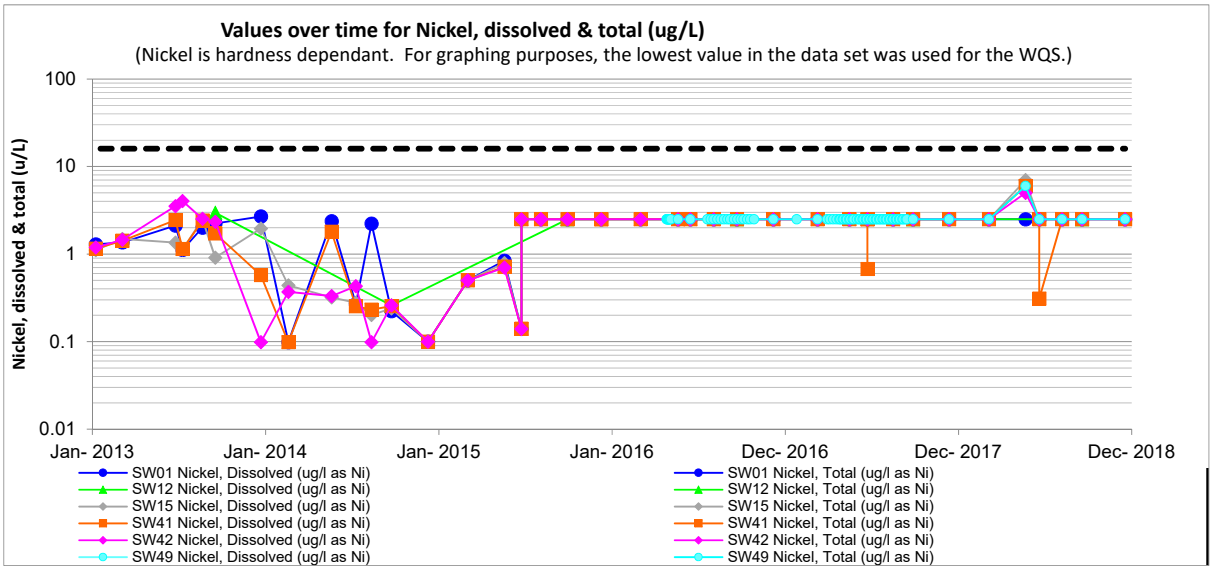

Values over time for Hardness (CaCO3) (mg/L)
Hardness (CaCO3) (mg/L)
1000
100
10
Jan- 2013
Jan- 2014
Jan- 2015
Jan- 2016
Dec- 2016
Dec- 2017
Dec- 2018
SW01 Hardness, Total (mg/l as CaCO3)
SW12 Hardness, Total (mg/l as CaCO3)
SW15 Hardness, Total (mg/l as CaCO3)
SW41 Hardness, Total (mg/l as CaCO3)
SW42 Hardness, Total (mg/l as CaCO3)
SW49 Hardness, Total (mg/l as CaCO3)

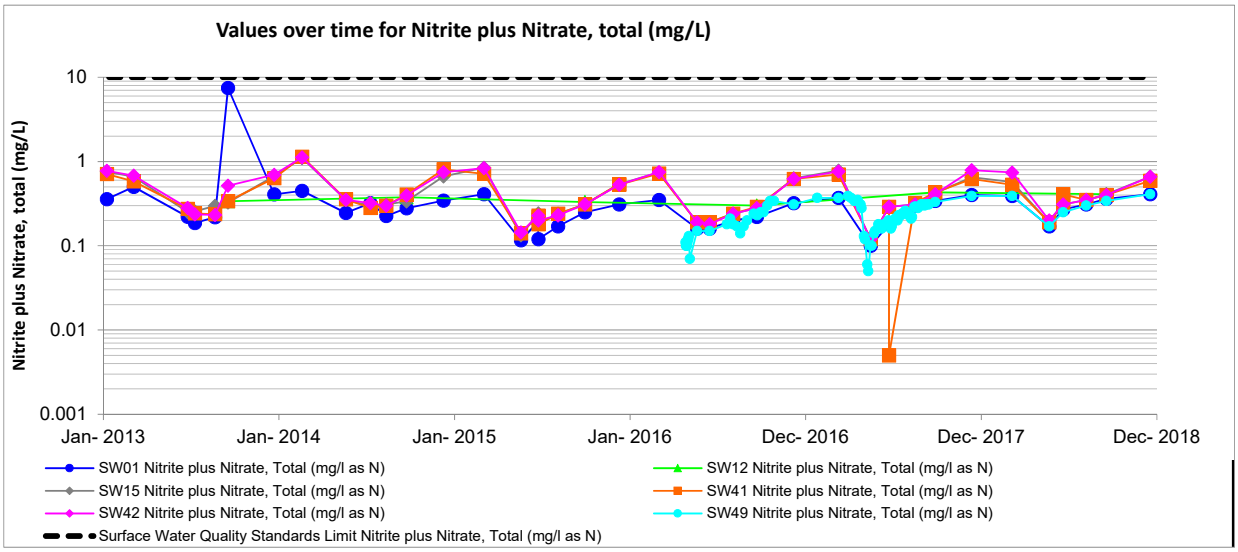

Values over time for Iron, total (ug/L)
Iron, total (ug/L)
10000
1000
100
10
1
Jan- 2013
Jan- 2014
Jan- 2015
Jan- 2016
Dec- 2016
Dec- 2017
Dec- 2018
SW01 Iron, Total (ug/l as Fe)
SW12 Iron, Total (ug/l as Fe)
SW15 Iron, Total (ug/l as Fe)
SW41 Iron, Total (ug/l as Fe)
SW42 Iron, Total (ug/l as Fe)
SW49 Iron, Total (ug/l as Fe)
Surface Water Quality Standards Limit Iron, Total (ug/l as Fe)

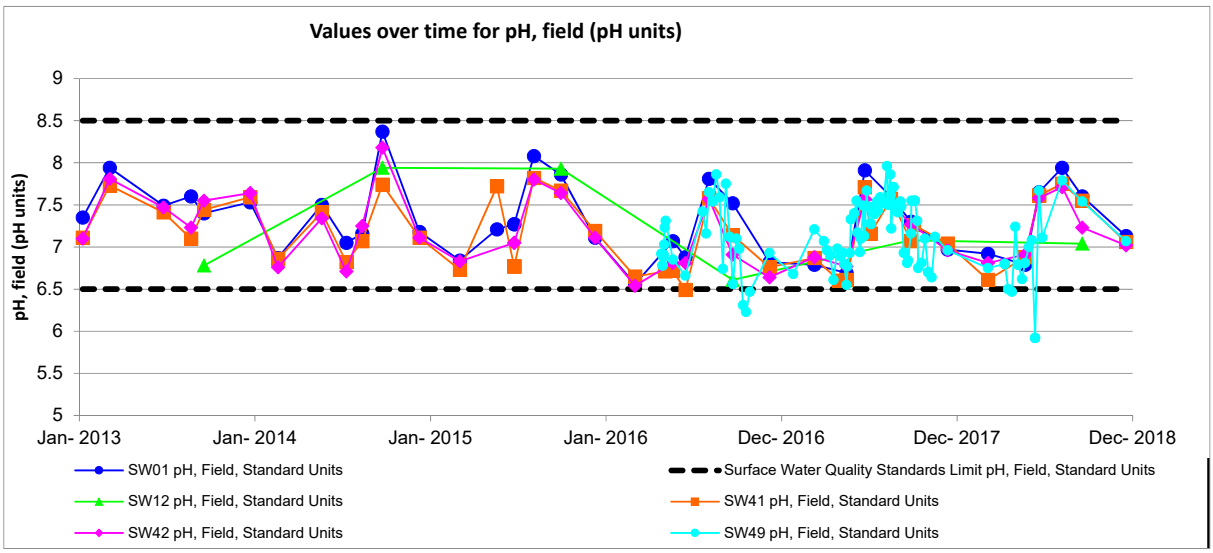

Values over time for Lead, dissolved & total (ug/L)
(Lead is hardness dependant. For graphing purposes, the lowest value in the data set was used for the WQS.)
Lead, dissolved & total (u/L)
10
1
0.1
0.01
Jan- 2013
Jan- 2014
Jan- 2015
Jan- 2016
Dec- 2016
Dec- 2017
Dec- 2018
SW01 Lead, Dissolved (ug/l as Pb)
SW01 Lead, Total (ug/l as Pb)
SW12 Lead, Dissolved (ug/l as Pb)
SW12 Lead, Total (ug/l as Pb)
SW15 Lead, Dissolved (ug/l as Pb)
SW15 Lead, Total (ug/l as Pb)
SW41 Lead, Dissolved (ug/l as Pb)
SW41 Lead, Total (ug/l as Pb)
SW42 Lead, Dissolved (ug/l as Pb)
SW42 Lead, Total (ug/l as Pb)
SW49 Lead, Dissolved (ug/l as Pb)
SW49 Lead, Total (ug/l as Pb)

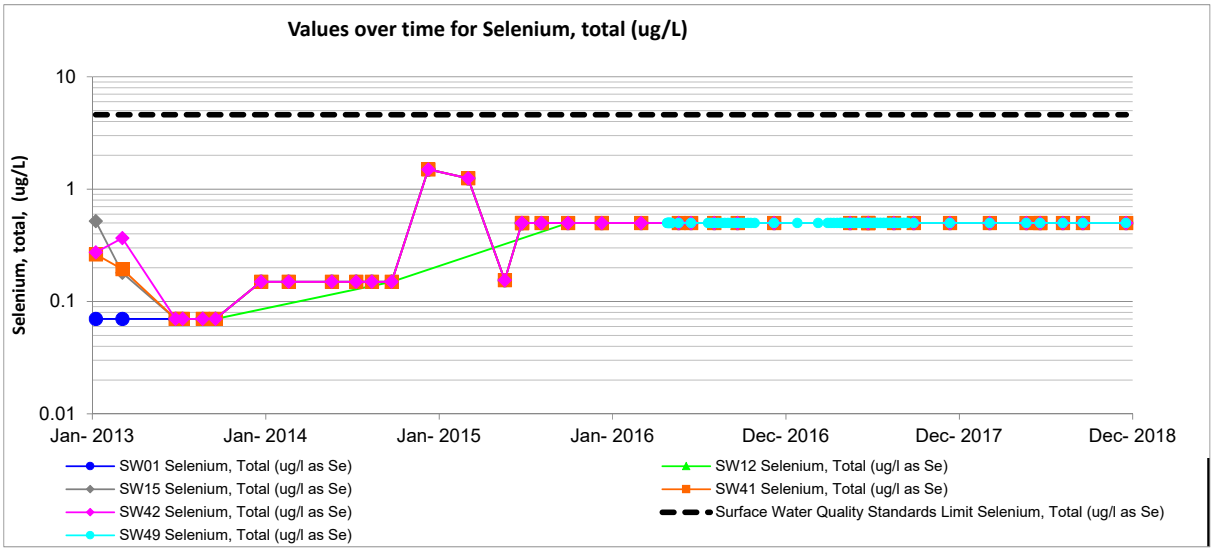

Values over time for Manganese, total (ug/L)
Manganese, total (ug/L)
1000
100
10
1
0.1
Jan- 2013
Jan- 2014
Jan- 2015
Jan- 2016
Dec- 2016
Dec- 2017
Dec- 2018
SW01 Manganese, Total (ug/l as Mn)
SW12 Manganese, Total (ug/l as Mn)
SW15 Manganese, Total (ug/l as Mn)
SW41 Manganese, Total (ug/l as Mn)
SW42 Manganese, Total (ug/l as Mn)
SW49 Manganese, Total (ug/l as Mn)
Surface Water Quality Standards Limit Manganese, Total (ug/l as Mn)

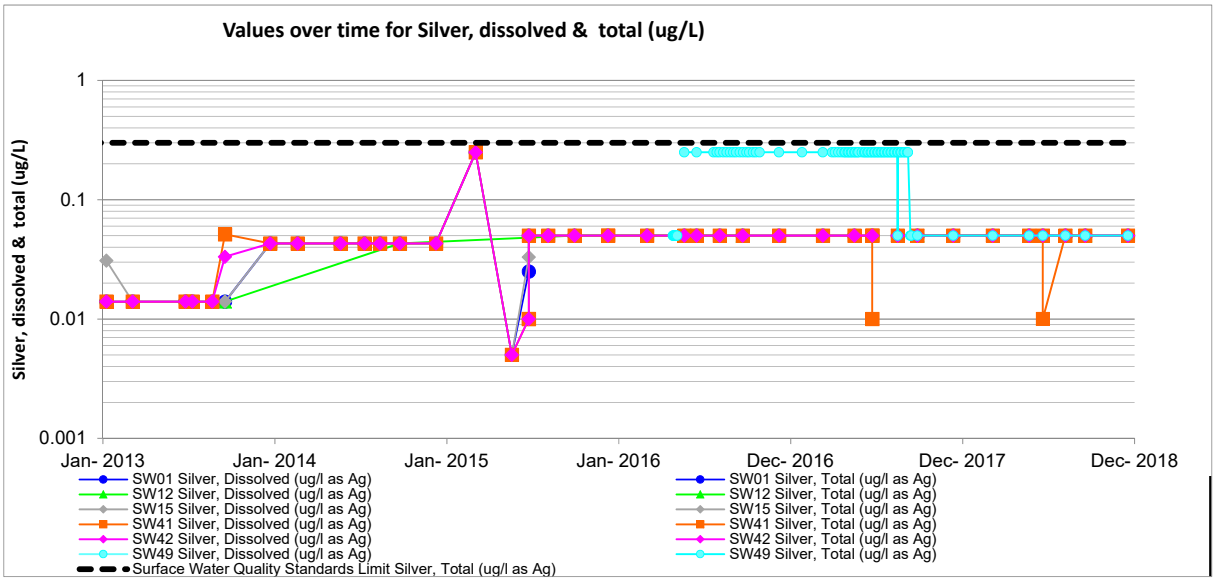

Values over time for Mercury, dissolved & total (ug/L)
Mercury, dissolved & total (ug/L)
0.1
0.01
0.001
0.0001
Jan- 2013
Jan- 2014
Jan- 2015
Jan- 2016
Dec- 2016
Dec- 2017
Dec- 2018
SW01 Mercury, Dissolved (ug/l as Hg)
SW12 Mercury, Dissolved (ug/l as Hg)
SW15 Mercury, Dissolved (ug/l as Hg)
SW41 Mercury, Dissolved (ug/l as Hg)
SW42 Mercury, Dissolved (ug/l as Hg)
SW49 Mercury, Dissolved (ug/l as Hg)
SW01 Mercury, Total (ug/l as Hg)
SW12 Mercury, Total (ug/l as Hg)
SW15 Mercury, Total (ug/l as Hg)
SW41 Mercury, Total (ug/l as Hg)
SW42 Mercury, Total (ug/l as Hg)
SW49 Mercury, Total (ug/l as Hg)
Surface Water Quality Standards Limit Mercury, Total (ug/l as Hg)

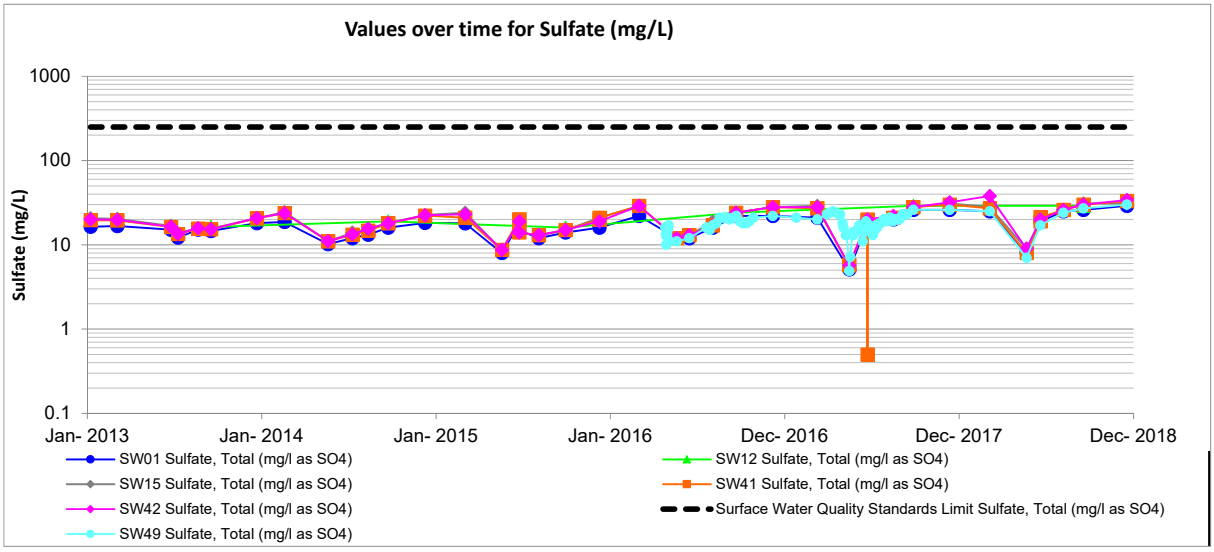

Values over time for Nickel, dissolved & total (ug/L)
(Nickel is hardness dependant. For graphing purposes, the lowest value in the data set was used for the WQS.)
Nickel, dissolved & total (u/L)
100
10
1
0.1
0.01
Jan- 2013
Jan- 2014
Jan- 2015
Jan- 2016
Dec- 2016
Dec- 2017
Dec- 2018
SW01 Nickel, Dissolved (ug/l as Ni)
SW12 Nickel, Dissolved (ug/l as Ni)
SW15 Nickel, Dissolved (ug/l as Ni)
SW41 Nickel, Dissolved (ug/l as Ni)
SW42 Nickel, Dissolved (ug/l as Ni)
SW49 Nickel, Dissolved (ug/l as Ni)
SW01 Nickel, Total (ug/l as Ni)
SW12 Nickel, Total (ug/l as Ni)
SW15 Nickel, Total (ug/l as Ni)
SW41 Nickel, Total (ug/l as Ni)
SW42 Nickel, Total (ug/l as Ni)
SW49 Nickel, Total (ug/l as Ni)

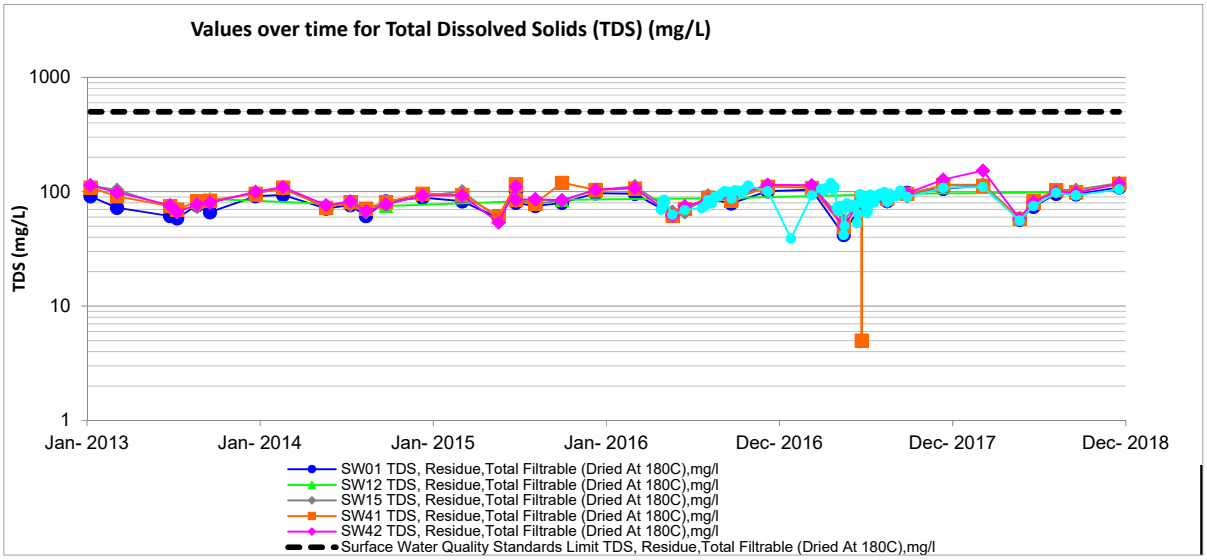

Values over time for Nitrite plus Nitrate, total (mg/L)
Nitrite plus Nitrate, total (mg/L)
10
1
0.1
0.01
0.001
Jan- 2013
Jan- 2014
Jan- 2015
Jan- 2016
Dec- 2016
Dec- 2017
Dec- 2018
SW01 Nitrite plus Nitrate, Total (mg/l as N)
SW12 Nitrite plus Nitrate, Total (mg/l as N)
SW15 Nitrite plus Nitrate, Total (mg/l as N)
SW41 Nitrite plus Nitrate, Total (mg/l as N)
SW42 Nitrite plus Nitrate, Total (mg/l as N)
SW49 Nitrite plus Nitrate, Total (mg/l as N)
Surface Water Quality Standards Limit Nitrite plus Nitrate, Total (mg/l as N)

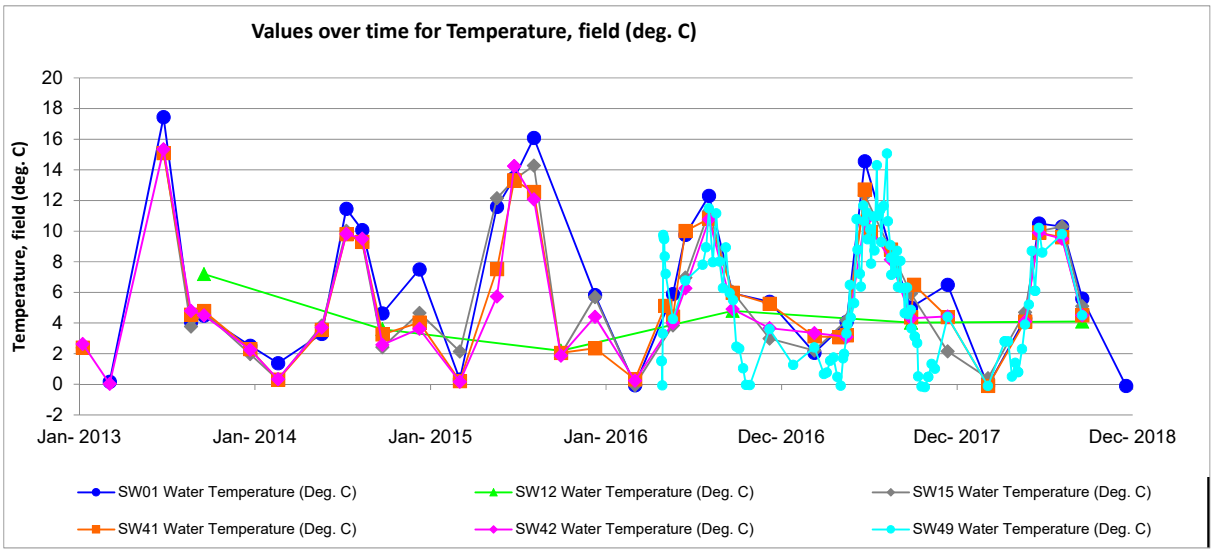

Values over time for pH, field (pH units)
pH, field (pH units)
9
8.5
8
7.5
7
6.5
6
5.5
5
Jan- 2013
Jan- 2014
Jan- 2015
Jan- 2016
Dec- 2016
Dec- 2017
Dec- 2018
SW01 pH, Field, Standard Units
Surface Water Quality Standards Limit pH, Field, Standard Units
SW12 pH, Field, Standard Units
SW41 pH, Field, Standard Units
SW42 pH, Field, Standard Units
SW49 pH, Field, Standard Units

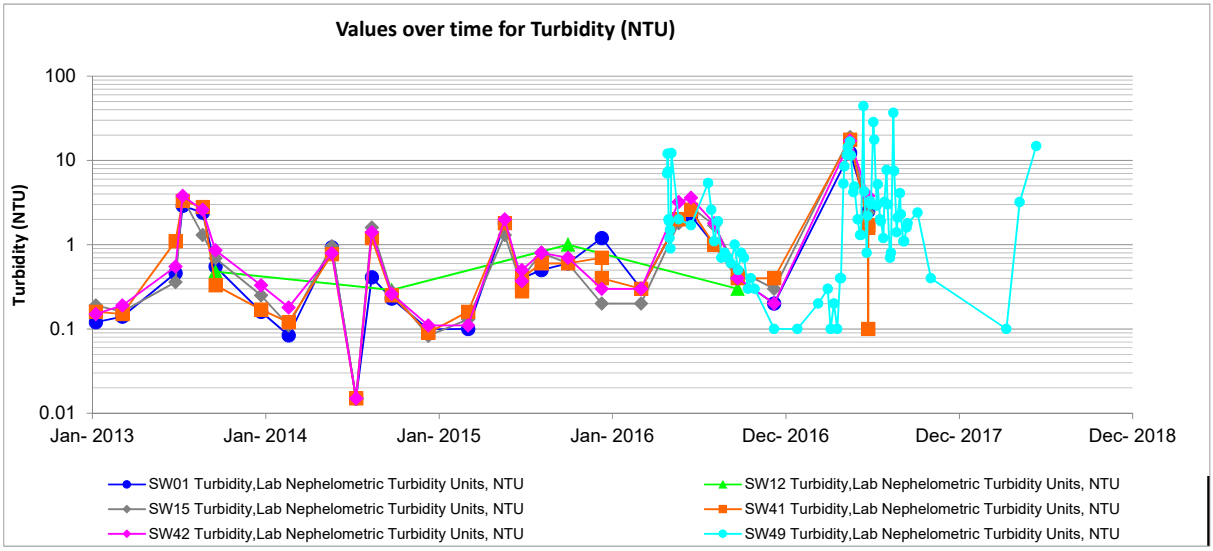

Values over time for Selenium, total (ug/L)
Selenium, total, (ug/L)
10
1
0.1
0.01
Jan- 2013
Jan- 2014
Jan- 2015
Jan- 2016
Dec- 2016
Dec- 2017
Dec- 2018
SW01 Selenium, Total (ug/l as Se)
SW12 Selenium, Total (ug/l as Se)
SW15 Selenium, Total (ug/l as Se)
SW41 Selenium, Total (ug/l as Se)
SW42 Selenium, Total (ug/l as Se)
Surface Water Quality Standards Limit Selenium, Total (ug/l as Se)
SW49 Selenium, Total (ug/l as Se)

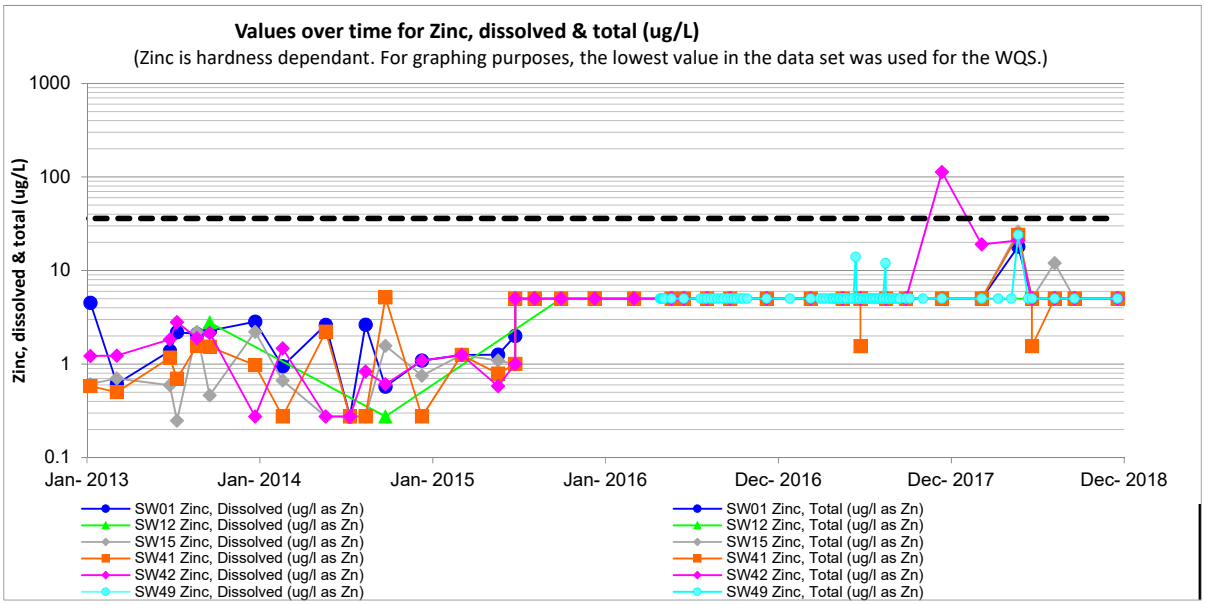

Values over time for Silver, dissolved & total (ug/L)
Silver, dissolved & total (ug/L)
1
0.1
0.01
0.001
Jan- 2013
Jan- 2014
Jan- 2015
Jan- 2016
Dec- 2016
Dec- 2017
Dec- 2018
SW01 Silver, Dissolved (ug/l as Ag)
SW01 Silver, Total (ug/l as Ag)
SW12 Silver, Dissolved (ug/l as Ag)
SW12 Silver, Total (ug/l as Ag)
SW15 Silver, Dissolved (ug/l as Ag)
SW15 Silver, Total (ug/l as Ag)
SW41 Silver, Dissolved (ug/l as Ag)
SW41 Silver, Total (ug/l as Ag)
SW42 Silver, Dissolved (ug/l as Ag)
SW42 Silver, Total (ug/l as Ag)
SW49 Silver, Dissolved (ug/l as Ag)
SW49 Silver, Total (ug/l as Ag)
Surface Water Quality Standards Limit Silver, Total (ug/l as Ag)


Values over time for Sulfate (mg/L)
Sulfate (mg/L)
1000
100
10
1
0.1
Jan- 2013
Jan- 2014
Jan- 2015
Jan- 2016
Dec- 2016
Dec- 2017
Dec- 2018
SW01 Sulfate, Total (mg/l as SO4)
SW12 Sulfate, Total (mg/l as SO4)
SW15 Sulfate, Total (mg/l as SO4)
SW41 Sulfate, Total (mg/l as SO4)
SW42 Sulfate, Total (mg/l as SO4)
Surface Water Quality Standards Limit Sulfate, Total (mg/l as SO4)
SW49 Sulfate, Total (mg/l as SO4)


Values over time for Total Dissolved Solids (TDS) (mg/L)
TDS (mg/L)
1000
100
10
1
Jan- 2013
Jan- 2014
Jan- 2015
Jan- 2016
Dec- 2016
Dec- 2017
Dec- 2018
SW01 TDS, Residue,Total Filtrable (Dried At 180C),mg/l
SW12 TDS, Residue,Total Filtrable (Dried At 180C),mg/l
SW15 TDS, Residue,Total Filtrable (Dried At 180C),mg/l
SW41 TDS, Residue,Total Filtrable (Dried At 180C),mg/l
SW42 TDS, Residue,Total Filtrable (Dried At 180C),mg/l
Surface Water Quality Standards Limit TDS, Residue,Total Filtrable (Dried At 180C),mg/l

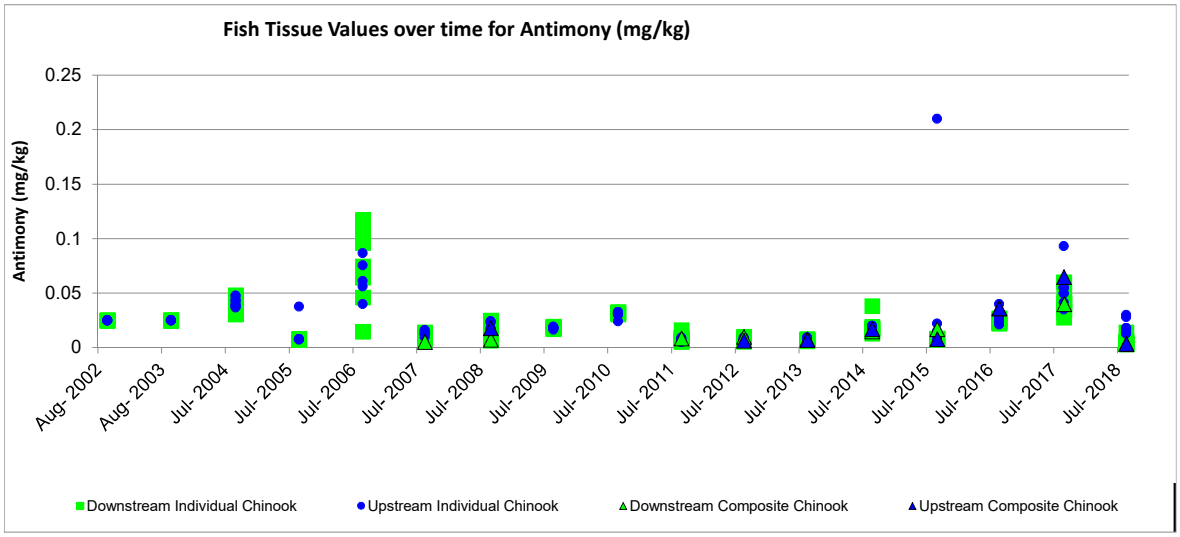

Values over time for Temperature, field (deg. C)
Temperature, field (deg. C)
20
18
16
14
12
10
8
6
4
2
0
-2
Jan- 2013
Jan- 2014
Jan- 2015
Jan- 2016
Dec- 2016
Dec- 2017
Dec- 2018
SW01 Water Temperature (Deg. C)
SW12 Water Temperature (Deg. C)
SW15 Water Temperature (Deg. C)
SW41 Water Temperature (Deg. C)
SW42 Water Temperature (Deg. C)
SW49 Water Temperature (Deg. C)

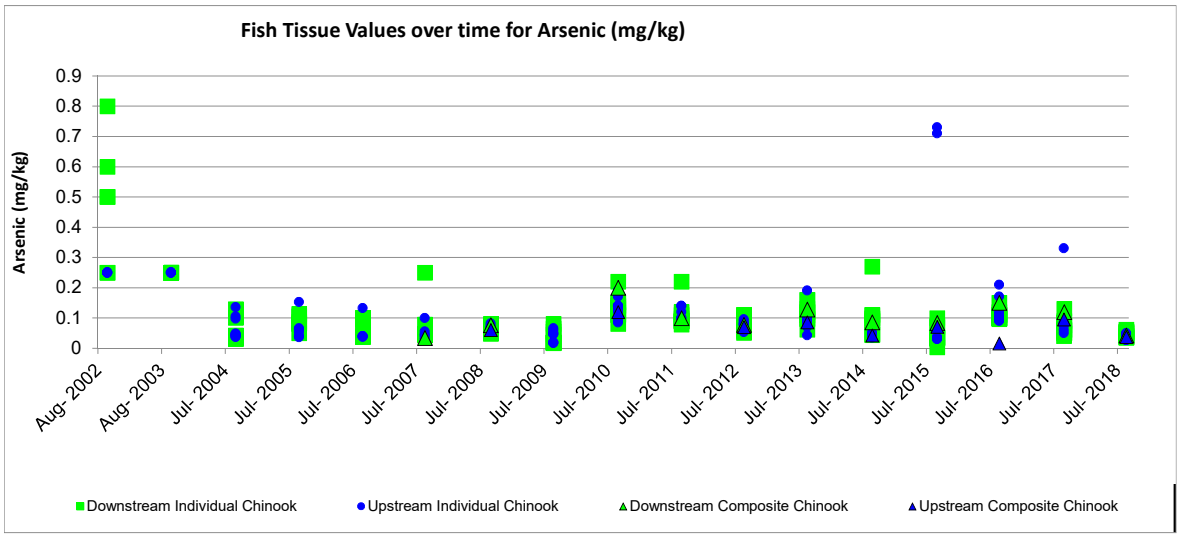

Values over time for Turbidity (NTU)
Turbidity (NTU)
100
10
1
0.1
0.01
Jan- 2013
Jan- 2014
Jan- 2015
Jan- 2016
Dec- 2016
Dec- 2017
Dec- 2018
SW01 Turbidity,Lab Nephelometric Turbidity Units, NTU
SW12 Turbidity,Lab Nephelometric Turbidity Units, NTU
SW15 Turbidity,Lab Nephelometric Turbidity Units, NTU
SW41 Turbidity,Lab Nephelometric Turbidity Units, NTU
SW42 Turbidity,Lab Nephelometric Turbidity Units, NTU
SW49 Turbidity,Lab Nephelometric Turbidity Units, NTU

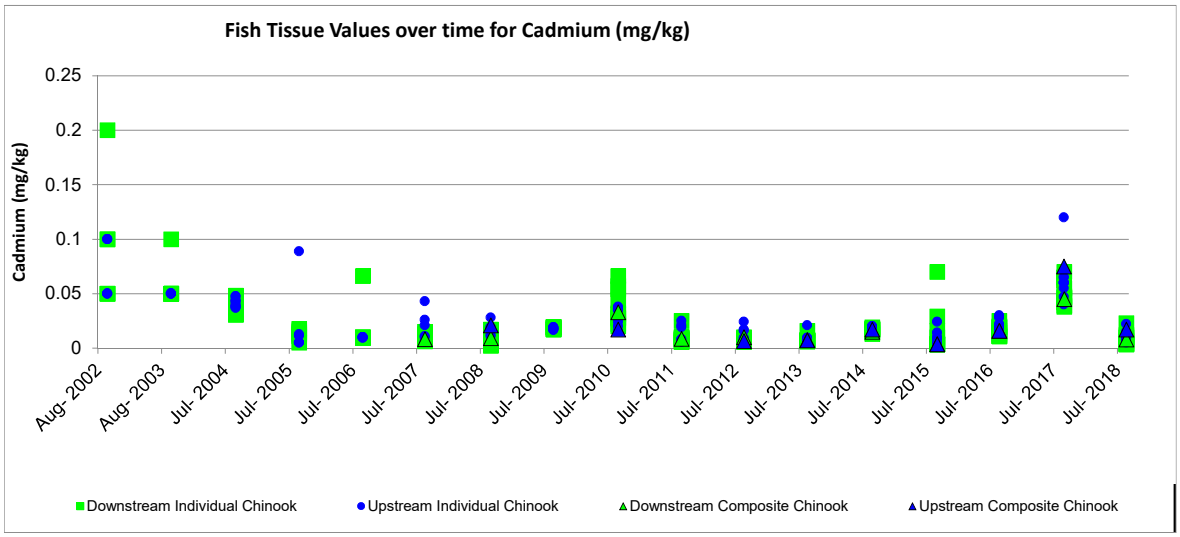

Values over time for Zinc, dissolved & total (ug/L)
(Zinc is hardness dependant. For graphing purposes, the lowest value in the data set was used for the WQS.)
Zinc, dissolved & total (ug/L)
1000
100
10
1
0.1
Jan- 2013
Jan- 2014
Jan- 2015
Jan- 2016
Dec- 2016
Dec- 2017
Dec- 2018
SW01 Zinc, Dissolved (ug/l as Zn)
SW12 Zinc, Dissolved (ug/l as Zn)
SW15 Zinc, Dissolved (ug/l as Zn)
SW41 Zinc, Dissolved (ug/l as Zn)
SW42 Zinc, Dissolved (ug/l as Zn)
SW49 Zinc, Dissolved (ug/l as Zn)
SW01 Zinc, Total (ug/l as Zn)
SW12 Zinc, Total (ug/l as Zn)
SW15 Zinc, Total (ug/l as Zn)
SW41 Zinc, Total (ug/l as Zn)
SW42 Zinc, Total (ug/l as Zn)
SW49 Zinc, Total (ug/l as Zn)

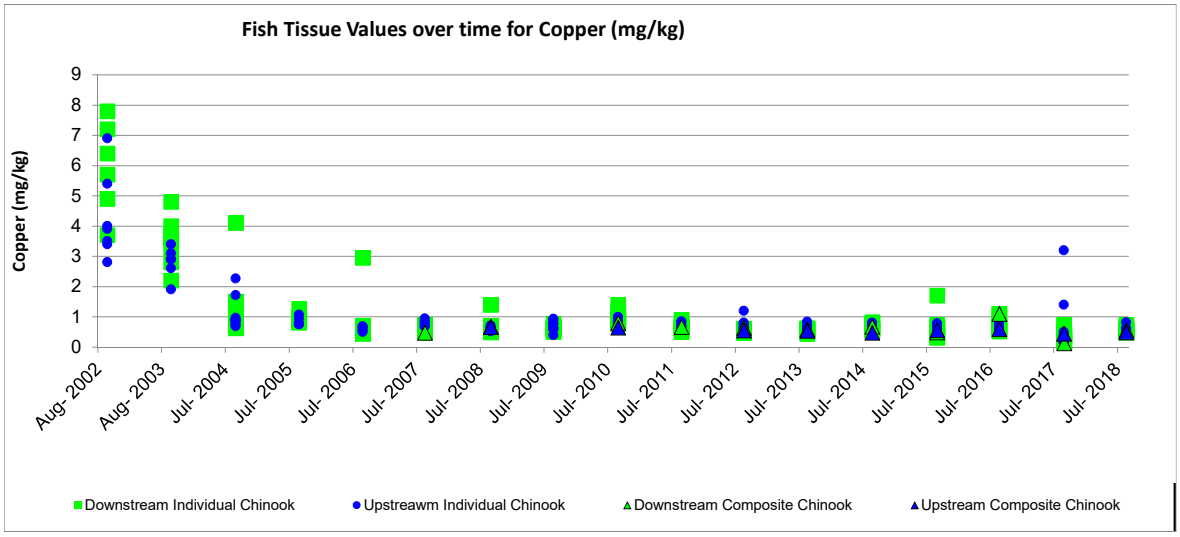
APPENDIX C –

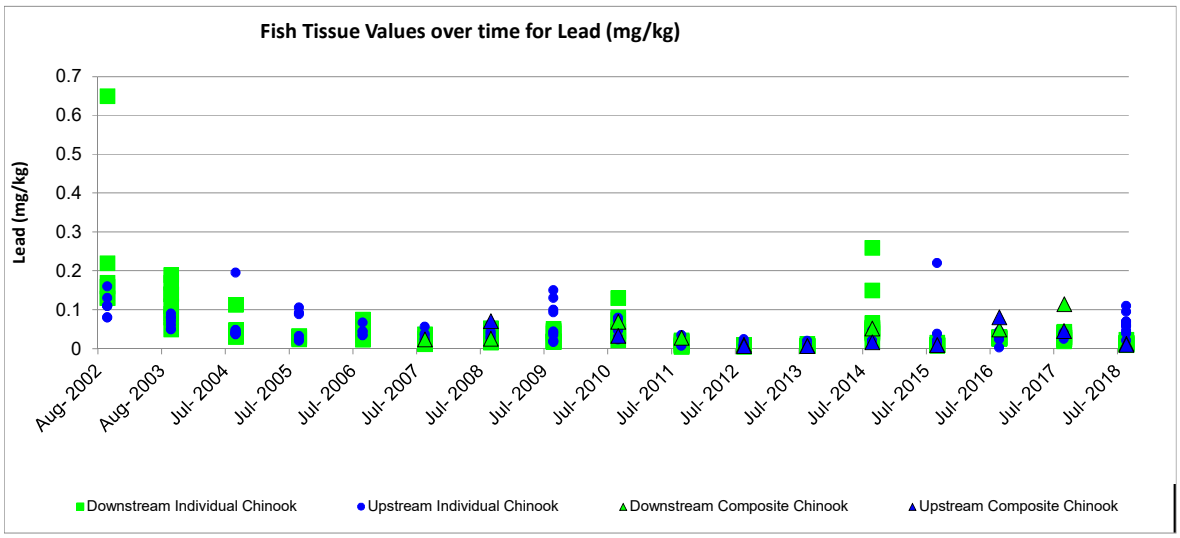
Fish Tissue Data Graphs

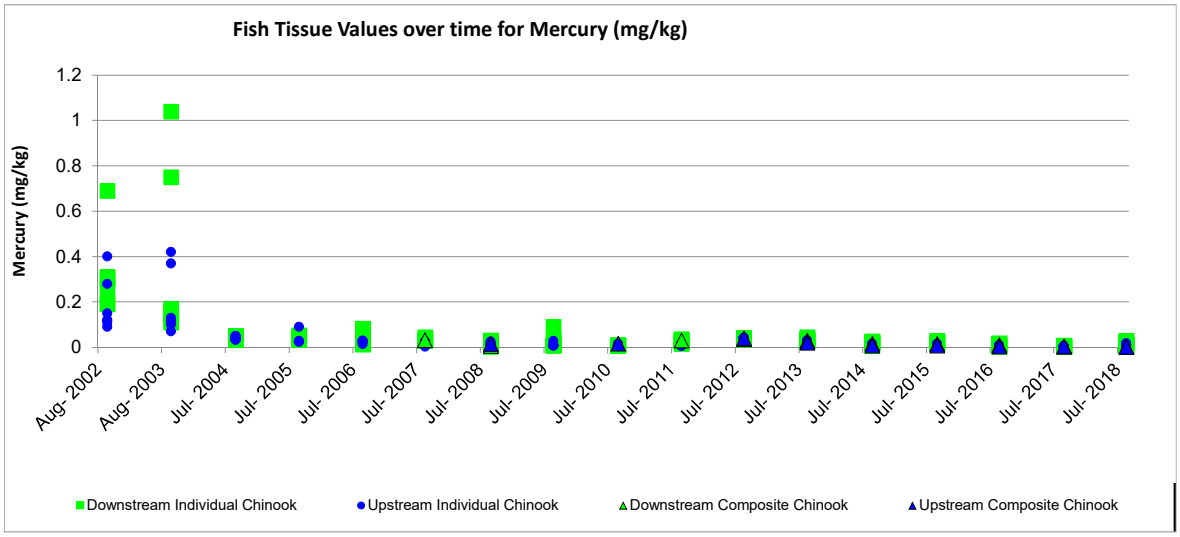

Fish Tissue Values over time for Antimony (mg/kg)
Antimony (mg/kg)
0.25
0.2
0.15
0.1
0.05
0
Aug- 2002
Aug- 2003
Jul- 2004
Jul- 2005
Jul- 2006
Jul- 2007
Jul- 2008
Jul- 2009
Jul- 2010
Jul- 2011
Jul- 2012
Jul- 2013
Jul- 2014
Jul- 2015
Jul- 2016
Jul- 2017
Jul- 2018
Downstream Individual Chinook
Upstream Individual Chinook
Downstream Composite Chinook
Upstream Composite Chinook

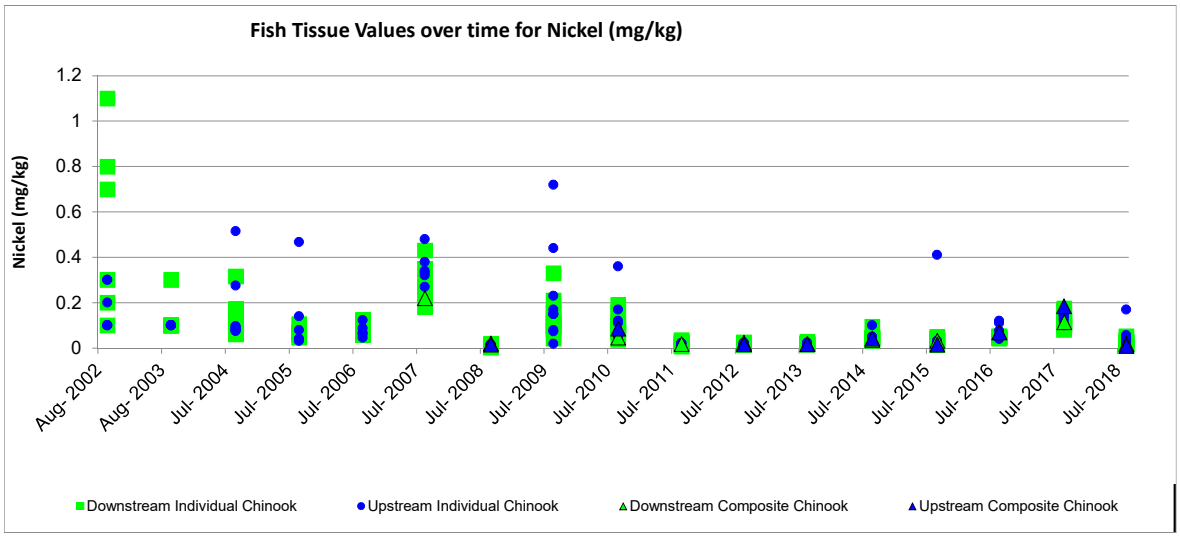

Fish Tissue Values over time for Arsenic (mg/kg)
Arsenic (mg/kg)
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
Aug- 2002
Aug- 2003
Jul- 2004
Jul- 2005
Jul- 2006
Jul- 2007
Jul- 2008
Jul- 2009
Jul- 2010
Jul- 2011
Jul- 2012
Jul- 2013
Jul- 2014
Jul- 2015
Jul- 2016
Jul- 2017
Jul- 2018
Downstream Individual Chinook
Upstream Individual Chinook
Downstream Composite Chinook
Upstream Composite Chinook

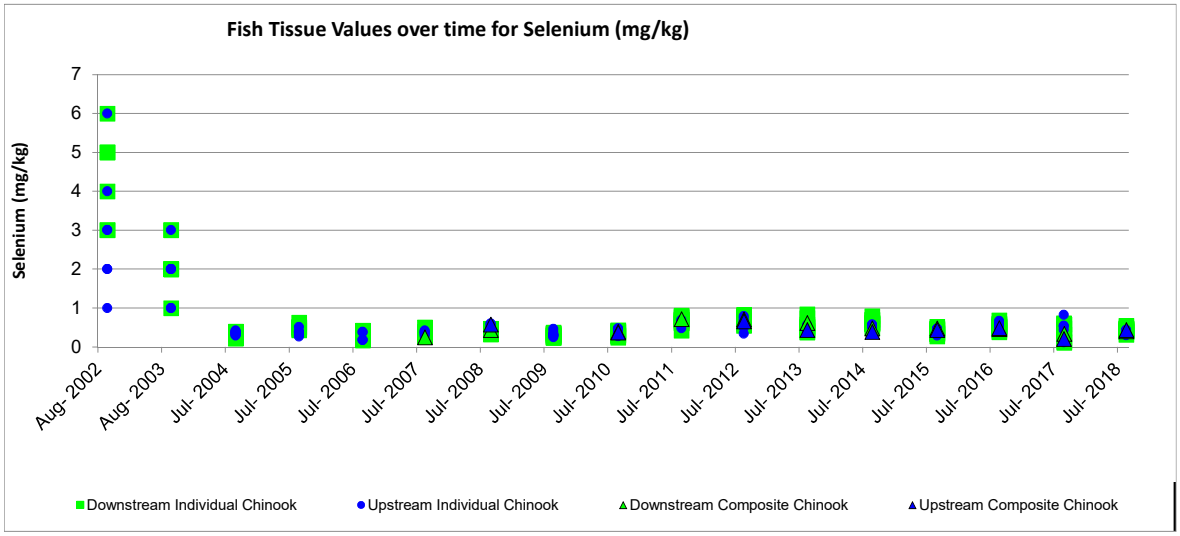

Fish Tissue Values over time for Cadmium (mg/kg)
Cadmium (mg/kg)
0.25
0.2
0.15
0.1
0.05
0
Aug- 2002
Aug- 2003
Jul- 2004
Jul- 2005
Jul- 2006
Jul- 2007
Jul- 2008
Jul- 2009
Jul- 2010
Jul- 2011
Jul- 2012
Jul- 2013
Jul- 2014
Jul- 2015
Jul- 2016
Jul- 2017
Jul- 2018
Downstream Individual Chinook
Upstream Individual Chinook
Downstream Composite Chinook
Upstream Composite Chinook

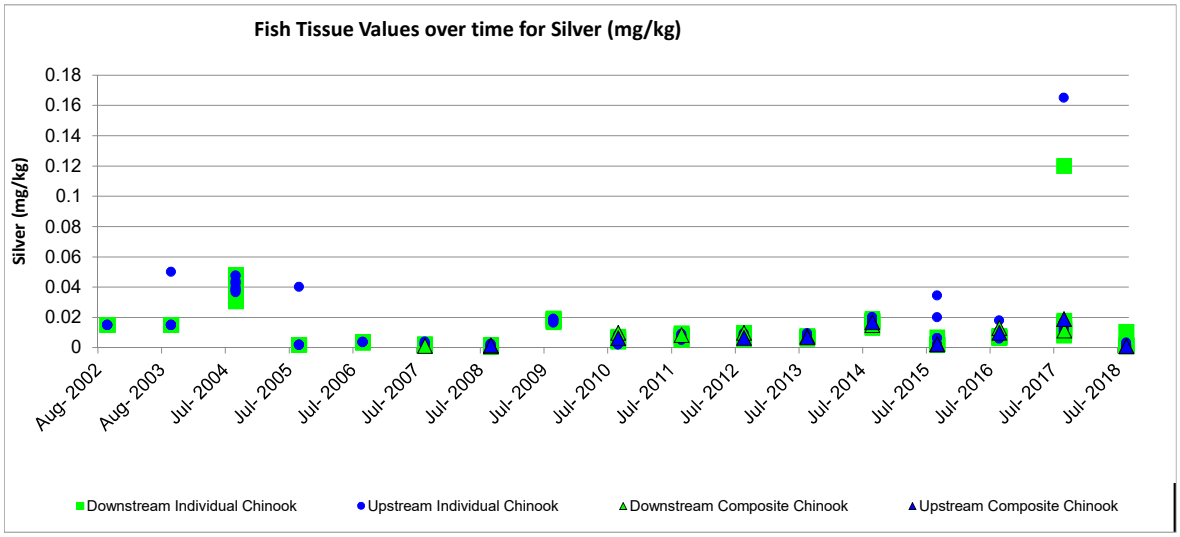

Fish Tissue Values over time for Copper (mg/kg)
Copper (mg/kg)
9
8
7
6
5
4
3
2
1
0
Aug- 2002
Aug- 2003
Jul- 2004
Jul- 2005
Jul- 2006
Jul- 2007
Jul- 2008
Jul- 2009
Jul- 2010
Jul- 2011
Jul- 2012
Jul- 2013
Jul- 2014
Jul- 2015
Jul- 2016
Jul- 2017
Jul- 2018
Downstream Individual Chinook
Upstreawm Individual Chinook
Downstream Composite Chinook
Upstream Composite Chinook


Fish Tissue Values over time for Lead (mg/kg)
Lead (mg/kg)
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
Aug- 2002
Aug- 2003
Jul- 2004
Jul- 2005
Jul- 2006
Jul- 2007
Jul- 2008
Jul- 2009
Jul- 2010
Jul- 2011
Jul- 2012
Jul- 2013
Jul- 2014
Jul- 2015
Jul- 2016
Jul- 2017
Jul- 2018
Downstream Individual Chinook
Upstream Individual Chinook
Downstream Composite Chinook
Upstream Composite Chinook


Fish Tissue Values over time for Mercury (mg/kg)
Mercury (mg/kg)
1.2
1
0.8
0.6
0.4
0.2
0
Aug- 2002
Aug- 2003
Jul- 2004
Jul- 2005
Jul- 2006
Jul- 2007
Jul- 2008
Jul- 2009
Jul- 2010
Jul- 2011
Jul- 2012
Jul- 2013
Jul- 2014
Jul- 2015
Jul- 2016
Jul- 2017
Jul- 2018
Downstream Individual Chinook
Upstream Individual Chinook
Downstream Composite Chinook
Upstream Composite Chinook


Fish Tissue Values over time for Nickel (mg/kg)
Nickel (mg/kg)
1.2
1
0.8
0.6
0.4
0.2
0
Aug- 2002
Aug- 2003
Jul- 2004
Jul- 2005
Jul- 2006
Jul- 2007
Jul- 2008
Jul- 2009
Jul- 2010
Jul- 2011
Jul- 2012
Jul- 2013
Jul- 2014
Jul- 2015
Jul- 2016
Jul- 2017
Jul- 2018
Downstream Individual Chinook
Upstream Individual Chinook
Downstream Composite Chinook
Upstream Composite Chinook

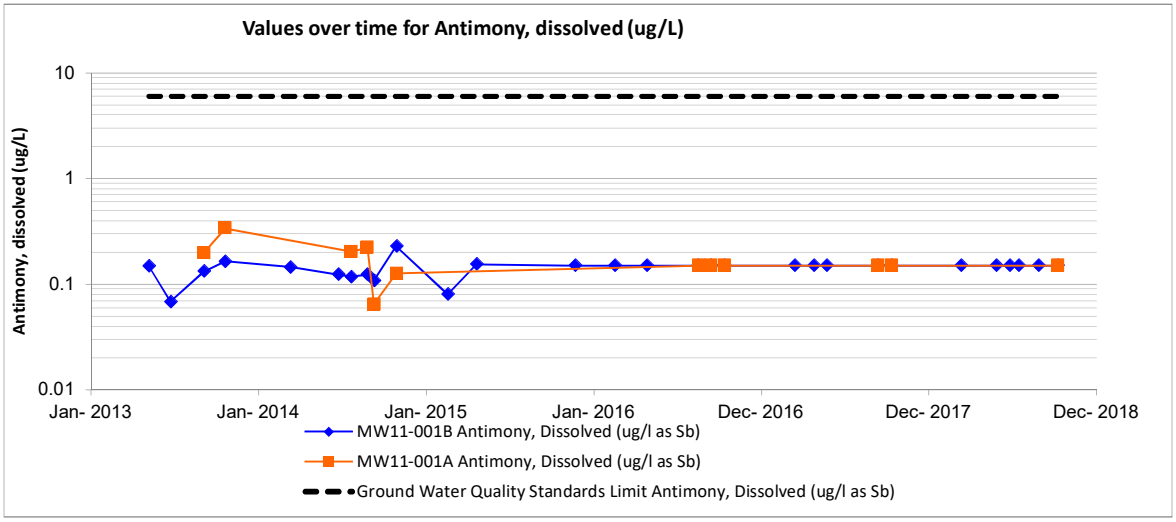

Fish Tissue Values over time for Selenium (mg/kg)
Selenium (mg/kg)
7
6
5
4
3
2
1
0
Aug- 2002
Aug- 2003
Jul- 2004
Jul- 2005
Jul- 2006
Jul- 2007
Jul- 2008
Jul- 2009
Jul- 2010
Jul- 2011
Jul- 2012
Jul- 2013
Jul- 2014
Jul- 2015
Jul- 2016
Jul- 2017
Jul- 2018
Downstream Individual Chinook
Upstream Individual Chinook
Downstream Composite Chinook
Upstream Composite Chinook

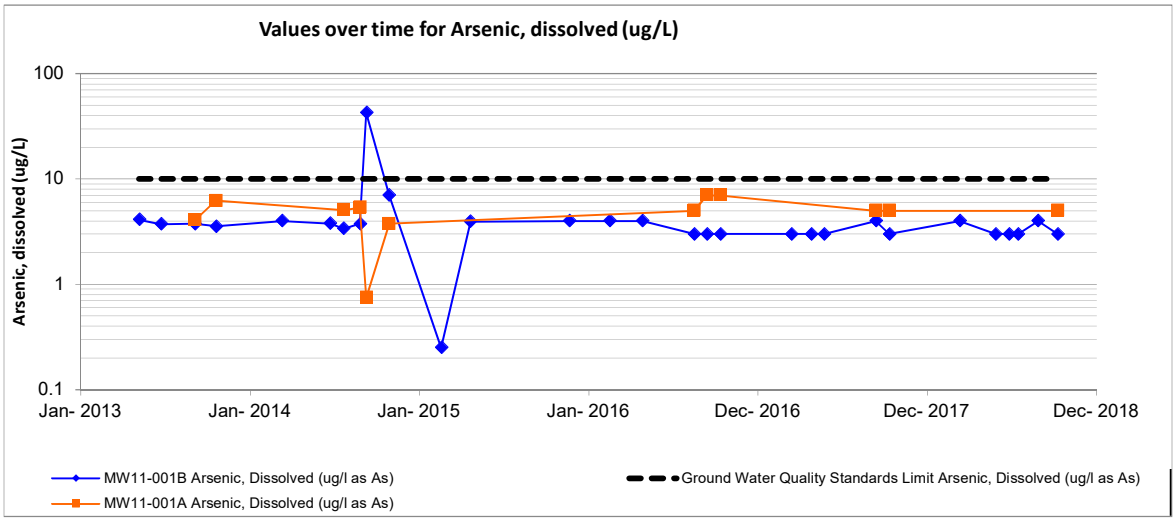

Fish Tissue Values over time for Silver (mg/kg)
Silver (mg/kg)
0.18
0.16
0.14
0.12
0.1
0.08
0.06
0.04
0.02
0
Aug- 2002
Aug- 2003
Jul- 2004
Jul- 2005
Jul- 2006
Jul- 2007
Jul- 2008
Jul- 2009
Jul- 2010
Jul- 2011
Jul- 2012
Jul- 2013
Jul- 2014
Jul- 2015
Jul- 2016
Jul- 2017
Jul- 2018
Downstream Individual Chinook
Upstream Individual Chinook
Downstream Composite Chinook
Upstream Composite Chinook

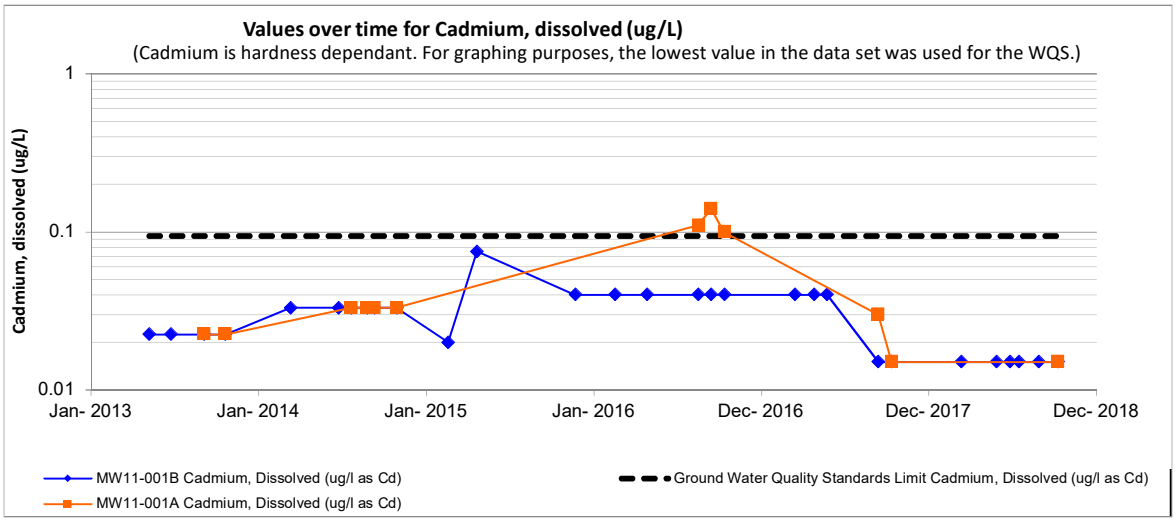
APPENDIX C –

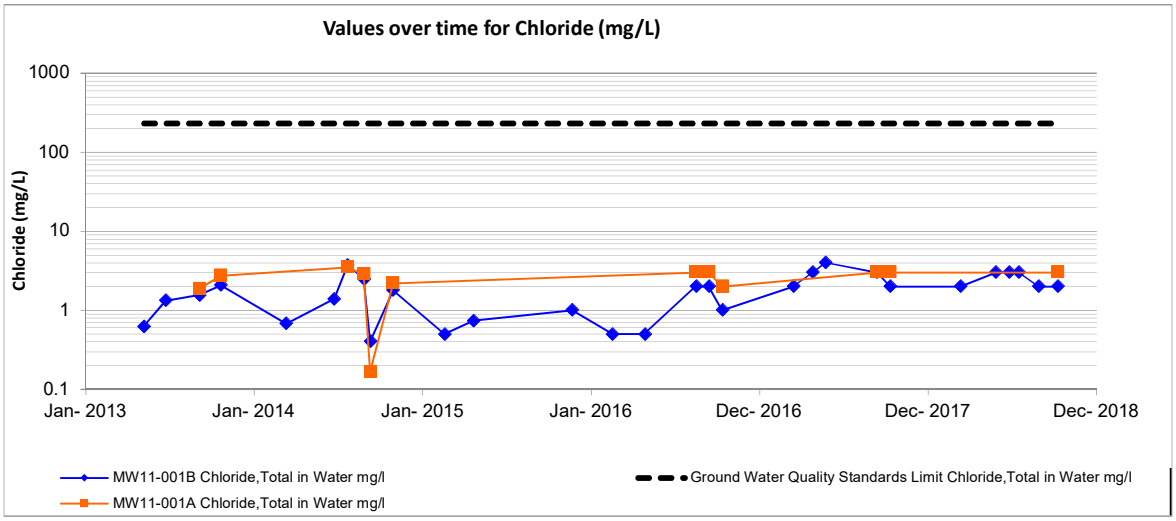
MW11-001A and MW11-001B

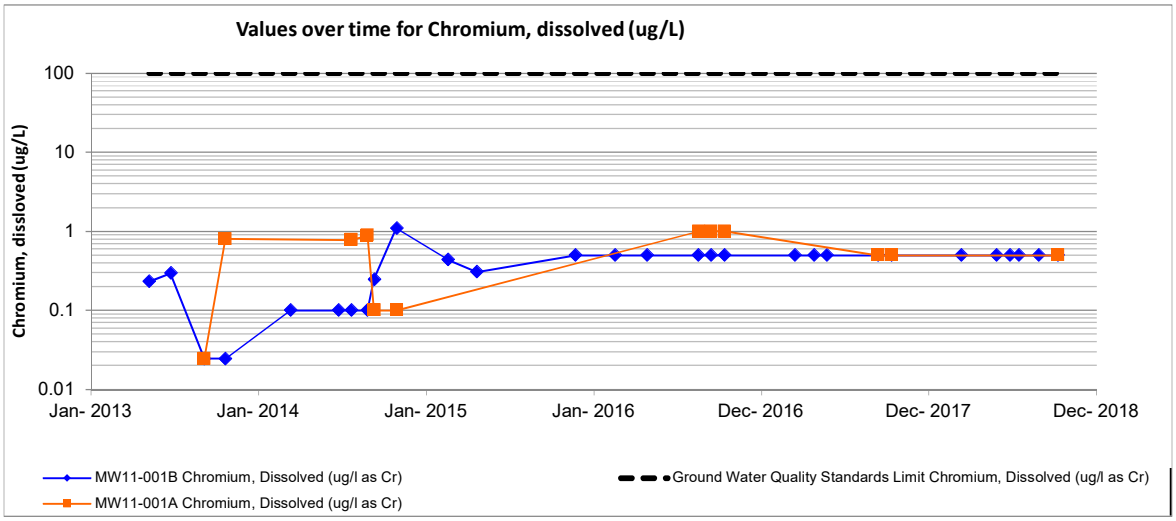
Well Graphs

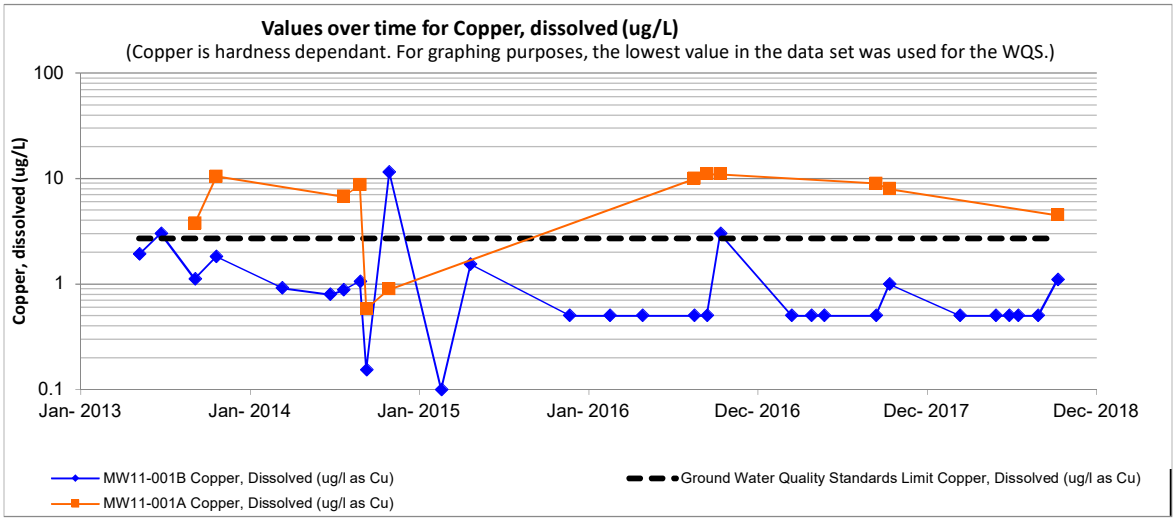

Values over time for Antimony, dissolved (ug/L)
Antimony, dissolved (ug/L)
10
1
0.1
0.01
Jan- 2013
Jan- 2014
Jan- 2015
Jan- 2016
Dec- 2016
Dec- 2017
Dec- 2018
MW11-001B Antimony, Dissolved (ug/l as Sb)
MW11-001A Antimony, Dissolved (ug/l as Sb)
Ground Water Quality Standards Limit Antimony, Dissolved (ug/l as Sb)

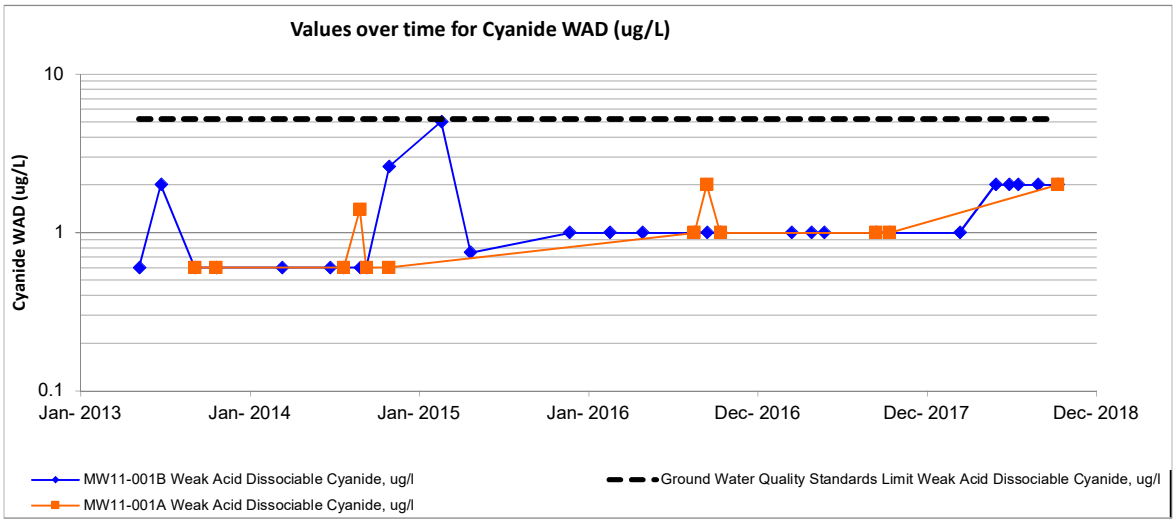

Values over time for Arsenic, dissolved (ug/L)
Arsenic, dissolved (ug/L)
100
10
1
0.1
Jan- 2013
Jan- 2014
Jan- 2015
Jan- 2016
Dec- 2016
Dec- 2017
Dec- 2018
MW11-001B Arsenic, Dissolved (ug/l as As)
MW11-001A Arsenic, Dissolved (ug/l as As)
Ground Water Quality Standards Limit Arsenic, Dissolved (ug/l as As)

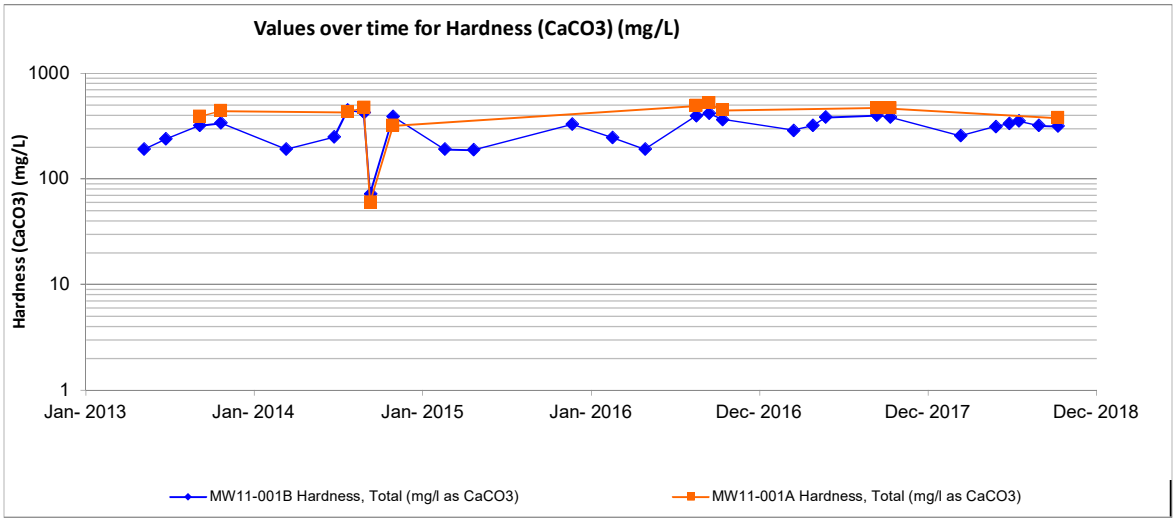

Values over time for Cadmium, dissolved (ug/L)
(Cadmium is hardness dependant. For graphing purposes, the lowest value in the data set was used for the WQS.)
Cadmium, dissolved (ug/L)
1
0.1
0.01
Jan- 2013
Jan- 2014
Jan- 2015
Jan- 2016
Dec- 2016
Dec- 2017
Dec- 2018
MW11-001B Cadmium, Dissolved (ug/l as Cd)
MW11-001A Cadmium, Dissolved (ug/l as Cd)
Ground Water Quality Standards Limit Cadmium, Dissolved (ug/l as Cd)

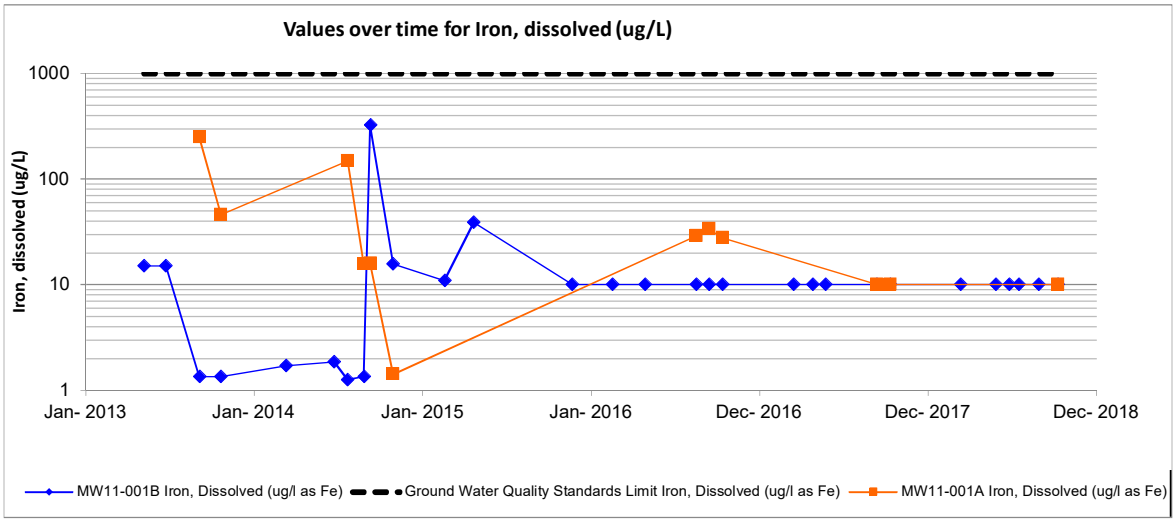

Values over time for Chloride (mg/L)
Chloride (mg/L)
1000
100
10
1
0.1
Jan- 2013
Jan- 2014
Jan- 2015
Jan- 2016
Dec- 2016
Dec- 2017
Dec- 2018
MW11-001B Chloride,Total in Water mg/l
MW11-001A Chloride,Total in Water mg/l
Ground Water Quality Standards Limit Chloride,Total in Water mg/l

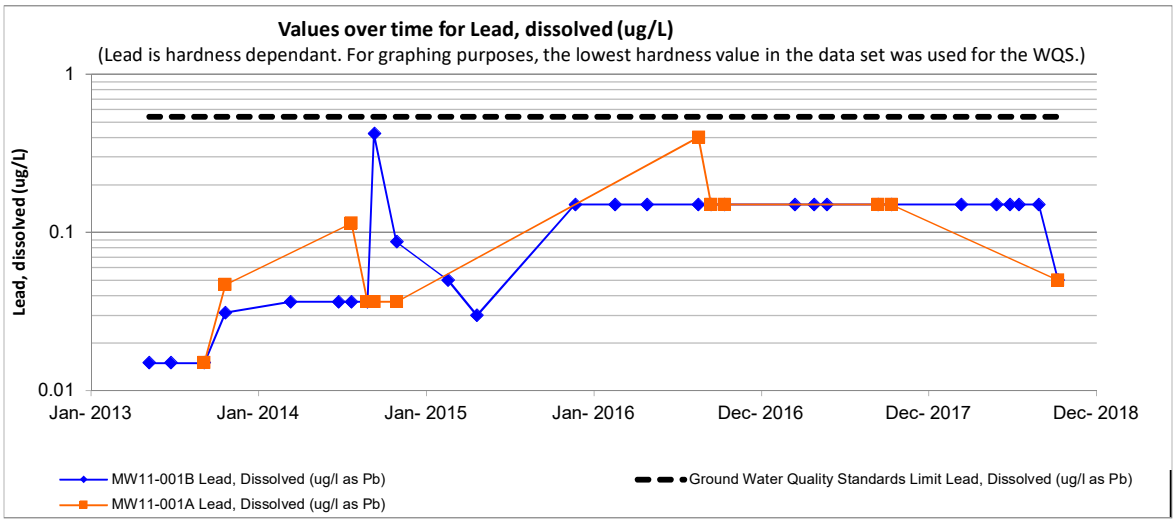

Values over time for Chromium, dissolved (ug/L)
Chromium, dissloved (ug/L)
100
10
1
0.1
0.01
Jan- 2013
Jan- 2014
Jan- 2015
Jan- 2016
Dec- 2016
Dec- 2017
Dec- 2018
MW11-001B Chromium, Dissolved (ug/l as Cr)
MW11-001A Chromium, Dissolved (ug/l as Cr)
Ground Water Quality Standards Limit Chromium, Dissolved (ug/l as Cr)

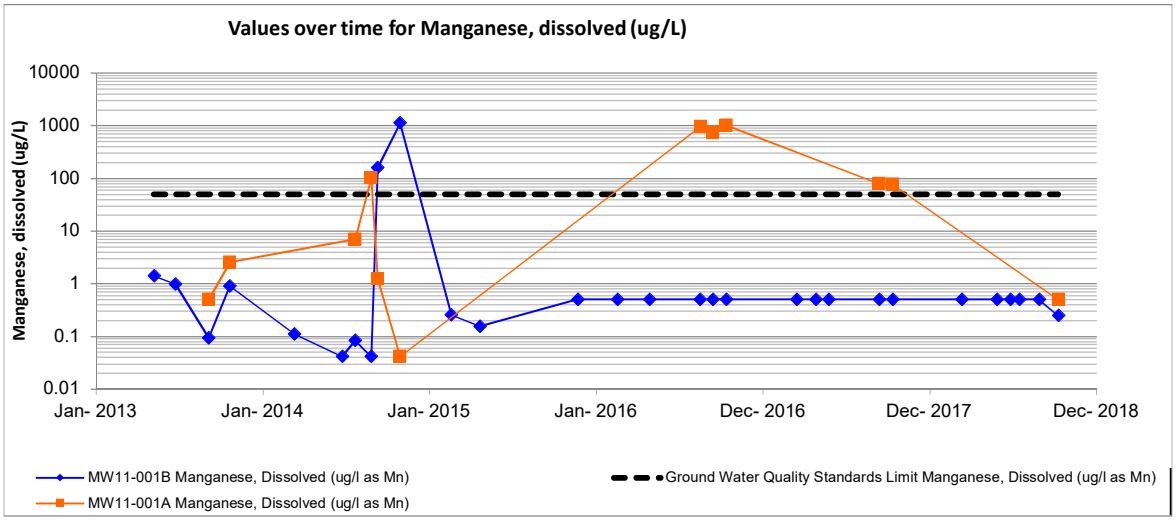

Values over time for Copper, dissolved (ug/L)
(Copper is hardness dependant. For graphing purposes, the lowest value in the data set was used for the WQS.)
Copper, dissolved (ug/L)
100
10
1
0.1
Jan- 2013
Jan- 2014
Jan- 2015
Jan- 2016
Dec- 2016
Dec- 2017
Dec- 2018
MW11-001B Copper, Dissolved (ug/l as Cu)
MW11-001A Copper, Dissolved (ug/l as Cu)
Ground Water Quality Standards Limit Copper, Dissolved (ug/l as Cu)

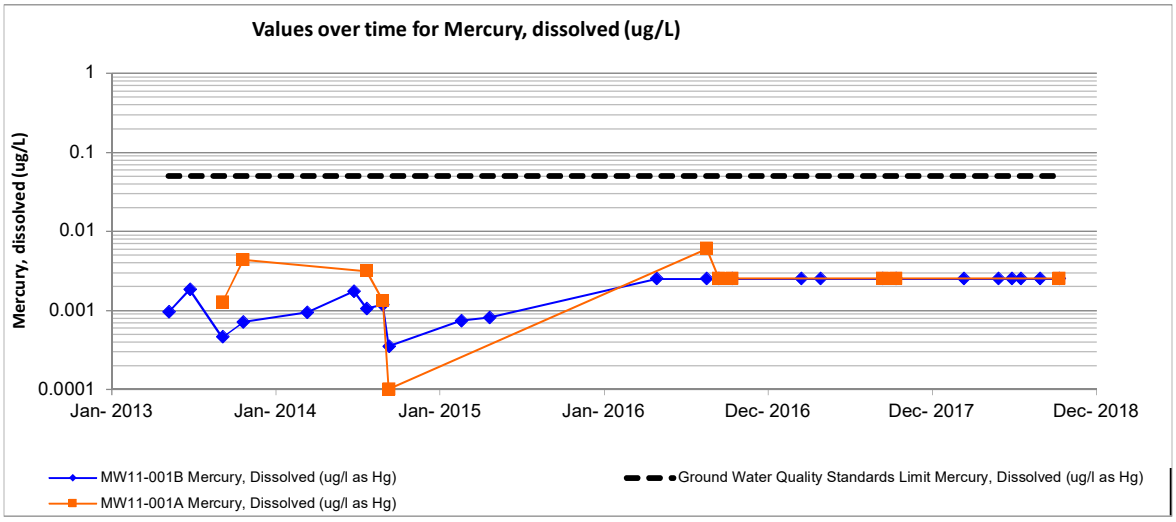

Values over time for Cyanide WAD (ug/L)
Cyanide WAD (ug/L)
10
1
0.1
Jan- 2013
Jan- 2014
Jan- 2015
Jan- 2016
Dec- 2016
Dec- 2017
Dec- 2018
MW11-001B Weak Acid Dissociable Cyanide, ug/l
Ground Water Quality Standards Limit Weak Acid Dissociable Cyanide, ug/l
MW11-001A Weak Acid Dissociable Cyanide, ug/l

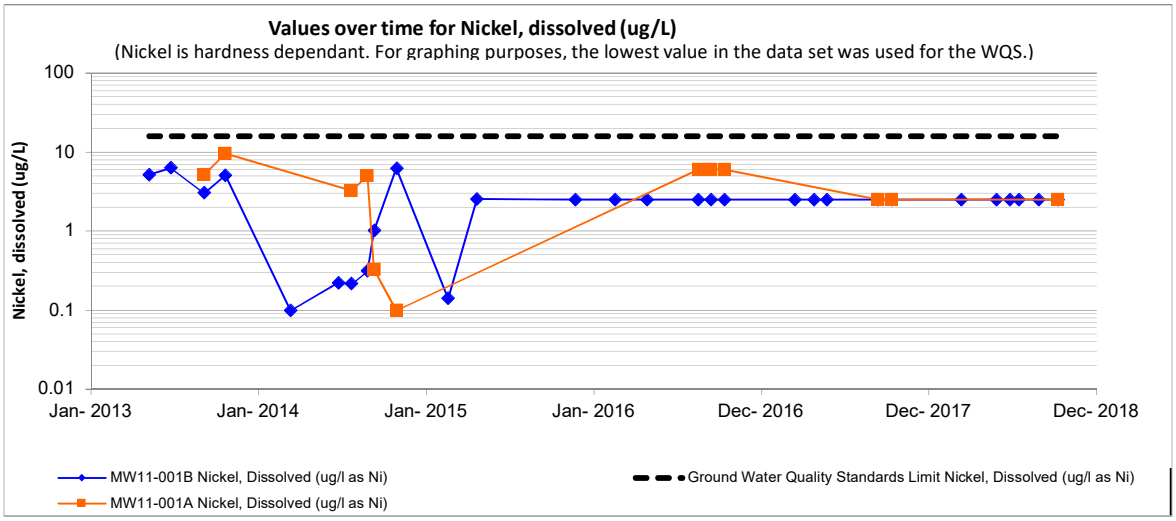

Values over time for Hardness (CaCO3) (mg/L)
Hardness (CaCO3) (mg/L)
1000
100
10
1
Jan- 2013
Jan- 2014
Jan- 2015
Jan- 2016
Dec- 2016
Dec- 2017
Dec- 2018
MW11-001B Hardness, Total (mg/l as CaCO3)
MW11-001A Hardness, Total (mg/l as CaCO3)

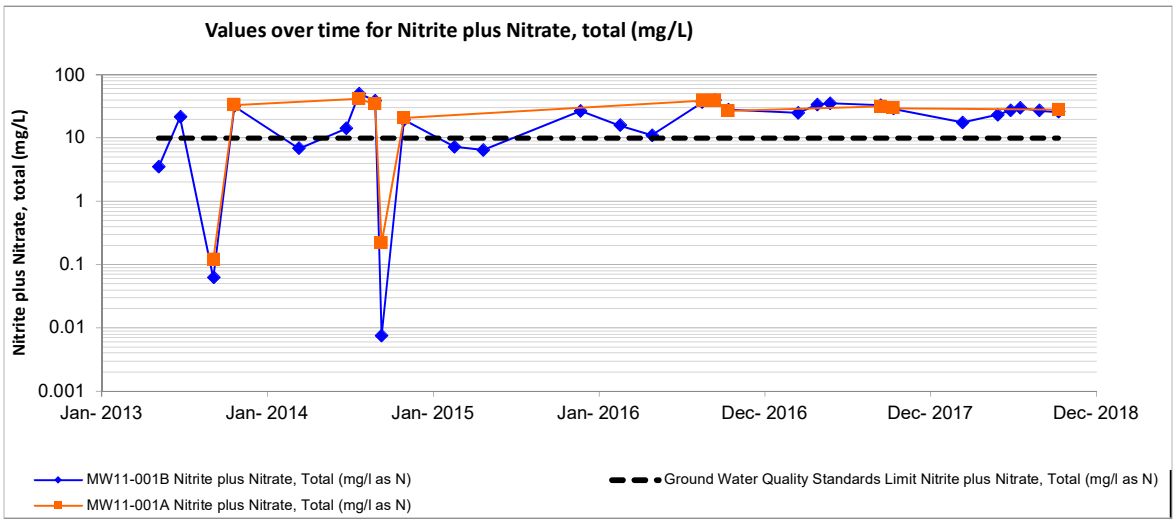

Values over time for Iron, dissolved (ug/L)
Iron, dissolved (ug/L)
1000
100
10
1
Jan- 2013
Jan- 2014
Jan- 2015
Jan- 2016
Dec- 2016
Dec- 2017
Dec- 2018
MW11-001B Iron, Dissolved (ug/l as Fe)
Ground Water Quality Standards Limit Iron, Dissolved (ug/l as Fe)
MW11-001A Iron, Dissolved (ug/l as Fe)

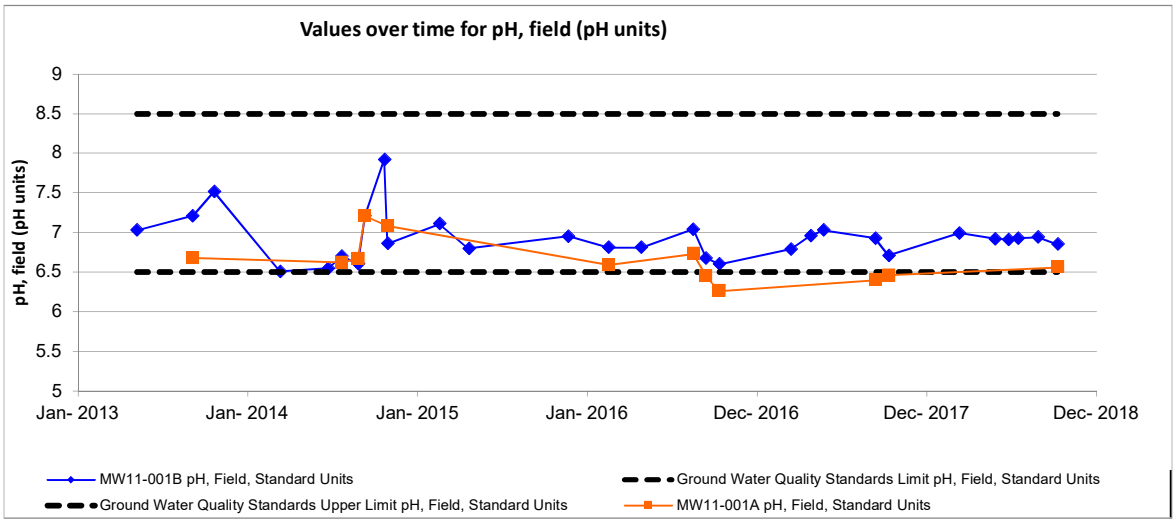

Values over time for Lead, dissolved (ug/L)
(Lead is hardness dependant. For graphing purposes, the lowest hardness value in the data set was used for the WQS.)
Lead, dissolved (ug/L)
1
0.1
0.01
Jan- 2013
Jan- 2014
Jan- 2015
Jan- 2016
Dec- 2016
Dec- 2017
Dec- 2018
MW11-001B Lead, Dissolved (ug/l as Pb)
MW11-001A Lead, Dissolved (ug/l as Pb)
Ground Water Quality Standards Limit Lead, Dissolved (ug/l as Pb)

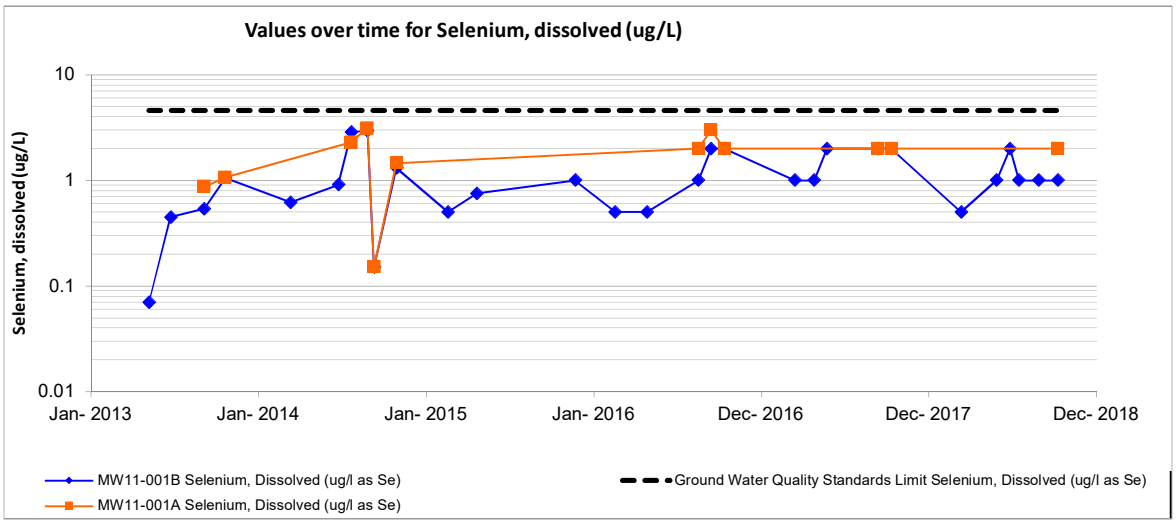

Values over time for Manganese, dissolved (ug/L)
Manganese, dissolved (ug/L)
10000
1000
100
10
1
0.1
0.01
Jan- 2013
Jan- 2014
Jan- 2015
Jan- 2016
Dec- 2016
Dec- 2017
Dec- 2018
MW11-001B Manganese, Dissolved (ug/l as Mn)
MW11-001A Manganese, Dissolved (ug/l as Mn)
Ground Water Quality Standards Limit Manganese, Dissolved (ug/l as Mn)

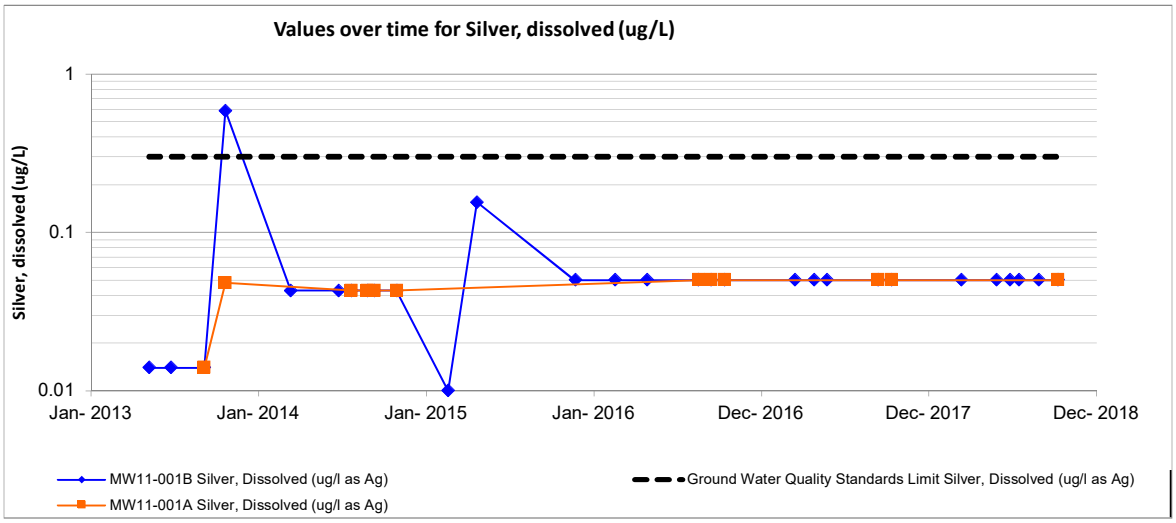

Values over time for Mercury, dissolved (ug/L)
Mercury, dissolved (ug/L)
1
0.1
0.01
0.001
0.0001
Jan- 2013
Jan- 2014
Jan- 2015
Jan- 2016
Dec- 2016
Dec- 2017
Dec- 2018
MW11-001B Mercury, Dissolved (ug/l as Hg)
MW11-001A Mercury, Dissolved (ug/l as Hg)
Ground Water Quality Standards Limit Mercury, Dissolved (ug/l as Hg)

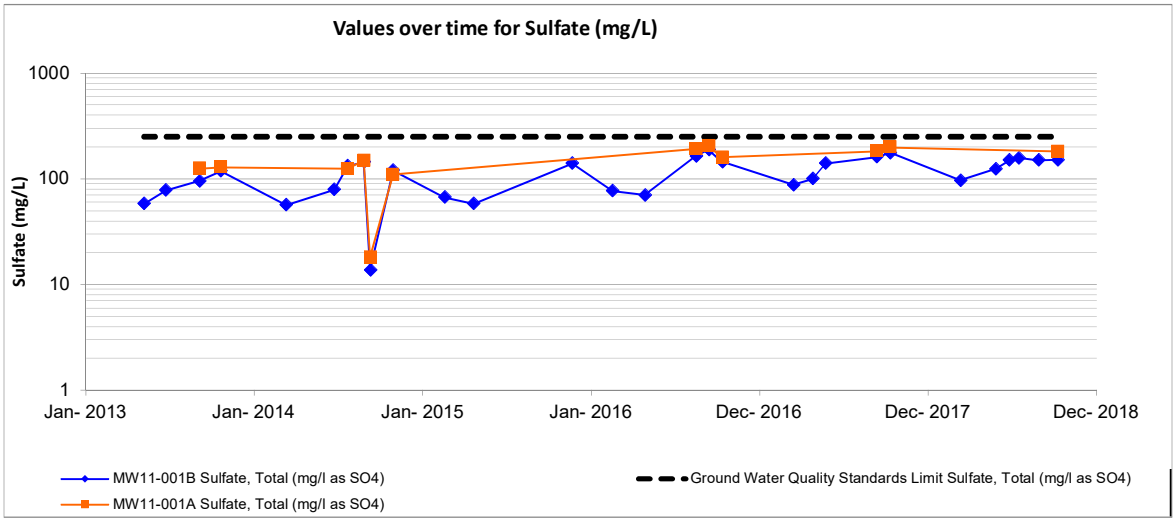

Values over time for Nickel, dissolved (ug/L)
(Nickel is hardness dependant. For graphing purposes, the lowest value in the data set was used for the WQS.)
Nickel, dissolved (ug/L)
100
10
1
0.1
0.01
Jan- 2013
Jan- 2014
Jan- 2015
Jan- 2016
Dec- 2016
Dec- 2017
Dec- 2018
MW11-001B Nickel, Dissolved (ug/l as Ni)
MW11-001A Nickel, Dissolved (ug/l as Ni)
Ground Water Quality Standards Limit Nickel, Dissolved (ug/l as Ni)

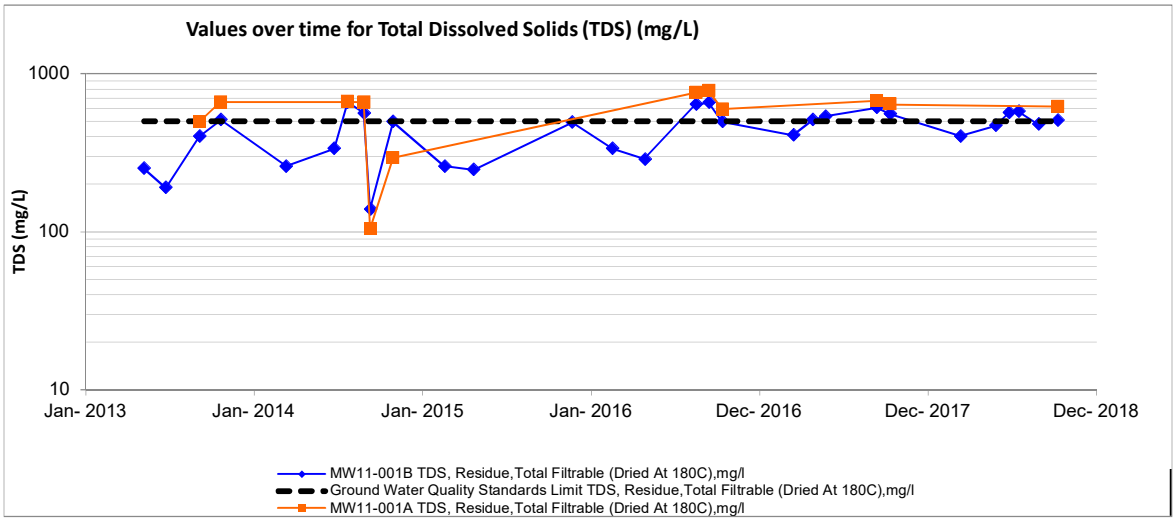

Values over time for Nitrite plus Nitrate, total (mg/L)
Nitrite plus Nitrate, total (mg/L)
100
10
1
0.1
0.01
0.001
Jan- 2013
Jan- 2014
Jan- 2015
Jan- 2016
Dec- 2016
Dec- 2017
Dec- 2018
MW11-001B Nitrite plus Nitrate, Total (mg/l as N)
MW11-001A Nitrite plus Nitrate, Total (mg/l as N)
Ground Water Quality Standards Limit Nitrite plus Nitrate, Total (mg/l as N)

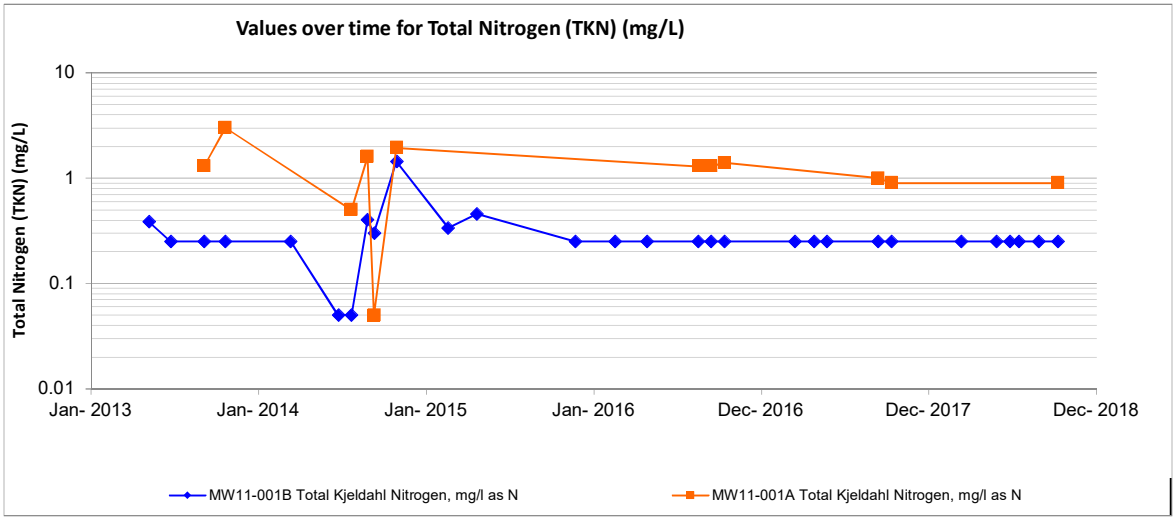

Values over time for pH, field (pH units)
pH, field (pH units)
9
8.5
8
7.5
7
6.5
6
5.5
5
Jan- 2013
Jan- 2014
Jan- 2015
Jan- 2016
Dec- 2016
Dec- 2017
Dec- 2018
MW11-001B pH, Field, Standard Units
Ground Water Quality Standards Limit pH, Field, Standard Units
Ground Water Quality Standards Upper Limit pH, Field, Standard Units
MW11-001A pH, Field, Standard Units

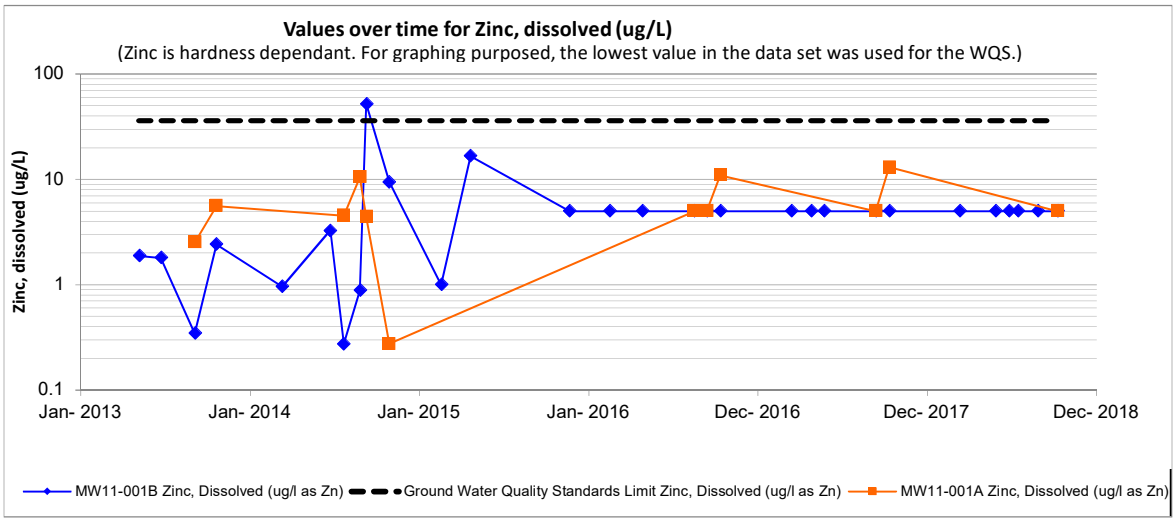

Values over time for Selenium, dissolved (ug/L)
Selenium, dissolved (ug/L)
10
1
0.1
0.01
Jan- 2013
Jan- 2014
Jan- 2015
Jan- 2016
Dec- 2016
Dec- 2017
Dec- 2018
MW11-001B Selenium, Dissolved (ug/l as Se)
MW11-001A Selenium, Dissolved (ug/l as Se)
Ground Water Quality Standards Limit Selenium, Dissolved (ug/l as Se)


Values over time for Silver, dissolved (ug/L)
Silver, dissolved (ug/L)
1
0.1
0.01
Jan- 2013
Jan- 2014
Jan- 2015
Jan- 2016
Dec- 2016
Dec- 2017
Dec- 2018
MW11-001B Silver, Dissolved (ug/l as Ag)
MW11-001A Silver, Dissolved (ug/l as Ag)
Ground Water Quality Standards Limit Silver, Dissolved (ug/l as Ag)


Values over time for Sulfate (mg/L)
Sulfate (mg/L)
1000
100
10
1
Jan- 2013
Jan- 2014
Jan- 2015
Jan- 2016
Dec- 2016
Dec- 2017
Dec- 2018
MW11-001B Sulfate, Total (mg/l as SO4)
MW11-001A Sulfate, Total (mg/l as SO4)
Ground Water Quality Standards Limit Sulfate, Total (mg/l as SO4)


Values over time for Total Dissolved Solids (TDS) (mg/L)
TDS (mg/L)
1000
100
10
Jan- 2013
Jan- 2014
Jan- 2015
Jan- 2016
Dec- 2016
Dec- 2017
Dec- 2018
MW11-001B TDS, Residue,Total Filtrable (Dried At 180C),mg/l
Ground Water Quality Standards Limit TDS, Residue,Total Filtrable (Dried At 180C),mg/l
MW11-001A TDS, Residue,Total Filtrable (Dried At 180C),mg/l

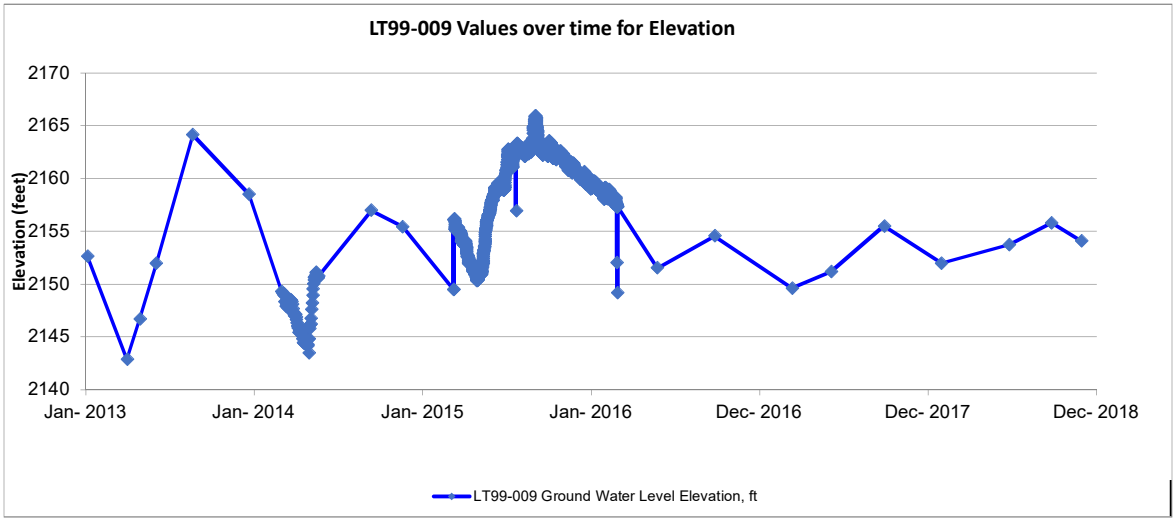

Values over time for Total Nitrogen (TKN) (mg/L)
Total Nitrogen (TKN) (mg/L)
10
1
0.1
0.01
Jan- 2013
Jan- 2014
Jan- 2015
Jan- 2016
Dec- 2016
Dec- 2017
Dec- 2018
MW11-001B Total Kjeldahl Nitrogen, mg/l as N
MW11-001A Total Kjeldahl Nitrogen, mg/l as N

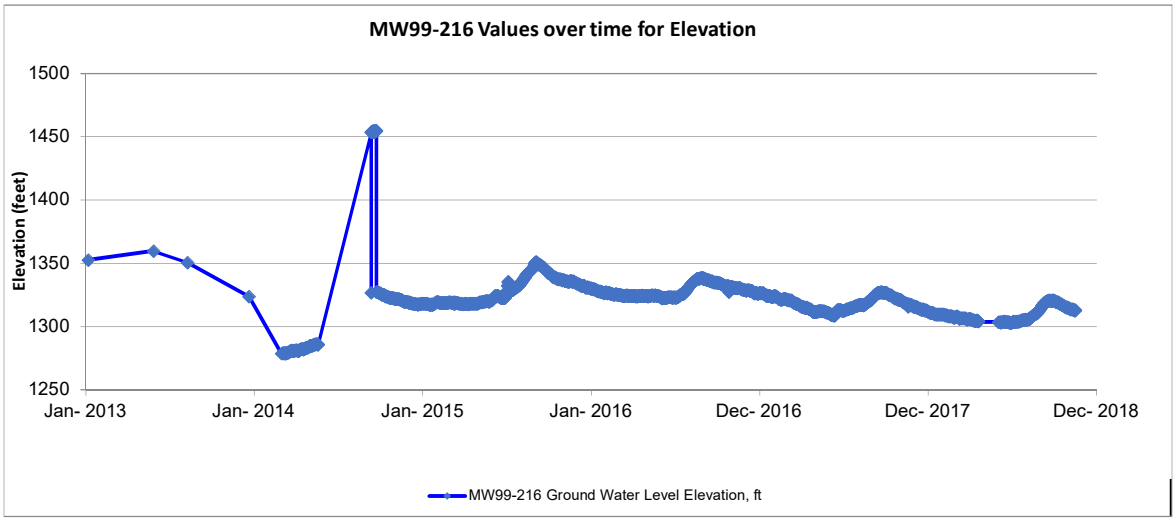

Values over time for Zinc, dissolved (ug/L)
(Zinc is hardness dependant. For graphing purposed, the lowest value in the data set was used for the WQS.)
Zinc, dissolved (ug/L)
100
10
1
0.1
Jan- 2013
Jan- 2014
Jan- 2015
Jan- 2016
Dec- 2016
Dec- 2017
Dec- 2018
MW11-001B Zinc, Dissolved (ug/l as Zn)
Ground Water Quality Standards Limit Zinc, Dissolved (ug/l as Zn)
MW11-001A Zinc, Dissolved (ug/l as Zn)

APPENDIX C –

MW99-216 and LT99-0099

Groundwater Elevation Graphs

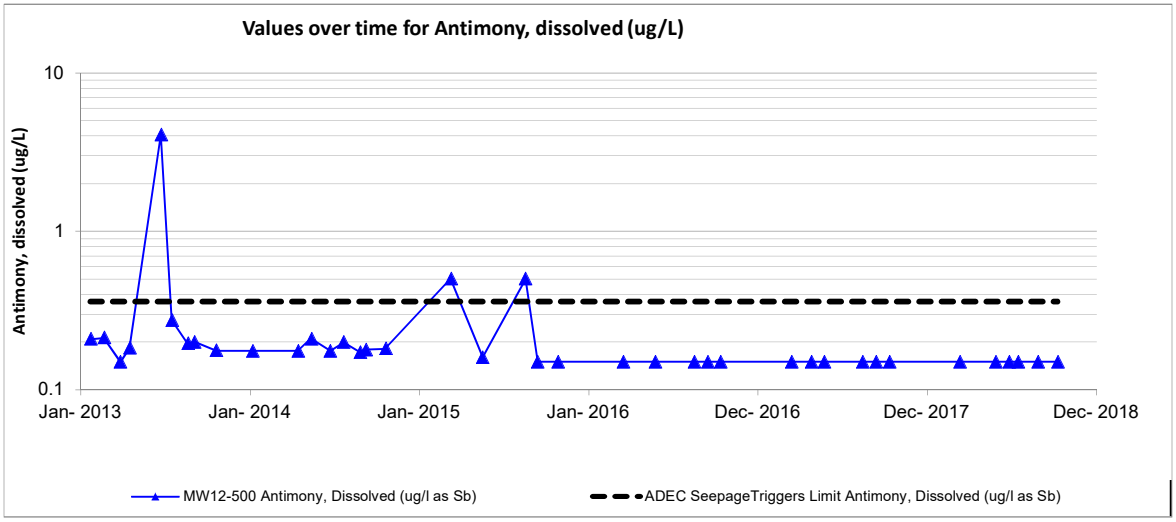

LT99-009 Values over time for Elevation
Elevation (feet)
2170
2165
2160
2155
2150
2145
2140
Jan- 2013
Jan- 2014
Jan- 2015
Jan- 2016
Dec- 2016
Dec- 2017
Dec- 2018
LT99-009 Ground Water Level Elevation, ft

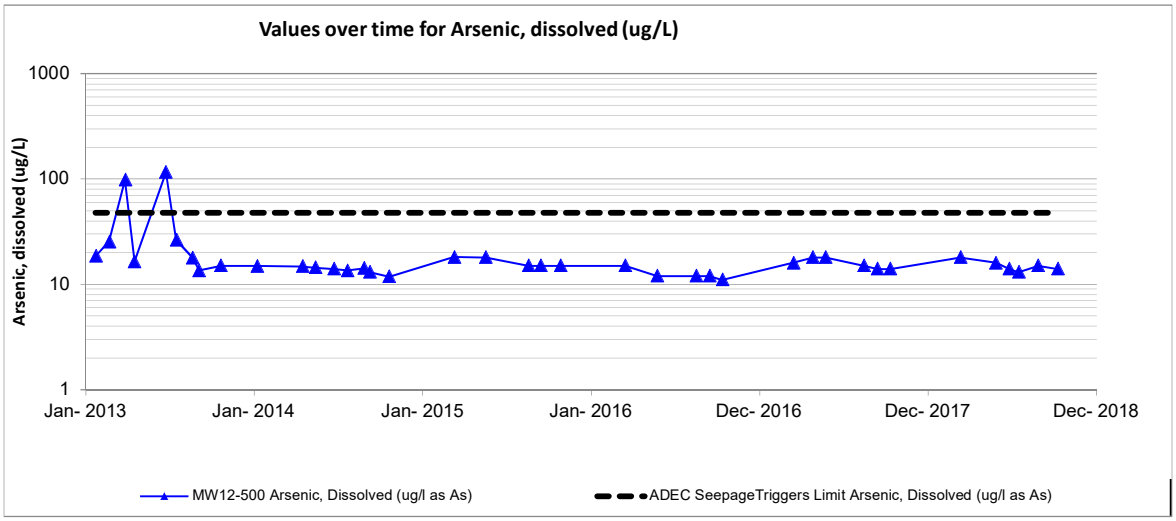

MW99-216 Values over time for Elevation
Elevation (feet)
1500
1450
1400
1350
1300
1250
Jan- 2013
Jan- 2014
Jan- 2015
Jan- 2016
Dec- 2016
Dec- 2017
Dec- 2018
MW99-216 Ground Water Level Elevation, ft

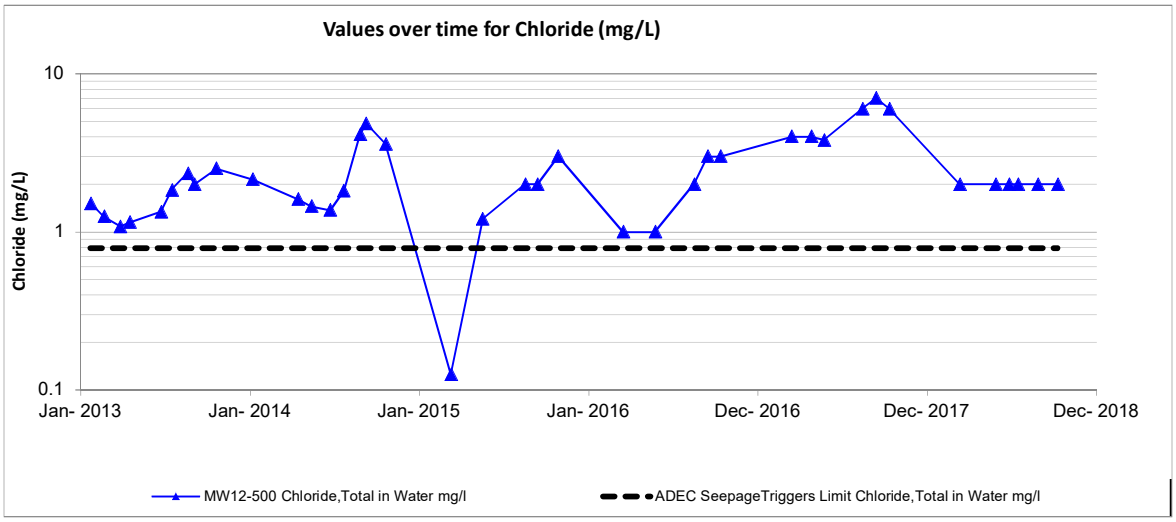
APPENDIX C –

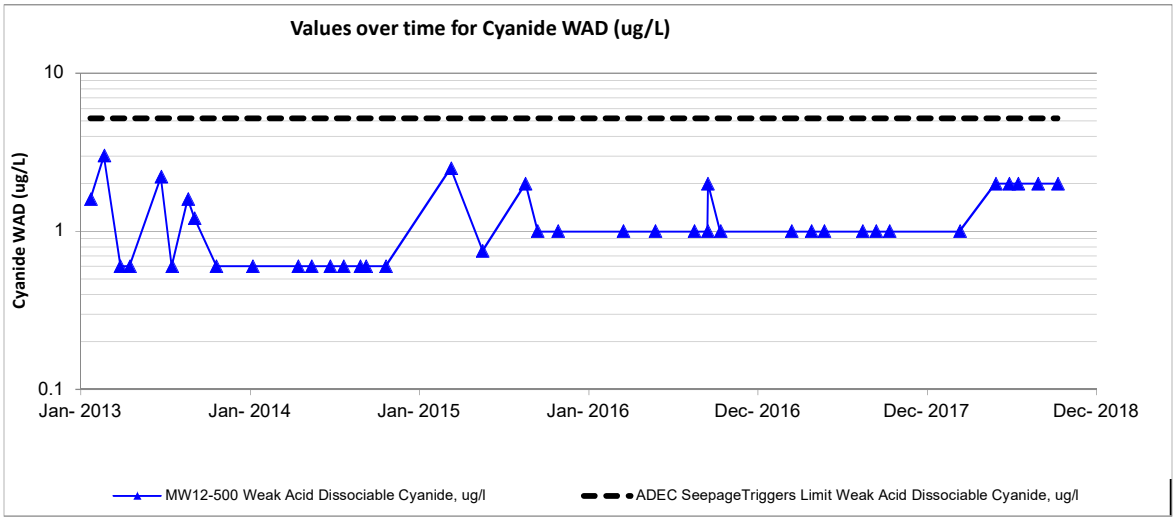
MW12-500 Well Graphs

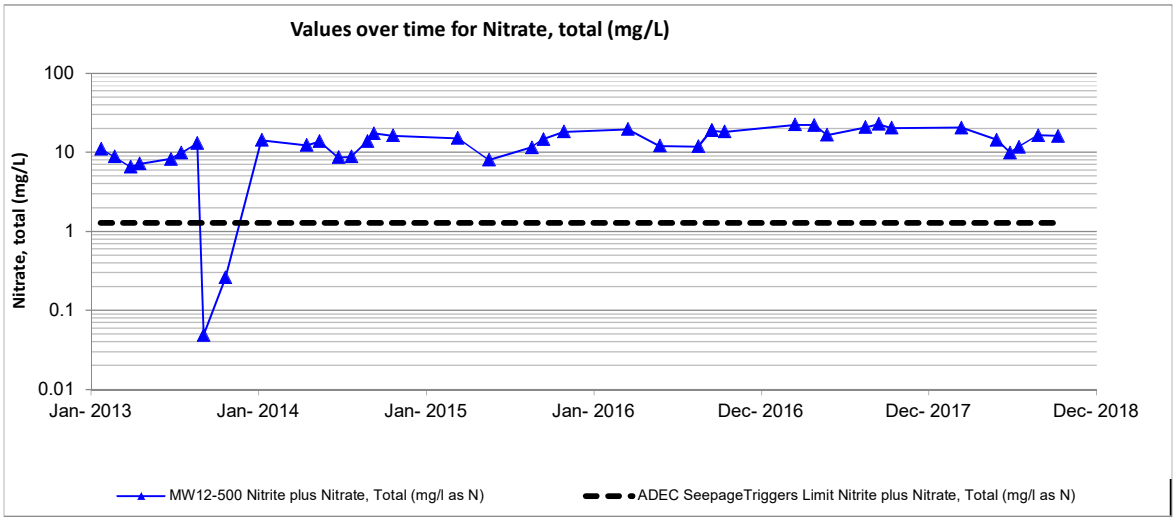
with Seepage Trigger Limits

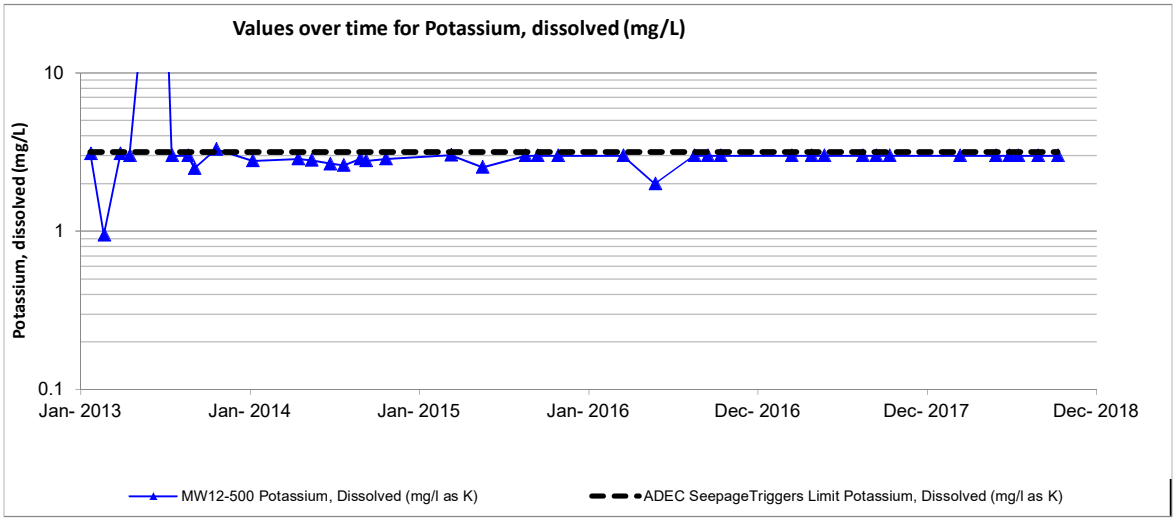

Values over time for Antimony, dissolved (ug/L)
Antimony, dissolved (ug/L)
10
1
0.1
Jan- 2013
Jan- 2014
Jan- 2015
Jan- 2016
Dec- 2016
Dec- 2017
Dec- 2018
MW12-500 Antimony, Dissolved (ug/l as Sb)
ADEC SeepageTriggers Limit Antimony, Dissolved (ug/l as Sb)

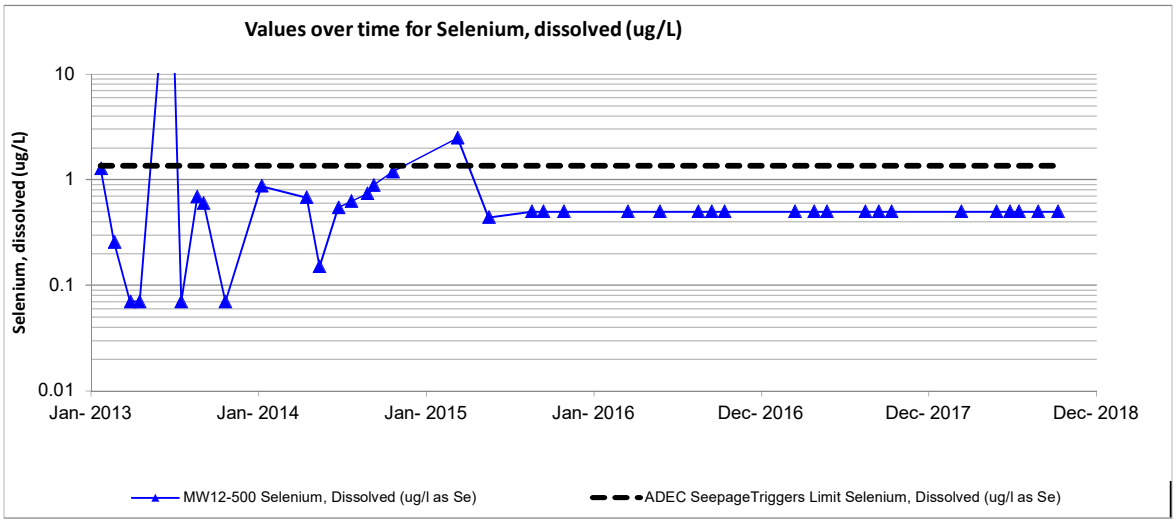

Values over time for Arsenic, dissolved (ug/L)
Arsenic, dissolved (ug/L)
1000
100
10
1
Jan- 2013
Jan- 2014
Jan- 2015
Jan- 2016
Dec- 2016
Dec- 2017
Dec- 2018
MW12-500 Arsenic, Dissolved (ug/l as As)
ADEC SeepageTriggers Limit Arsenic, Dissolved (ug/l as As)

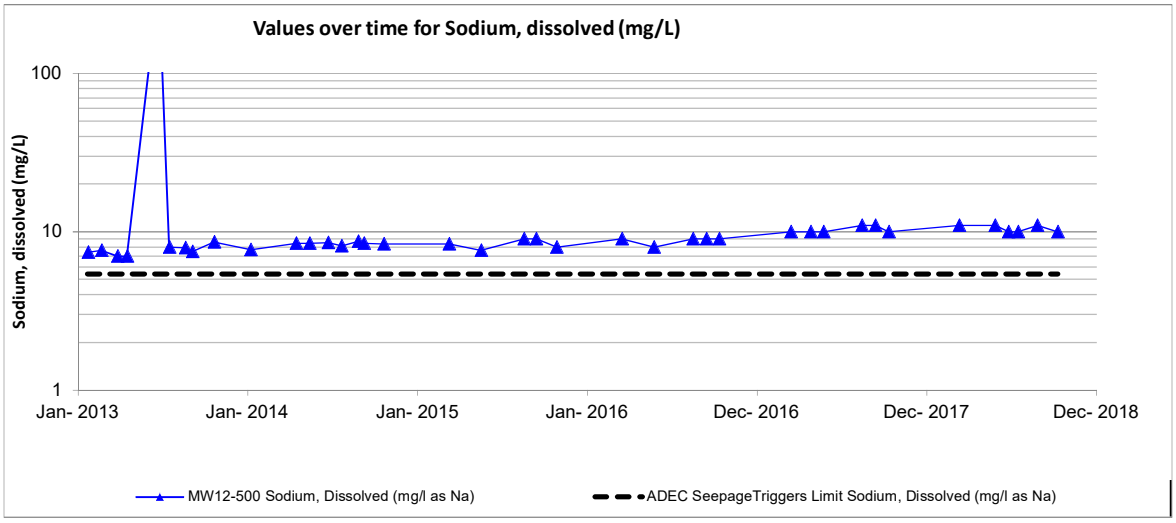

Values over time for Chloride (mg/L)
Chloride (mg/L)
10
1
0.1
Jan- 2013
Jan- 2014
Jan- 2015
Jan- 2016
Dec- 2016
Dec- 2017
Dec- 2018
MW12-500 Chloride,Total in Water mg/l
ADEC SeepageTriggers Limit Chloride,Total in Water mg/l


Values over time for Cyanide WAD (ug/L)
Cyanide WAD (ug/L)
10
1
0.1
Jan- 2013
Jan- 2014
Jan- 2015
Jan- 2016
Dec- 2016
Dec- 2017
Dec- 2018
MW12-500 Weak Acid Dissociable Cyanide, ug/l
ADEC SeepageTriggers Limit Weak Acid Dissociable Cyanide, ug/l


Values over time for Nitrate, total (mg/L)
Nitrate, total (mg/L)
100
10
1
0.1
0.01
Jan- 2013
Jan- 2014
Jan- 2015
Jan- 2016
Dec- 2016
Dec- 2017
Dec- 2018
MW12-500 Nitrite plus Nitrate, Total (mg/l as N)
ADEC SeepageTriggers Limit Nitrite plus Nitrate, Total (mg/l as N)


Values over time for Potassium, dissolved (mg/L)
Potassium, dissolved (mg/L)
10
1
0.1
Jan- 2013
Jan- 2014
Jan- 2015
Jan- 2016
Dec- 2016
Dec- 2017
Dec- 2018
MW12-500 Potassium, Dissolved (mg/l as K)
ADEC SeepageTriggers Limit Potassium, Dissolved (mg/l as K)

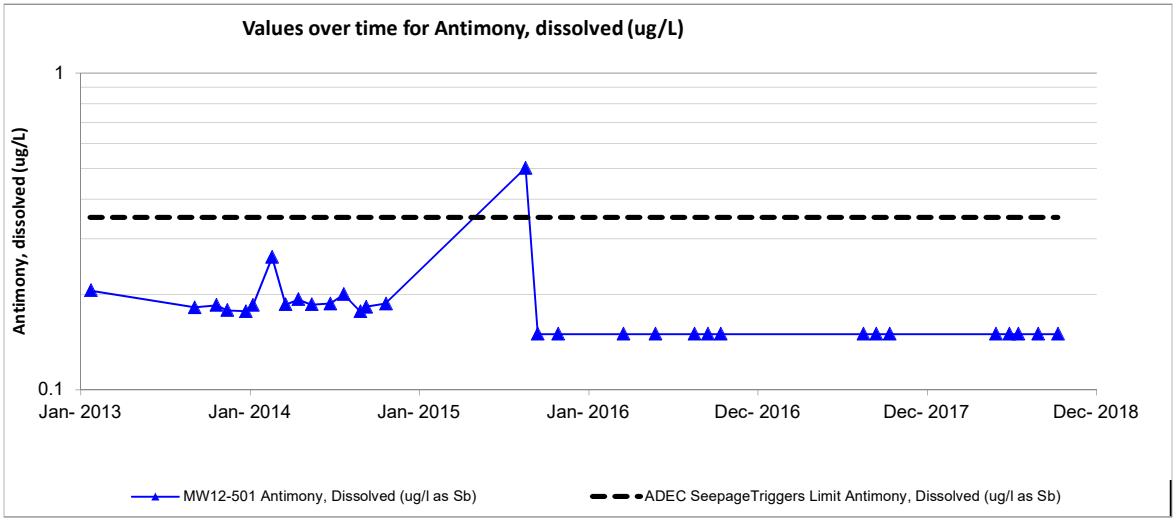

Values over time for Selenium, dissolved (ug/L)
Selenium, dissolved (ug/L)
10
1
0.1
0.01
Jan- 2013
Jan- 2014
Jan- 2015
Jan- 2016
Dec- 2016
Dec- 2017
Dec- 2018
MW12-500 Selenium, Dissolved (ug/l as Se)
ADEC SeepageTriggers Limit Selenium, Dissolved (ug/l as Se)

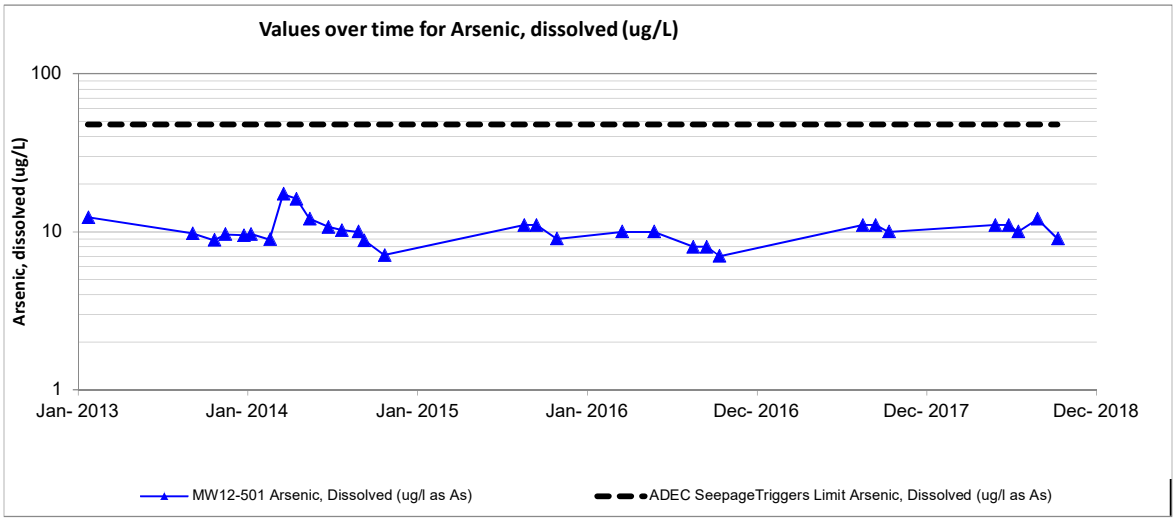

Values over time for Sodium, dissolved (mg/L)
Sodium, dissolved (mg/L)
100
10
1
Jan- 2013
Jan- 2014
Jan- 2015
Jan- 2016
Dec- 2016
Dec- 2017
Dec- 2018
MW12-500 Sodium, Dissolved (mg/l as Na)
ADEC SeepageTriggers Limit Sodium, Dissolved (mg/l as Na)

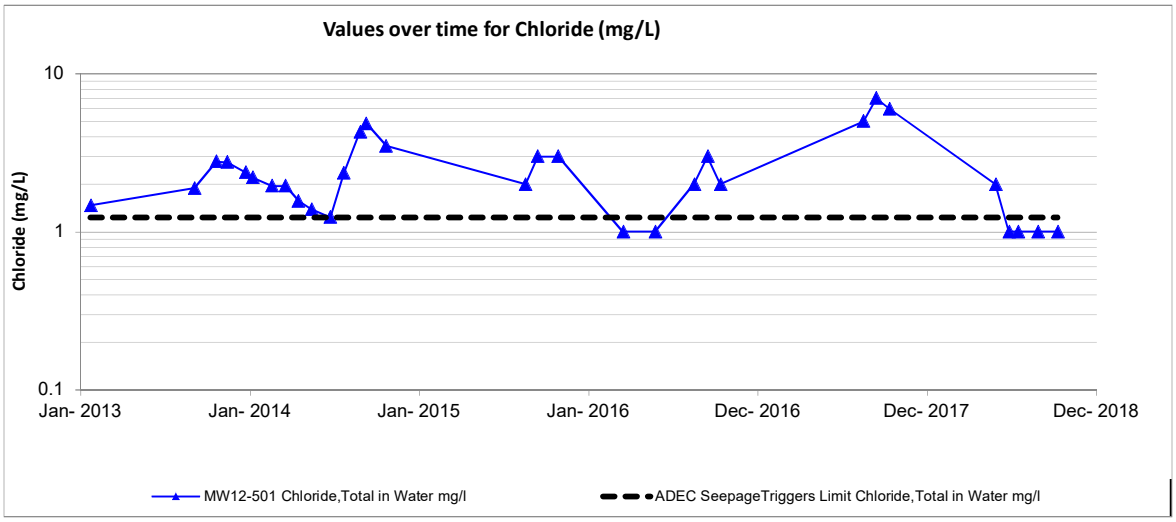
APPENDIX C –

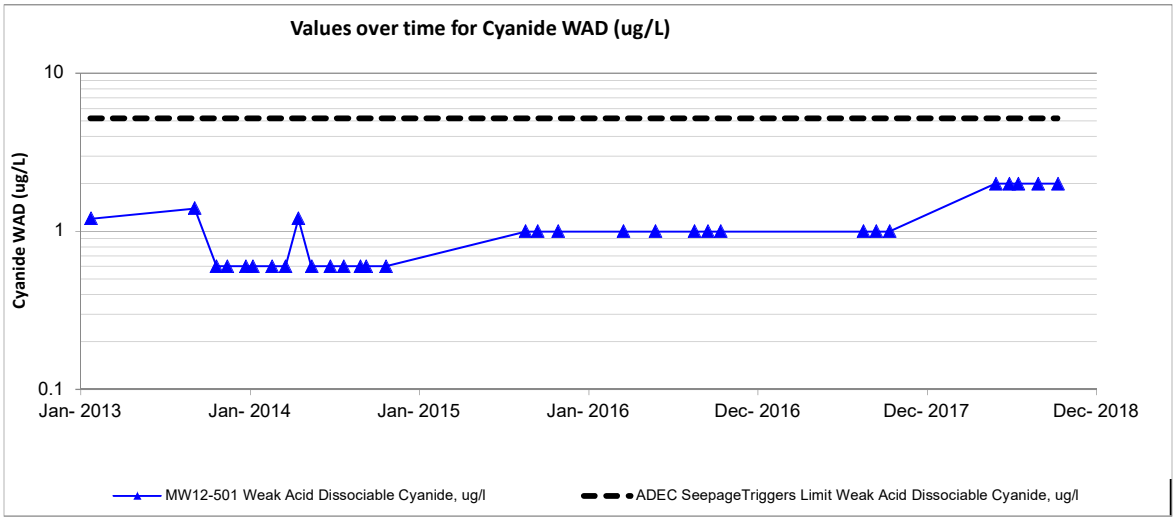
MW12-501 Well Graphs

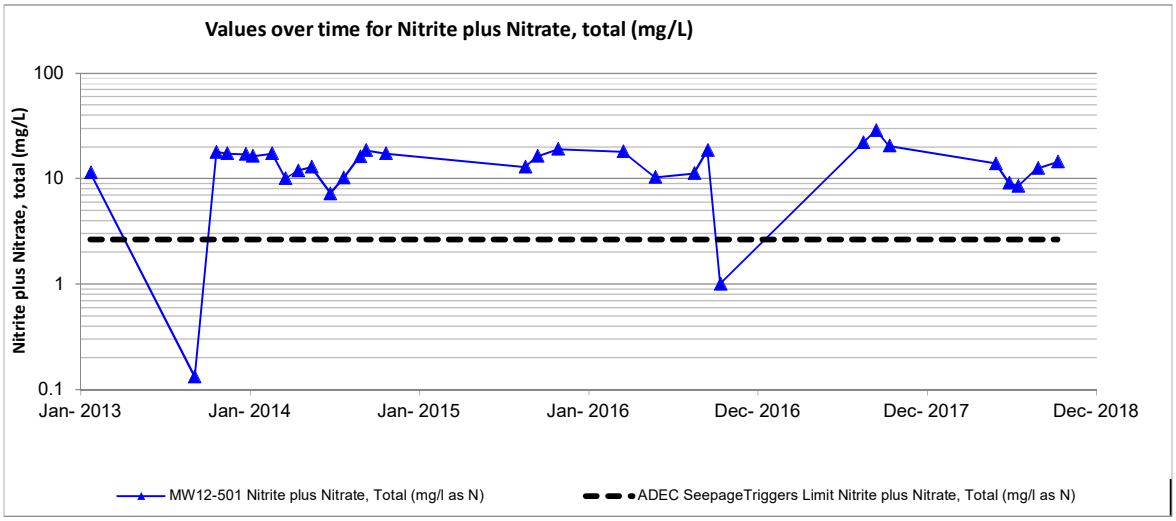
with Seepage Trigger Limits

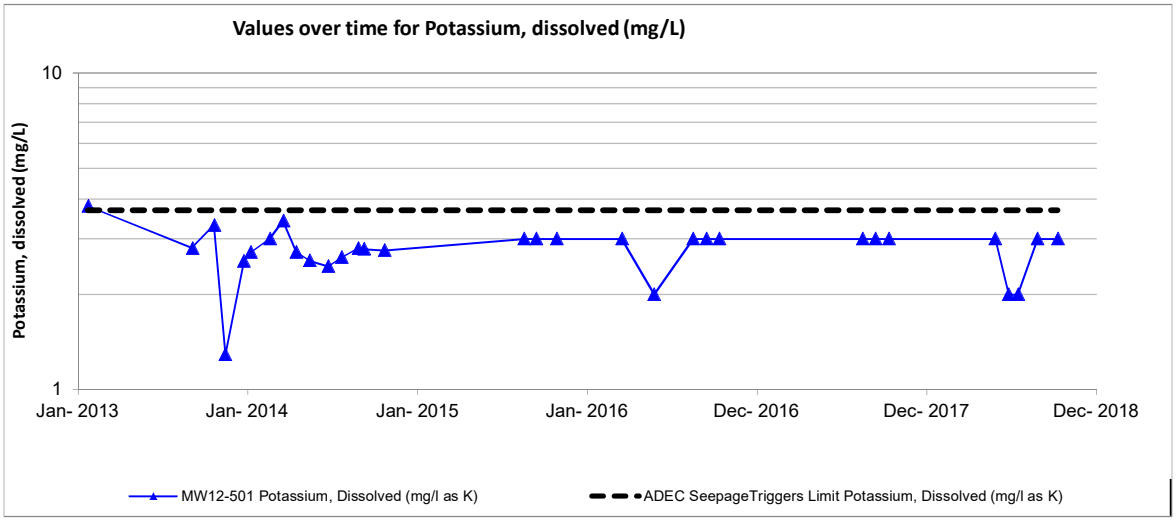

Values over time for Antimony, dissolved (ug/L)
Antimony, dissolved (ug/L)
1
0.1
Jan- 2013
Jan- 2014
Jan- 2015
Jan- 2016
Dec- 2016
Dec- 2017
Dec- 2018
MW12-501 Antimony, Dissolved (ug/l as Sb)
ADEC SeepageTriggers Limit Antimony, Dissolved (ug/l as Sb)

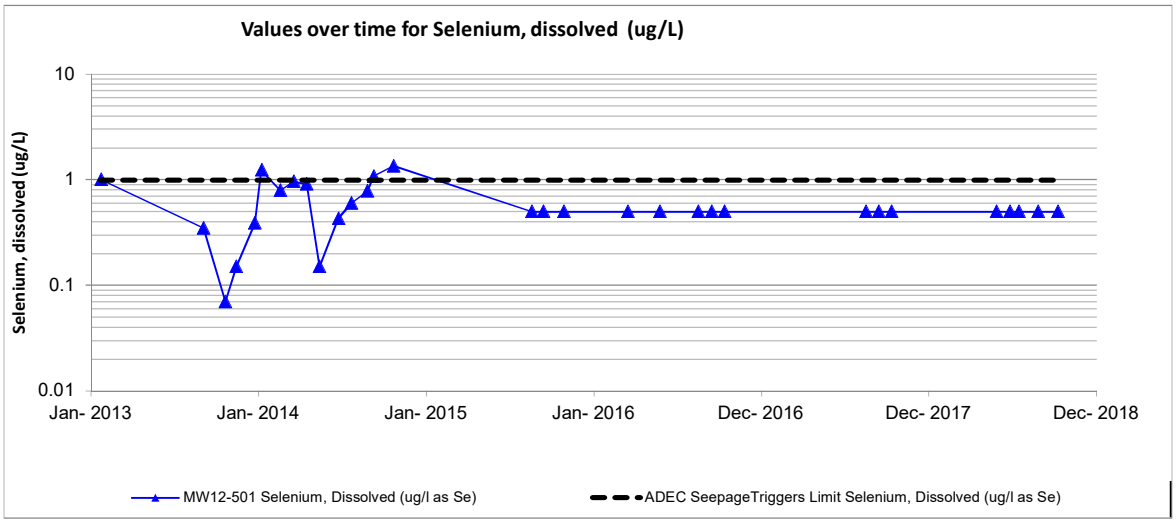

Values over time for Arsenic, dissolved (ug/L)
Arsenic, dissolved (ug/L)
100
10
1
Jan- 2013
Jan- 2014
Jan- 2015
Jan- 2016
Dec- 2016
Dec- 2017
Dec- 2018
MW12-501 Arsenic, Dissolved (ug/l as As)
ADEC SeepageTriggers Limit Arsenic, Dissolved (ug/l as As)

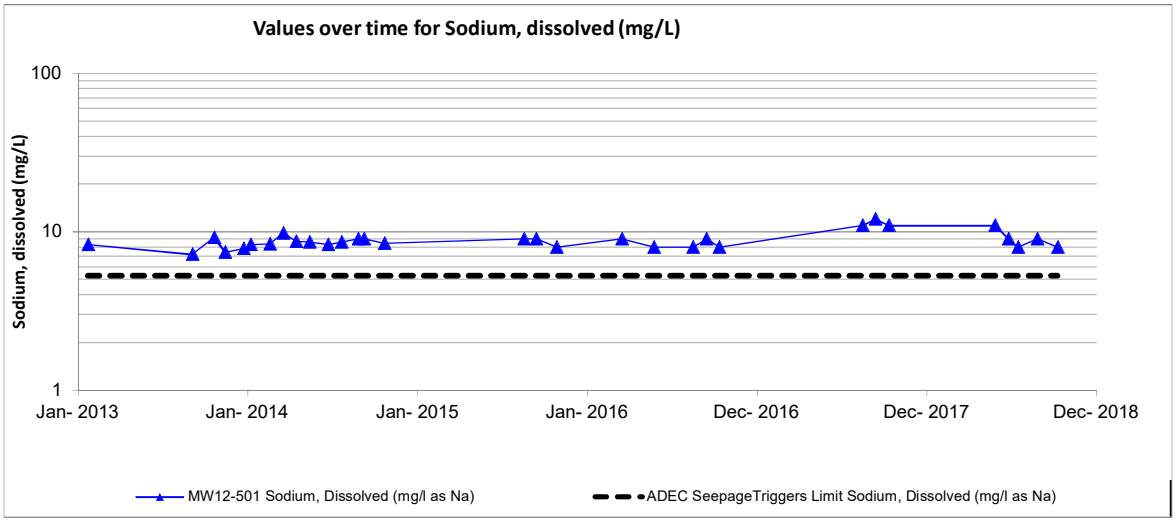

Values over time for Chloride (mg/L)
Chloride (mg/L)
10
1
0.1
Jan- 2013
Jan- 2014
Jan- 2015
Jan- 2016
Dec- 2016
Dec- 2017
Dec- 2018
MW12-501 Chloride,Total in Water mg/l
ADEC SeepageTriggers Limit Chloride,Total in Water mg/l


Values over time for Cyanide WAD (ug/L)
Cyanide WAD (ug/L)
10
1
0.1
Jan- 2013
Jan- 2014
Jan- 2015
Jan- 2016
Dec- 2016
Dec- 2017
Dec- 2018
MW12-501 Weak Acid Dissociable Cyanide, ug/l
ADEC SeepageTriggers Limit Weak Acid Dissociable Cyanide, ug/l


Values over time for Nitrite plus Nitrate, total (mg/L)
Nitrite plus Nitrate, total (mg/L)
100
10
1
0.1
Jan- 2013
Jan- 2014
Jan- 2015
Jan- 2016
Dec- 2016
Dec- 2017
Dec- 2018
MW12-501 Nitrite plus Nitrate, Total (mg/l as N)
ADEC SeepageTriggers Limit Nitrite plus Nitrate, Total (mg/l as N)


Values over time for Potassium, dissolved (mg/L)
Potassium, dissolved (mg/L)
10
1
Jan- 2013
Jan- 2014
Jan- 2015
Jan- 2016
Dec- 2016
Dec- 2017
Dec- 2018
MW12-501 Potassium, Dissolved (mg/l as K)
ADEC SeepageTriggers Limit Potassium, Dissolved (mg/l as K)

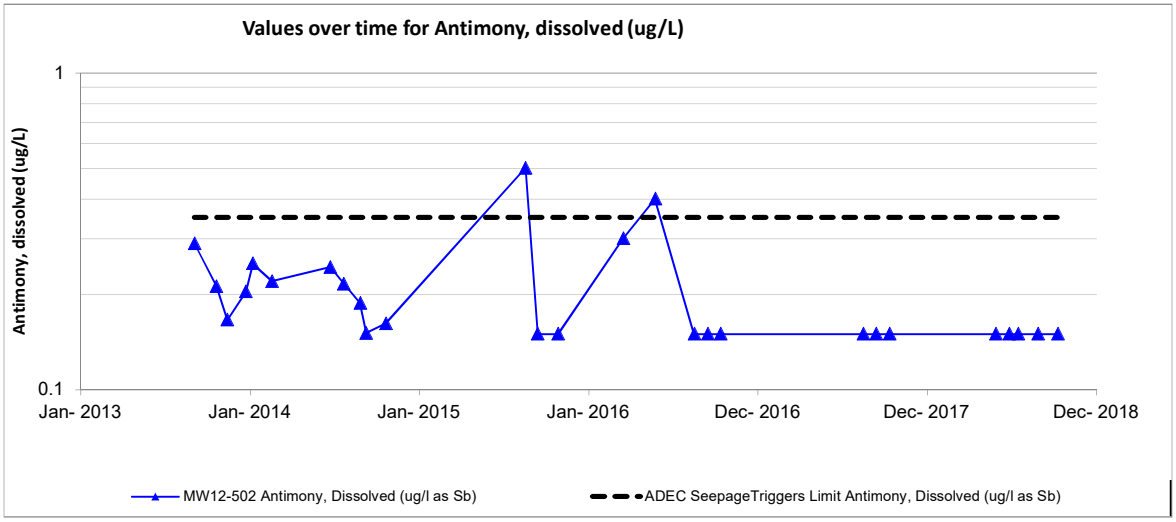

Values over time for Selenium, dissolved (ug/L)
Selenium, dissolved (ug/L)
10
1
0.1
0.01
Jan- 2013
Jan- 2014
Jan- 2015
Jan- 2016
Dec- 2016
Dec- 2017
Dec- 2018
MW12-501 Selenium, Dissolved (ug/l as Se)
ADEC SeepageTriggers Limit Selenium, Dissolved (ug/l as Se)

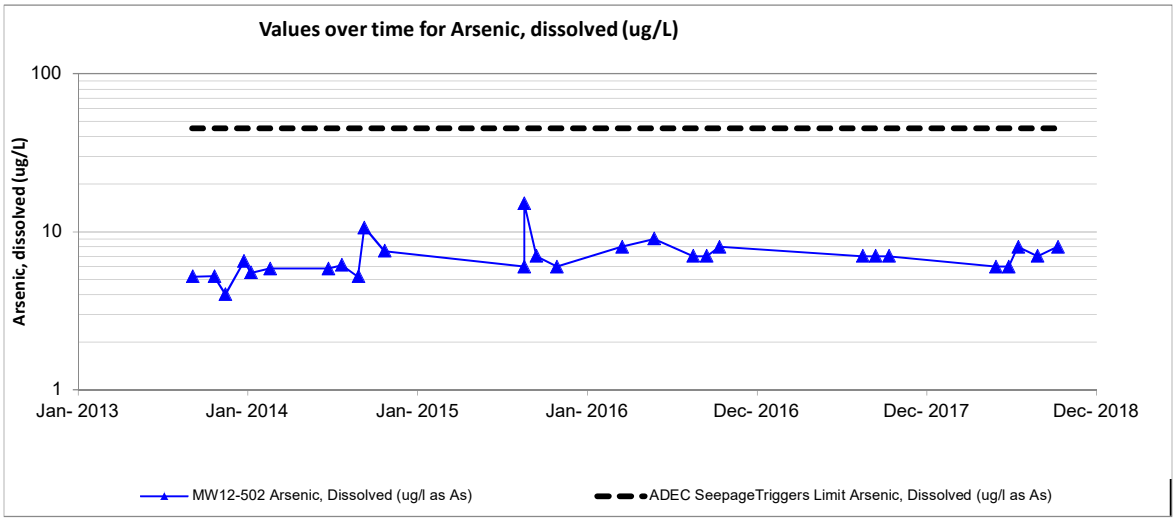

Values over time for Sodium, dissolved (mg/L)
Sodium, dissolved (mg/L)
100
10
1
Jan- 2013
Jan- 2014
Jan- 2015
Jan- 2016
Dec- 2016
Dec- 2017
Dec- 2018
MW12-501 Sodium, Dissolved (mg/l as Na)
ADEC SeepageTriggers Limit Sodium, Dissolved (mg/l as Na)

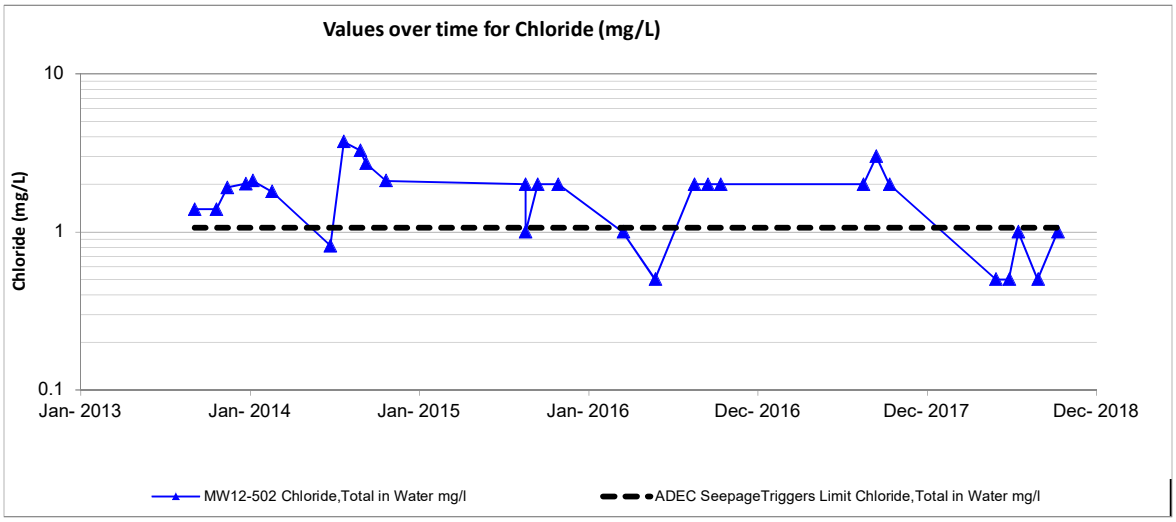
APPENDIX C –

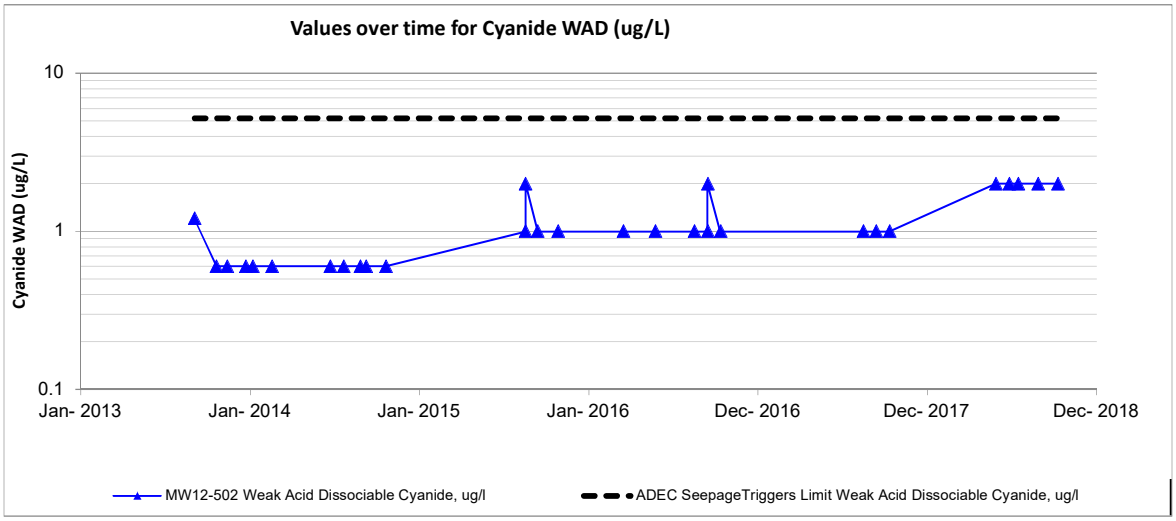
MW12-502 Well Graphs

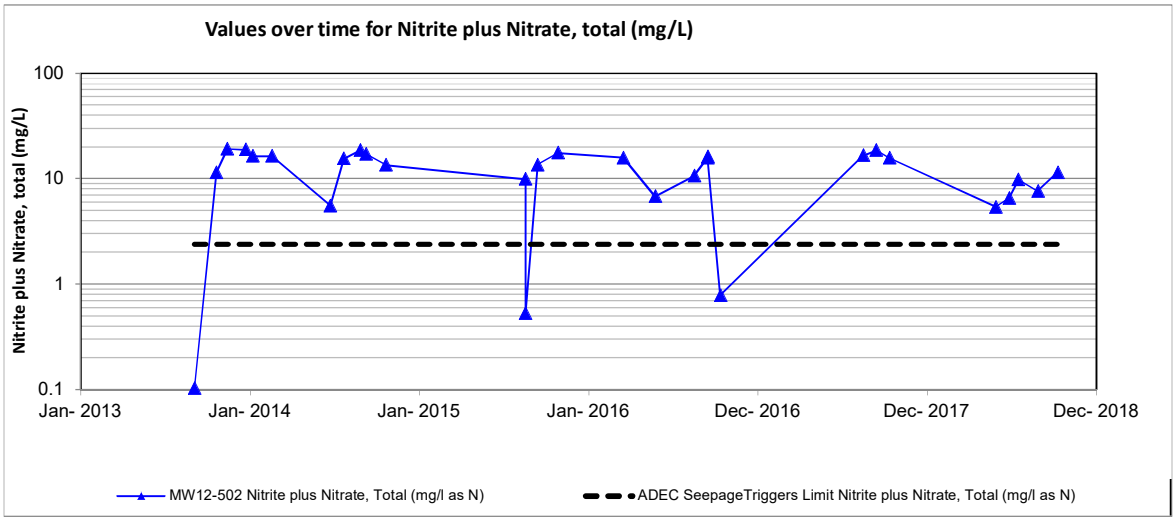
with Seepage Trigger Limits

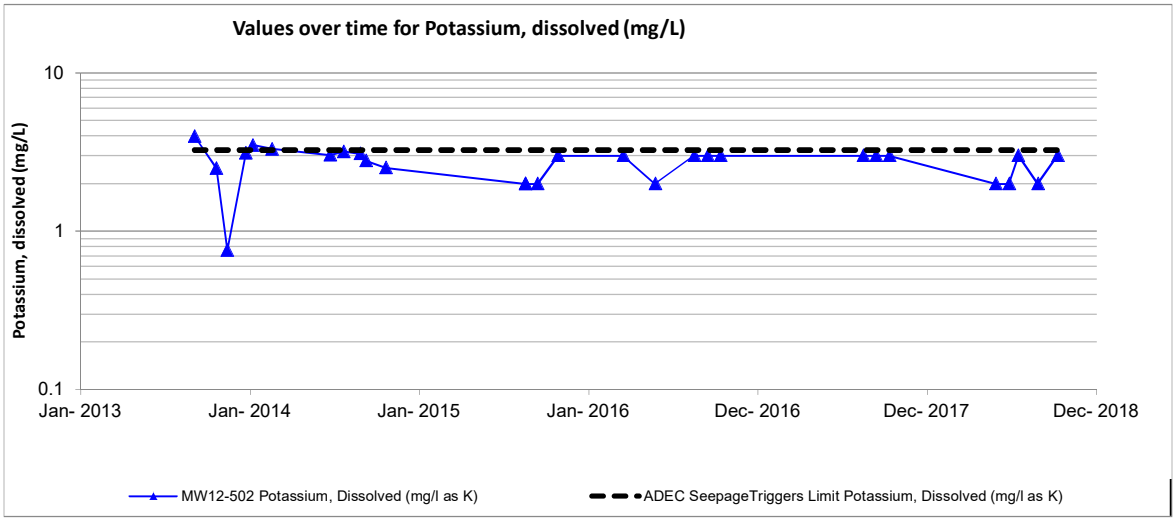

Values over time for Antimony, dissolved (ug/L)
Antimony, dissolved (ug/L)
1
0.1
Jan- 2013
Jan- 2014
Jan- 2015
Jan- 2016
Dec- 2016
Dec- 2017
Dec- 2018
MW12-502 Antimony, Dissolved (ug/l as Sb)
ADEC SeepageTriggers Limit Antimony, Dissolved (ug/l as Sb)

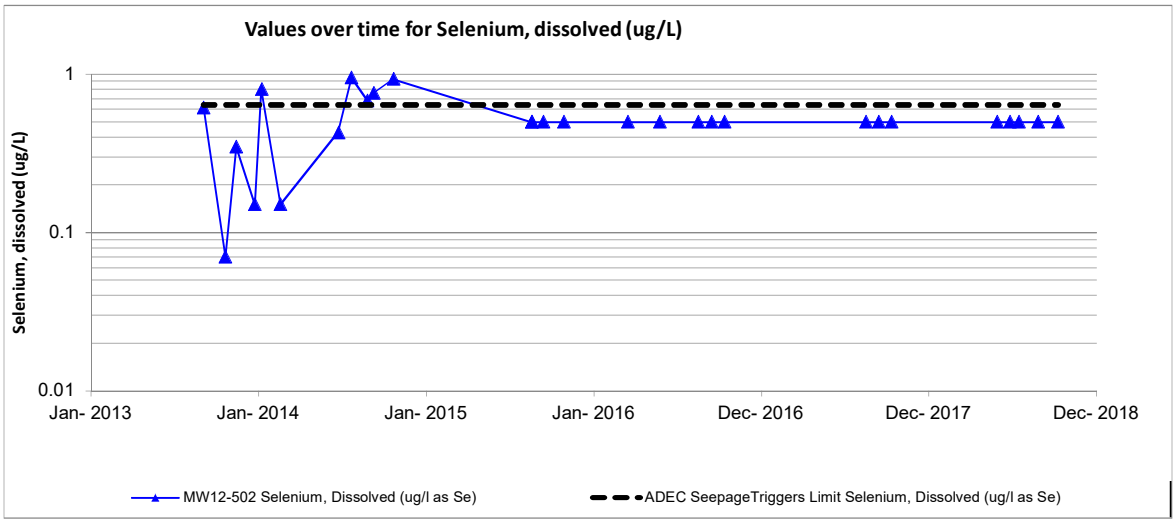

Values over time for Arsenic, dissolved (ug/L)
Arsenic, dissolved (ug/L)
100
10
1
Jan- 2013
Jan- 2014
Jan- 2015
Jan- 2016
Dec- 2016
Dec- 2017
Dec- 2018
MW12-502 Arsenic, Dissolved (ug/l as As)
ADEC SeepageTriggers Limit Arsenic, Dissolved (ug/l as As)

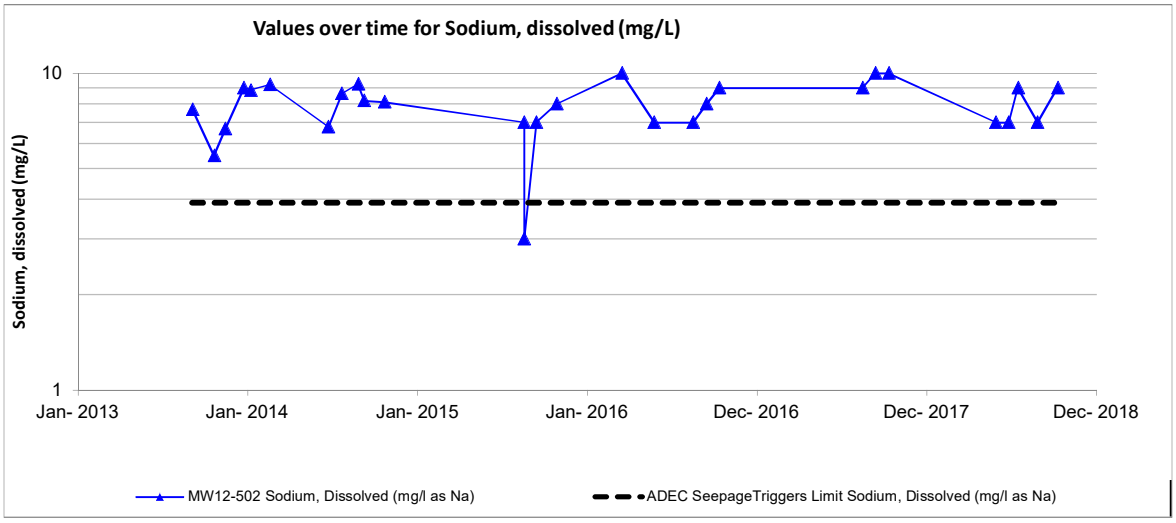

Values over time for Chloride (mg/L)
Chloride (mg/L)
10
1
0.1
Jan- 2013
Jan- 2014
Jan- 2015
Jan- 2016
Dec- 2016
Dec- 2017
Dec- 2018
MW12-502 Chloride,Total in Water mg/l
ADEC SeepageTriggers Limit Chloride,Total in Water mg/l


Values over time for Cyanide WAD (ug/L)
Cyanide WAD (ug/L)
10
1
0.1
Jan- 2013
Jan- 2014
Jan- 2015
Jan- 2016
Dec- 2016
Dec- 2017
Dec- 2018
MW12-502 Weak Acid Dissociable Cyanide, ug/l
ADEC SeepageTriggers Limit Weak Acid Dissociable Cyanide, ug/l


Values over time for Nitrite plus Nitrate, total (mg/L)
Nitrite plus Nitrate, total (mg/L)
100
10
1
0.1
Jan- 2013
Jan- 2014
Jan- 2015
Jan- 2016
Dec- 2016
Dec- 2017
Dec- 2018
MW12-502 Nitrite plus Nitrate, Total (mg/l as N)
ADEC SeepageTriggers Limit Nitrite plus Nitrate, Total (mg/l as N)


Values over time for Potassium, dissolved (mg/L)
Potassium, dissolved (mg/L)
10
1
0.1
Jan- 2013
Jan- 2014
Jan- 2015
Jan- 2016
Dec- 2016
Dec- 2017
Dec- 2018
MW12-502 Potassium, Dissolved (mg/l as K)
ADEC SeepageTriggers Limit Potassium, Dissolved (mg/l as K)

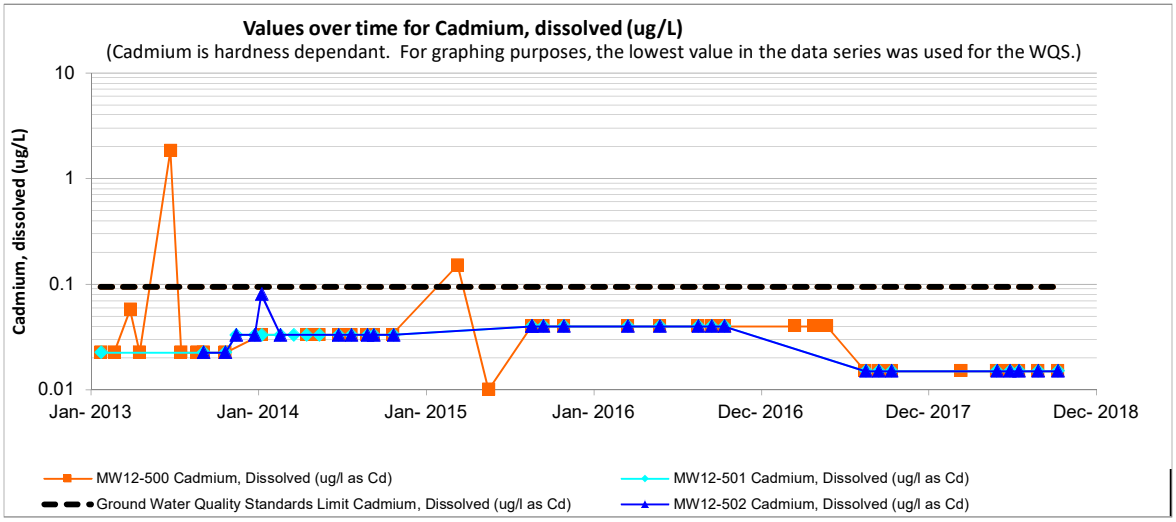

Values over time for Selenium, dissolved (ug/L)
Selenium, dissolved (ug/L)
1
0.1
0.01
Jan- 2013
Jan- 2014
Jan- 2015
Jan- 2016
Dec- 2016
Dec- 2017
Dec- 2018
MW12-502 Selenium, Dissolved (ug/l as Se)
ADEC SeepageTriggers Limit Selenium, Dissolved (ug/l as Se)

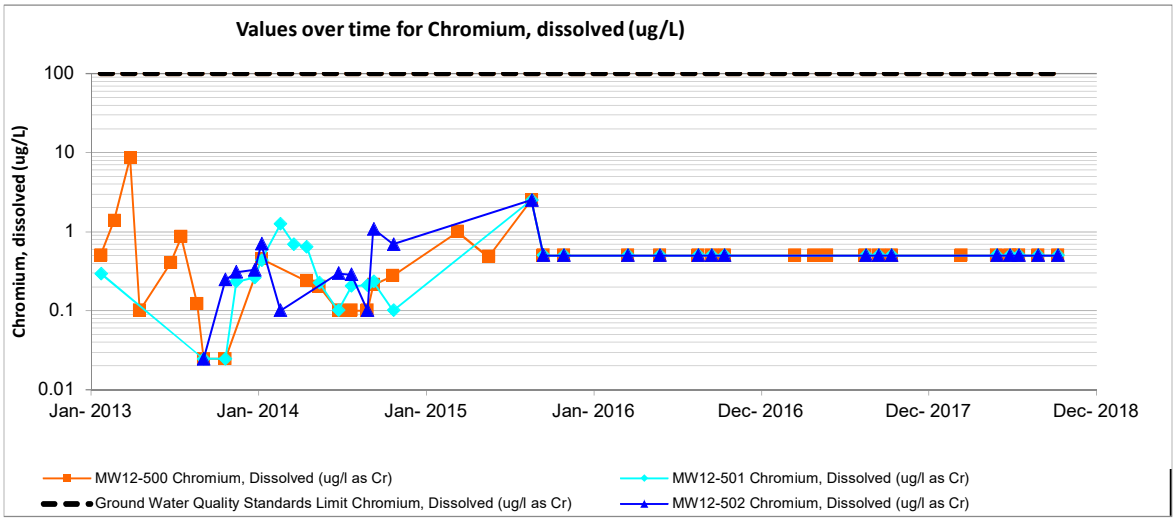

Values over time for Sodium, dissolved (mg/L)
Sodium, dissolved (mg/L)
10
1
Jan- 2013
Jan- 2014
Jan- 2015
Jan- 2016
Dec- 2016
Dec- 2017
Dec- 2018
MW12-502 Sodium, Dissolved (mg/l as Na)
ADEC SeepageTriggers Limit Sodium, Dissolved (mg/l as Na)

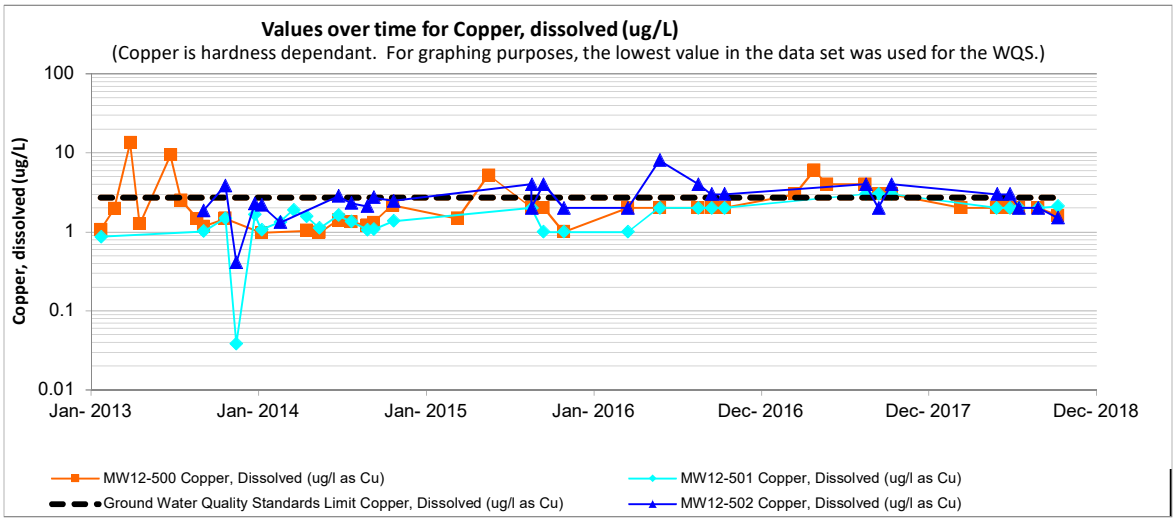
APPENDIX C –

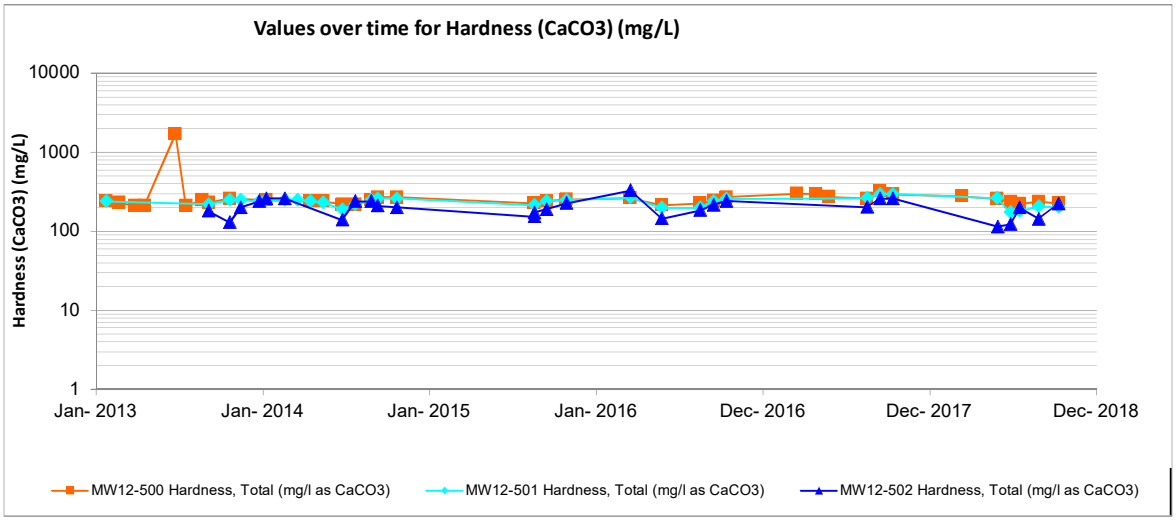
MW12-500 Wells

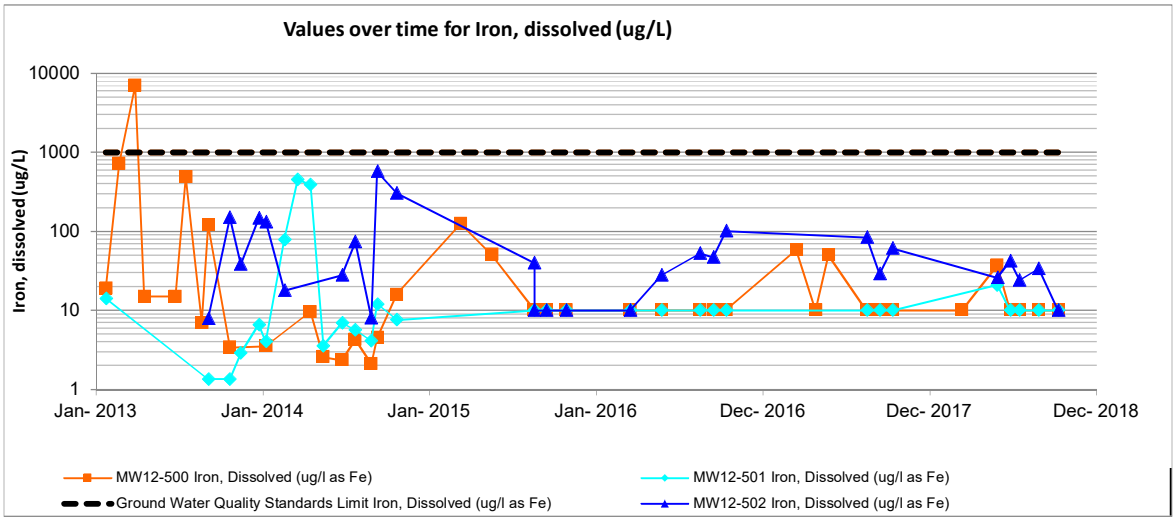
Graphs with WQS

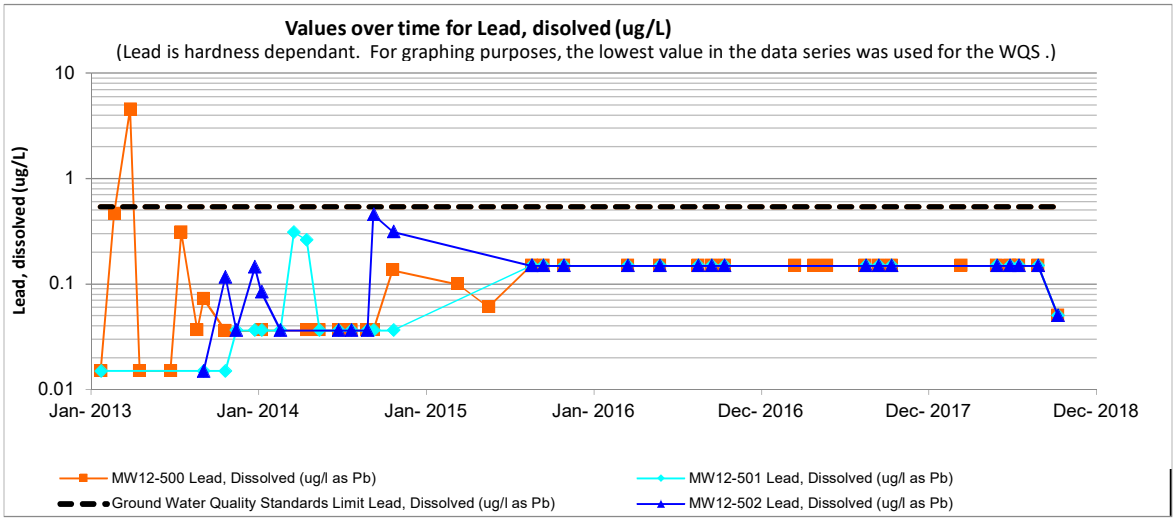

Values over time for Cadmium, dissolved (ug/L)
(Cadmium is hardness dependant. For graphing purposes, the lowest value in the data series was used for the WQS.)
Cadmium, dissolved (ug/L)
10
1
0.1
0.01
Jan- 2013
Jan- 2014
Jan- 2015
Jan- 2016
Dec- 2016
Dec- 2017
Dec- 2018
MW12-500 Cadmium, Dissolved (ug/l as Cd)
MW12-501 Cadmium, Dissolved (ug/l as Cd)
Ground Water Quality Standards Limit Cadmium, Dissolved (ug/l as Cd)
MW12-502 Cadmium, Dissolved (ug/l as Cd)

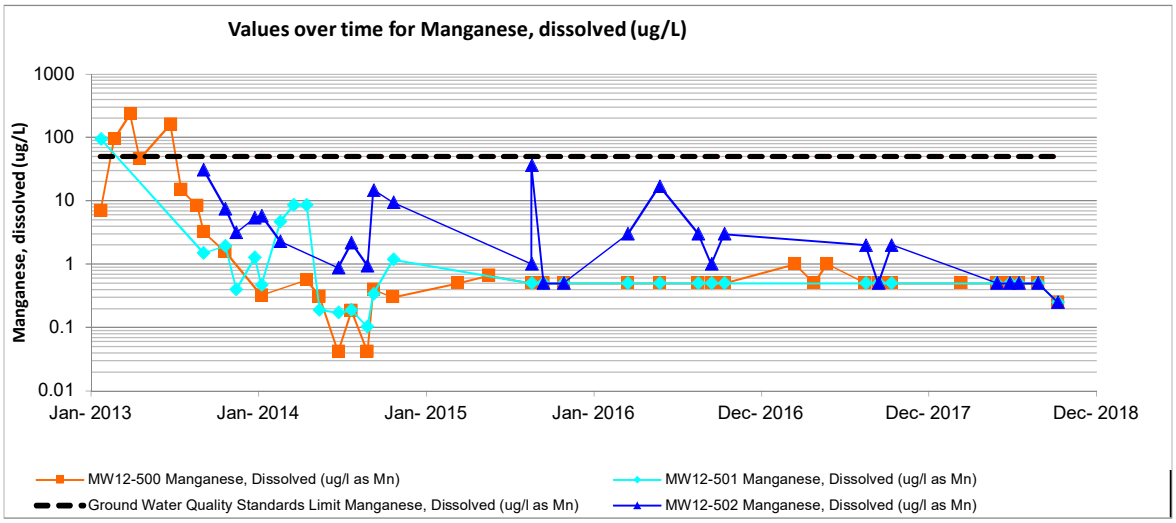

Values over time for Chromium, dissolved (ug/L)
Chromium, dissolved (ug/L)
100
10
1
0.1
0.01
Jan- 2013
Jan- 2014
Jan- 2015
Jan- 2016
Dec- 2016
Dec- 2017
Dec- 2018
MW12-500 Chromium, Dissolved (ug/l as Cr)
MW12-501 Chromium, Dissolved (ug/l as Cr)
Ground Water Quality Standards Limit Chromium, Dissolved (ug/l as Cr)
MW12-502 Chromium, Dissolved (ug/l as Cr)

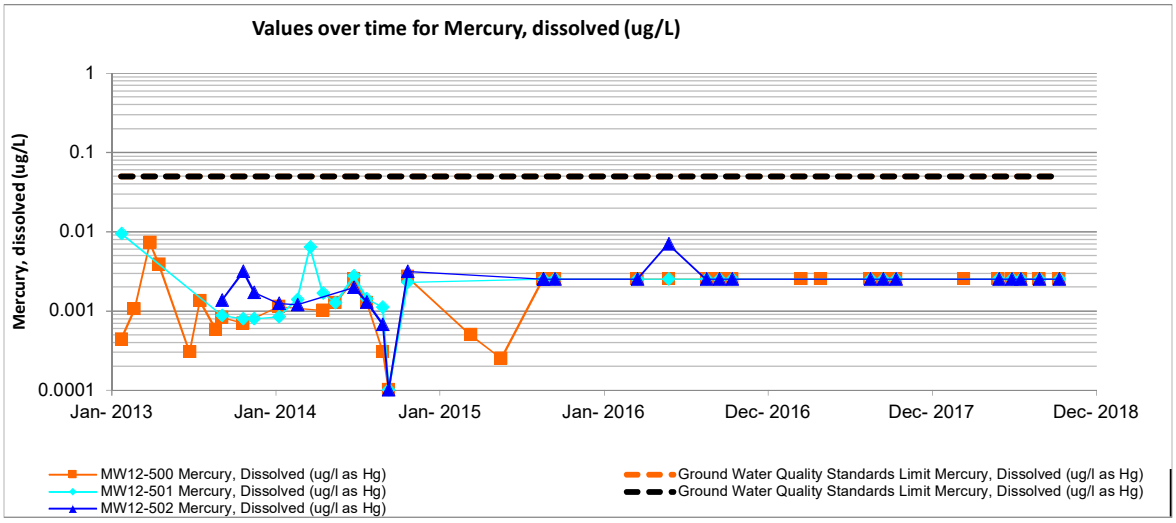

Values over time for Copper, dissolved (ug/L)
(Copper is hardness dependant. For graphing purposes, the lowest value in the data set was used for the WQS.)
Copper, dissolved (ug/L)
100
10
1
0.1
0.01
Jan- 2013
Jan- 2014
Jan- 2015
Jan- 2016
Dec- 2016
Dec- 2017
Dec- 2018
MW12-500 Copper, Dissolved (ug/l as Cu)
MW12-501 Copper, Dissolved (ug/l as Cu)
Ground Water Quality Standards Limit Copper, Dissolved (ug/l as Cu)
MW12-502 Copper, Dissolved (ug/l as Cu)

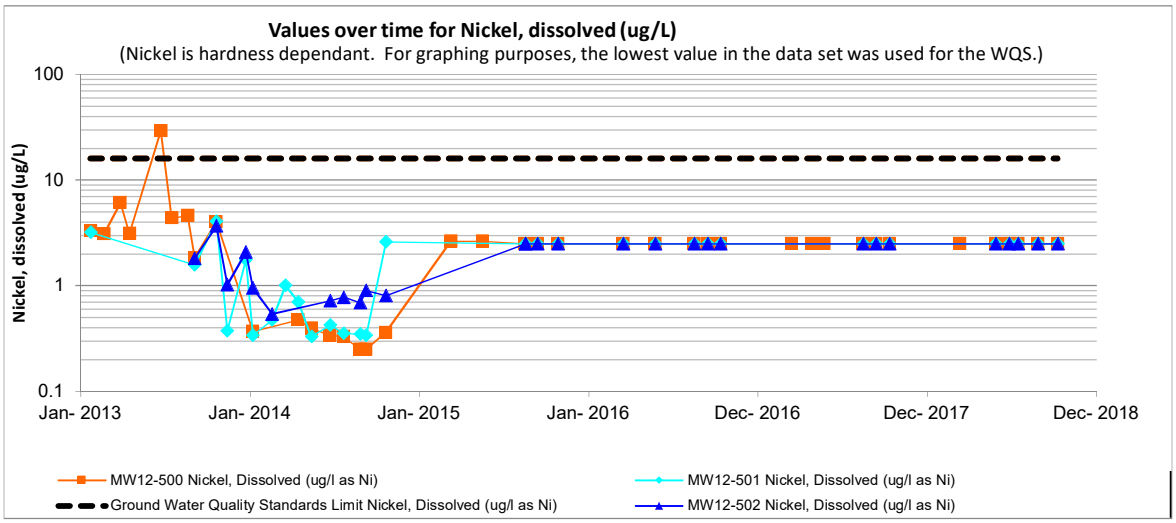

Values over time for Hardness (CaCO3) (mg/L)
Hardness (CaCO3) (mg/L)
10000
1000
100
10
1
Jan- 2013
Jan- 2014
Jan- 2015
Jan- 2016
Dec- 2016
Dec- 2017
Dec- 2018
MW12-500 Hardness, Total (mg/l as CaCO3)
MW12-501 Hardness, Total (mg/l as CaCO3)
MW12-502 Hardness, Total (mg/l as CaCO3)

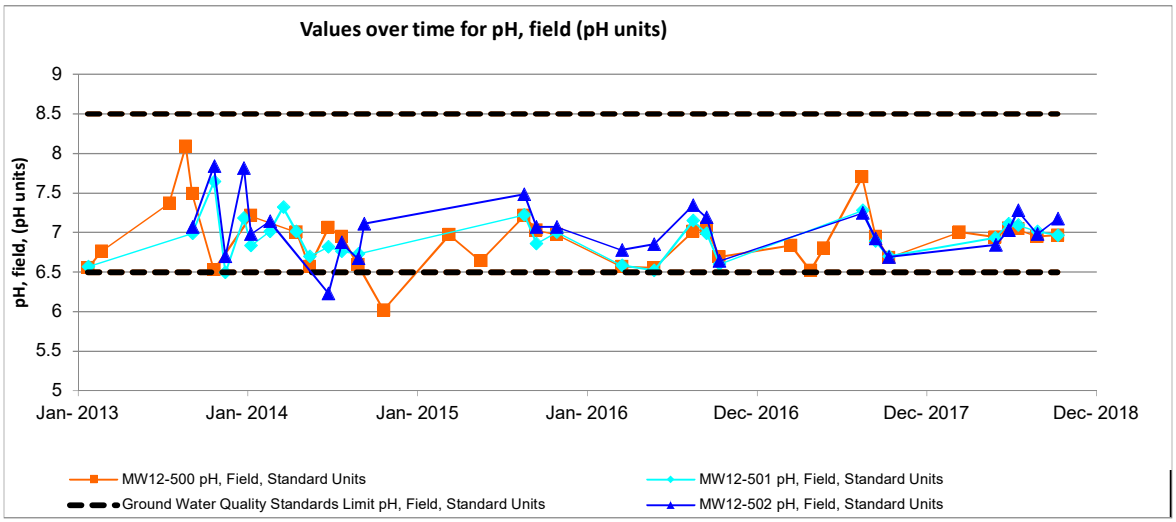

Values over time for Iron, dissolved (ug/L)
Iron, dissolved (ug/L)
10000
1000
100
10
1
Jan- 2013
Jan- 2014
Jan- 2015
Jan- 2016
Dec- 2016
Dec- 2017
Dec- 2018
MW12-500 Iron, Dissolved (ug/l as Fe)
MW12-501 Iron, Dissolved (ug/l as Fe)
Ground Water Quality Standards Limit Iron, Dissolved (ug/l as Fe)
MW12-502 Iron, Dissolved (ug/l as Fe)

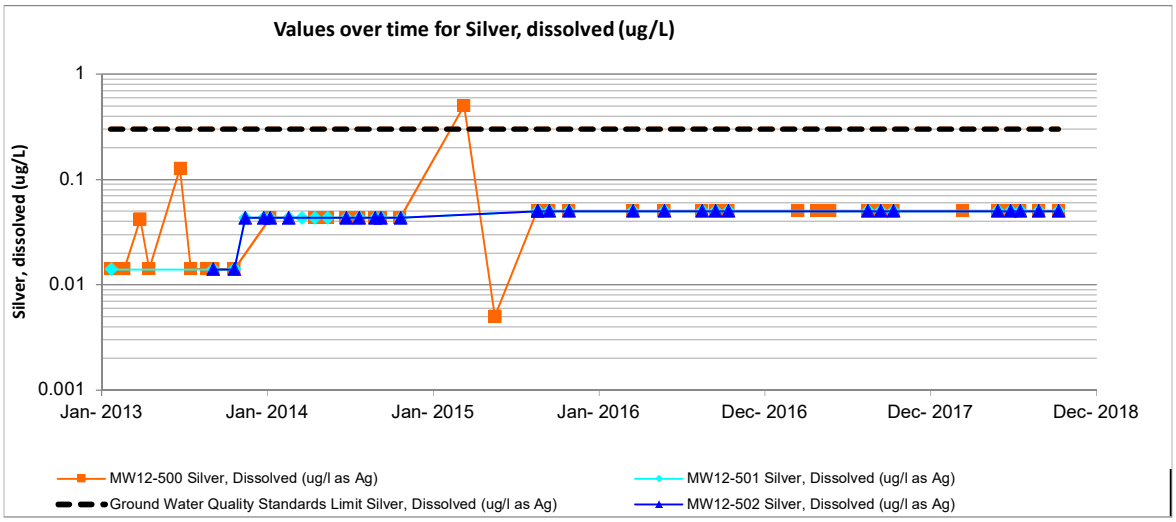

Values over time for Lead, disolved (ug/L)
(Lead is hardness dependant. For graphing purposes, the lowest value in the data series was used for the WQS .)
Lead, dissolved (ug/L)
10
1
0.1
0.01
Jan- 2013
Jan- 2014
Jan- 2015
Jan- 2016
Dec- 2016
Dec- 2017
Dec- 2018
MW12-500 Lead, Dissolved (ug/l as Pb)
MW12-501 Lead, Dissolved (ug/l as Pb)
Ground Water Quality Standards Limit Lead, Dissolved (ug/l as Pb)
MW12-502 Lead, Dissolved (ug/l as Pb)

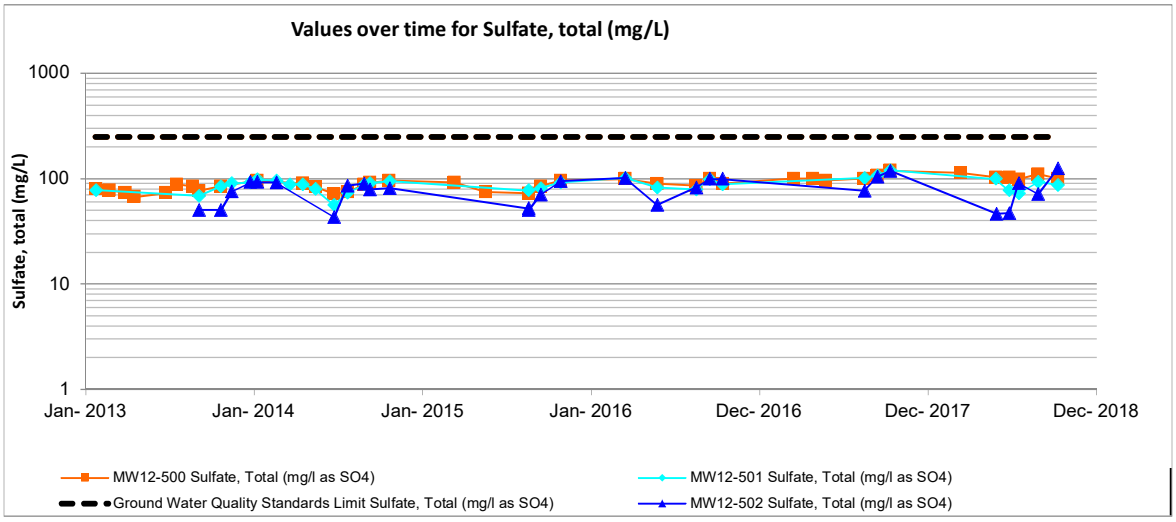

Values over time for Manganese, dissolved (ug/L)
Manganese, dissolved (ug/L)
1000
100
10
1
0.1
0.01
Jan- 2013
Jan- 2014
Jan- 2015
Jan- 2016
Dec- 2016
Dec- 2017
Dec- 2018
MW12-500 Manganese, Dissolved (ug/l as Mn)
MW12-501 Manganese, Dissolved (ug/l as Mn)
Ground Water Quality Standards Limit Manganese, Dissolved (ug/l as Mn)
MW12-502 Manganese, Dissolved (ug/l as Mn)

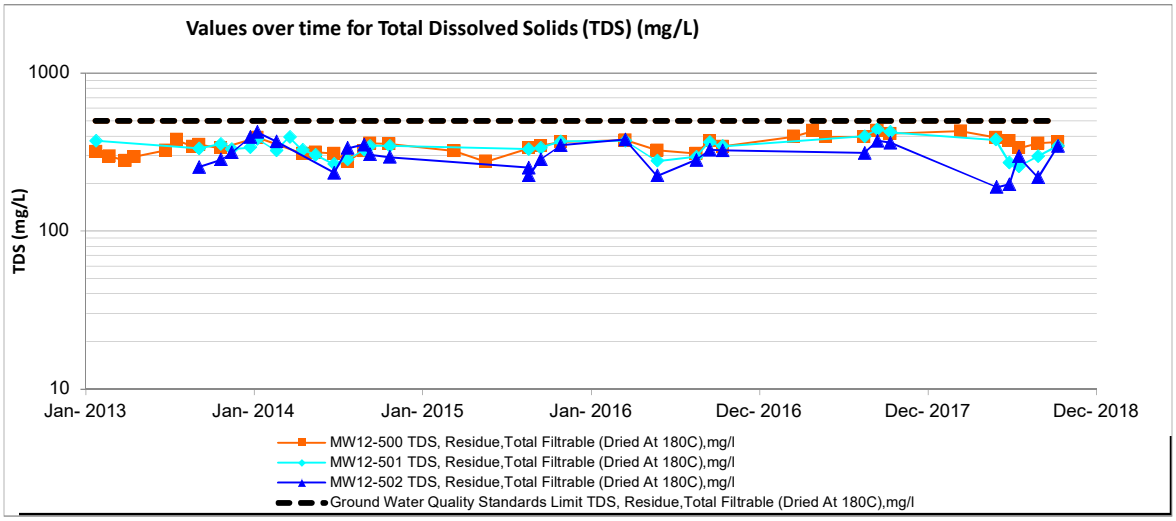

Values over time for Mercury, dissolved (ug/L)
Mercury, dissolved (ug/L)
1
0.1
0.01
0.001
0.0001
Jan- 2013
Jan- 2014
Jan- 2015
Jan- 2016
Dec- 2016
Dec- 2017
Dec- 2018
MW12-500 Mercury, Dissolved (ug/l as Hg)
MW12-501 Mercury, Dissolved (ug/l as Hg)
MW12-502 Mercury, Dissolved (ug/l as Hg)
Ground Water Quality Standards Limit Mercury, Dissolved (ug/l as Hg)
Ground Water Quality Standards Limit Mercury, Dissolved (ug/l as Hg)

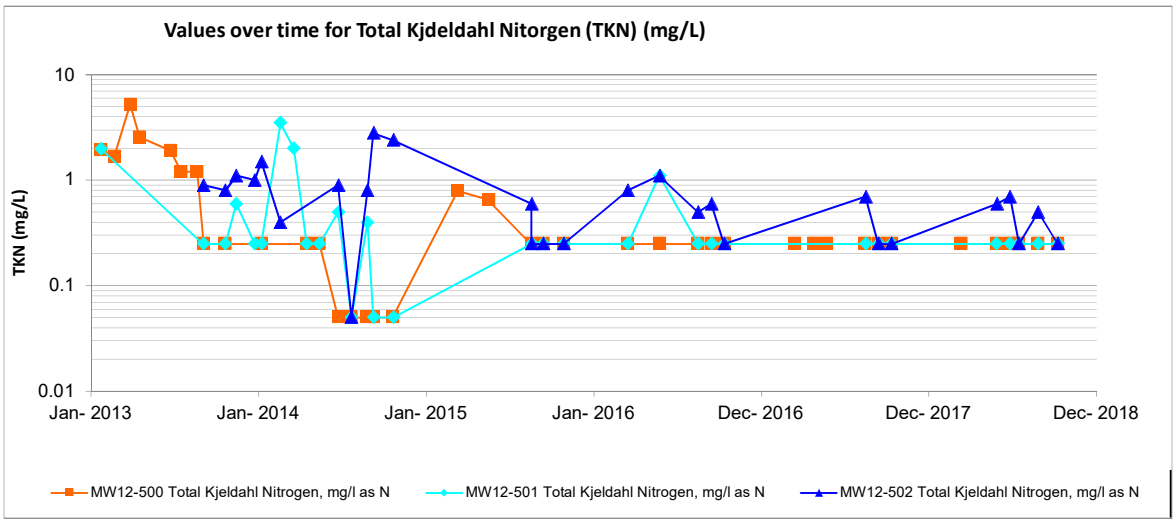

Values over time for Nickel, dissolved (ug/L)
(Nickel is hardness dependant. For graphing purposes, the lowest value in the data set was used for the WQS.)
Nickel, dissolved (ug/L)
100
10
1
0.1
Jan- 2013
Jan- 2014
Jan- 2015
Jan- 2016
Dec- 2016
Dec- 2017
Dec- 2018
MW12-500 Nickel, Dissolved (ug/l as Ni)
MW12-501 Nickel, Dissolved (ug/l as Ni)
Ground Water Quality Standards Limit Nickel, Dissolved (ug/l as Ni)
MW12-502 Nickel, Dissolved (ug/l as Ni)

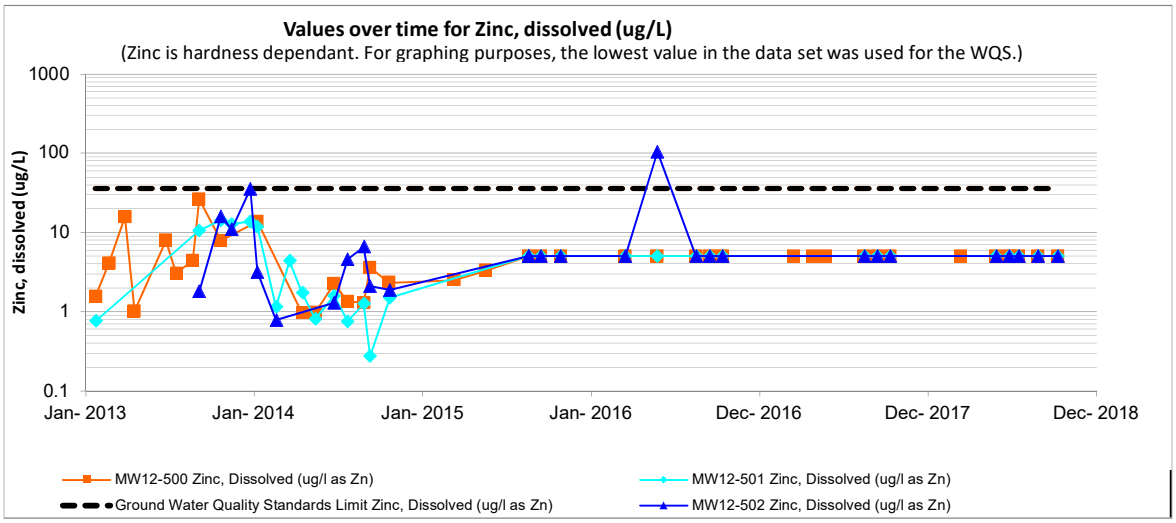

Values over time for pH, field (pH units)
pH, field, (pH units)
9
8.5
8
7.5
7
6.5
6
5.5
5
Jan- 2013
Jan- 2014
Jan- 2015
Jan- 2016
Dec- 2016
Dec- 2017
Dec- 2018
MW12-500 pH, Field, Standard Units
MW12-501 pH, Field, Standard Units
Ground Water Quality Standards Limit pH, Field, Standard Units
MW12-502 pH, Field, Standard Units


Values over time for Silver, dissolved (ug/L)
Silver, dissolved (ug/L)
1
0.1
0.01
0.001
Jan- 2013
Jan- 2014
Jan- 2015
Jan- 2016
Dec- 2016
Dec- 2017
Dec- 2018
MW12-500 Silver, Dissolved (ug/l as Ag)
MW12-501 Silver, Dissolved (ug/l as Ag)
Ground Water Quality Standards Limit Silver, Dissolved (ug/l as Ag)
MW12-502 Silver, Dissolved (ug/l as Ag)


Values over time for Sulfate, total (mg/L)
Sulfate, total (mg/L)
1000
100
10
1
Jan- 2013
Jan- 2014
Jan- 2015
Jan- 2016
Dec- 2016
Dec- 2017
Dec- 2018
MW12-500 Sulfate, Total (mg/l as SO4)
MW12-501 Sulfate, Total (mg/l as SO4)
Ground Water Quality Standards Limit Sulfate, Total (mg/l as SO4)
MW12-502 Sulfate, Total (mg/l as SO4)


Values over time for Total Dissolved Solids (TDS) (mg/L)
TDS (mg/L)
1000
100
10
Jan- 2013
Jan- 2014
Jan- 2015
Jan- 2016
Dec- 2016
Dec- 2017
Dec- 2018
MW12-500 TDS, Residue,Total Filtrable (Dried At 180C),mg/l
MW12-501 TDS, Residue,Total Filtrable (Dried At 180C),mg/l
MW12-502 TDS, Residue,Total Filtrable (Dried At 180C),mg/l
Ground Water Quality Standards Limit TDS, Residue,Total Filtrable (Dried At 180C),mg/l

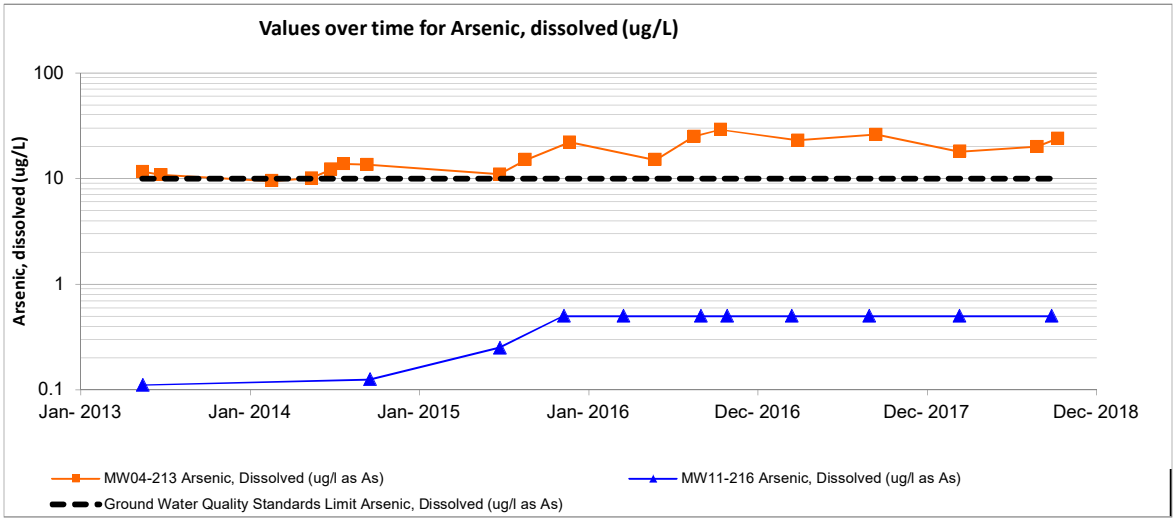

Values over time for Total Kjdeldahl Nitorgen (TKN) (mg/L)
TKN (mg/L)
10
1
0.1
0.01
Jan- 2013
Jan- 2014
Jan- 2015
Jan- 2016
Dec- 2016
Dec- 2017
Dec- 2018
MW12-500 Total Kjeldahl Nitrogen, mg/l as N
MW12-501 Total Kjeldahl Nitrogen, mg/l as N
MW12-502 Total Kjeldahl Nitrogen, mg/l as N

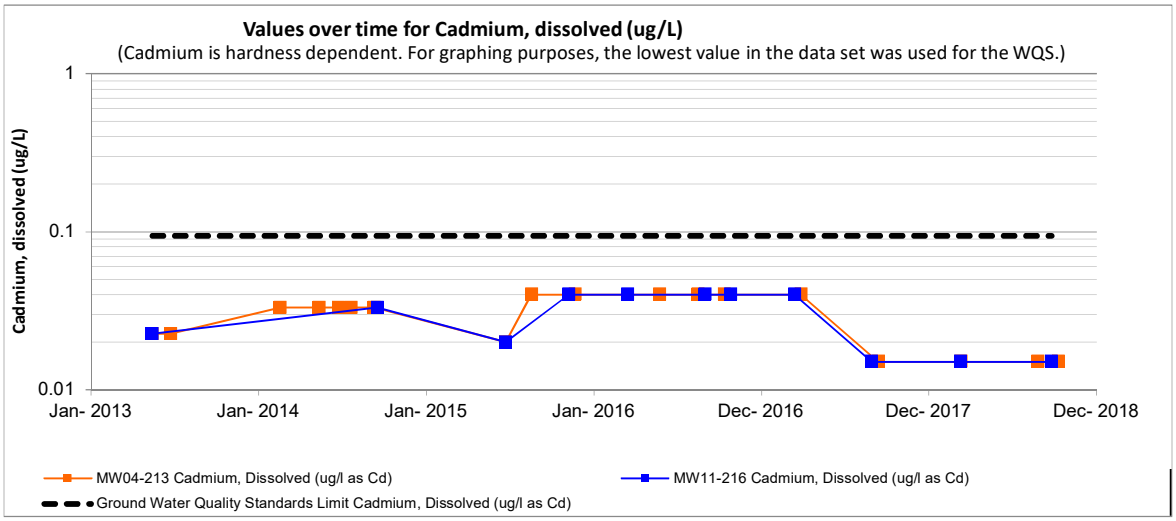

Values over time for Zinc, dissolved (ug/L)
(Zinc is hardness dependant. For graphing purposes, the lowest value in the data set was used for the WQS.)
Zinc, dissolved (ug/L)
1000
100
10
1
0.1
Jan- 2013
Jan- 2014
Jan- 2015
Jan- 2016
Dec- 2016
Dec- 2017
Dec- 2018
MW12-500 Zinc, Dissolved (ug/l as Zn)
MW12-501 Zinc, Dissolved (ug/l as Zn)
Ground Water Quality Standards Limit Zinc, Dissolved (ug/l as Zn)
MW12-502 Zinc, Dissolved (ug/l as Zn)

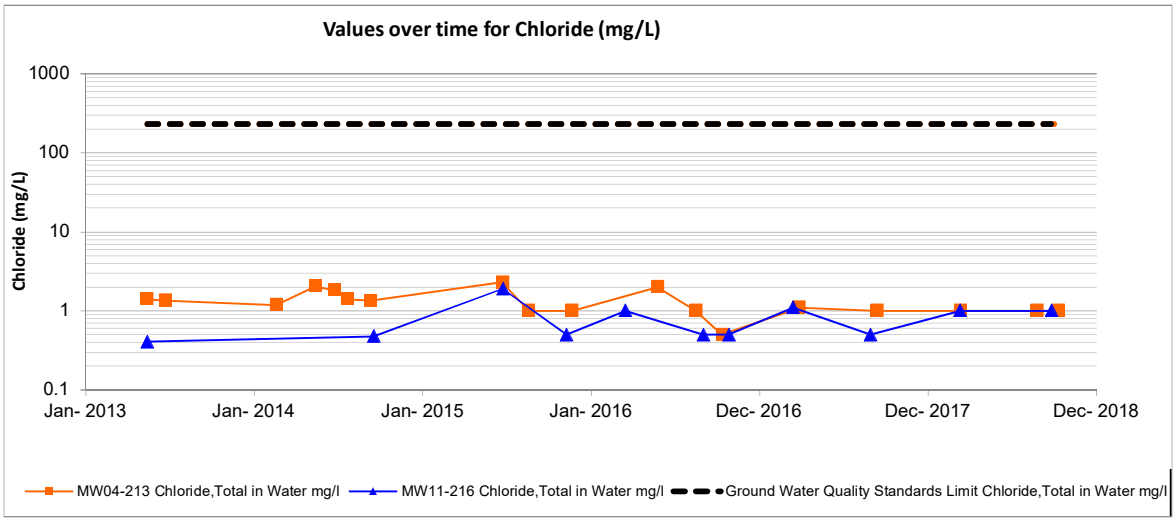
APPENDIX C –

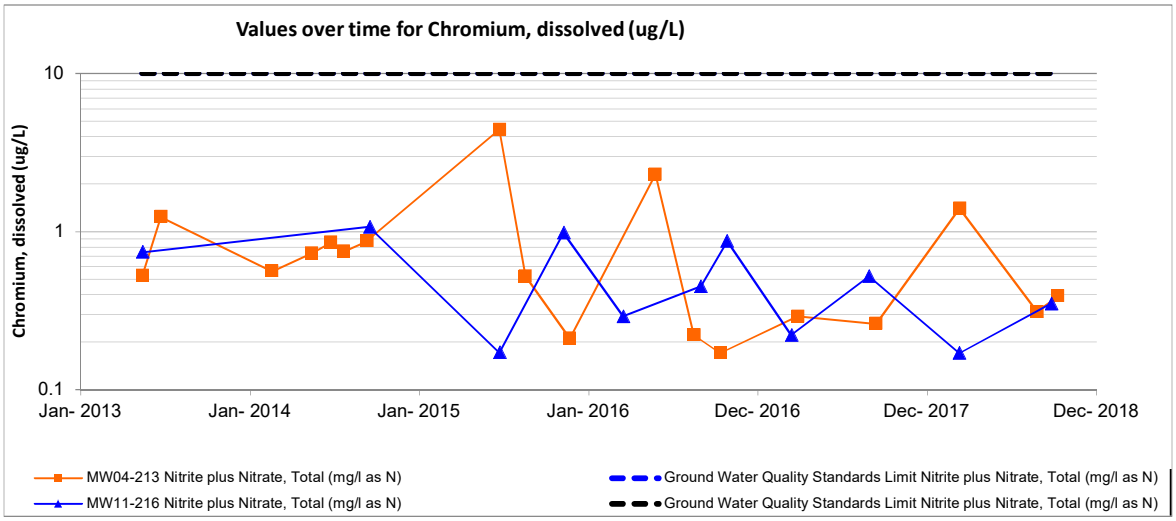
MW04-213 and MW11-216

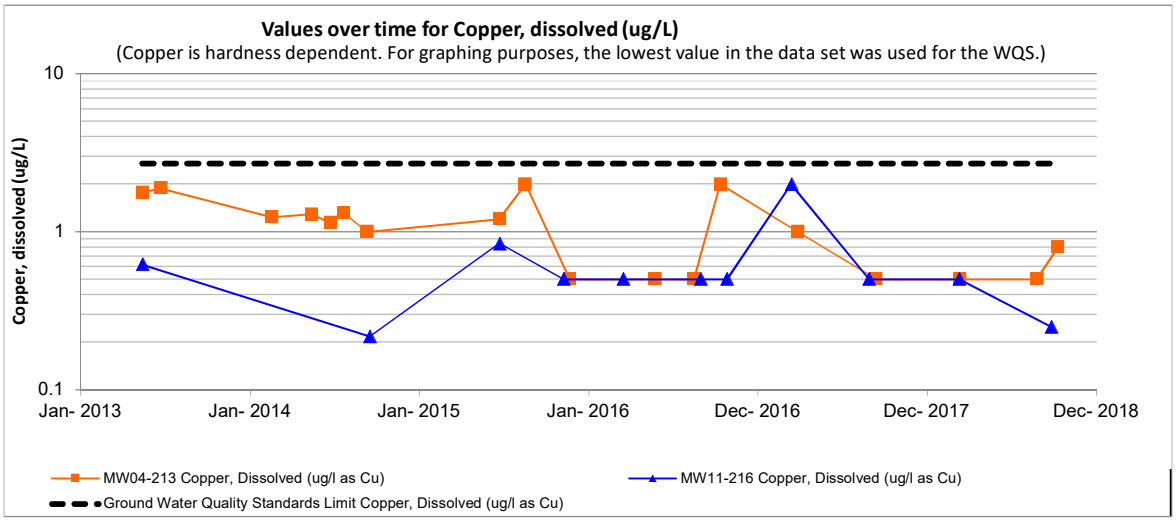
Wells Graphs

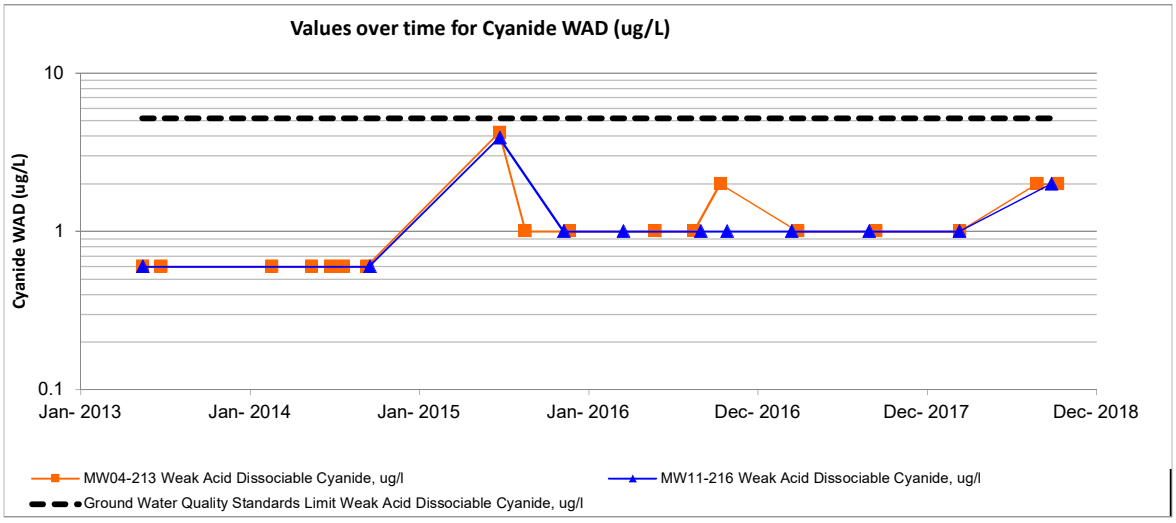

Values over time for Arsenic, dissolved (ug/L)
Arsenic, dissolved (ug/L)
100
10
1
0.1
Jan- 2013
Jan- 2014
Jan- 2015
Jan- 2016
Dec- 2016
Dec- 2017
Dec- 2018
MW04-213 Arsenic, Dissolved (ug/l as As)
MW11-216 Arsenic, Dissolved (ug/l as As)
Ground Water Quality Standards Limit Arsenic, Dissolved (ug/l as As)

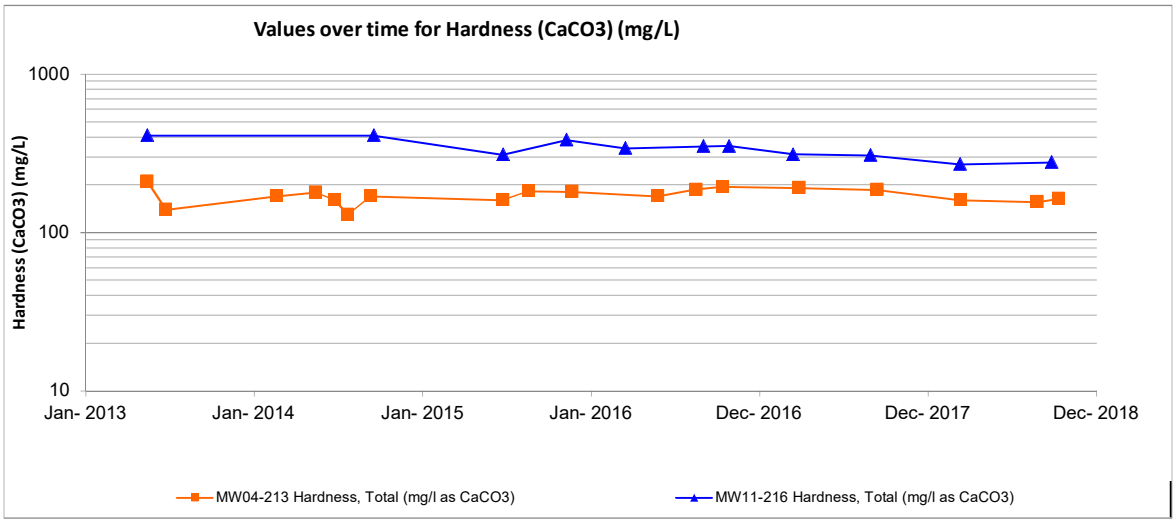

Values over time for Cadmium, dissolved (ug/L)
(Cadmium is hardness dependent. For graphing purposes, the lowest value in the data set was used for the WQS.)
Cadmium, dissolved (ug/L)
1
0.1
0.01
Jan- 2013
Jan- 2014
Jan- 2015
Jan- 2016
Dec- 2016
Dec- 2017
Dec- 2018
MW04-213 Cadmium, Dissolved (ug/l as Cd)
MW11-216 Cadmium, Dissolved (ug/l as Cd)
Ground Water Quality Standards Limit Cadmium, Dissolved (ug/l as Cd)

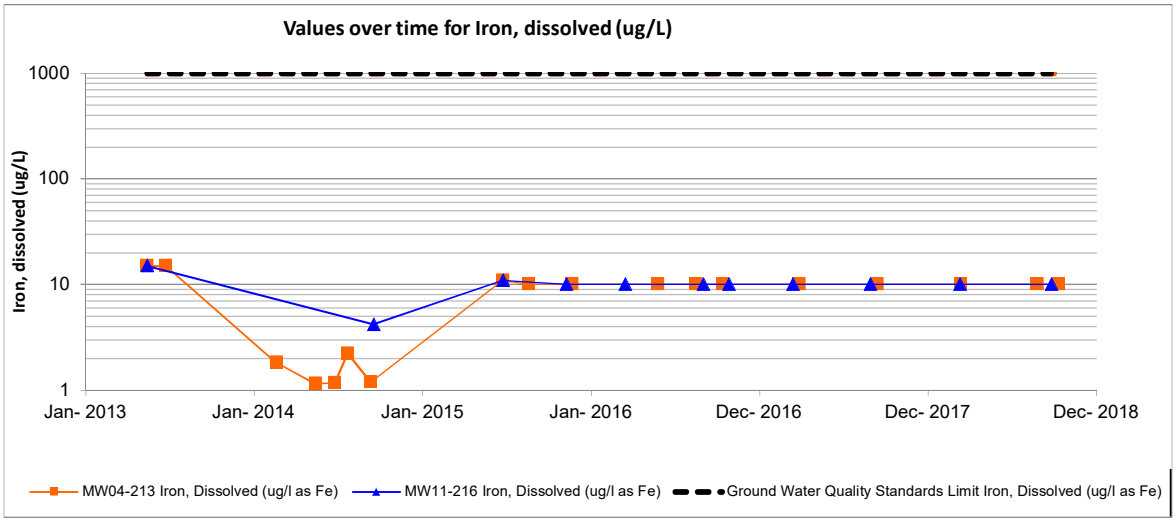

Values over time for Chloride (mg/L)
Chloride (mg/L)
1000
100
10
1
0.1
Jan- 2013
Jan- 2014
Jan- 2015
Jan- 2016
Dec- 2016
Dec- 2017
Dec- 2018
MW04-213 Chloride,Total in Water mg/l
MW11-216 Chloride,Total in Water mg/l
Ground Water Quality Standards Limit Chloride,Total in Water mg/l

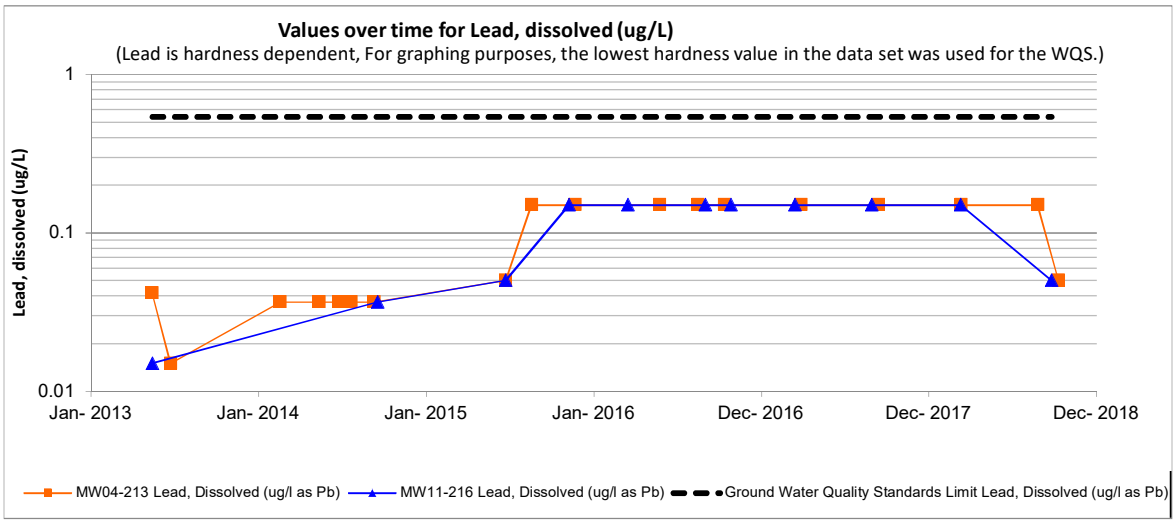

Values over time for Chromium, dissolved (ug/L)
Chromium, dissolved (ug/L)
10
1
0.1
Jan- 2013
Jan- 2014
Jan- 2015
Jan- 2016
Dec- 2016
Dec- 2017
Dec- 2018
MW04-213 Nitrite plus Nitrate, Total (mg/l as N)
MW11-216 Nitrite plus Nitrate, Total (mg/l as N)
Ground Water Quality Standards Limit Nitrite plus Nitrate, Total (mg/l as N)
Ground Water Quality Standards Limit Nitrite plus Nitrate, Total (mg/l as N)

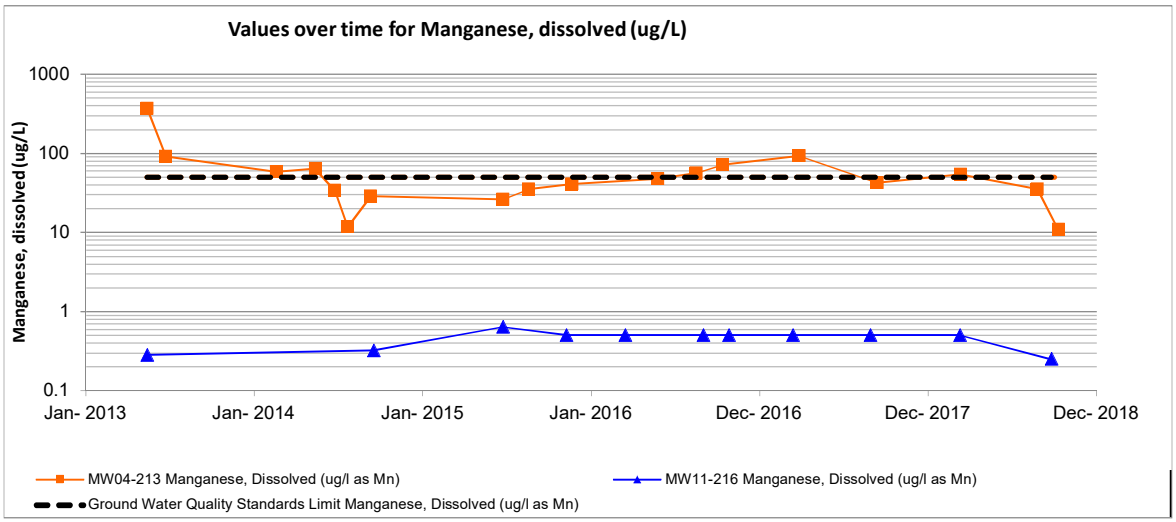

Values over time for Copper, dissolved (ug/L)
(Copper is hardness dependent. For graphing purposes, the lowest value in the data set was used for the WQS.)
Copper, dissolved (ug/L)
10
1
0.1
Jan- 2013
Jan- 2014
Jan- 2015
Jan- 2016
Dec- 2016
Dec- 2017
Dec- 2018
MW04-213 Copper, Dissolved (ug/l as Cu)
MW11-216 Copper, Dissolved (ug/l as Cu)
Ground Water Quality Standards Limit Copper, Dissolved (ug/l as Cu)

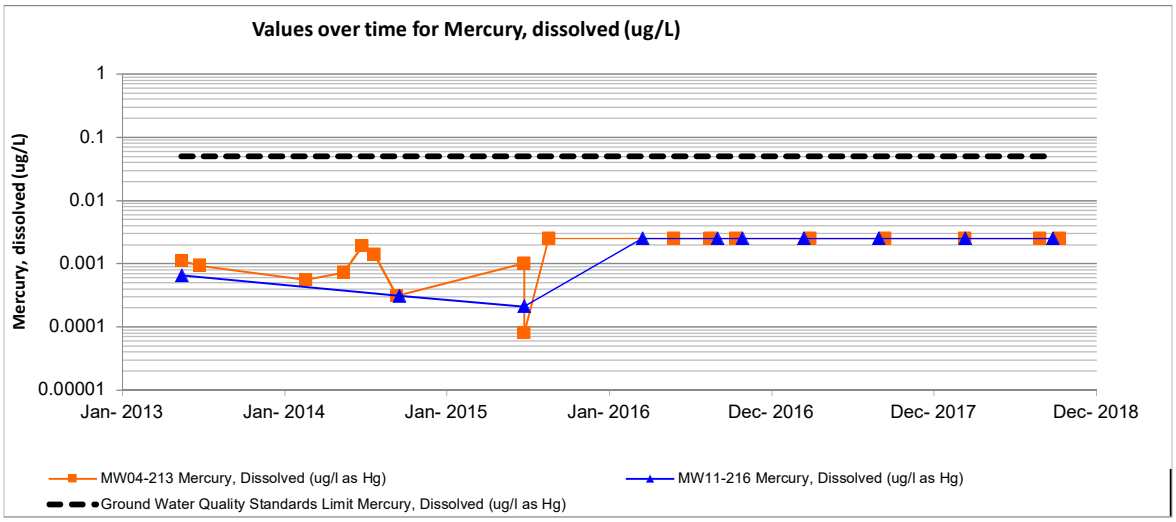

Values over time for Cyanide WAD (ug/L)
Cyanide WAD (ug/L)
10
1
0.1
Jan- 2013
Jan- 2014
Jan- 2015
Jan- 2016
Dec- 2016
Dec- 2017
Dec- 2018
MW04-213 Weak Acid Dissociable Cyanide, ug/l
MW11-216 Weak Acid Dissociable Cyanide, ug/l
Ground Water Quality Standards Limit Weak Acid Dissociable Cyanide, ug/l

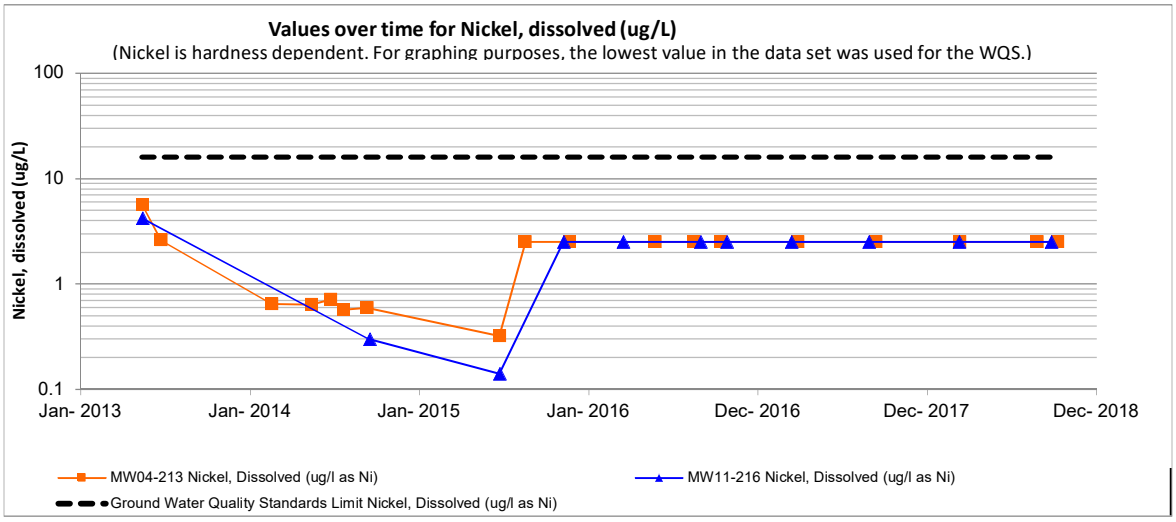

Values over time for Hardness (CaCO3) (mg/L)
Hardness (CaCO3) (mg/L)
1000
100
10
Jan- 2013
Jan- 2014
Jan- 2015
Jan- 2016
Dec- 2016
Dec- 2017
Dec- 2018
MW04-213 Hardness, Total (mg/l as CaCO3)
MW11-216 Hardness, Total (mg/l as CaCO3)

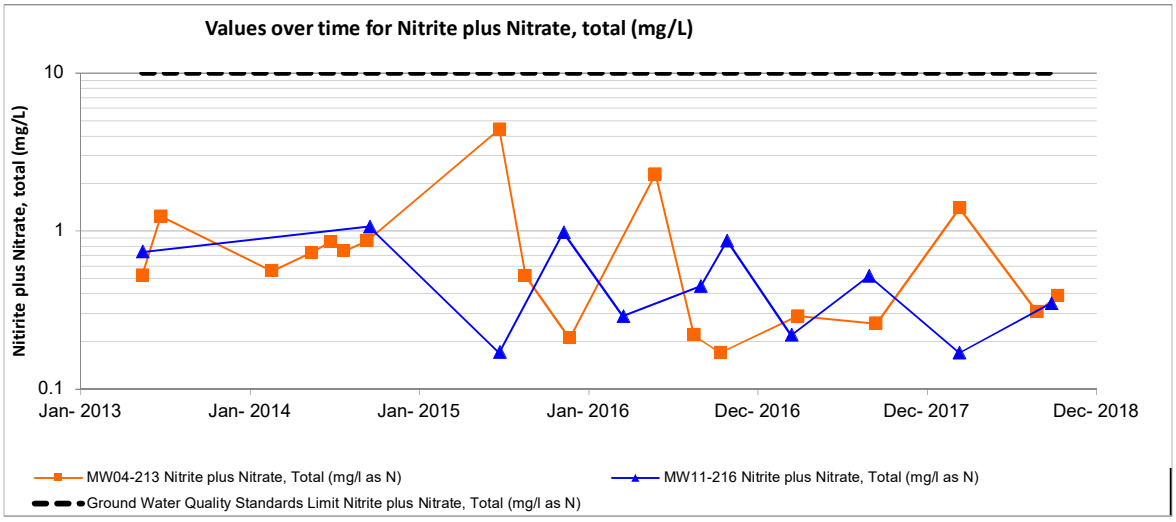

Values over time for Iron, dissolved (ug/L)
Iron, dissolved (ug/L)
1000
100
10
1
Jan- 2013
Jan- 2014
Jan- 2015
Jan- 2016
Dec- 2016
Dec- 2017
Dec- 2018
MW04-213 Iron, Dissolved (ug/l as Fe)
MW11-216 Iron, Dissolved (ug/l as Fe)
Ground Water Quality Standards Limit Iron, Dissolved (ug/l as Fe)

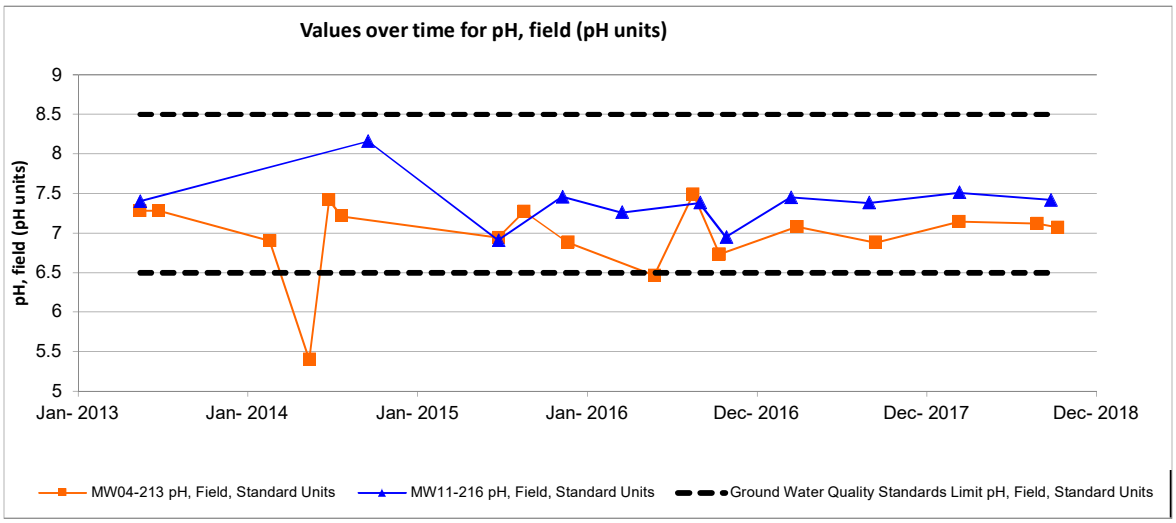

Values over time for Lead, dissolved (ug/L)
(Lead is hardness dependent, For graphing purposes, the lowest hardness value in the data set was used for the WQS.)
Lead, dissolved (ug/L)
1
0.1
0.01
Jan- 2013
Jan- 2014
Jan- 2015
Jan- 2016
Dec- 2016
Dec- 2017
Dec- 2018
MW04-213 Lead, Dissolved (ug/l as Pb)
MW11-216 Lead, Dissolved (ug/l as Pb)
Ground Water Quality Standards Limit Lead, Dissolved (ug/l as Pb)

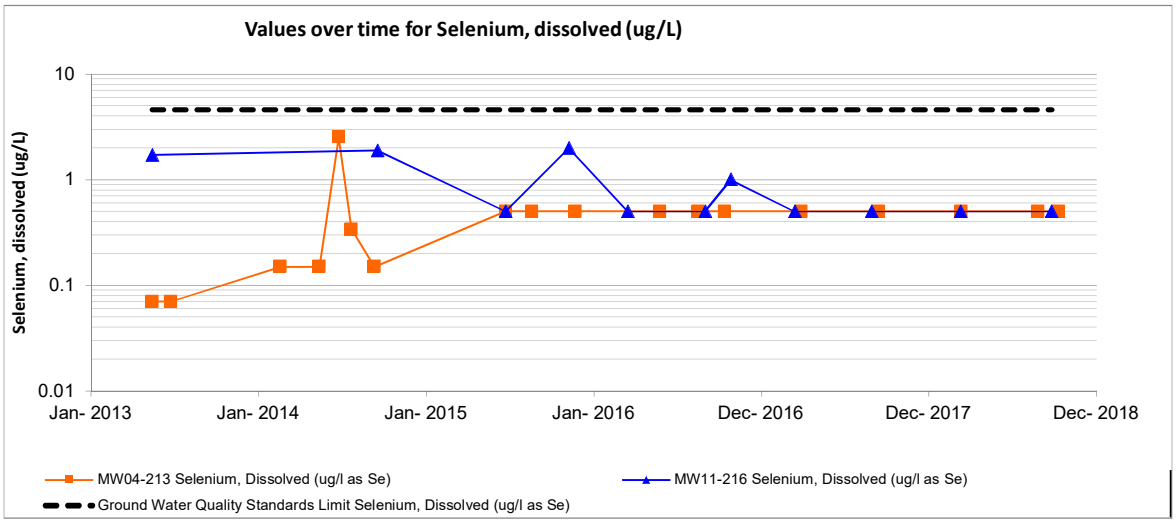

Values over time for Manganese, dissolved (ug/L)
Manganese, dissolved (ug/L)
1000
100
10
1
0.1
Jan- 2013
Jan- 2014
Jan- 2015
Jan- 2016
Dec- 2016
Dec- 2017
Dec- 2018
MW04-213 Manganese, Dissolved (ug/l as Mn)
MW11-216 Manganese, Dissolved (ug/l as Mn)
Ground Water Quality Standards Limit Manganese, Dissolved (ug/l as Mn)

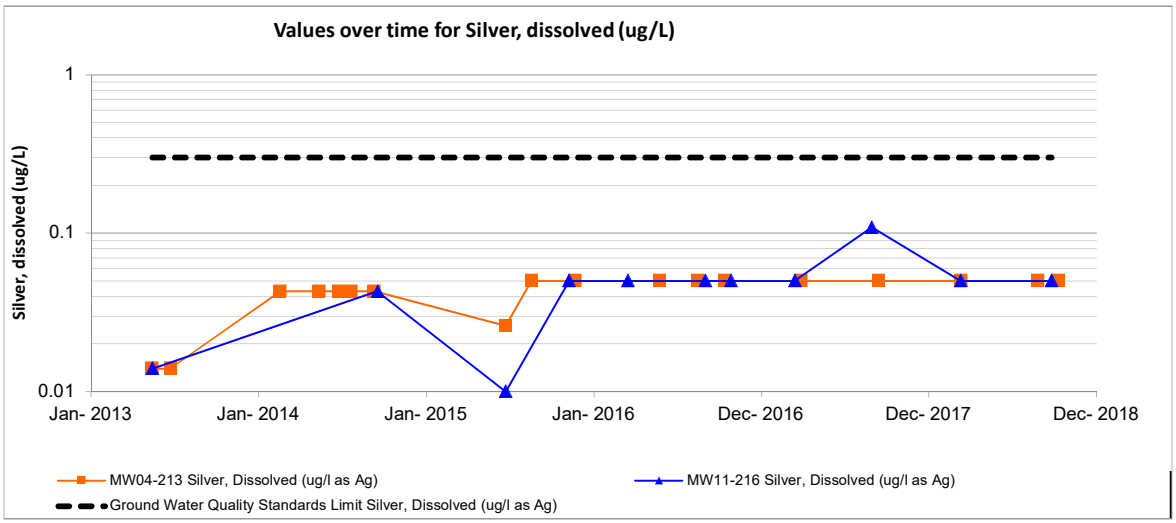

Values over time for Mercury, dissolved (ug/L)
Mercury, dissolved (ug/L)
1
0.1
0.01
0.001
0.0001
0.00001
Jan- 2013
Jan- 2014
Jan- 2015
Jan- 2016
Dec- 2016
Dec- 2017
Dec- 2018
MW04-213 Mercury, Dissolved (ug/l as Hg)
MW11-216 Mercury, Dissolved (ug/l as Hg)
Ground Water Quality Standards Limit Mercury, Dissolved (ug/l as Hg)

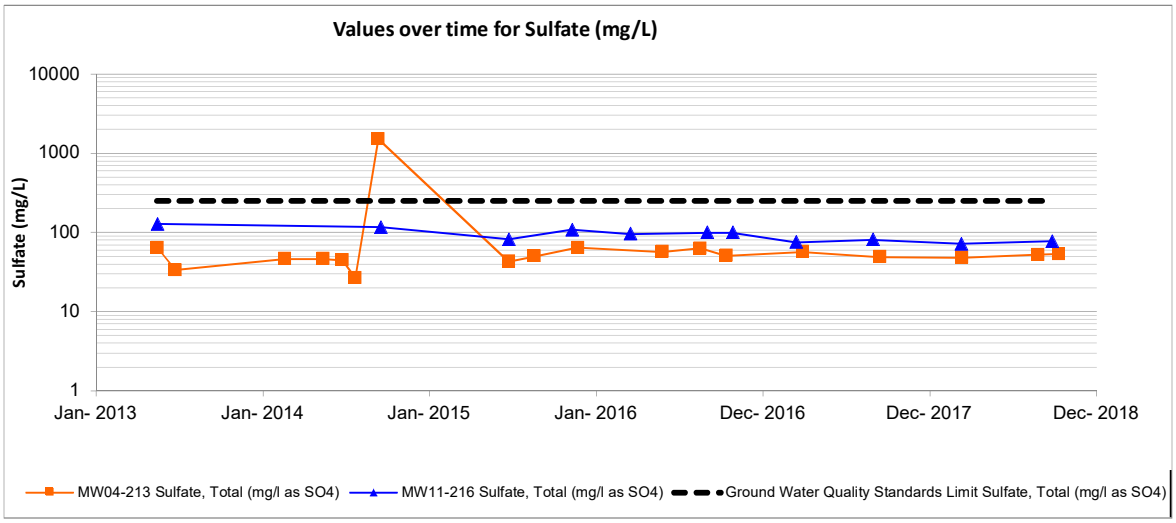

Values over time for Nickel, dissolved (ug/L)
(Nickel is hardness dependent. For graphing purposes, the lowest value in the data set was used for the WQS.)
Nickel, dissolved (ug/L)
100
10
1
0.1
Jan- 2013
Jan- 2014
Jan- 2015
Jan- 2016
Dec- 2016
Dec- 2017
Dec- 2018
MW04-213 Nickel, Dissolved (ug/l as Ni)
MW11-216 Nickel, Dissolved (ug/l as Ni)
Ground Water Quality Standards Limit Nickel, Dissolved (ug/l as Ni)

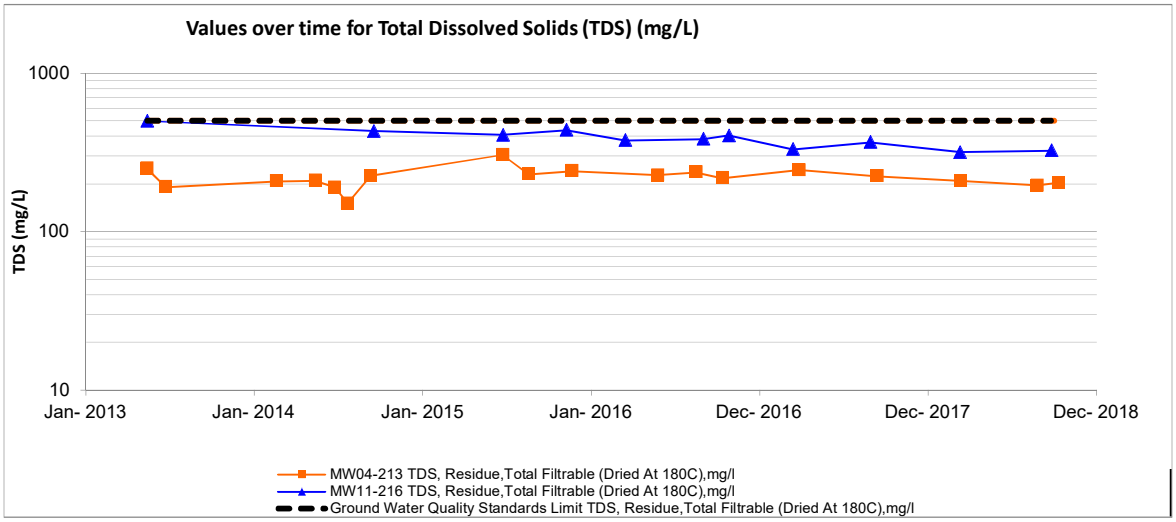

Values over time for Nitrite plus Nitrate, total (mg/L)
Nitirite plus Nitrate, total (mg/L)
10
1
0.1
Jan- 2013
Jan- 2014
Jan- 2015
Jan- 2016
Dec- 2016
Dec- 2017
Dec- 2018
MW04-213 Nitrite plus Nitrate, Total (mg/l as N)
MW11-216 Nitrite plus Nitrate, Total (mg/l as N)
Ground Water Quality Standards Limit Nitrite plus Nitrate, Total (mg/l as N)

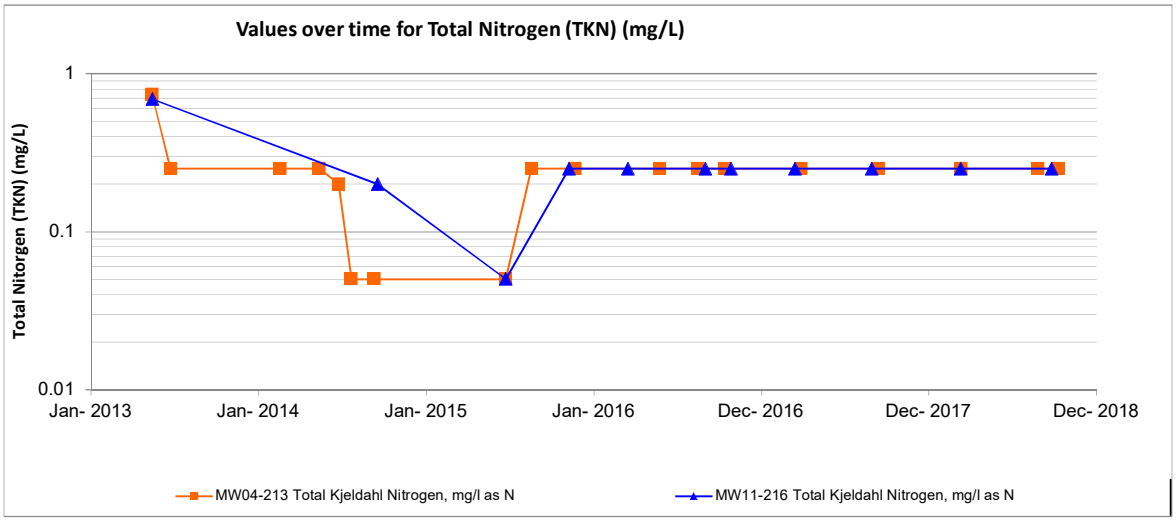

Values over time for pH, field (pH units)
pH, field (pH units)
9
8.5
8
7.5
7
6.5
6
5.5
5
Jan- 2013
Jan- 2014
Jan- 2015
Jan- 2016
Dec- 2016
Dec- 2017
Dec- 2018
MW04-213 pH, Field, Standard Units
MW11-216 pH, Field, Standard Units
Ground Water Quality Standards Limit pH, Field, Standard Units

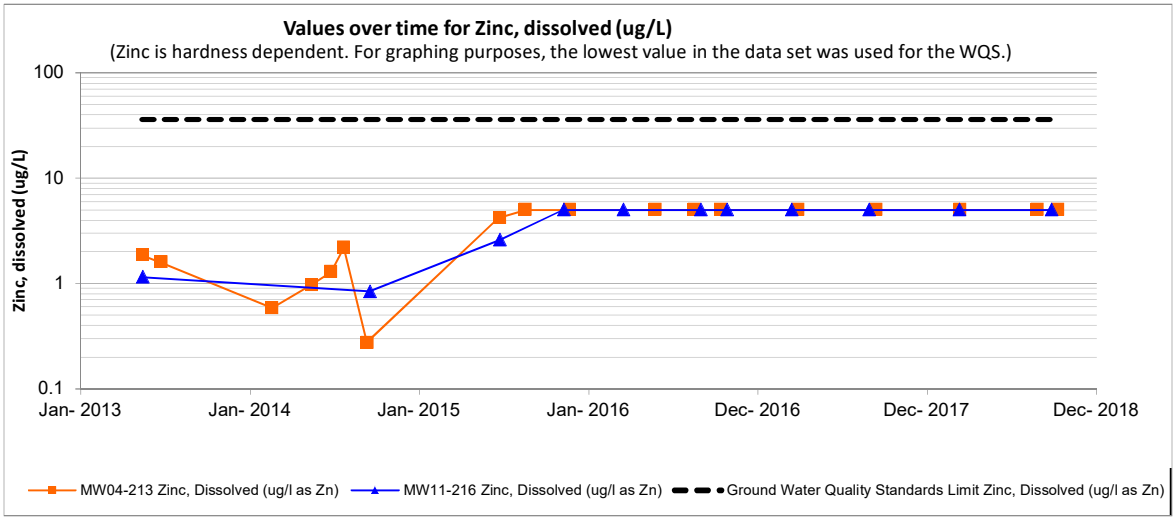

Values over time for Selenium, dissolved (ug/L)
Selenium, dissolved (ug/L)
10
1
0.1
0.01
Jan- 2013
Jan- 2014
Jan- 2015
Jan- 2016
Dec- 2016
Dec- 2017
Dec- 2018
MW04-213 Selenium, Dissolved (ug/l as Se)
MW11-216 Selenium, Dissolved (ug/l as Se)
Ground Water Quality Standards Limit Selenium, Dissolved (ug/l as Se)


Values over time for Silver, dissolved (ug/L)
Silver, dissolved (ug/L)
1
0.1
0.01
Jan- 2013
Jan- 2014
Jan- 2015
Jan- 2016
Dec- 2016
Dec- 2017
Dec- 2018
MW04-213 Silver, Dissolved (ug/l as Ag)
MW11-216 Silver, Dissolved (ug/l as Ag)
Ground Water Quality Standards Limit Silver, Dissolved (ug/l as Ag)


Values over time for Sulfate (mg/L)
Sulfate (mg/L)
10000
1000
100
10
1
Jan- 2013
Jan- 2014
Jan- 2015
Jan- 2016
Dec- 2016
Dec- 2017
Dec- 2018
MW04-213 Sulfate, Total (mg/l as SO4)
MW11-216 Sulfate, Total (mg/l as SO4)
Ground Water Quality Standards Limit Sulfate, Total (mg/l as SO4)


Values over time for Total Dissolved Solids (TDS) (mg/L)
TDS (mg/L)
1000
100
10
Jan- 2013
Jan- 2014
Jan- 2015
Jan- 2016
Dec- 2016
Dec- 2017
Dec- 2018
MW04-213 TDS, Residue,Total Filtrable (Dried At 180C),mg/l
MW11-216 TDS, Residue,Total Filtrable (Dried At 180C),mg/l
Ground Water Quality Standards Limit TDS, Residue,Total Filtrable (Dried At 180C),mg/l

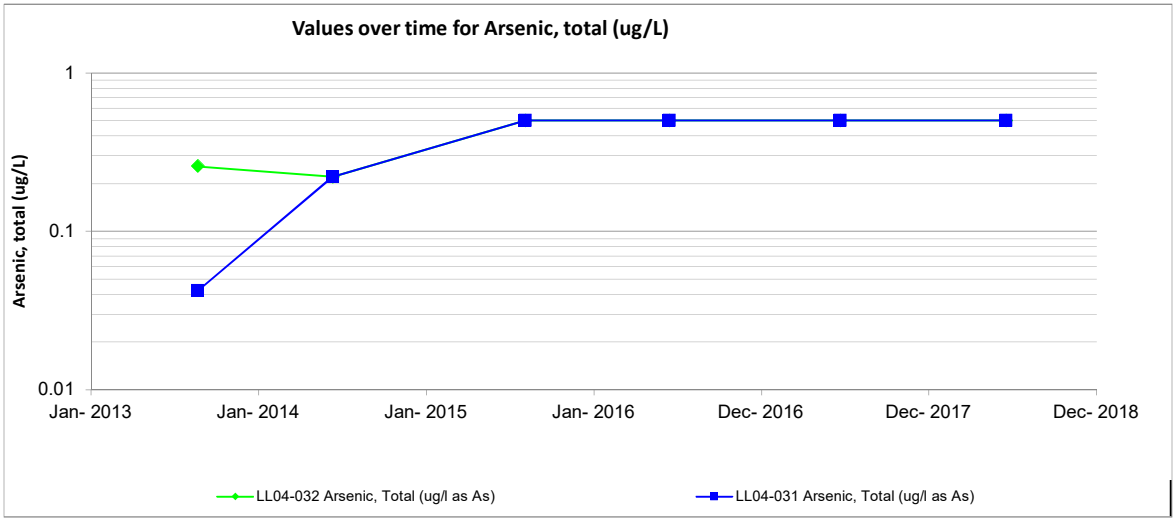

Values over time for Total Nitrogen (TKN) (mg/L)
Total Nitorgen (TKN) (mg/L)
1
0.1
0.01
Jan- 2013
Jan- 2014
Jan- 2015
Jan- 2016
Dec- 2016
Dec- 2017
Dec- 2018
MW04-213 Total Kjeldahl Nitrogen, mg/l as N
MW11-216 Total Kjeldahl Nitrogen, mg/l as N

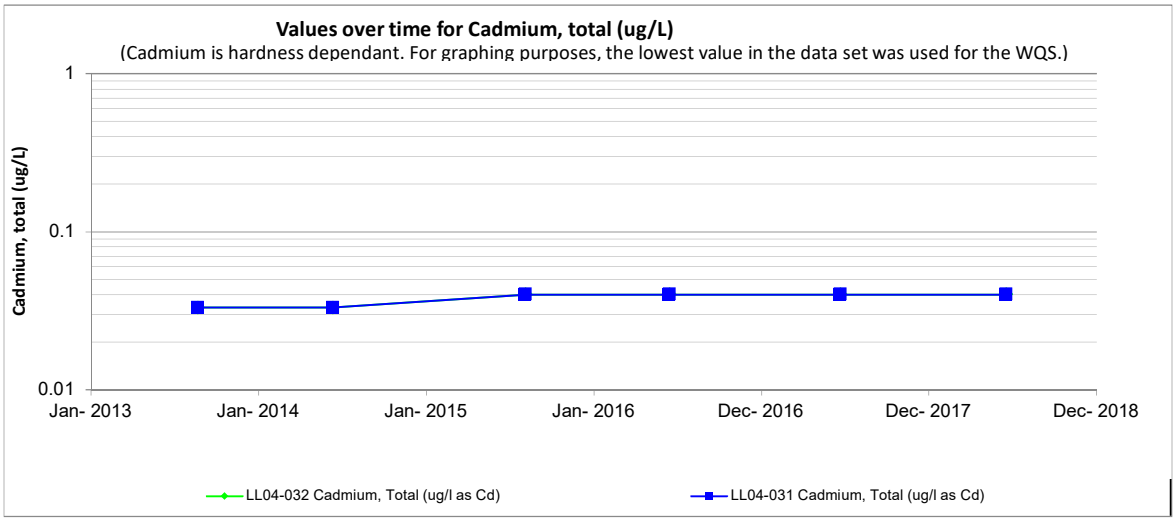

Values over time for Zinc, dissolved (ug/L)
(Zinc is hardness dependent. For graphing purposes, the lowest value in the data set was used for the WQS.)
Zinc, dissolved (ug/L)
100
10
1
0.1
Jan- 2013
Jan- 2014
Jan- 2015
Jan- 2016
Dec- 2016
Dec- 2017
Dec- 2018
MW04-213 Zinc, Dissolved (ug/l as Zn)
MW11-216 Zinc, Dissolved (ug/l as Zn)
Ground Water Quality Standards Limit Zinc, Dissolved (ug/l as Zn)

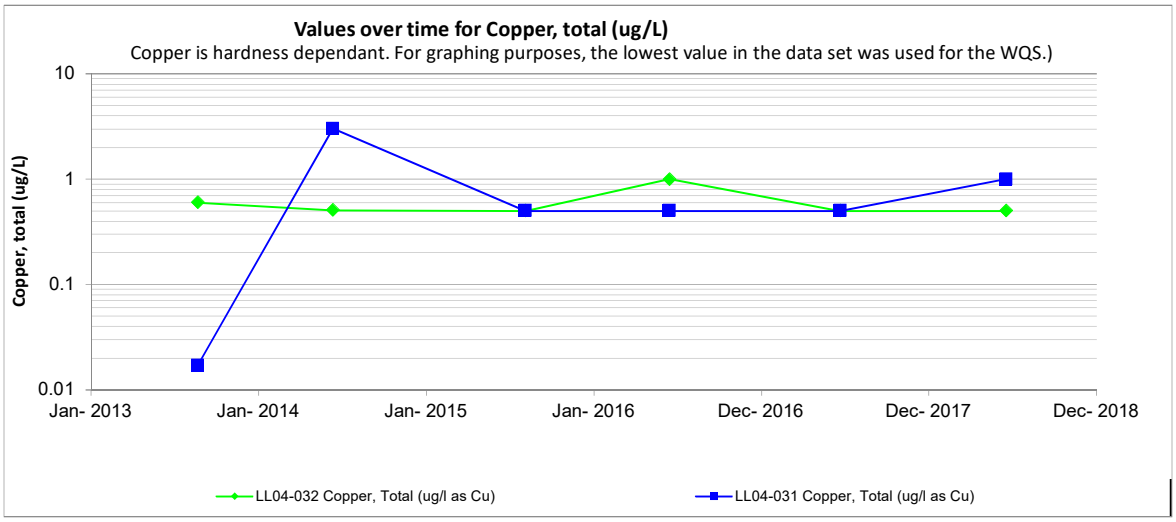
APPENDIX C –

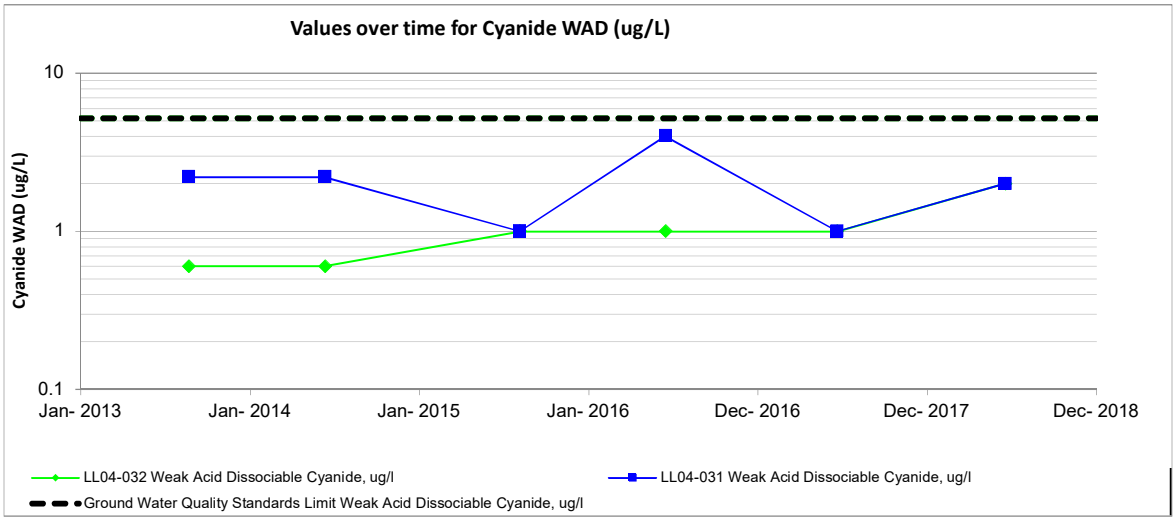
LL04-032 and LL04-031

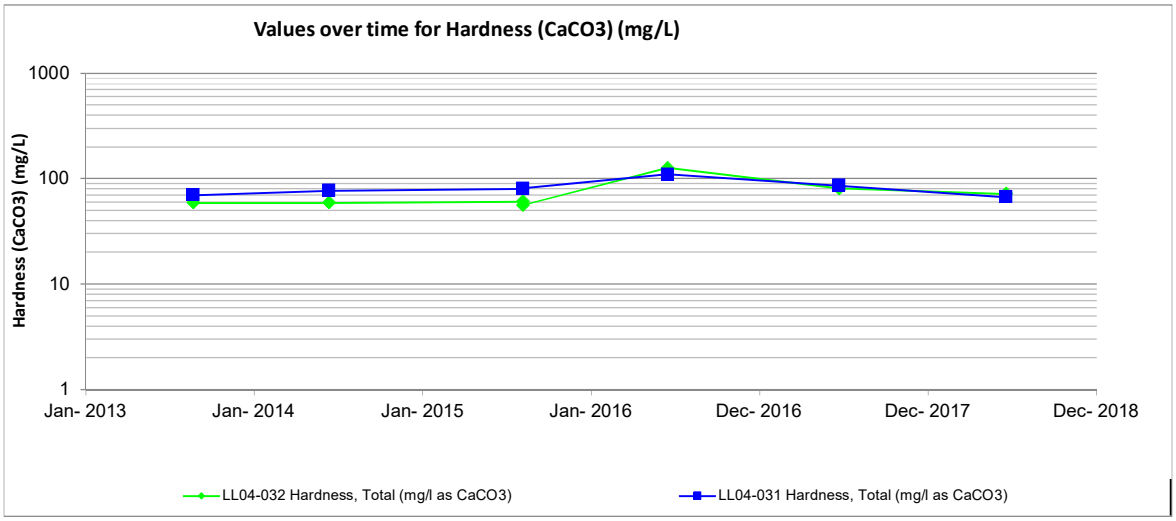
Well Graphs

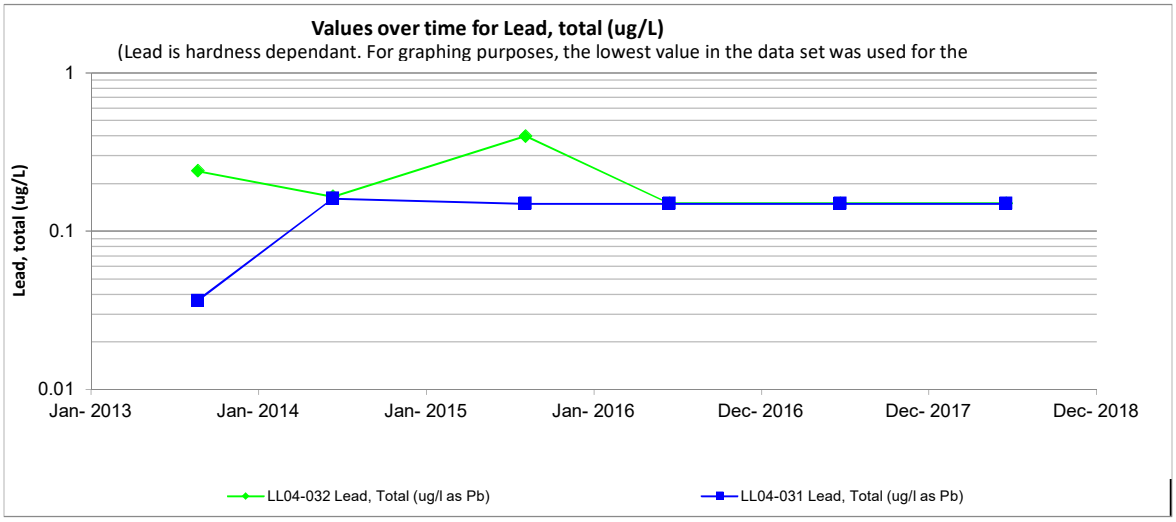

Values over time for Arsenic, total (ug/L)
Arsenic, total (ug/L)
1
0.1
0.01
Jan- 2013
Jan- 2014
Jan- 2015
Jan- 2016
Dec- 2016
Dec- 2017
Dec- 2018
LL04-032 Arsenic, Total (ug/l as As)
LL04-031 Arsenic, Total (ug/l as As)

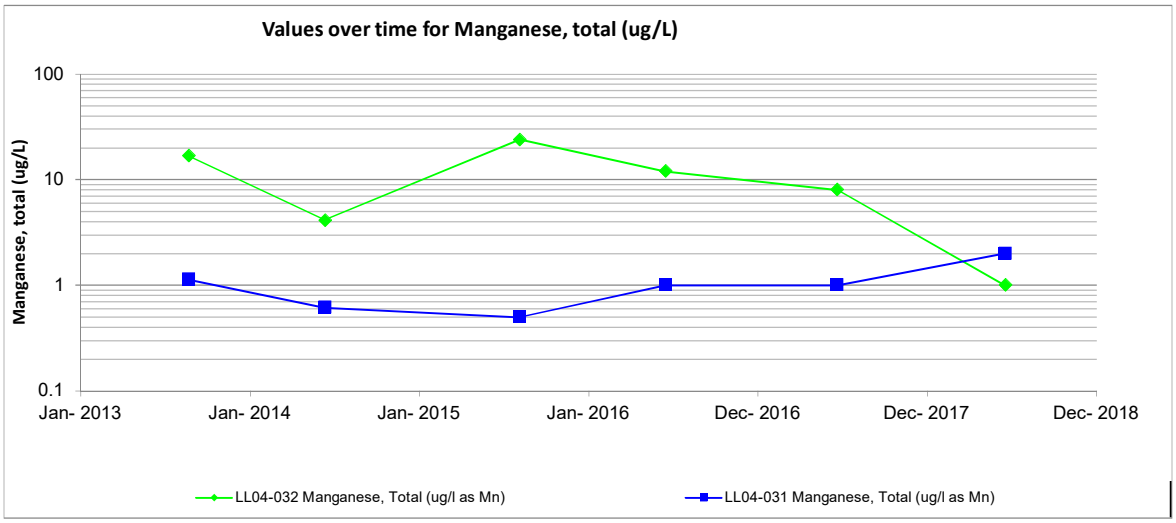

Values over time for Cadmium, total (ug/L)
(Cadmium is hardness dependant. For graphing purposes, the lowest value in the data set was used for the WQS.)
Cadmium, total (ug/L)
1
0.1
0.01
Jan- 2013
Jan- 2014
Jan- 2015
Jan- 2016
Dec- 2016
Dec- 2017
Dec- 2018
LL04-032 Cadmium, Total (ug/l as Cd)
LL04-031 Cadmium, Total (ug/l as Cd)

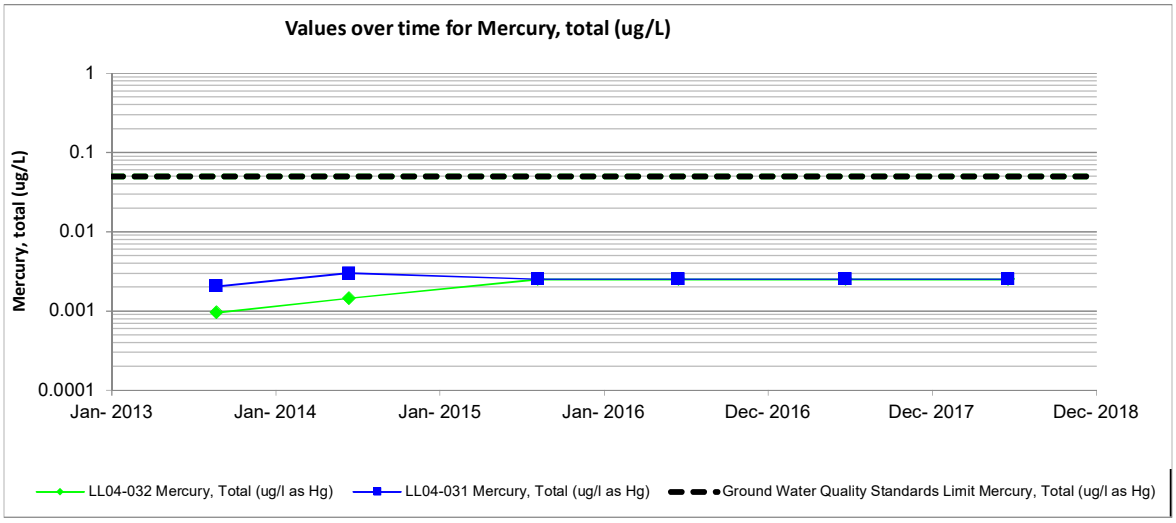

Values over time for Copper, total (ug/L)
Copper is hardness dependant. For graphing purposes, the lowest value in the data set was used for the WQS.)
Copper, total (ug/L)
10
1
0.1
0.01
Jan- 2013
Jan- 2014
Jan- 2015
Jan- 2016
Dec- 2016
Dec- 2017
Dec- 2018
LL04-032 Copper, Total (ug/l as Cu)
LL04-031 Copper, Total (ug/l as Cu)

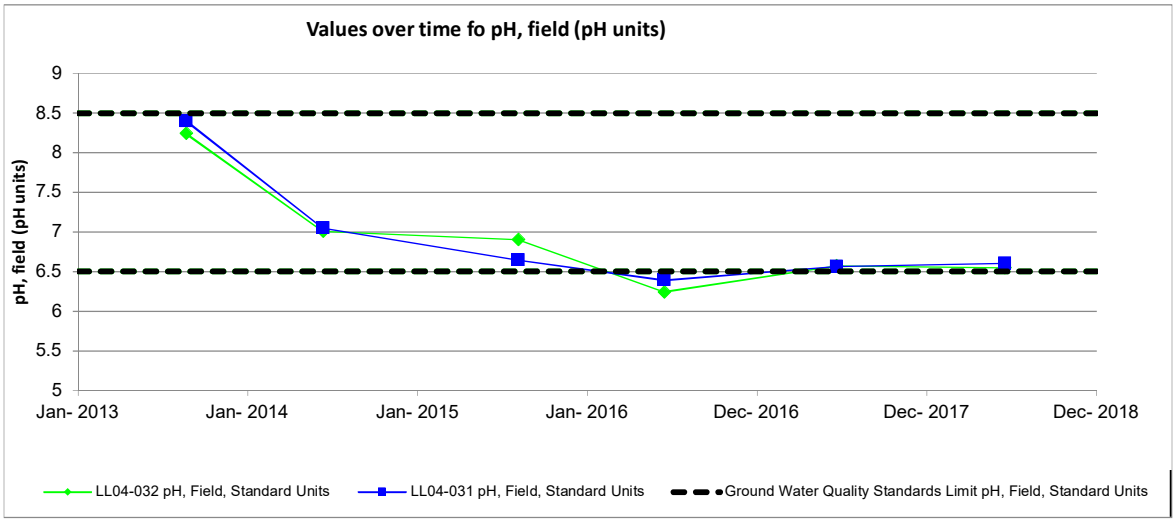

Values over time for Cyanide WAD (ug/L)
Cyanide WAD (ug/L)
10
1
0.1
Jan- 2013
Jan- 2014
Jan- 2015
Jan- 2016
Dec- 2016
Dec- 2017
Dec- 2018
LL04-032 Weak Acid Dissociable Cyanide, ug/l
LL04-031 Weak Acid Dissociable Cyanide, ug/l
Ground Water Quality Standards Limit Weak Acid Dissociable Cyanide, ug/l

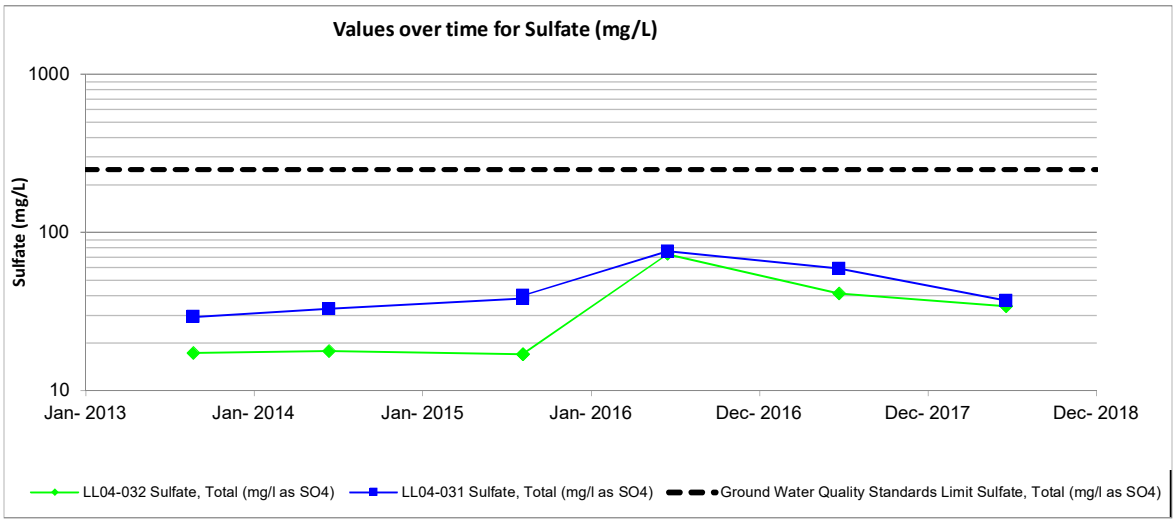

Values over time for Hardness (CaCO3) (mg/L)
Hardness (CaCO3) (mg/L)
1000
100
10
1
Jan- 2013
Jan- 2014
Jan- 2015
Jan- 2016
Dec- 2016
Dec- 2017
Dec- 2018
LL04-032 Hardness, Total (mg/l as CaCO3)
LL04-031 Hardness, Total (mg/l as CaCO3)

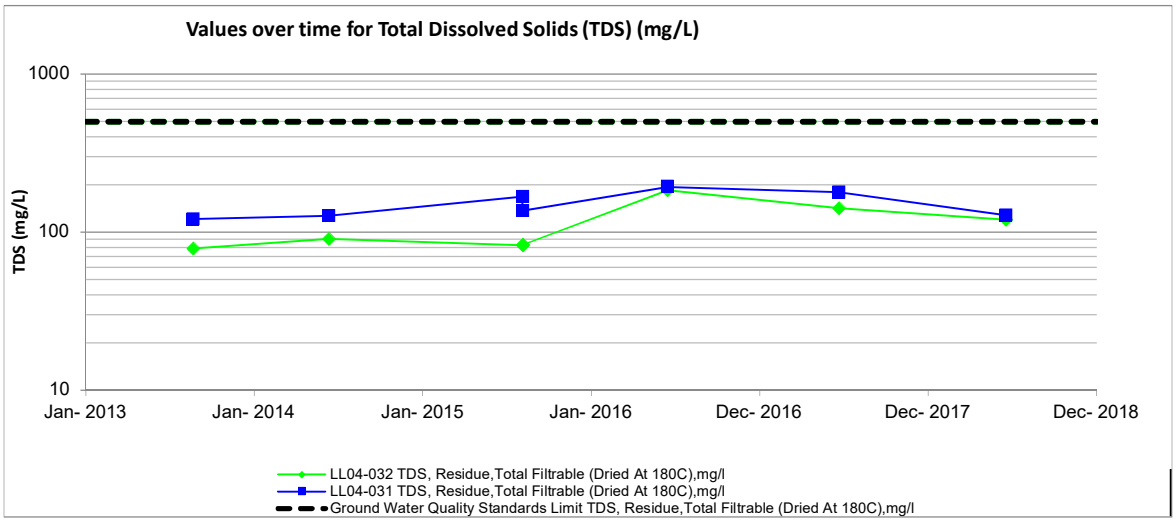

Values over time for Lead, total (ug/L)
(Lead is hardness dependant. For graphing purposes, the lowest value in the data set was used for the
Lead, total (ug/L)
1
0.1
0.01
Jan- 2013
Jan- 2014
Jan- 2015
Jan- 2016
Dec- 2016
Dec- 2017
Dec- 2018
LL04-032 Lead, Total (ug/l as Pb)
LL04-031 Lead, Total (ug/l as Pb)

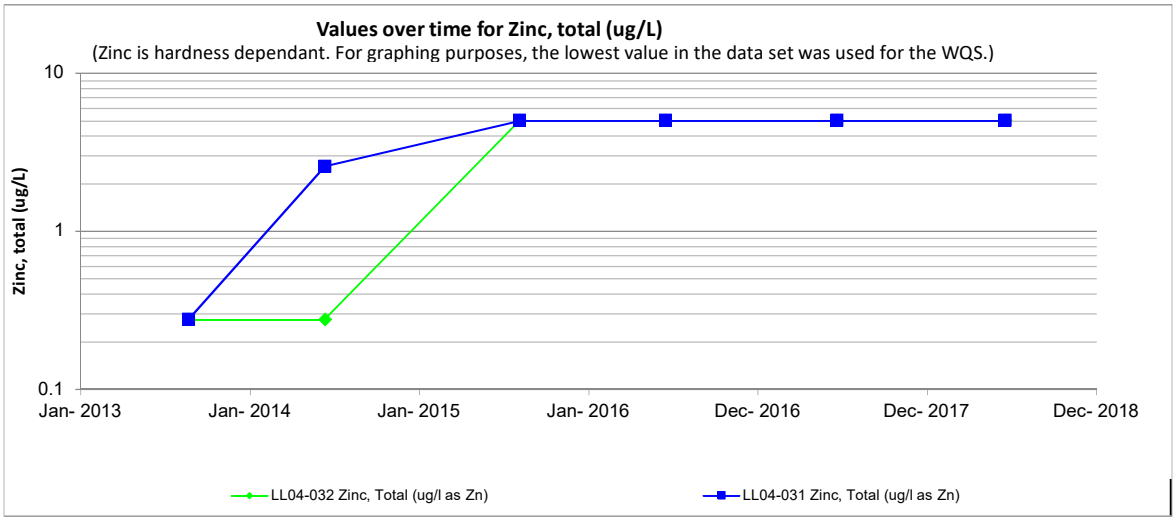

Values over time for Manganese, total (ug/L)
Manganese, total (ug/L)
100
10
1
0.1
Jan- 2013
Jan- 2014
Jan- 2015
Jan- 2016
Dec- 2016
Dec- 2017
Dec- 2018
LL04-032 Manganese, Total (ug/l as Mn)
LL04-031 Manganese, Total (ug/l as Mn)


Values over time for Mercury, total (ug/L)
Mercury, total (ug/L)
1
0.1
0.01
0.001
0.0001
Jan- 2013
Jan- 2014
Jan- 2015
Jan- 2016
Dec- 2016
Dec- 2017
Dec- 2018
LL04-032 Mercury, Total (ug/l as Hg)
LL04-031 Mercury, Total (ug/l as Hg)
Ground Water Quality Standards Limit Mercury, Total (ug/l as Hg)


Values over time fo pH, field (pH units)
pH, field (pH units)
9
8.5
8
7.5
7
6.5
6
5.5
5
Jan- 2013
Jan- 2014
Jan- 2015
Jan- 2016
Dec- 2016
Dec- 2017
Dec- 2018
LL04-032 pH, Field, Standard Units
LL04-031 pH, Field, Standard Units
Ground Water Quality Standards Limit pH, Field, Standard Units


Values over time for Sulfate (mg/L)
Sulfate (mg/L)
1000
100
10
Jan- 2013
Jan- 2014
Jan- 2015
Jan- 2016
Dec- 2016
Dec- 2017
Dec- 2018
LL04-032 Sulfate, Total (mg/l as SO4)
LL04-031 Sulfate, Total (mg/l as SO4)
Ground Water Quality Standards Limit Sulfate, Total (mg/l as SO4)

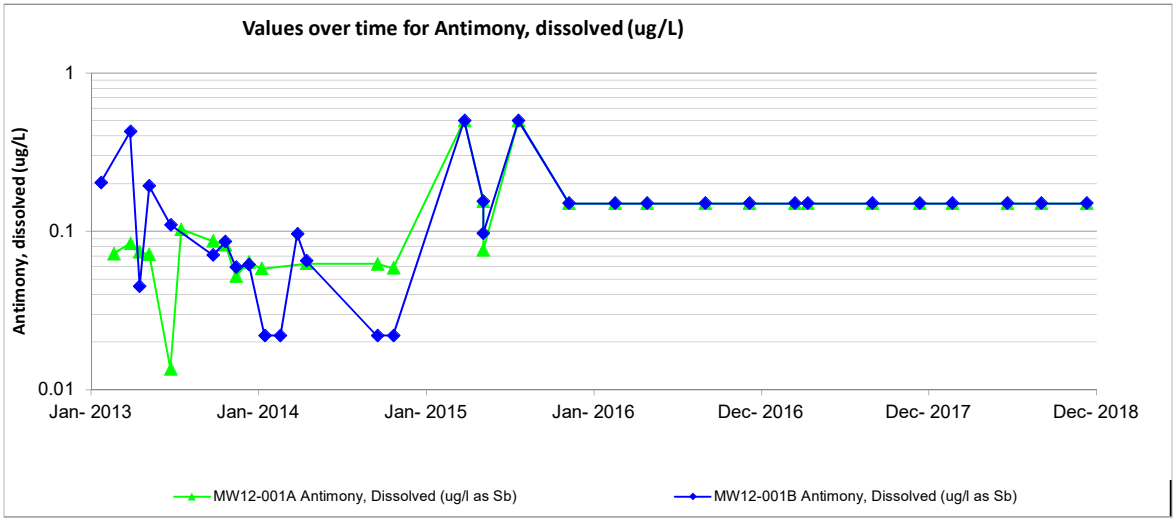

Values over time for Total Dissolved Solids (TDS) (mg/L)
TDS (mg/L)
1000
100
10
Jan- 2013
Jan- 2014
Jan- 2015
Jan- 2016
Dec- 2016
Dec- 2017
Dec- 2018
LL04-032 TDS, Residue,Total Filtrable (Dried At 180C),mg/l
LL04-031 TDS, Residue,Total Filtrable (Dried At 180C),mg/l
Ground Water Quality Standards Limit TDS, Residue,Total Filtrable (Dried At 180C),mg/l

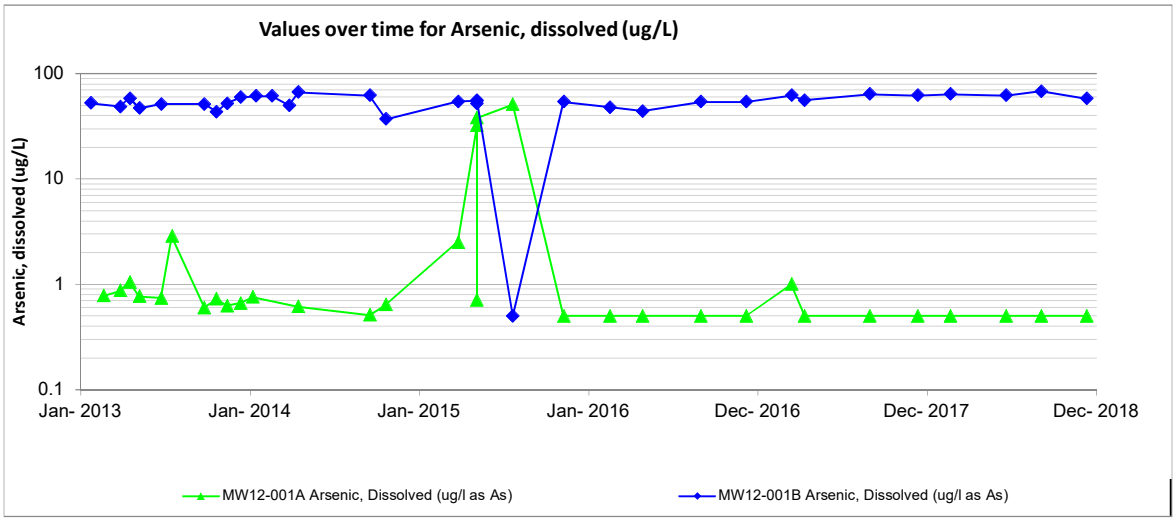

Values over time for Zinc, total (ug/L)
(Zinc is hardness dependant. For graphing purposes, the lowest value in the data set was used for the WQS.)
Zinc, total (ug/L)
10
1
0.1
Jan- 2013
Jan- 2014
Jan- 2015
Jan- 2016
Dec- 2016
Dec- 2017
Dec- 2018
LL04-032 Zinc, Total (ug/l as Zn)
LL04-031 Zinc, Total (ug/l as Zn)

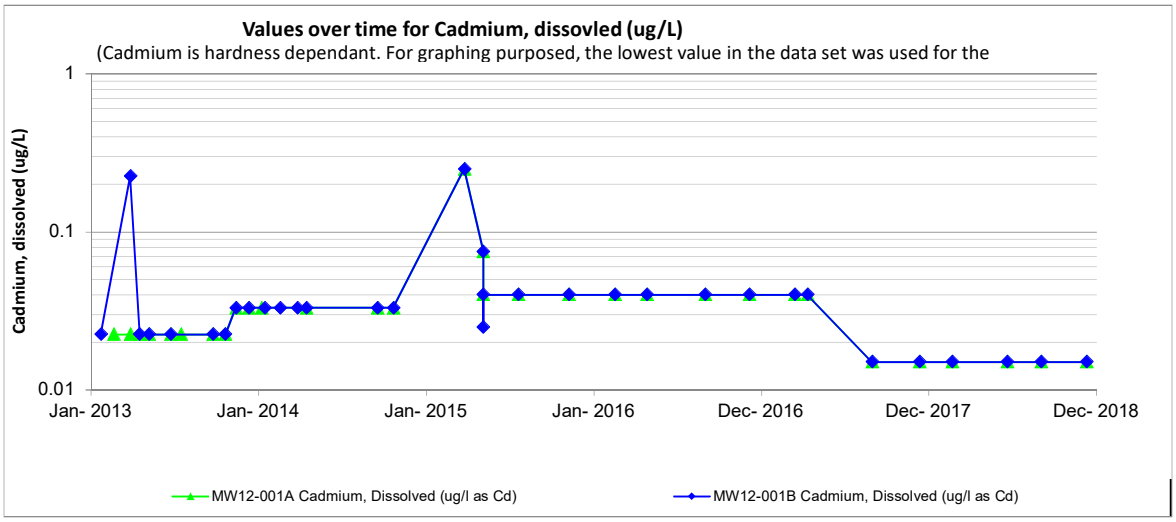
APPENDIX C –

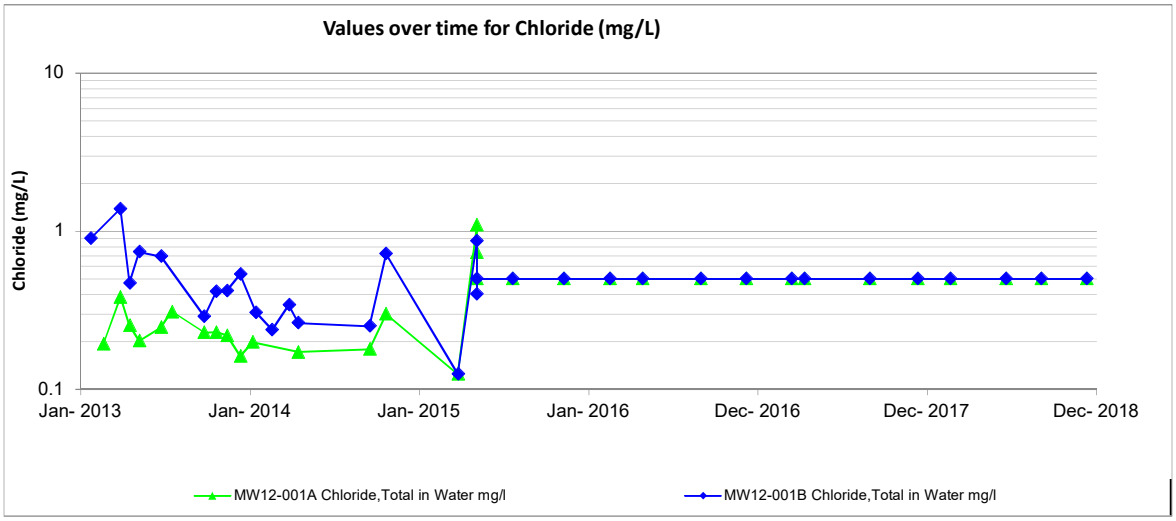
MW12-001A and MW12-001B

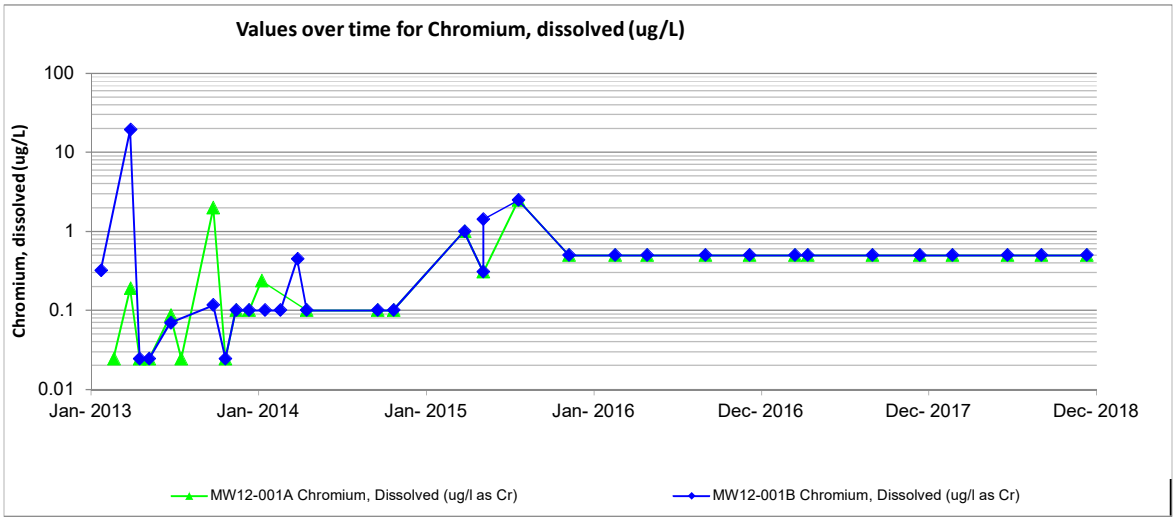
Wells Graphs

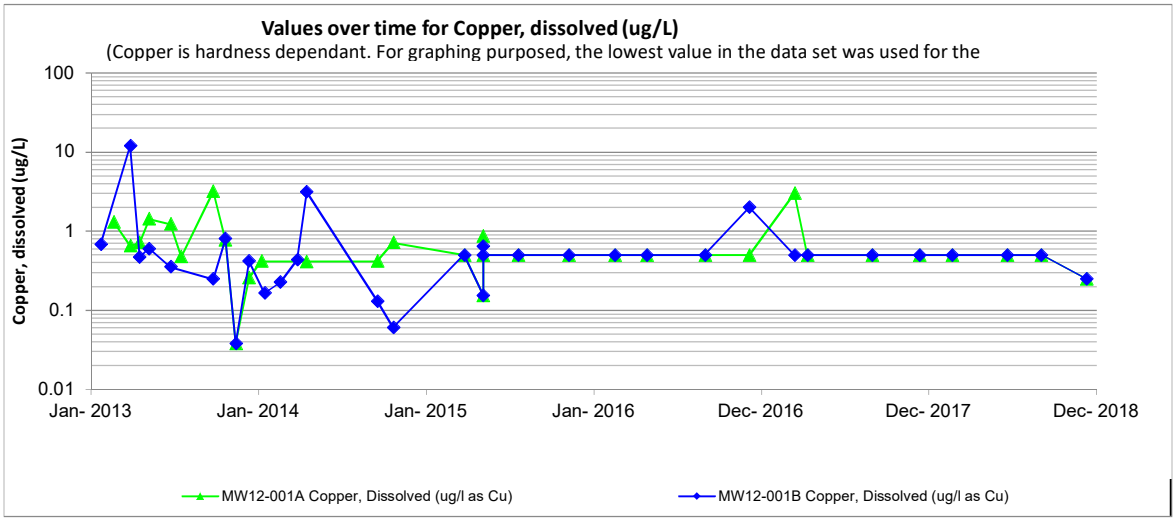

Values over time for Antimony, dissolved (ug/L)
Antimony, dissolved (ug/L)
1
0.1
0.01
Jan- 2013
Jan- 2014
Jan- 2015
Jan- 2016
Dec- 2016
Dec- 2017
Dec- 2018
MW12-001A Antimony, Dissolved (ug/l as Sb)
MW12-001B Antimony, Dissolved (ug/l as Sb)

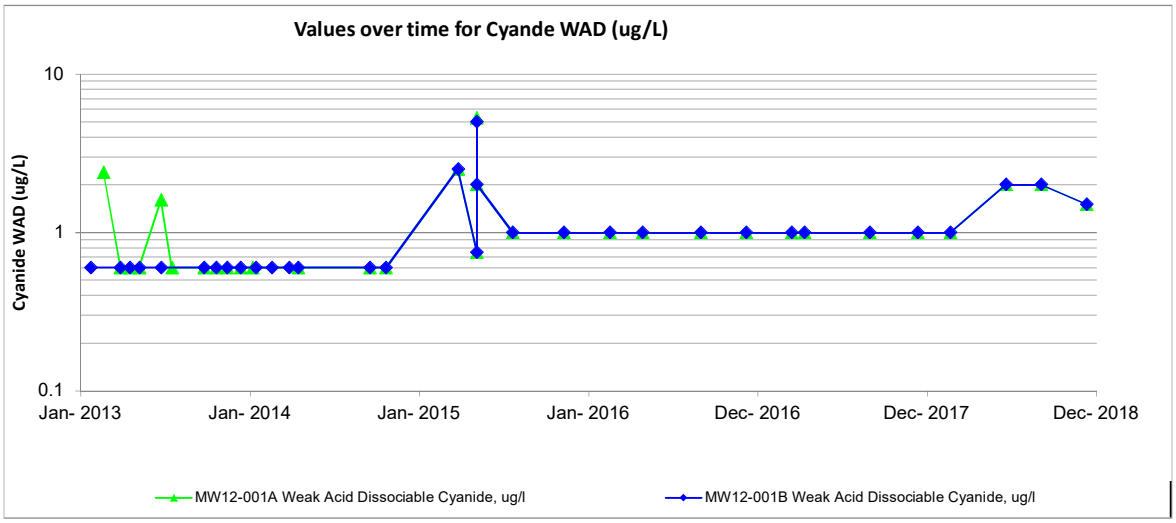

Values over time for Arsenic, dissolved (ug/L)
Arsenic, dissolved (ug/L)
100
10
1
0.1
Jan- 2013
Jan- 2014
Jan- 2015
Jan- 2016
Dec- 2016
Dec- 2017
Dec- 2018
MW12-001A Arsenic, Dissolved (ug/l as As)
MW12-001B Arsenic, Dissolved (ug/l as As)

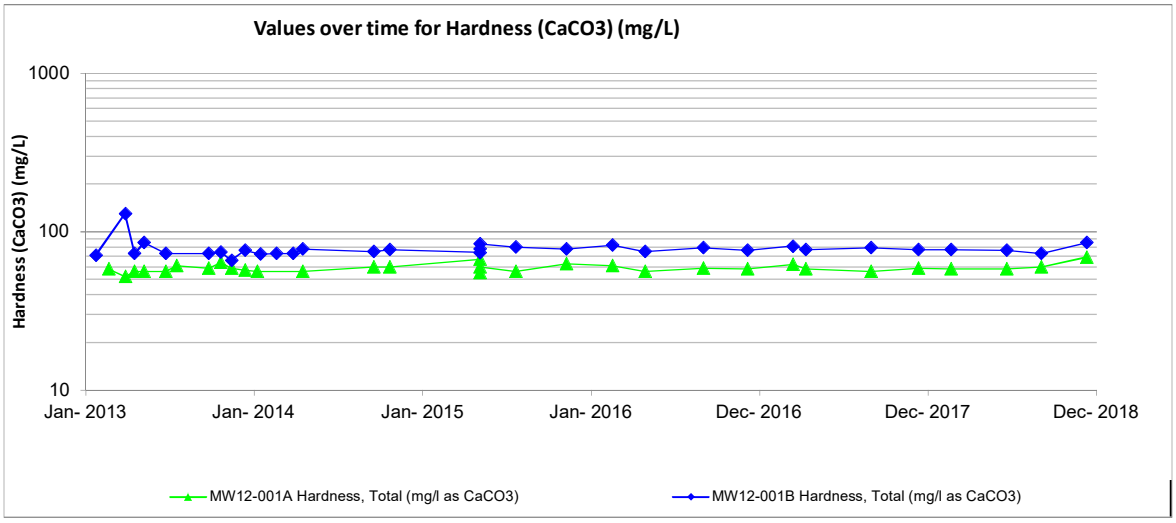

Values over time for Cadmium, dissovled (ug/L)
(Cadmium is hardness dependant. For graphing purposed, the lowest value in the data set was used for the
Cadmium, dissolved (ug/L)
1
0.1
0.01
Jan- 2013
Jan- 2014
Jan- 2015
Jan- 2016
Dec- 2016
Dec- 2017
Dec- 2018
MW12-001A Cadmium, Dissolved (ug/l as Cd)
MW12-001B Cadmium, Dissolved (ug/l as Cd)

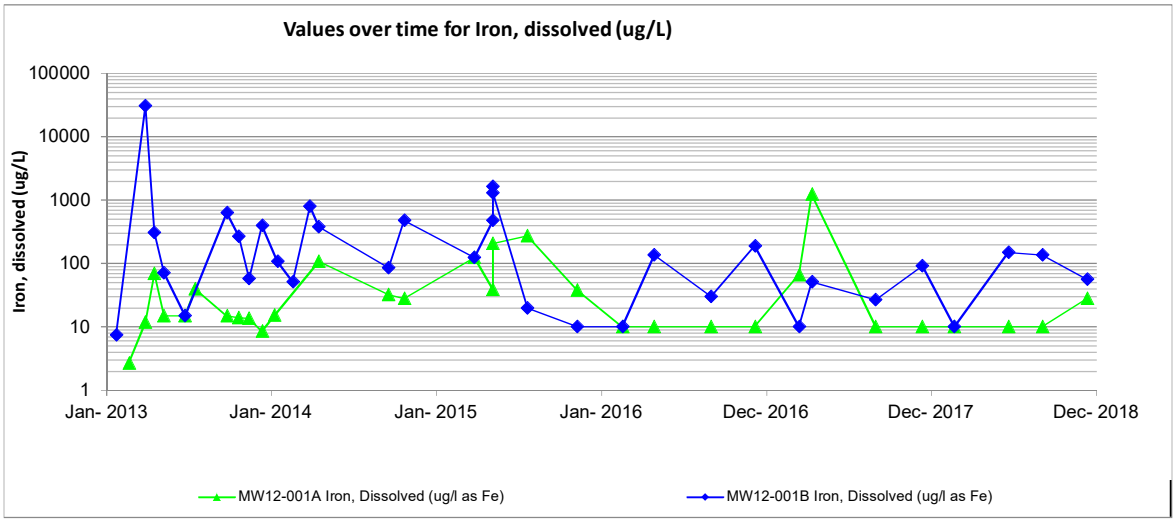

Values over time for Chloride (mg/L)
Chloride (mg/L)
10
1
0.1
Jan- 2013
Jan- 2014
Jan- 2015
Jan- 2016
Dec- 2016
Dec- 2017
Dec- 2018
MW12-001A Chloride,Total in Water mg/l
MW12-001B Chloride,Total in Water mg/l

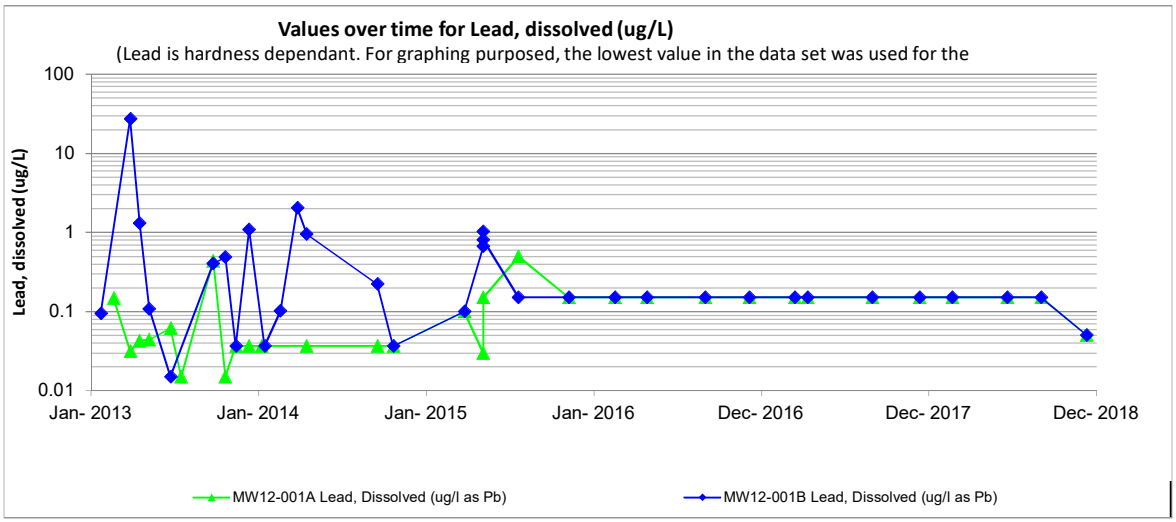

Values over time for Chromium, dissolved (ug/L)
Chromium, dissolved (ug/L)
100
10
1
0.1
0.01
Jan- 2013
Jan- 2014
Jan- 2015
Jan- 2016
Dec- 2016
Dec- 2017
Dec- 2018
MW12-001A Chromium, Dissolved (ug/l as Cr)
MW12-001B Chromium, Dissolved (ug/l as Cr)

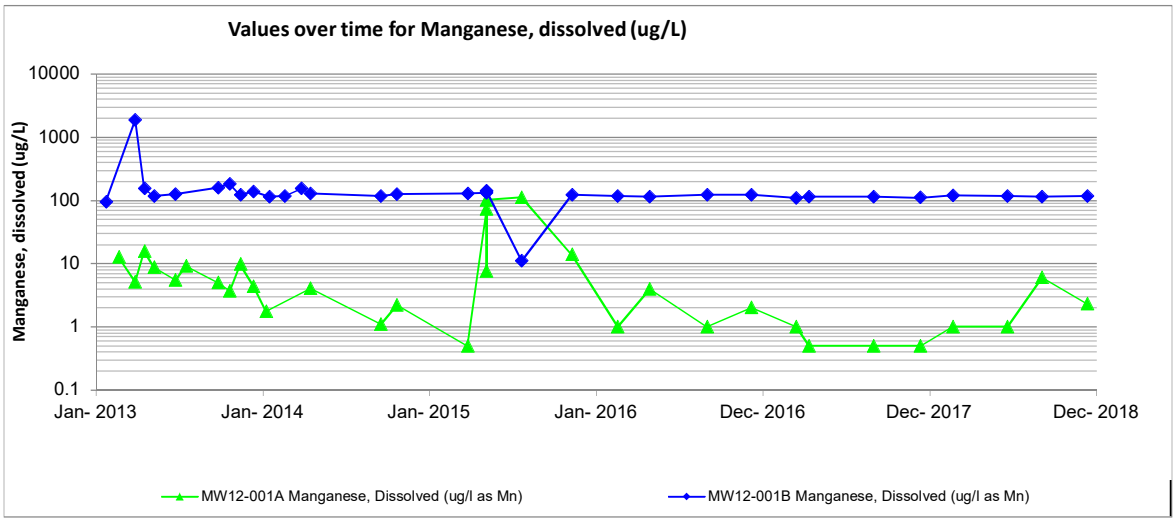

Values over time for Copper, dissolved (ug/L)
(Copper is hardness dependant. For graphing purposed, the lowest value in the data set was used for the
Copper, dissolved (ug/L)
100
10
1
0.1
0.01
Jan- 2013
Jan- 2014
Jan- 2015
Jan- 2016
Dec- 2016
Dec- 2017
Dec- 2018
MW12-001A Copper, Dissolved (ug/l as Cu)
MW12-001B Copper, Dissolved (ug/l as Cu)

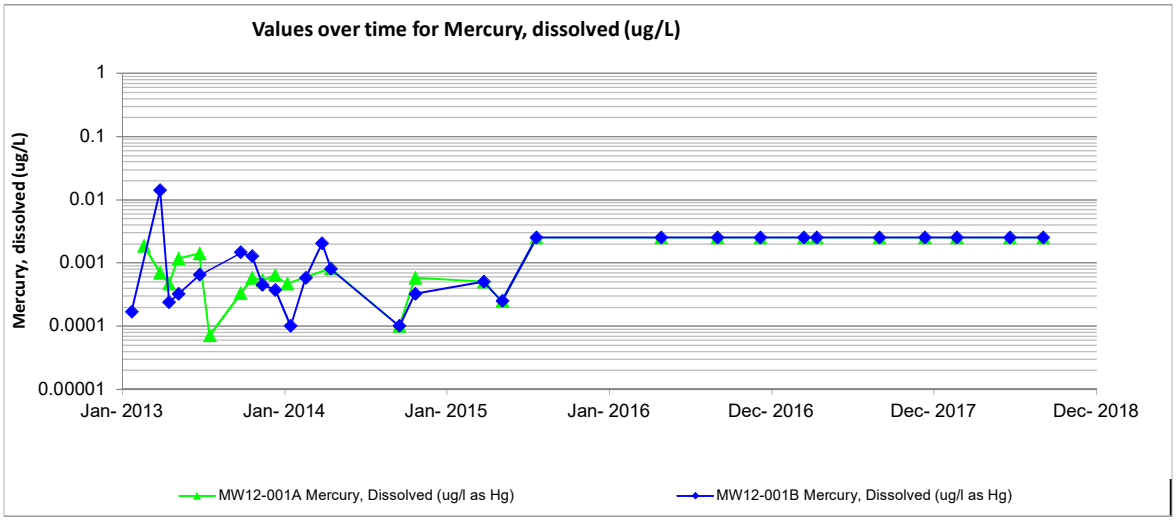

Values over time for Cyande WAD (ug/L)
Cyanide WAD (ug/L)
10
1
0.1
Jan- 2013
Jan- 2014
Jan- 2015
Jan- 2016
Dec- 2016
Dec- 2017
Dec- 2018
MW12-001A Weak Acid Dissociable Cyanide, ug/l
MW12-001B Weak Acid Dissociable Cyanide, ug/l

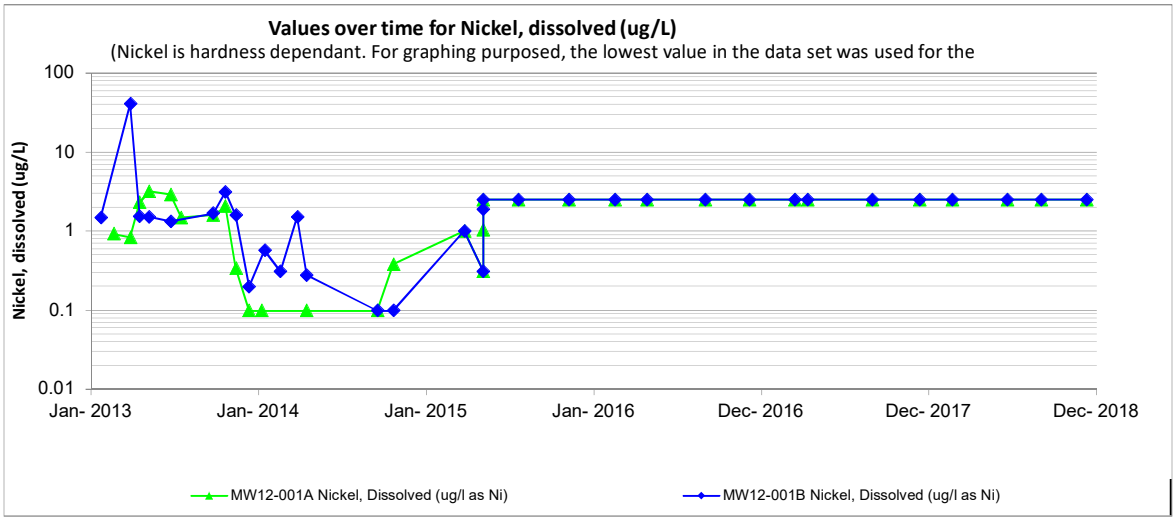

Values over time for Hardness (CaCO3) (mg/L)
Hardness (CaCO3) (mg/L)
1000
100
10
Jan- 2013
Jan- 2014
Jan- 2015
Jan- 2016
Dec- 2016
Dec- 2017
Dec- 2018
MW12-001A Hardness, Total (mg/l as CaCO3)
MW12-001B Hardness, Total (mg/l as CaCO3)

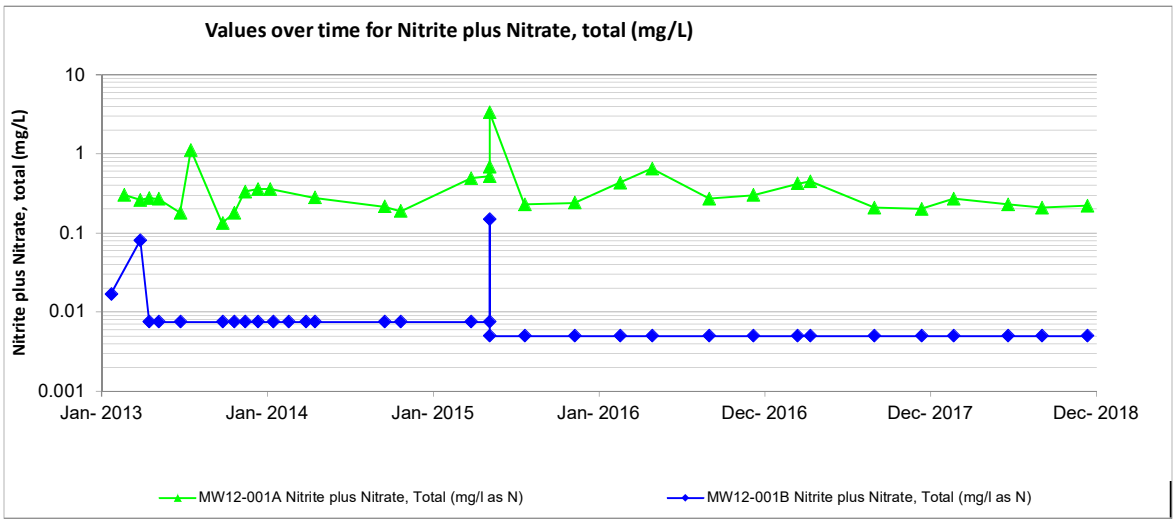

Values over time for Iron, dissolved (ug/L)
Iron, dissolved (ug/L)
100000
10000
1000
100
10
1
Jan- 2013
Jan- 2014
Jan- 2015
Jan- 2016
Dec- 2016
Dec- 2017
Dec- 2018
MW12-001A Iron, Dissolved (ug/l as Fe)
MW12-001B Iron, Dissolved (ug/l as Fe)

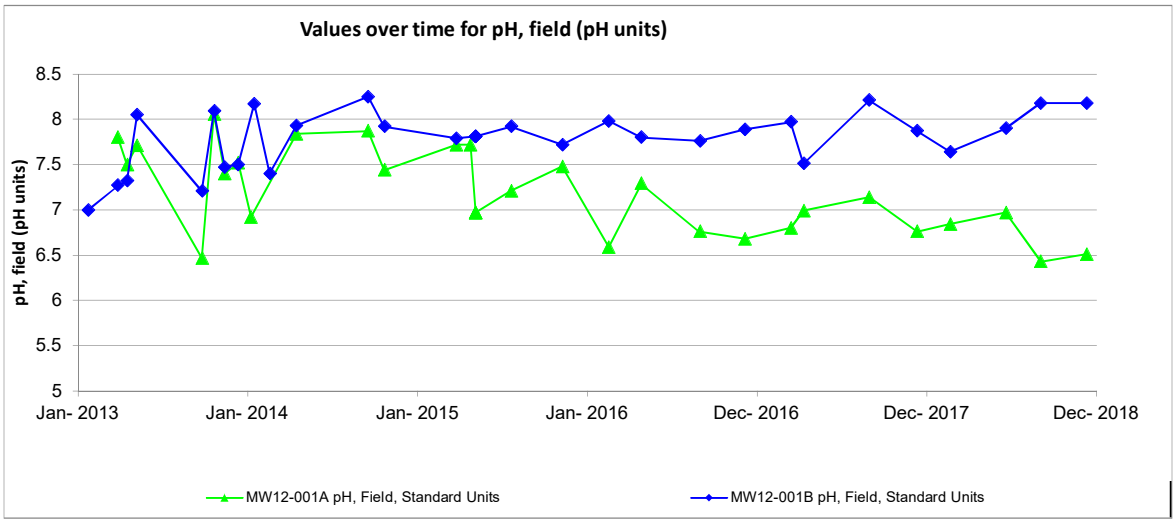

Values over time for Lead, dissolved (ug/L)
(Lead is hardness dependant. For graphing purposed, the lowest value in the data set was used for the
Lead, dissolved (ug/L)
100
10
1
0.1
0.01
Jan- 2013
Jan- 2014
Jan- 2015
Jan- 2016
Dec- 2016
Dec- 2017
Dec- 2018
MW12-001A Lead, Dissolved (ug/l as Pb)
MW12-001B Lead, Dissolved (ug/l as Pb)

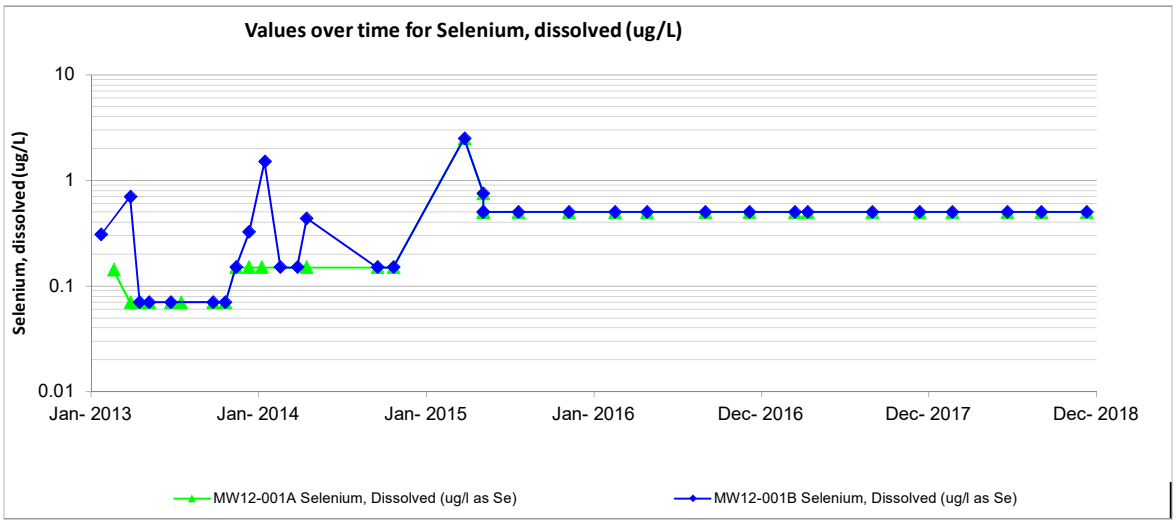

Values over time for Manganese, dissolved (ug/L)
Manganese, dissolved (ug/L)
10000
1000
100
10
1
0.1
Jan- 2013
Jan- 2014
Jan- 2015
Jan- 2016
Dec- 2016
Dec- 2017
Dec- 2018
MW12-001A Manganese, Dissolved (ug/l as Mn)
MW12-001B Manganese, Dissolved (ug/l as Mn)

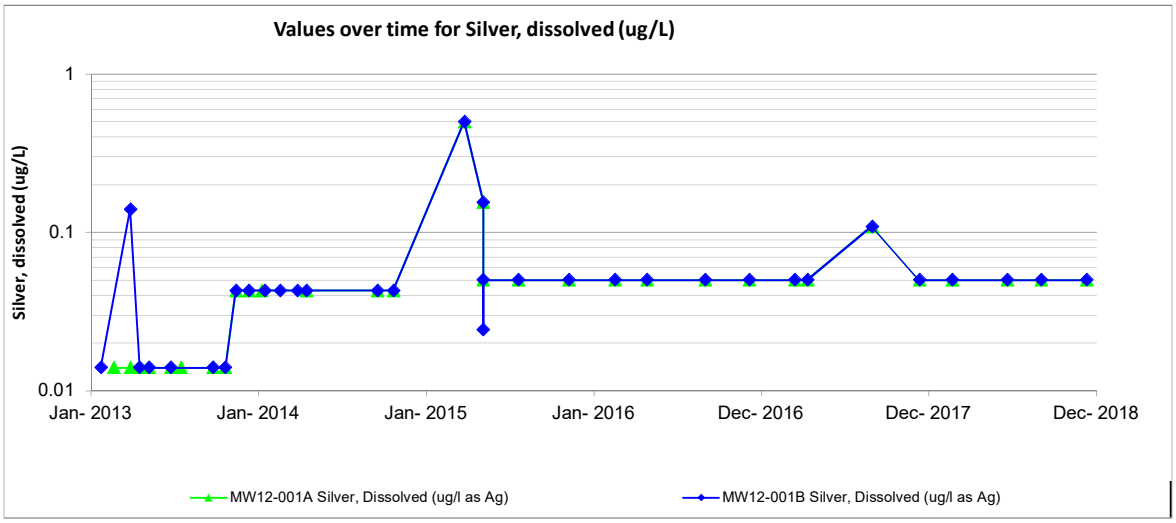

Values over time for Mercury, dissolved (ug/L)
Mercury, dissolved (ug/L)
1
0.1
0.01
0.001
0.0001
0.00001
Jan- 2013
Jan- 2014
Jan- 2015
Jan- 2016
Dec- 2016
Dec- 2017
Dec- 2018
MW12-001A Mercury, Dissolved (ug/l as Hg)
MW12-001B Mercury, Dissolved (ug/l as Hg)

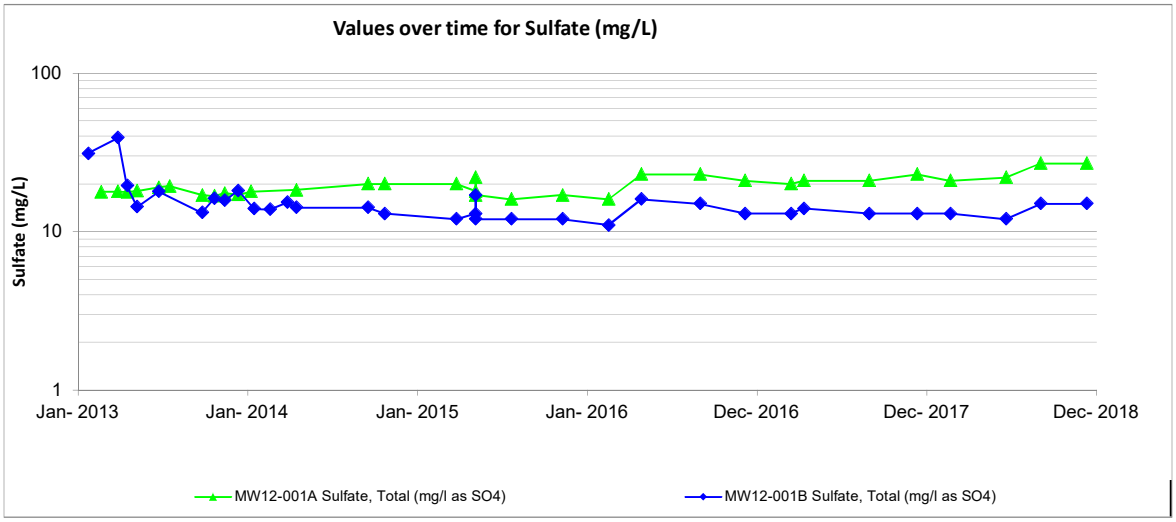

Values over time for Nickel, dissolved (ug/L)
(Nickel is hardness dependant. For graphing purposed, the lowest value in the data set was used for the
Nickel, dissolved (ug/L)
100
10
1
0.1
0.01
Jan- 2013
Jan- 2014
Jan- 2015
Jan- 2016
Dec- 2016
Dec- 2017
Dec- 2018
MW12-001A Nickel, Dissolved (ug/l as Ni)
MW12-001B Nickel, Dissolved (ug/l as Ni)

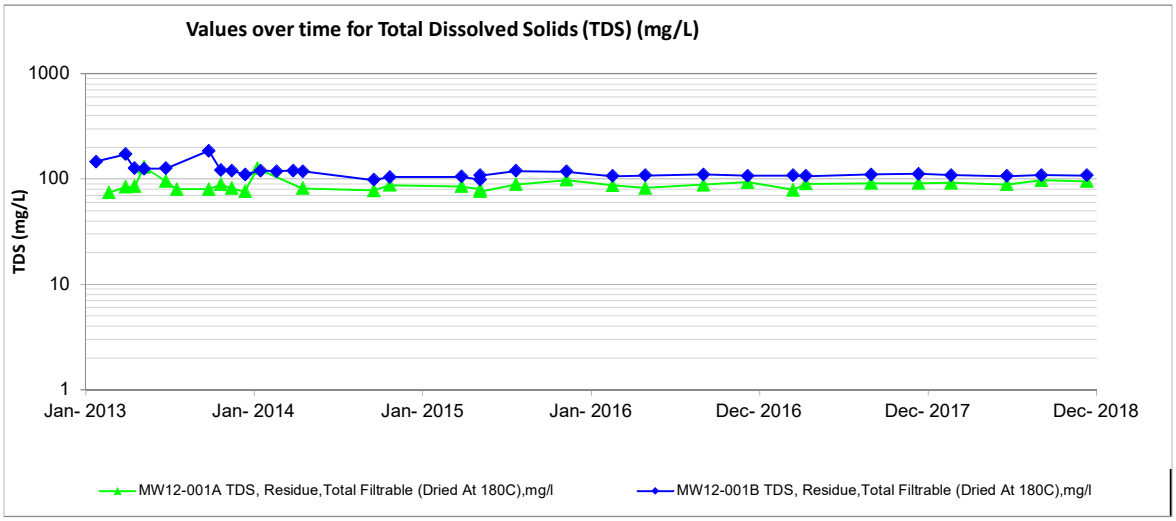

Values over time for Nitrite plus Nitrate, total (mg/L)
Nitrite plus Nitrate, total (mg/L)
10
1
0.1
0.01
0.001
Jan- 2013
Jan- 2014
Jan- 2015
Jan- 2016
Dec- 2016
Dec- 2017
Dec- 2018
MW12-001A Nitrite plus Nitrate, Total (mg/l as N)
MW12-001B Nitrite plus Nitrate, Total (mg/l as N)

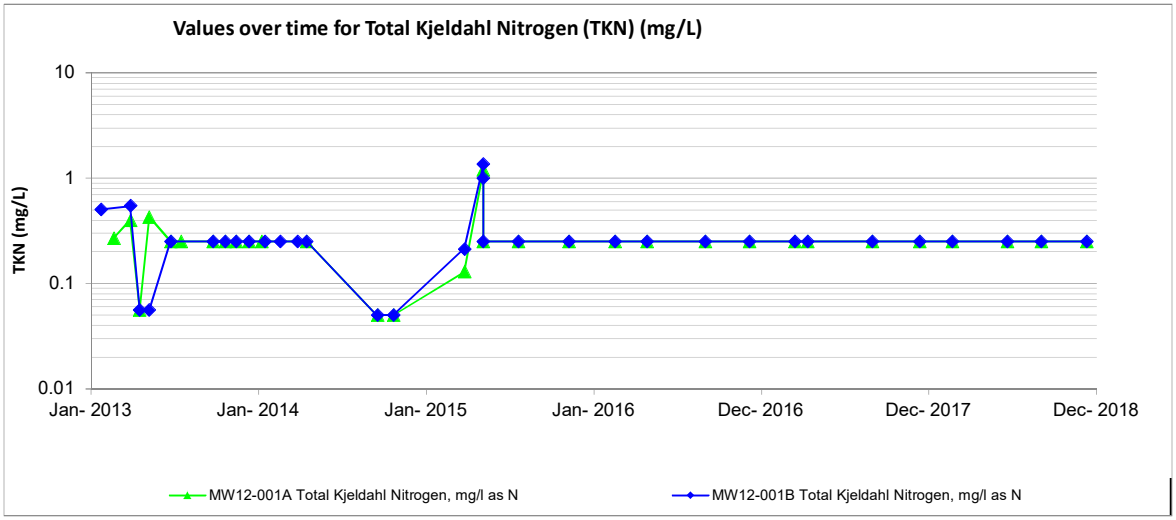

Values over time for pH, field (pH units)
pH, field (pH units)
8.5
8
7.5
7
6.5
6
5.5
5
Jan- 2013
Jan- 2014
Jan- 2015
Jan- 2016
Dec- 2016
Dec- 2017
Dec- 2018
MW12-001A pH, Field, Standard Units
MW12-001B pH, Field, Standard Units

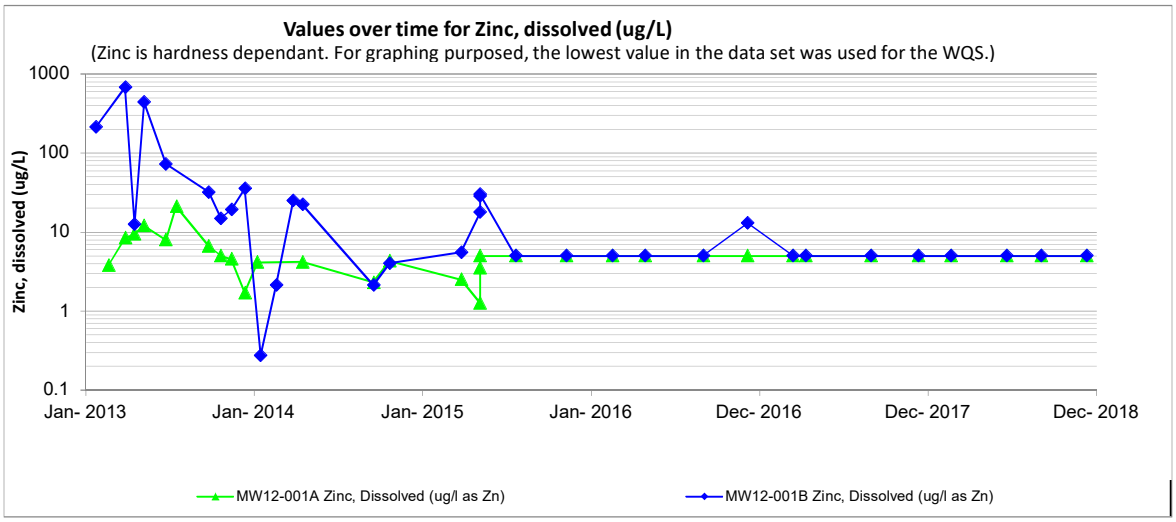

Values over time for Selenium, dissolved (ug/L)
Selenium, dissolved (ug/L)
10
1
0.1
0.01
Jan- 2013
Jan- 2014
Jan- 2015
Jan- 2016
Dec- 2016
Dec- 2017
Dec- 2018
MW12-001A Selenium, Dissolved (ug/l as Se)
MW12-001B Selenium, Dissolved (ug/l as Se)


Values over time for Silver, dissolved (ug/L)
Silver, dissolved (ug/L)
1
0.1
0.01
Jan- 2013
Jan- 2014
Jan- 2015
Jan- 2016
Dec- 2016
Dec- 2017
Dec- 2018
MW12-001A Silver, Dissolved (ug/l as Ag)
MW12-001B Silver, Dissolved (ug/l as Ag)


Values over time for Sulfate (mg/L)
Sulfate (mg/L)
100
10
1
Jan- 2013
Jan- 2014
Jan- 2015
Jan- 2016
Dec- 2016
Dec- 2017
Dec- 2018
MW12-001A Sulfate, Total (mg/l as SO4)
MW12-001B Sulfate, Total (mg/l as SO4)

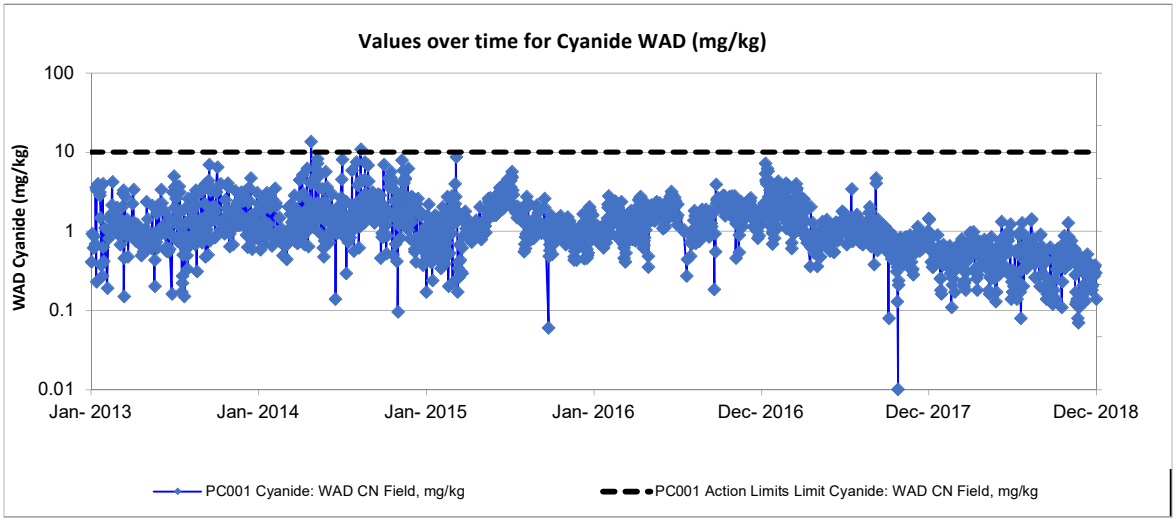

Values over time for Total Dissolved Solids (TDS) (mg/L)
TDS (mg/L)
1000
100
10
1
Jan- 2013
Jan- 2014
Jan- 2015
Jan- 2016
Dec- 2016
Dec- 2017
Dec- 2018
MW12-001A TDS, Residue,Total Filtrable (Dried At 180C),mg/l
MW12-001B TDS, Residue,Total Filtrable (Dried At 180C),mg/l


Values over time for Total Kjeldahl Nitrogen (TKN) (mg/L)
TKN (mg/L)
10
1
0.1
0.01
Jan- 2013
Jan- 2014
Jan- 2015
Jan- 2016
Dec- 2016
Dec- 2017
Dec- 2018
MW12-001A Total Kjeldahl Nitrogen, mg/l as N
MW12-001B Total Kjeldahl Nitrogen, mg/l as N


Values over time for Zinc, dissolved (ug/L)
(Zinc is hardness dependant. For graphing purposed, the lowest value in the data set was used for the WQS.)
Zinc, dissolved (ug/L)
1000
100
10
1
0.1
Jan- 2013
Jan- 2014
Jan- 2015
Jan- 2016
Dec- 2016
Dec- 2017
Dec- 2018
MW12-001A Zinc, Dissolved (ug/l as Zn)
MW12-001B Zinc, Dissolved (ug/l as Zn)

APPENDIX C –

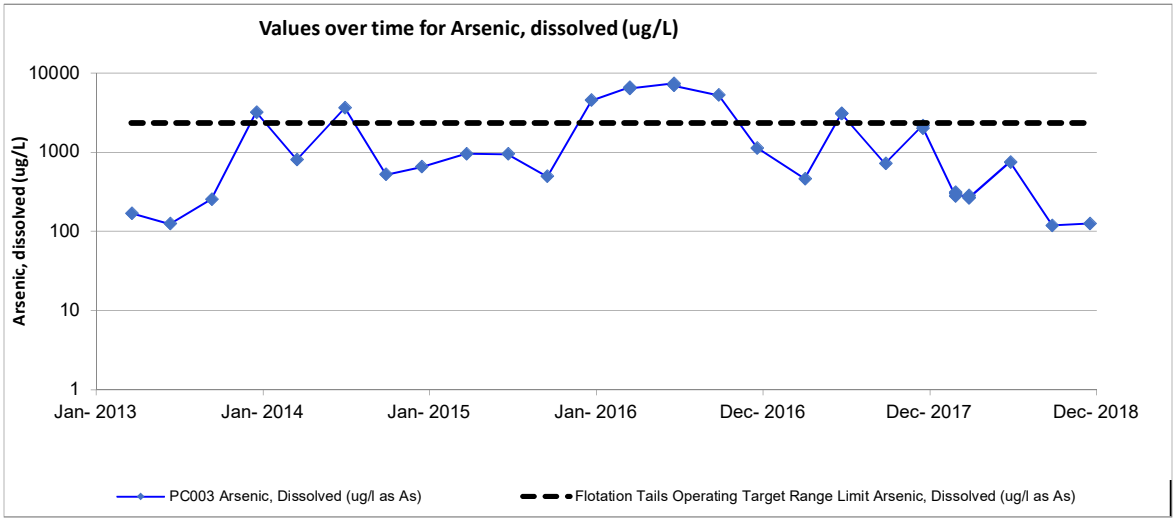
PC001 Graph

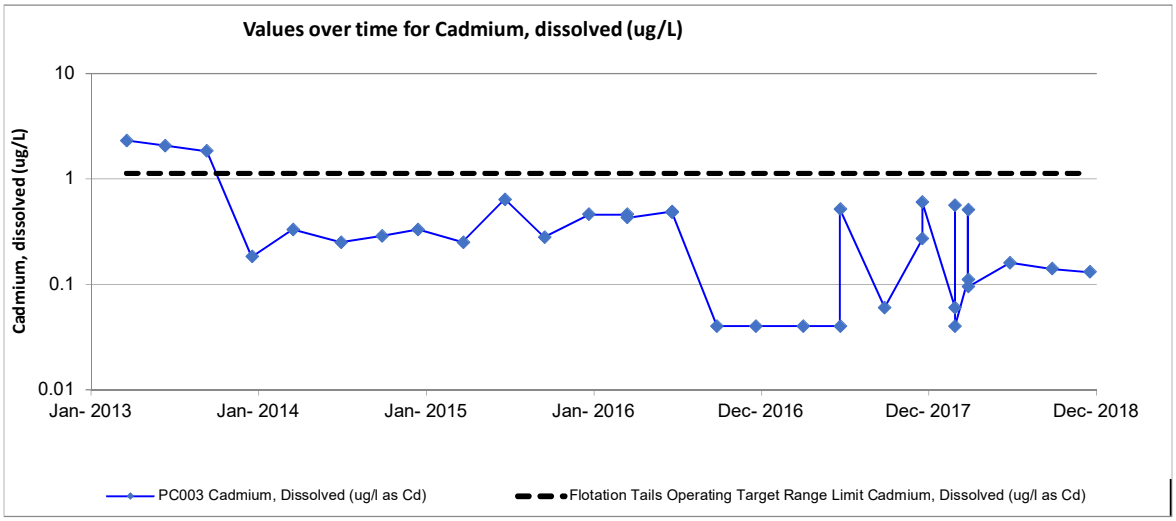

Values over time for Cyanide WAD (mg/kg)
WAD Cyanide (mg/kg)
100
10
1
0.1
0.01
Jan- 2013
Jan- 2014
Jan- 2015
Jan- 2016
Dec- 2016
Dec- 2017
Dec- 2018
PC001 Cyanide: WAD CN Field, mg/kg
PC001 Action Limits Limit Cyanide: WAD CN Field, mg/kg

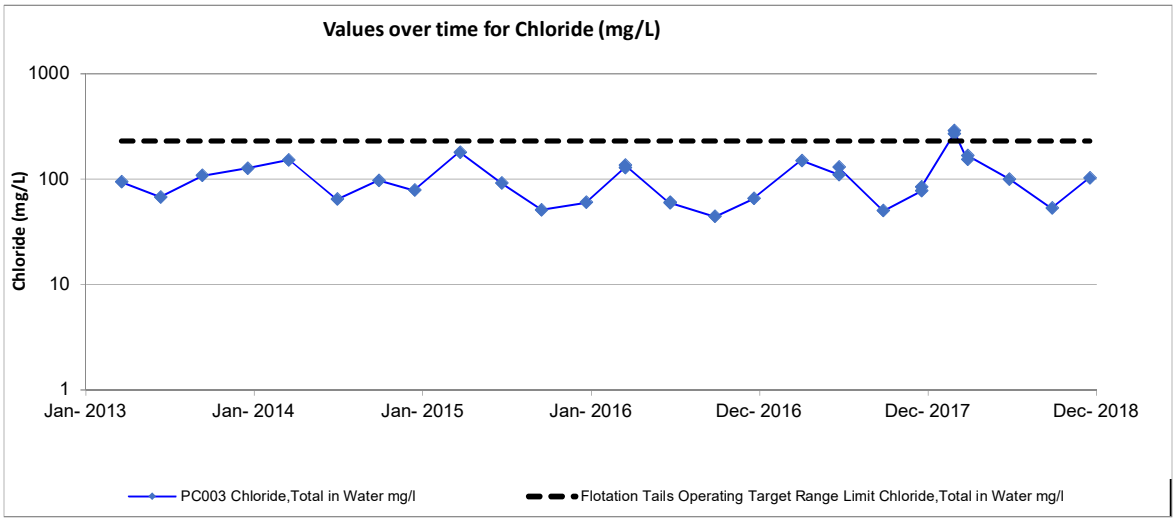
APPENDIX C –

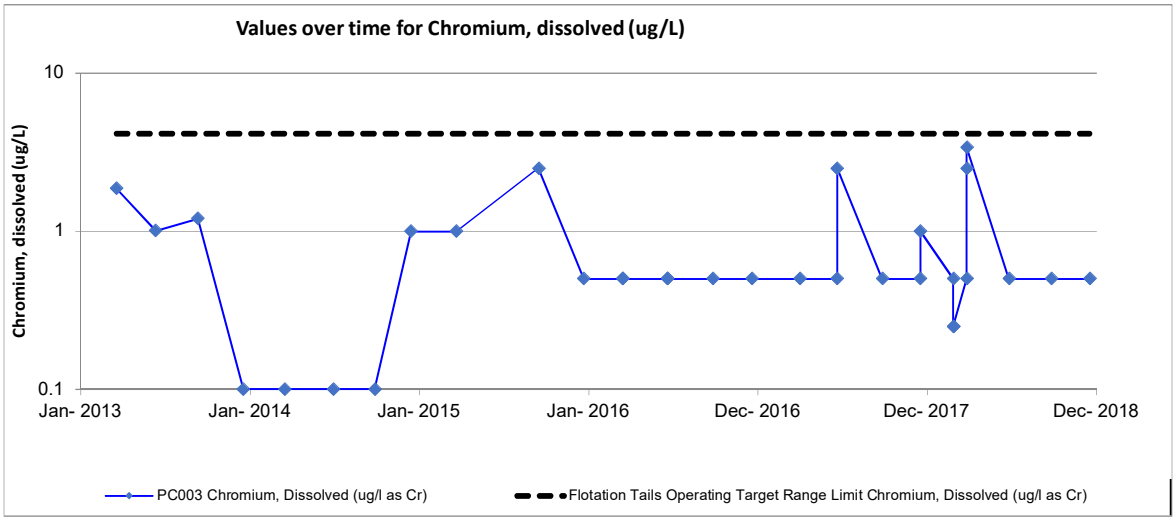
PC003 Interstitial Water

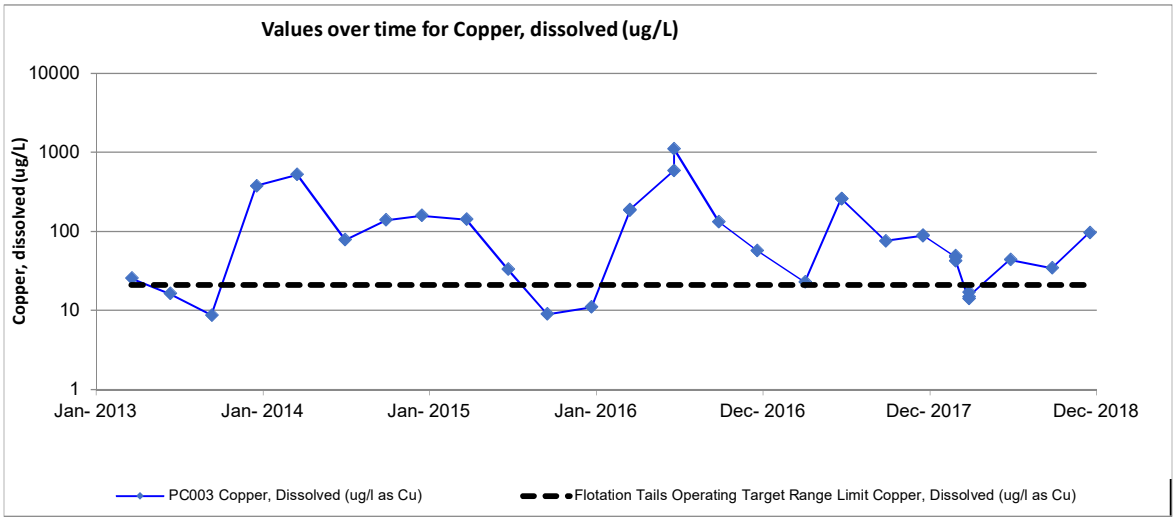
Graphs

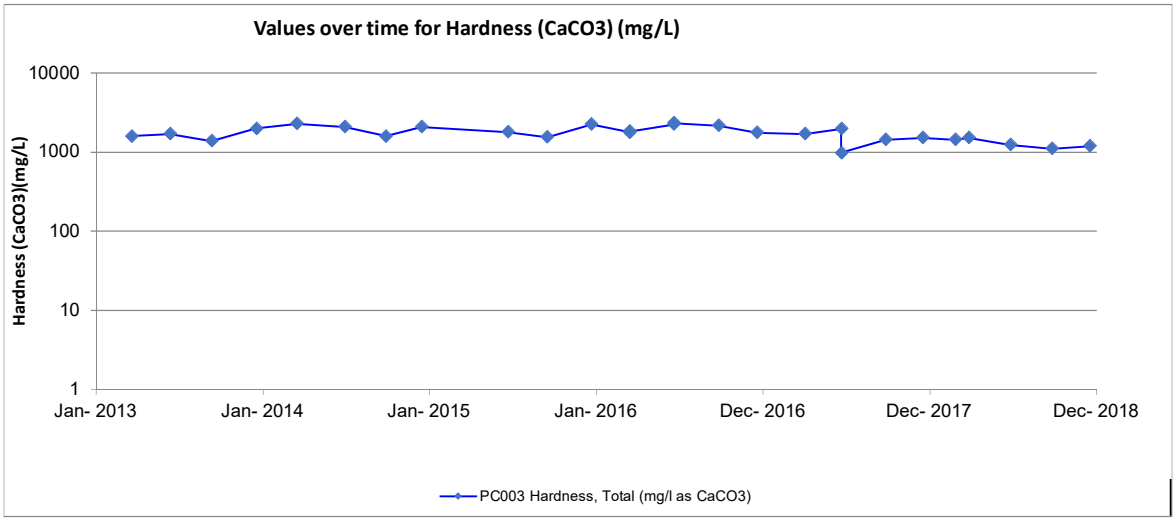

Values over time for Arsenic, dissolved (ug/L)
Arsenic, dissolved (ug/L)
10000
1000
100
10
1
Jan- 2013
Jan- 2014
Jan- 2015
Jan- 2016
Dec- 2016
Dec- 2017
Dec- 2018
PC003 Arsenic, Dissolved (ug/l as As)
Flotation Tails Operating Target Range Limit Arsenic, Dissolved (ug/l as As)

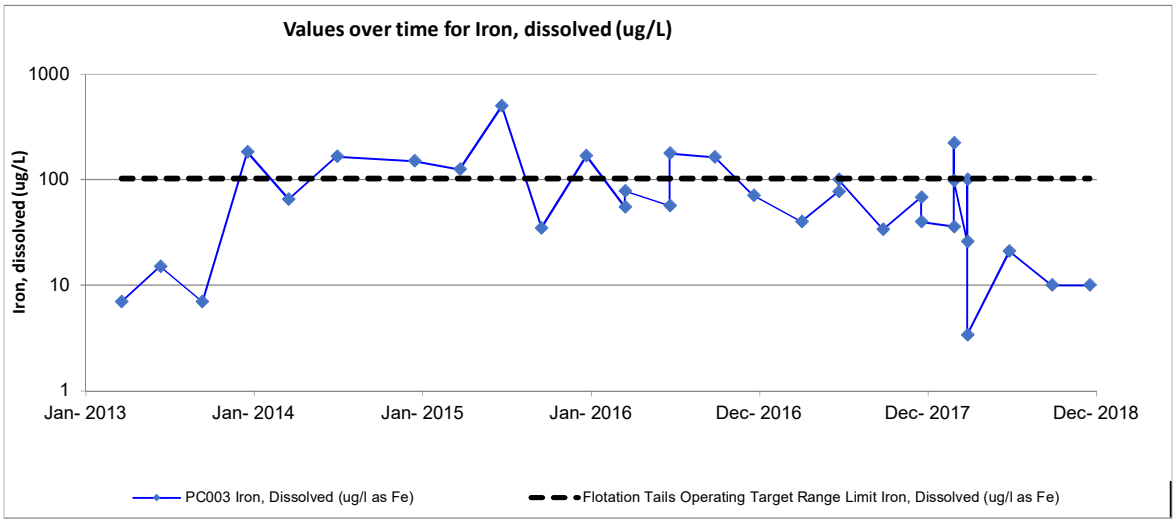

Values over time for Cadmium, dissolved (ug/L)
Cadmium, dissolved (ug/L)
10
1
0.1
0.01
Jan- 2013
Jan- 2014
Jan- 2015
Jan- 2016
Dec- 2016
Dec- 2017
Dec- 2018
PC003 Cadmium, Dissolved (ug/l as Cd)
Flotation Tails Operating Target Range Limit Cadmium, Dissolved (ug/l as Cd)

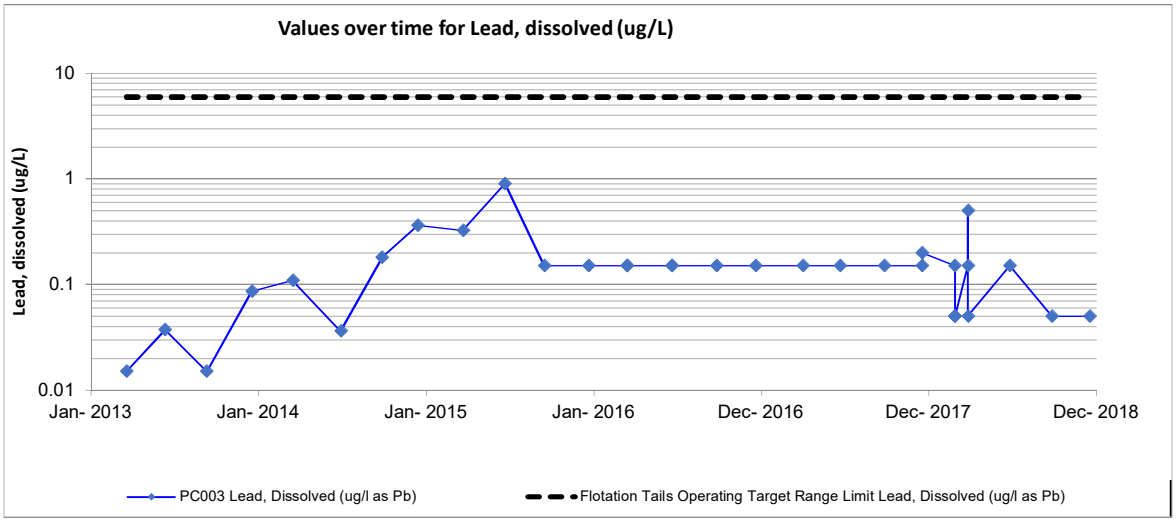

Values over time for Chloride (mg/L)
Chloride (mg/L)
1000
100
10
1
Jan- 2013
Jan- 2014
Jan- 2015
Jan- 2016
Dec- 2016
Dec- 2017
Dec- 2018
PC003 Chloride,Total in Water mg/l
Flotation Tails Operating Target Range Limit Chloride,Total in Water mg/l

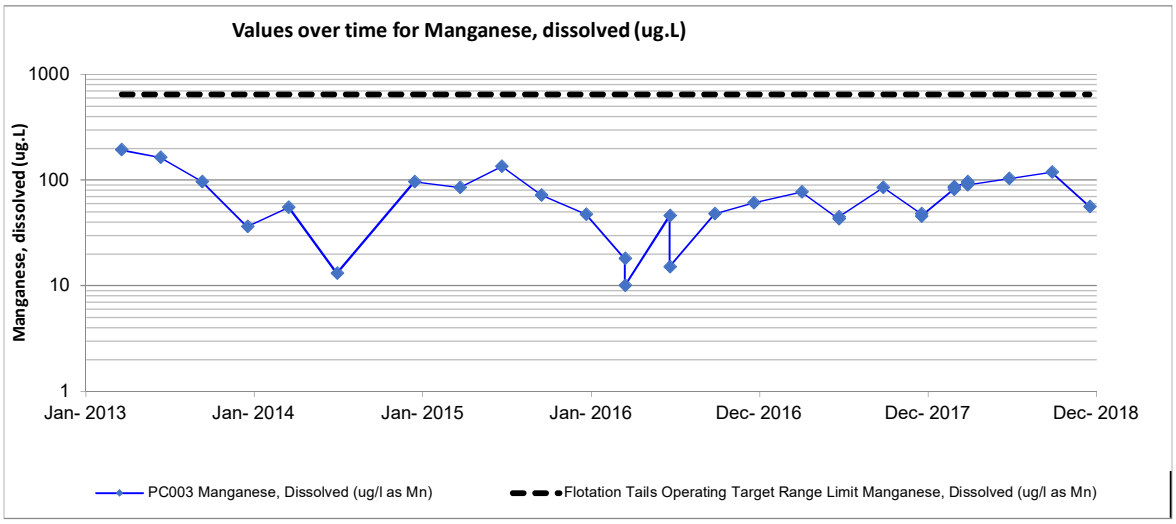

Values over time for Chromium, dissolved (ug/L)
Chromium, dissolved (ug/L)
10
1
0.1
Jan- 2013
Jan- 2014
Jan- 2015
Jan- 2016
Dec- 2016
Dec- 2017
Dec- 2018
PC003 Chromium, Dissolved (ug/l as Cr)
Flotation Tails Operating Target Range Limit Chromium, Dissolved (ug/l as Cr)

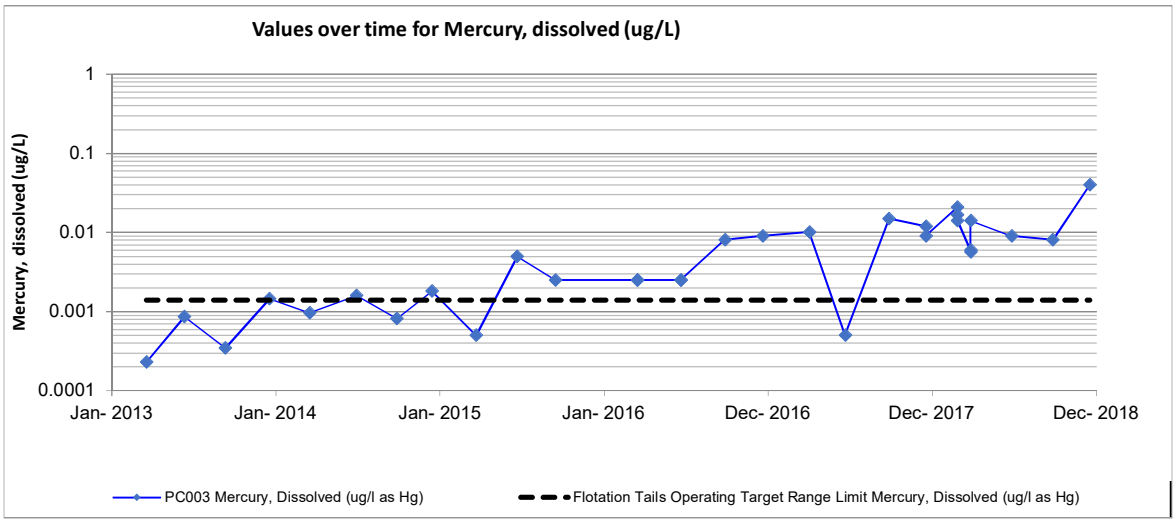

Values over time for Copper, dissolved (ug/L)
Copper, dissolved (ug/L)
10000
1000
100
10
1
Jan- 2013
Jan- 2014
Jan- 2015
Jan- 2016
Dec- 2016
Dec- 2017
Dec- 2018
PC003 Copper, Dissolved (ug/l as Cu)
Flotation Tails Operating Target Range Limit Copper, Dissolved (ug/l as Cu)

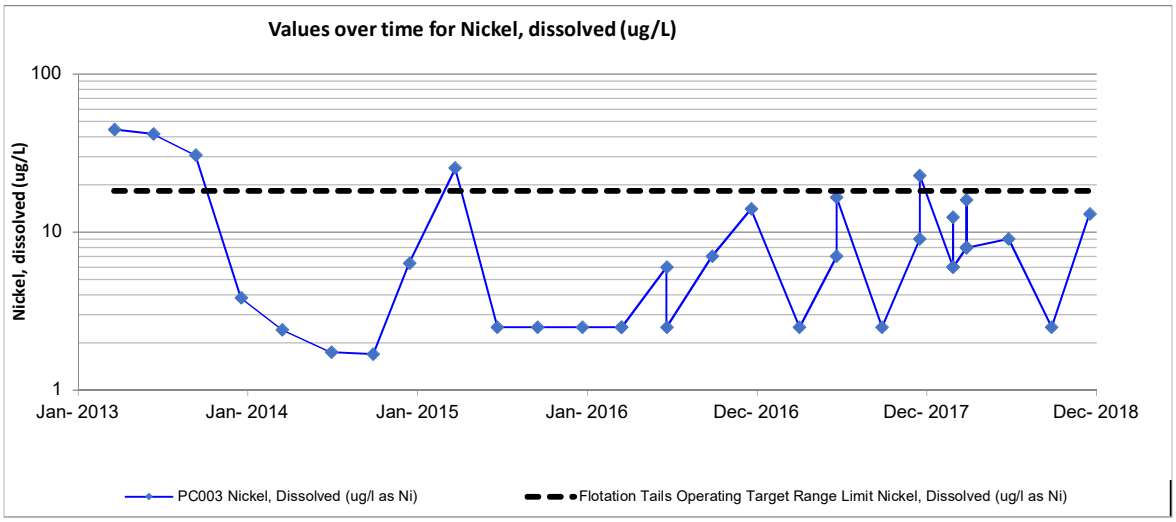

Values over time for Hardness (CaCO3) (mg/L)
Hardness (CaCO3)(mg/L)
10000
1000
100
10
1
Jan- 2013
Jan- 2014
Jan- 2015
Jan- 2016
Dec- 2016
Dec- 2017
Dec- 2018
PC003 Hardness, Total (mg/l as CaCO3)

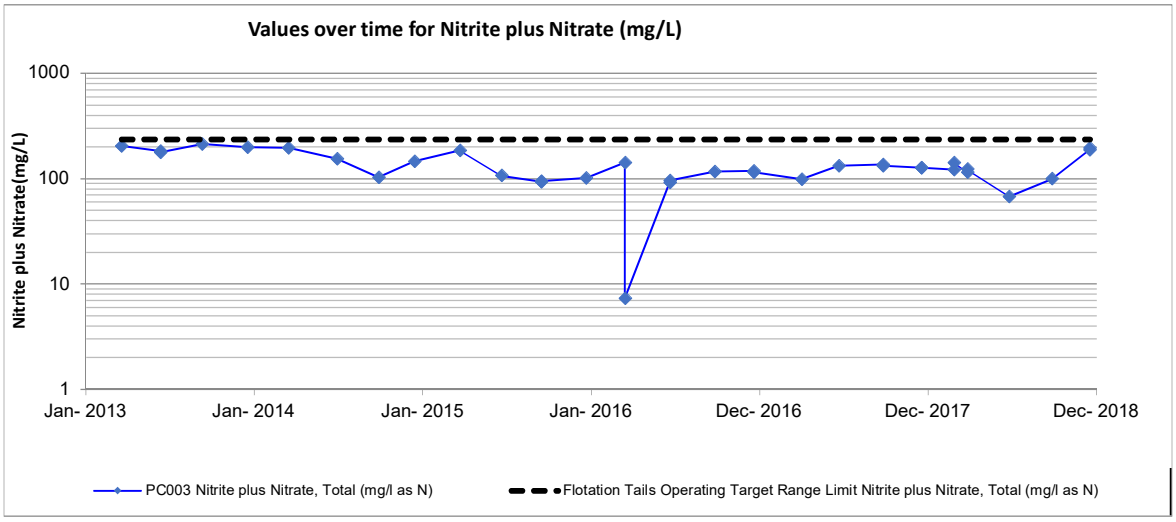

Values over time for Iron, dissolved (ug/L)
Iron, dissolved (ug/L)
1000
100
10
1
Jan- 2013
Jan- 2014
Jan- 2015
Jan- 2016
Dec- 2016
Dec- 2017
Dec- 2018
PC003 Iron, Dissolved (ug/l as Fe)
Flotation Tails Operating Target Range Limit Iron, Dissolved (ug/l as Fe)

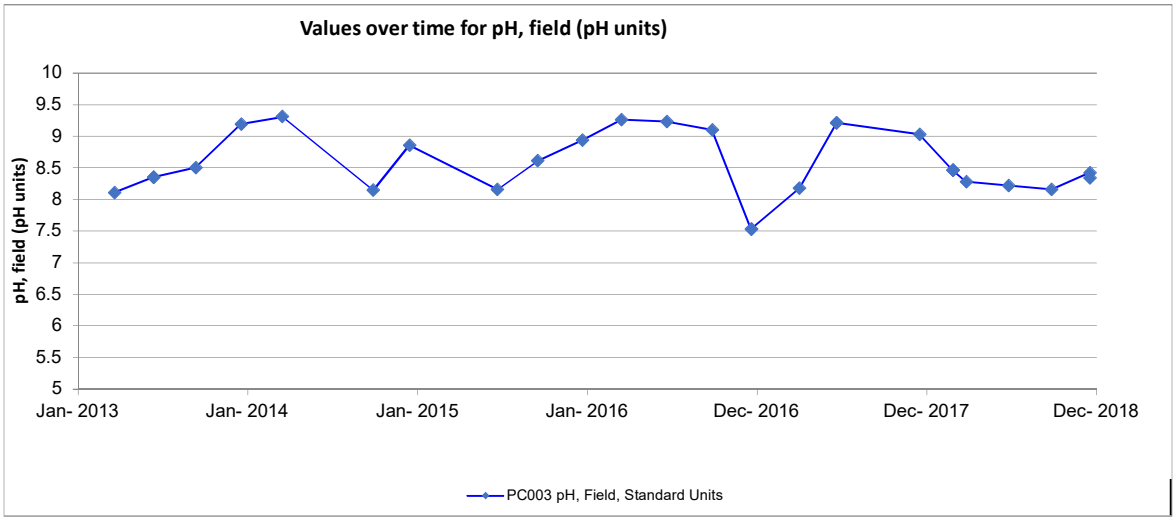

Values over time for Lead, dissolved (ug/L)
Lead, dissolved (ug/L)
10
1
0.1
0.01
Jan- 2013
Jan- 2014
Jan- 2015
Jan- 2016
Dec- 2016
Dec- 2017
Dec- 2018
PC003 Lead, Dissolved (ug/l as Pb)
Flotation Tails Operating Target Range Limit Lead, Dissolved (ug/l as Pb)

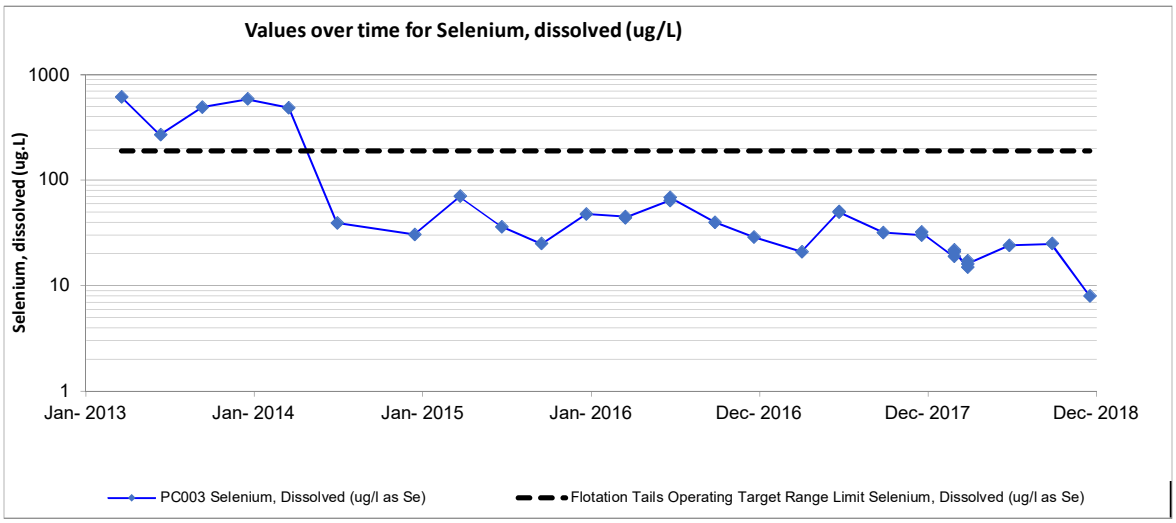

Values over time for Manganese, dissolved (ug.L)
Manganese, dissolved (ug.L)
1000
100
10
1
Jan- 2013
Jan- 2014
Jan- 2015
Jan- 2016
Dec- 2016
Dec- 2017
Dec- 2018
PC003 Manganese, Dissolved (ug/l as Mn)
Flotation Tails Operating Target Range Limit Manganese, Dissolved (ug/l as Mn)

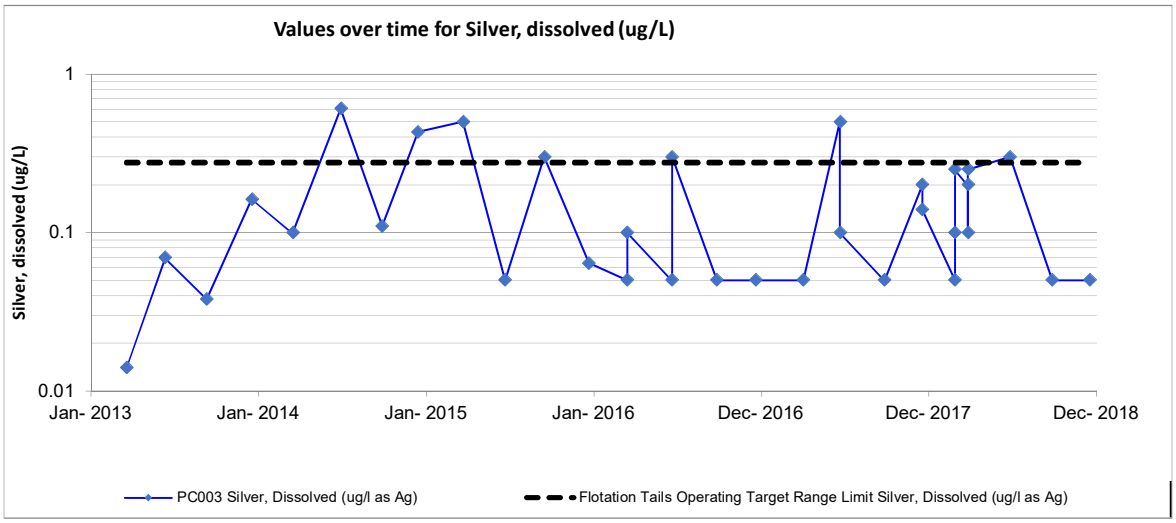

Values over time for Mercury, dissolved (ug/L)
Mercury, dissolved (ug/L)
1
0.1
0.01
0.001
0.0001
Jan- 2013
Jan- 2014
Jan- 2015
Jan- 2016
Dec- 2016
Dec- 2017
Dec- 2018
PC003 Mercury, Dissolved (ug/l as Hg)
Flotation Tails Operating Target Range Limit Mercury, Dissolved (ug/l as Hg)

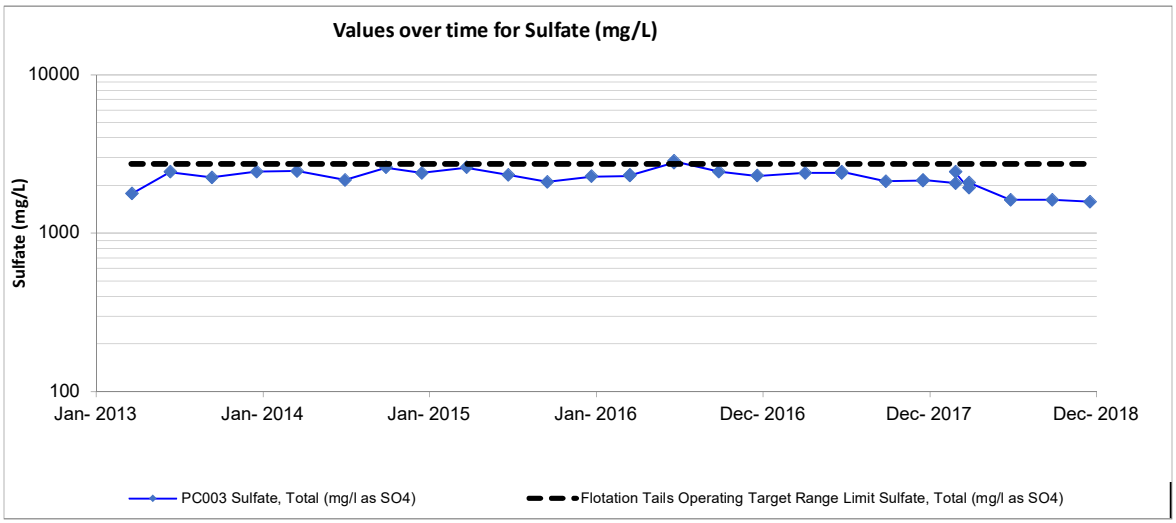

Values over time for Nickel, dissolved (ug/L)
Nickel, dissolved (ug/L)
100
10
1
Jan- 2013
Jan- 2014
Jan- 2015
Jan- 2016
Dec- 2016
Dec- 2017
Dec- 2018
PC003 Nickel, Dissolved (ug/l as Ni)
Flotation Tails Operating Target Range Limit Nickel, Dissolved (ug/l as Ni)

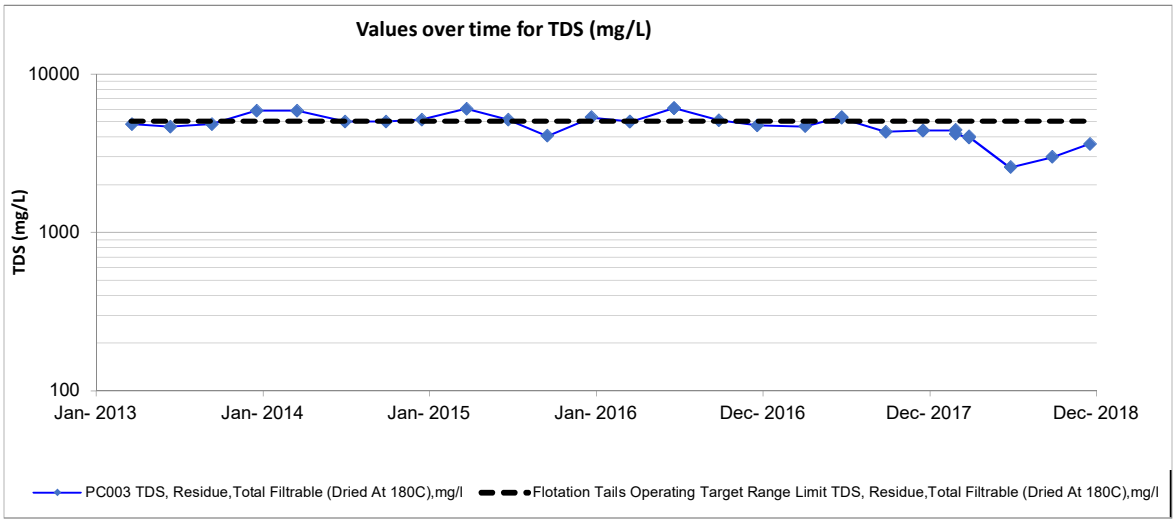

Values over time for Nitrite plus Nitrate (mg/L)
Nitrite plus Nitrate(mg/L)
1000
100
10
1
Jan- 2013
Jan- 2014
Jan- 2015
Jan- 2016
Dec- 2016
Dec- 2017
Dec- 2018
PC003 Nitrite plus Nitrate, Total (mg/l as N)
Flotation Tails Operating Target Range Limit Nitrite plus Nitrate, Total (mg/l as N)

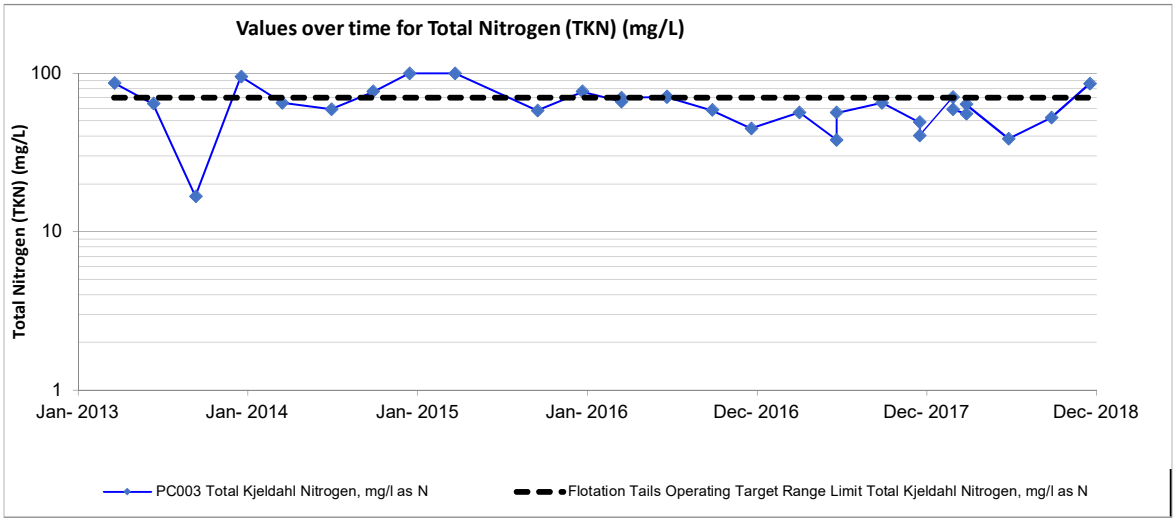

Values over time for pH, field (pH units)
pH, field (pH units)
10
9.5
9
8.5
8
7.5
7
6.5
6
5.5
5
Jan- 2013
Jan- 2014
Jan- 2015
Jan- 2016
Dec- 2016
Dec- 2017
Dec- 2018
PC003 pH, Field, Standard Units

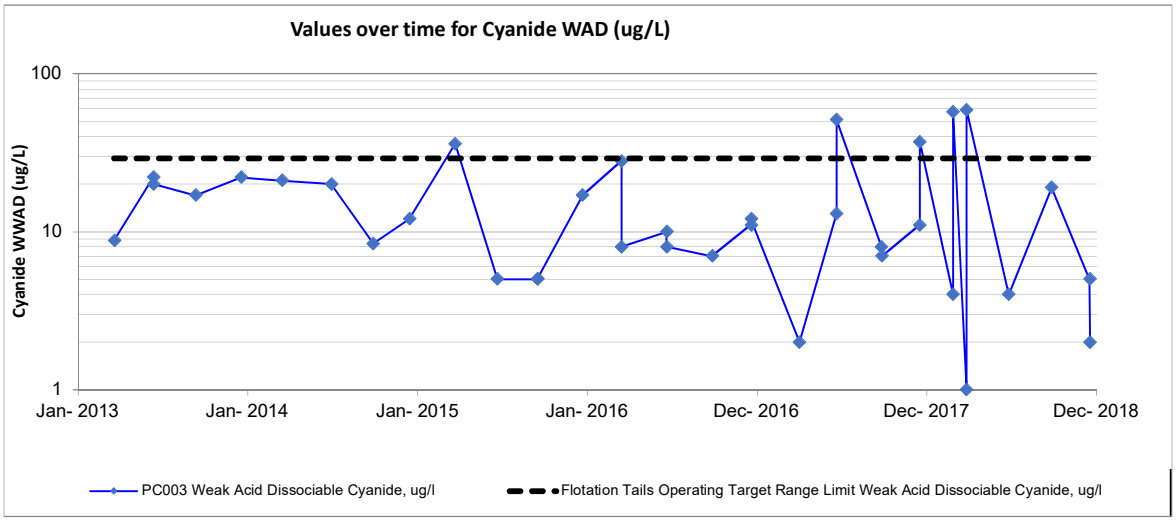

Values over time for Selenium, dissolved (ug/L)
Selenium, dissolved (ug.L)
1000
100
10
1
Jan- 2013
Jan- 2014
Jan- 2015
Jan- 2016
Dec- 2016
Dec- 2017
Dec- 2018
PC003 Selenium, Dissolved (ug/l as Se)
Flotation Tails Operating Target Range Limit Selenium, Dissolved (ug/l as Se)

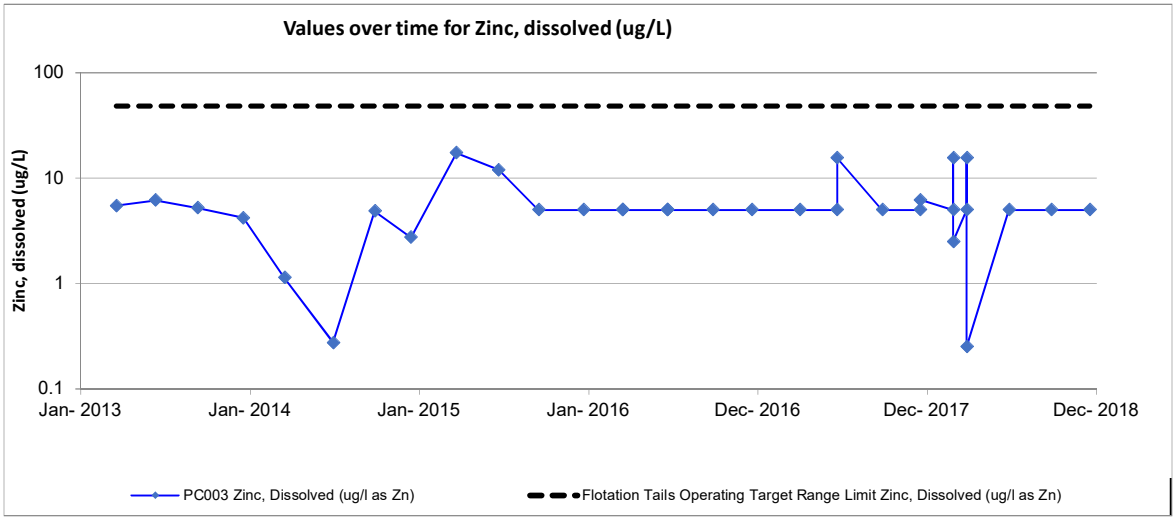

Values over time for Silver, dissolved (ug/L)
Silver, dissolved (ug/L)
1
0.1
0.01
Jan- 2013
Jan- 2014
Jan- 2015
Jan- 2016
Dec- 2016
Dec- 2017
Dec- 2018
PC003 Silver, Dissolved (ug/l as Ag)
Flotation Tails Operating Target Range Limit Silver, Dissolved (ug/l as Ag)


Values over time for Sulfate (mg/L)
Sulfate (mg/L)
10000
1000
100
Jan- 2013
Jan- 2014
Jan- 2015
Jan- 2016
Dec- 2016
Dec- 2017
Dec- 2018
PC003 Sulfate, Total (mg/l as SO4)
Flotation Tails Operating Target Range Limit Sulfate, Total (mg/l as SO4)


Values over time for TDS (mg/L)
TDS (mg/L)
10000
1000
100
Jan- 2013
Jan- 2014
Jan- 2015
Jan- 2016
Dec- 2016
Dec- 2017
Dec- 2018
PC003 TDS, Residue,Total Filtrable (Dried At 180C),mg/l
Flotation Tails Operating Target Range Limit TDS, Residue,Total Filtrable (Dried At 180C),mg/l


Values over time for Total Nitrogen (TKN) (mg/L)
Total Nitrogen (TKN) (mg/L)
100
10
1
Jan- 2013
Jan- 2014
Jan- 2015
Jan- 2016
Dec- 2016
Dec- 2017
Dec- 2018
PC003 Total Kjeldahl Nitrogen, mg/l as N
Flotation Tails Operating Target Range Limit Total Kjeldahl Nitrogen, mg/l as N


Values over time for Cyanide WAD (ug/L)
Cyanide WWAD (ug/L)
100
10
1
Jan- 2013
Jan- 2014
Jan- 2015
Jan- 2016
Dec- 2016
Dec- 2017
Dec- 2018
PC003 Weak Acid Dissociable Cyanide, ug/l
Flotation Tails Operating Target Range Limit Weak Acid Dissociable Cyanide, ug/l


Values over time for Zinc, dissolved (ug/L)
Zinc, dissolved (ug/L)
100
10
1
0.1
Jan- 2013
Jan- 2014
Jan- 2015
Jan- 2016
Dec- 2016
Dec- 2017
Dec- 2018
PC003 Zinc, Dissolved (ug/l as Zn)
Flotation Tails Operating Target Range Limit Zinc, Dissolved (ug/l as Zn)

APPENDIX D –

2018 WHOLE EFFLUENT TOXICITY TESTING

(WET) LABORATORY REPORTS

TRE Environmental Strategies, LLC
100 Racquette Drive, Unit A, Fort Collins, Colorado, 80524
T 970.416.0916 F 970.490.2963

TRE Environmental Strategies

July 13, 2018

Mr. Martin Weiser
Sumitomo Metal Mining, Pogo LLC
P.O. Box 145
Delta Junction, Alaska 99737

RE: Results of WET test – June 2018

Dear Mr. Weiser,

Attached is a copy of the report for the *Pimephales promelas* (fathead minnow) toxicity test conducted in June 2018 with effluent from your facility.

TRE Environmental Strategies, LLC greatly appreciates this opportunity to provide our services to Sumitomo Metal Mining Pogo. Please do not hesitate to call if you have any questions.

Sincerely,

Peggy Wood
Office Manager
woodpj.tre@gmail.com

Rami B. Naddy, Ph.D.
Manager/Environmental Toxicologist
naddyrb.tre@gmail.com

Enclosures

14001-412-027

cc: Stacy Staley
James Ward

TRE Environmental Strategies

Report of Short-Term Chronic Toxicity Testing using the Fathead Minnow (*Pimephales promelas*)

Project ID: 14001-412-027
June 2018

Sponsor and Laboratory Information

Sponsor	Sumitomo Metal Mining Pogo LLC Pogo Mine Joint Venture P.O. Box 145 Delta Junction, AK 99737
Project Officer	Stacy Staley (907) 895-2761
Testing Facility	TRE Environmental Strategies, LLC 100 Racquette Drive, Unit A Fort Collins, CO 80524 Fax: (970) 490-2963 State of Florida NELAP Laboratory ID: E87972
Study Director	Rami B. Naddy, Ph.D. (970) 416-0916 email: naddyrb.tre@gmail.com
Report Author	Whitney Naddy (970) 416-0916 email: naddywm.tre@gmail.com

Test Information

Test	Short-Term Chronic under Static-Renewal Conditions
Basis	USEPA (2002), method 1000.0
Test Dates and Time	June 19, 2018 @ 1615 to June 26, 2018 @ 1545
Test Length	7 days
Species	*Pimephales promelas*
Test Material	Effluent (Grab)
Outfall	001
Permit Number	AK-005334-1
Receiving Stream	Goodpaster River
Dilution Water	Moderately Hard Reconstituted Water
Test Concentrations	MH, 12.5, 25, 50, 75, and 100% effluent
IWC	100% effluent
Permit Compliance	_X_ **Pass** ____Fail

- *Results described in this report apply only to the samples submitted to the laboratory and analyzed, as listed in the report*
- *Test results comply with NELAC standards. Reports are intended to be considered in their entirety; TRE is not responsible for consequences arising from use of a partial report*
- *This report contains 6 pages plus 2 appendices*

Effluent Collection and Receipt

Sample No.	Field No.	Collection Date & Time	TRE No.	Date of Receipt	Temp. at Arrival (°C)	Qual.
1	NA	06/18/18 @ 0900 to 06/18/18 @ 0905	31508	06/19/18	2.9	
2	NA	06/20/18 @ 0845 to 06/20/18 @ 0850	31518	06/21/18	2.4	
3	NA	06/22/18 @ 0812 to 06/22/18 @ 0815	31522	06/23/18	2.5	

Note: See Appendix A for chain of custody records

Effluent Characterization

Sample No.	pH	Hard. (mg/L)[HA]	Alk. (mg/L)[HA]	Spec. Cond. (µS/cm)	TRC (mg/L)[G]	NH_3-N (mg/L)
1	7.8	66	34	226	<0.02	<1.0
2	7.7	80	36	231	<0.02	<1.0
3	7.7	100	38	229	0.02	<1.0

Initial Dilution/Control Water Characterization

Batch No.	pH	Hard. (mg/L)[HA]	Alk. (mg/L)[HA]	Spec. Cond. (µS/cm)	TRC (mg/L)[G]	NH_3-N (mg/L)
13342	8.3	92	60	339	<0.02	<1.0

Test Conditions

Type	Static-Renewal Short-term Chronic
Test Endpoints	Survival and Growth (Dry Weight Per Original Fish)
Test Chambers	500-ml plastic cups
Test Solution Volume	250 ml
Replicates per Treatment	4
Organisms per Replicate	10
Test Temperature	25 ± 1°C (≤ 3°C differential)
Lighting	Fluorescent, 16 hours light:8 hours dark
Chamber Placement	Random according to computer-generated chart
Aeration?	[X] No [ ] Yes
Test Solution Renewal	Daily

Test Organism

Species	*Pimephales promelas*
Age	<48 hours
Source	TRE In-house culture, batch 061818
Acclimation	None
Feeding	0.1 ml brine shrimp nauplii per test chamber 3x/day during the test[a]
Reference Toxicant Testing	Initiated June 1, 2018 using sodium chloride (NaCl)

[a] Feeding was reduced on some occasions to prevent build up of organic matter

TEST RESULTS

Biological Data

Treatment (% Effluent)	Percent Survival of *Pimephales promelas*							Mean Dry Weight (mg)[W1]	Significant Reduction Relative to Control?	
	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7		Surv.	Growth
0 (MH)	100	100	100	100	100	100	100	0.639	N/A	N/A
12.5	100	100	100	100	100	100	100	0.612	No	No
25	100	100	100	100	100	100	100	0.618	No	No
50	100	100	97.5	97.5	97.5	97.5	97.5	0.556	No	Yes
75[X4]	100	100	97.5	97.5	97.5	97.5	97.5	0.504	No	Yes
100	100	100	97.5	97.5	97.5	97.5	97.5	0.540	No	Yes
Percent Minimum Significant Difference (Growth)								9.6	Low[P1]	

Note: See Appendix B for copies of laboratory data sheets

Data Analysis and Test Endpoints

Biological Endpoint	Statistical Endpoint	Value (% Effluent)	Endpoint < IWC?
Survival	NOEC	100	No
	LOEC	>100	---
Growth (per original fish)	NOEC	25	Yes
	LOEC	50	---
	ChV	35.36	---
	IC_{25}	>100	No
	TU_c ($100/IC_{25}$)	<1.0	---

NOEC = No Observed Effect Concentration
LOEC = Lowest Observed Effect Concentration
ChV = Chronic Value
IC_{25} = 25% Inhibition Concentration
TU_c = Chronic Toxic Units
Note: Analyses completed using, where appropriate, CETIS version 1.8.7 (2014).

Physical and Chemical Data

Treatment (% Effluent)	pH		Dissolved Oxygen (mg/L)		Conductivity (µS/cm)		Temperature (°C)		Qual.
	Low	High	Low	High	Low	High	Low	High	
0 (MH)	7.6	8.4	4.5	6.8	303	339	25	26	
100	7.2	7.9	4.4	7.0	216	237	24	26	
All Treatments	7.2	8.4	≥4.3		NA		24	26	T3
							23	26	T4

Reference Toxicant Test Results for *P. promelas*

IC_{25} (mg Cl^-/L)	TRE Historical 95% Control Limits (mg Cl^-/L)	
	Low	High
1,138	969	1,348

References

CETIS. 2014. Comprehensive Environmental Toxicity Information System. User Guide (version 1.8.7). Tidepool Scientific, LLC. McKinleyville, CA.

USEPA. 2002. Short-term methods for estimating the chronic toxicity of effluents and receiving waters to freshwater organisms. Fourth Edition. EPA-821-R-02-013.

Explanation of Qualifiers

Note: study-specific narratives within the body of the report are denoted, if necessary, with the superscript letters **a - d**, and associated footnotes. Other qualifications and definitions are defined below.

S -	Sample temperature upon receipt was outside the range recommended by USEPA (2002), (i.e., 0 to 6°C or ambient if collected and used on the same day).
I -	Ice was present in the sample upon receipt.
N1 -	Sample was not used for testing.
N2 -	Liquid from container with ice was not used for testing.
F -	Sample was filtered to remove indigenous organisms prior to use.
HT -	Sample hold time (normally 36 hours) was exceeded.
HA -	Hardness and alkalinity concentrations are presented as $CaCO_3$.
G -	TRC = Total Residual Chlorine
T1 -	Temperatures measured in some of the old test solutions were outside the recommended test temperature range but the allowed 3°C differential was not exceeded.
T2 -	Temperatures measured in some of the old test solutions were outside the recommended test temperature range and the allowed 3°C differential was exceeded.
T3 -	Temperatures measured in test solutions.
T4 -	Continuous temperatures measured in the environmental chamber or water bath.
X1 -	Mean young per original female. If any 4th or higher broods were produced, they were excluded from calculation of mean young per female and statistical analysis of reproduction.
X2 -	One or more organisms in this treatment were lost or not found in the test chamber and were excluded from analysis, as the loss was attributed to technician error. See laboratory data sheets for additional detail, as appropriate.
X3 -	One or more male *C. dubia* were found in this treatment and were included in analysis of survival but excluded from analysis of reproduction. See laboratory data sheets for additional detail, as appropriate.
X4 -	One or more fish were alive at test termination but were lost during the drying/weighing process. These fish were included in analysis of survival but excluded from analysis of growth. See laboratory data sheets for additional detail, as appropriate.
O1 -	Dissolved oxygen concentrations were ≤ 4.0 mg/L in one or more treatments during the test; aeration was initiated in all test chambers. See laboratory data sheets for additional detail, as appropriate.
O2 -	Dissolved oxygen concentrations ≤ 4.0 mg/L were observed in one or more treatments only at test termination.
O3 -	Dissolved oxygen concentrations were ≤ 4.0 mg/L in one or more treatments during the test but aeration was not possible. See laboratory data sheets for additional detail, as appropriate.
W1 -	Weight per original number of organisms introduced at test initiation.
W2 -	Weight per surviving number of organisms at test termination.
V1 -	Value was statistically (α=0.05 or 0.01, as appropriate) reduced relative to the control, but was considered a Type I error (anomalous false positive), and was disregarded. The NOEC was interpreted accordingly.
V2 -	Value was not statistically (α=0.05 or 0.01, as appropriate) less than the control, but was considered a Type II error (anomalous false negative). The NOEC was interpreted accordingly.
P1 -	PMSD was below the lower bound indicated by USEPA (2002). A statistically significant reduction for a treatment was disregarded if the RPD for that treatment was less than the lower bound.
P2 -	PMSD was above the upper bound indicated by USEPA (2002), and statistically significant reductions in organism performance were detected.
P3 -	PMSD was above the upper bound indicated by USEPA (2002), and no statistically significant reductions in organism performance were detected.
R -	Monthly reference toxicant test endpoint for this species was outside the 95% control limits for the 20 most recent endpoints.

Statement of Quality Assurance

The test data were reviewed by the Quality Assurance Unit to assure that the study was performed in accordance with the protocol (if applicable) and standard operating procedures, and that the resulting data and report meet the requirements of the NELAC standards. This report is an accurate reflection of the raw data.

Quality Assurance Unit — Date: 07/12/18

Data Analyst — Date: July 13, 2018

For WMN

APPENDIX A

Chain of Custody Records

TRE Environmental Strategies, LLC

100 Racquette Drive, Unit A Fort Collins, CO 80524 Phone: (970) 416-0916 Fax: (970) 490-2963

Client/Project Name: Sumitomo Metal Mining Pogo
Project #: 14001-412(027)
Sampler (Print/Affiliation): Martin Weiser Env. Pogo. Signature:
Chain of Custody Tape #: 47580 Intact?(circle): Yes No

Client / Sample ID	Sample Collection Beginning Date	Beginning Time	Ending Date	Ending Time	Sample Type Grab	Comp.	Volume	Preservation (i.e.: 0-6°C)	Matrix (Liq., Soil, Sediment, etc.)	Test Requested FC						Sample Temp. Upon Arrival (Therm. # 1/2) °C	Lab Sample ID
Effl #1	6/18/18	0900	6/18/18	0905	✓		2.5Gal	0-6	L	✓						29	31508
OUTFALL001WET																	

Sample Relinquished By: (Print Name/Affiliation) Martin Weiser Pogo Env. Spec.
Signature:
Date: 6/18/18 Time: 11:20
Received By: (Print Name/Affiliation) Jillian VanBotten
Signature:
Date: 06/18/18 Time: 11:20

Sample Relinquished By: (Print Name/Affiliation) Jillian VanBotten
Signature:
Date: 06/18/18 Time: 4:00
Received By: (Print Name/Affiliation) Danny Loche TRE
Signature: Danny Loche
Date: 6/19/18 Time: 1600

Sample Relinquished By: (Print Name/Affiliation)
Signature:
Date: Time:
Received By: (Print Name/Affiliation)
Signature:
Date: Time:

Laboratory (Destination):
TRE Environmental Strategies, LLC
100 Racquette Drive, Unit A
Fort Collins, CO 80524
(970) 416-0916
(970) 490-2963 (FAX)

Sample Shipped Via (circle): FedEx Other UPS Courier
Temp Blank? Yes No

Comments: Received on ice

Serial No. 03132

TRE Environmental Strategies, LLC

100 Racquette Drive, Unit A Fort Collins, CO 80524 Phone: (970) 416-0916 Fax: (970) 490-2963

Client/Project Name: Sumitomo Metal Mining Pogo
Project #: 14001-412 (027)
Sampler (Print/Affiliation): Martin Weiser Pogo
Signature:
Chain of Custody Tape #: 47545
Intact? (circle): Yes No

Client / Sample ID	Sample Collection Beginning Date	Beginning Time	Ending Date	Ending Time	Sample Type Grab	Comp.	Volume	Preservation (i.e.: 0-6°C)	Matrix (Liq., Soil, Sediment, etc.)	Test Requested: FC						Sample Temp. Upon Arrival (Therm. # IR8) °C	Lab Sample ID
Effl #2	06/20/18	0845	06/20/18	0850	✓		1 Gal	0-6	L	X						2.4	31518
Effl #2	06/20/18	0845	06/20/18	0850	✓		2.5 Gal	0-6	L	X							

Sample Relinquished By: (Print Name/Affiliation)	Date / Time	Received By: (Print Name/Affiliation)	Date / Time
Martin Weiser Pogo Signature:	Date: 6/20/18 Time: 12:10	Jillian VanSotten (Pogo) Signature:	Date: 06/20/18 Time: 12:10
Jillian VanSotten (Pogo) Signature:	Date: 06/20/18 Time: 4:00	Amanda Bidlack / TRG Signature:	Date: 6/21/18 Time: 1425
Sample Relinquished By: (Print Name/Affiliation) Signature:	Date: Time:	Received By: (Print Name/Affiliation) Signature:	Date: Time:

Laboratory (Destination):

TRE Environmental Strategies, LLC
100 Racquette Drive, Unit A
Fort Collins, CO 80524
(970) 416-0916
(970) 490-2963 (FAX)

Sample Shipped Via (circle): FedEx UPS Other Courier
Temp Blank? Yes No

Comments: Received on ice

Serial No. 03133

TRE Environmental Strategies, LLC

100 Racquette Drive, Unit A Fort Collins, CO 80524 Phone: (970) 416-0916 Fax: (970) 490-2963

Client/Project Name: Sumitomo Metal Mining Pogo
Project #: 14001-412(027)
Sampler (Print/Affiliation): Martin Pogo Env.
Signature:
Chain of Custody Tape #: 47508
Intact?(circle): Yes No

Client / Sample ID	Sample Collection Beginning Date	Beginning Time	Ending Date	Ending Time	Sample Type Grab	Comp.	Volume	Preservation (i.e.: 0-6°C)	Matrix (Liq., Soil, Sediment, etc.)	Test Requested FC						Sample Temp. Upon Arrival (Therm. #12) °C	Lab Sample ID
Effl #3	6/22/18	0812	6/22/18	0815	✓		1 Gal	0-6	L	X						2.5	31522
Effl #3	6/22/18	0812	6/22/18	0815	✓		1.5 Gal	0-6	L	X							

Sample Relinquished By: (Print Name/Affiliation)	Date / Time	Received By: (Print Name/Affiliation)	Date / Time
Martin Weiser Pogo Env.	Date: 6/22/18 Time: 8:45	Jillian VanHatten (Pogo)	Date: 06/22/18 Time: 8:45
Jillian VanHatten	Date: 06/22/18 Time: 1:00	Janey Loche TRE	Date: 6/23/18 Time: 1330
	Date: Time:		Date: Time:

Signature: Signature: Signature: Signature: Signature: Signature: Signature: Signature:

Laboratory (Destination):

TRE Environmental Strategies, LLC
100 Racquette Drive, Unit A
Fort Collins, CO 80524
(970) 416-0916
(970) 490-2963 (FAX)

Sample Shipped Via (circle): FedEx UPS Other Courier

Temp Blank? Yes No

Comments: Received on ice

Serial No. 03134

APPENDIX B

Test Data

TOXICITY DATA PACKAGE COVER SHEET

QA: [illegible] 7/12/18

Test Type: Chronic

Project Number: 14001-412-027

Test Substance: Effluent-(Outfall 001)

Species: *Pimephales promelas*

Dilution Water Type: Mod Hard

Organism Lot or Batch Number: 061818

Concurrent Control Water Type: NA

Age: L48h (< 24 hr) Supplier: TRE

Date and Time Test Began: 6/19/18 @ 1615

Date and Time Test Ended: 6/26/18 @ 1545

Protocol Number: USEPA 2002, Method 1000.0

Investigator(s): [illegible]/[illegible]/MW/NH/CP/[illegible]

Background Information

pH control?: Yes **No**

Type of Test: Static-Renewal

If yes, give % CO_2: N/A

Test Temperature: 25 ± 1 °C

Env. Chmbr/Bath #: 25

Test Chmbrs: 500-ml cups/beakers

Test Solution Vol.: 250 ml

Number of Replicates per Treatment: 4

Length of Test: 7 days

Number of Organisms per Replicate: 10

Photoperiod: 16 h light : 8 h dark

Light Intensity: 50 to 100 ft.-c.

Type of Food and Quantity per Chamber: 0.1 ml B.S.

Feeding Frequency: 3 x Daily

Test Substance Characterization Parameters and Frequency:

Hardness: Sx Receipt Alkalinity: Sx Receipt NH_3: Sx Receipt TRC: Sx Receipt

pH: Daily Conductivity: Daily

Test Concentrations (Volume:Volume): 0 (MH), 12.5, 25, 50, 75, and 100%

Agency Summary Sheet(s)?: None

Reference Toxicant Data: Test Dates: 06/01/18 to 06/08/18 IC_{25}: 1138 mg/L Cl⁻

Hist. 95% Control Limits: 969 to 1348 Method for Determining Ref. Tox. Value: Linear Interp.

Special Procedures and Considerations:

D.O. maintained ≥ 4.0 mg/L

*Conductivity measured in dilution water and 100% effluent at test termination

If survival in any test chamber falls below 50%, reduce feeding in that chamber to 0.05 ml of brine shrimp

Appropriate correction factors have been applied to all temperatures recorded in this data package

Study Director Initials: MN Date: 6/19/18

QA Form No. 014
Revision 1
Effective 02/14

TEST SUBSTANCE USAGE LOG

Project Number: 14001-412-027

QA: DJP 7/12/18

	Sample 1	Sample 2	Sample 3	Sample 4
Test Substance Number	31508	31518	31522	
Test Substance Collection Date and Time	From: 6/18/18 @ 0900 To: 6/18/18 @ 0905	From: 6/20/18 @ 0845 To: 6/20/18 @ 0850	From: 6/22/18 @ 0812 To: 6/22/18 @ 0815	From: @ To: @
Sample Type (Grab or Comp)	Grab	grab	grab	
Date Test Substance Received	6/19/18	6/21/18	6/23/18	
Dilution Water Number RW# or TRE#, circle one	13342	13342 / 13348 *	13348	
Concurrent Control Water RW#	NA	NA	NA	
Date(s) Used	6/19/18 6/20/18	6/21/18 6/20/18 *	6/23/18 6/24/18 6/25/18	

Preparation of Test Solutions

Test Substance Conc. (% Effluent)	Test Substance Volume (ml)	Dilution Water Volume (ml)	Total Volume (ml)	Test Substance Volume (ml)	Dilution Water Volume (ml)	Total Volume (ml)	Test Substance Volume (ml)	Dilution Water Volume (ml)	Total Volume (ml)
0 (MH)	0	1000	1000						
12.5%	125.0	875.0	1000						
25%	250	750	1000						
50%	500	500	1000						
75%	750	250	1000						
100%	1000	0	1000						
Total	2625	3375	6000						

Initials / Date	N 6/19/18 MixedTC		
Initials / Date	N 6/20/18 " "		
Initials / Date	N 6/21/18 "		
Initials / Date	RJ 6/20/18 " "		
Initials / Date	N 6/23/18 " "		
Initials / Date	NH 6/24/18 " "		
Initials / Date	RJ 6/25/18 " "		
Initials / Date			

FATHEAD MINNOW (*PIMEPHALES PROMELAS*)
CHRONIC BIOLOGICAL DATA

QA: DHP 7/12/14

Project Number: 14001-412-027

%Conc.	Test Replicate	Number of Surviving Organisms Day 0	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7	(% Survival) Remarks
0 (MH)	A	10	10	10	10	10	10	10	10	100
	B	10	10	10	10	10	10	10	10	
	C	10	10	10	10	10	10	10	10	
	D	10	10	10	10	10	10	10	10	
12.5%	A	10	10	10	10	10	10	10	10	100
	B	10	10	10	10	10	10	10	10	
	C	10	10	10	10	10	10	10	10	
	D	10	10	10	10	10	10△	10	10	△ 1 org sighted
25%	A	10	10	10	10	10	10	10	10	100
	B	10	10	10	10	10	10	10	10	
	C	10	10	10	10	10	10	10	10	
	D	10	10	10	10	10	10	10	10	
50%	A	10	10	10	9	9	9	9	9	97.5
	B	10	10	10	10	10	10	10	10	
	C	10	10	10	10	10	10	10	10*	1 weak org
	D	10	10	10	10	10	10	10	10	
75%	A	10	10	10	10	10	10	10	10	97.5
	B	10	10	10	10	10	10	10	10	
	C	10	10	10	10	10	10	10	10	
	D	10	10	10	9	9	9	9	9	
100%	A	10	10	10	10	10	10	10	10	97.5
	B	10	10	10	9	9	9	9	9	
	C	10	10	10	10	10	10	10	10	
	D	10	10	10	10	10	10	10	10	
	A									
	B									
	C									
	D									
Date:		6/19/18	6/20/18	6/21/18	6/22/18	6/23/18	6/24/18	6/25/18	6/26/18	
Time:		1615	1120	1510	1510	1515	1110	1100	1545	
Initials:		RJ/N	N	N	RJ	N	NM	RJ	RJ	

CHRONIC CHEMICAL DATA (INITIAL)

QA: DAP 7/12/18

Project Number: 14001-412-027

Test Species: ***Pimephales promelas***

%	Day 0	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7	Meter #	Remarks
Conc.: 0 (MH)									All Conc.	
pH	8.3	8.2	8.2	8.1	8.3	8.4	8.4		FM-21	
D.O. (mg/L)	6.6	6.6	6.8	6.0	6.6	6.8	6.1		6	
Temp. (°C)	25	25	25	25	25	25	25		L-24	
Cond. (µS/cm)	339	317	320	305	311	303	309		15	
Hard. (mg/L)	92		92	86	100				Titr.	
Alk. (mg/L)	60		60	60	62				Titr.	
TRC (mg/L) (Colorimetric)	<0.02			<0.02					22	
NH_3 (mg/L) ↓	<1.0			<1.0					HAI	
Conc.: 12.5%										
pH	8.3	8.2	8.1	8.0	8.2	8.3	8.3			
D.O. (mg/L)	6.6	6.5	6.8	6.1	6.6	6.5	6.1			
Temp. (°C)	*	*	*	*	*	*	*			
Cond. (µS/cm)	320	305	301	297	297	292	298			
Hard. (mg/L)										
Alk. (mg/L)										
TRC (mg/L)										
NH_3 (mg/L)										
Conc.: 25%										
pH	8.2	8.0	8.1	8.0	8.1	8.2	8.2			
D.O. (mg/L)	6.7	6.5	6.9	6.2	6.6	6.4	6.2			
Temp. (°C)	*	*	*	*	*	*	*			
Cond. (µS/cm)	305	293	300	288	286	284	290			
Conc.: 50%										
pH	8.1	7.9	7.9	7.9	8.0	8.1	8.1			
D.O. (mg/L)	6.7	6.6	6.9	6.2	6.6	6.4	6.2			
Temp. (°C)	*	*	*	*	*	*	*			
Cond. (µS/cm)	279	269	286	269	269	264	272	①		
Date:	6/19/18	6/20/18	6/21/18	6/22/18	6/23/18	6/24/18	6/25/18	6/26/18		
Time:	1615	1105	1500	1490	1505	1100	1040			
Initials:	BJ	N	N	BJ	N	NH	BJ			

Note: Hardness, alkalinity, TRC, and NH3 data appearing on this page have been transcribed from the wet chemistry log QA Form No. 084.

*Dilution/control water and effluent were brought to 25°C prior to making the dilution series. The temperature of resulting effluent dilution is assumed to also be 25°C.

① BJ 6/26/18 E

CHRONIC CHEMICAL DATA (INITIAL)

QA: DSH 7/12/18

Project Number: 14001-412-027

Test Species: ***Pimephales promelas***

%	Day 0	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7	Meter #	Remarks
Conc.: 75%									All Conc.	
pH	8.0	7.8	7.8	7.8	7.9	8.0	8.0			
D.O. (mg/L)	6.7	6.5	6.9	6.3	6.6	6.4	6.2			
Temp. (°C)	*	*	*	*	*	*	*			
Cond. (µS/cm)	252	242	256	251	249	244	250			
Conc.:										
pH										
D.O. (mg/L)										
Temp. (°C)										
Cond. (µS/cm)										
Conc.:										
pH										
D.O. (mg/L)										
Temp. (°C)	① *									
Cond. (µS/cm)										
Conc.:										
pH										
D.O. (mg/L)										
Temp. (°C)										
Cond. (µS/cm)										
Conc.: 100%										
pH	7.8	7.6	7.7	7.7	7.7	7.9	7.9			
D.O. (mg/L)	6.8	6.5	7.0	6.5	6.6	6.5	6.2			
Temp. (°C)	*	25	25	25	25	25	25			
Cond. (µS/cm)	226	216	231	229	229	223	228			
Hard. (mg/L)	104		80		100					
Alk. (mg/L)	34		36		38					
TRC (mg/L)	<0.02		<0.02		0.02					
NH_3 (mg/L)	<1.0		<1.0		<1.0					
Date:	6/19/18	6/20/18	6/21/18	6/22/18	6/23/18	6/24/18	6/25/18			
Time:	1615	1105	1500	1450	1505	1400	1040			
Initials:	RS	N	N	RS	N	NH	RS			

Note: Hardness, alkalinity, TRC, and NH3 data appearing on this page have been transcribed from the wet chemistry log QA Form No. 084.

*Dilution/control water and effluent were brought to 25°C prior to making the dilution series. The temperature of resulting effluent dilution is assumed to also be 25°C.

① N 6/19/18 E

QA Form No. 059
Revision 3
Effective 02/14

QA: DSP 7/12/18

CHRONIC CHEMICAL DATA (FINAL)

Project Number:	14001-412-027
Test Species:	*Pimephales promelas*

%	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7	Day 8	Meter #	Remarks
Conc.: 0 (MH)							306		All Conc.	* conductivity (15)
pH	7.8	7.6	7.6	7.6	7.9	7.7	7.6		FM24	
D.O. (mg/L)	5.6	5.1	5.6	5.0	4.5	5.4	5.4		6	
Temp (°C)	25	25	26	26	26	25	26		L-24	
Conc.: 12.5%										
pH	7.7	7.5	7.5	7.6	7.8	7.6	7.6			
D.O. (mg/L)	5.3	4.7	5.2	4.9	4.5	5.4	5.1			
Temp (°C)	25	25	26	26	25	25	25			
Conc.: 25%										
pH	7.7	7.5	7.6	7.5	7.8	7.6	7.5			
D.O. (mg/L)	5.4	4.9	5.4	4.9	4.4	4.8	5.4			
Temp (°C)	25	25	26	26	26	25	26			
Conc.: 50%										
pH	7.6	7.4	7.5	7.5	7.7	7.5	7.5			
D.O. (mg/L)	5.4	4.6	5.4	4.7	4.5	4.5	5.4			
Temp (°C)	25	25	26	26	26	25	26			
Conc.: 75%										
pH	7.5	7.3	7.5	7.4	7.6	7.5	7.4			
D.O. (mg/L)	5.4	4.6	5.4	4.7	4.5	4.6	5.4			
Temp (°C)	25	25	26	26	25	25	26			
Conc.: 100%							237			* conductivity
pH	7.4	7.2	7.3	7.3	7.6	7.4	7.3			
D.O. (mg/L)	5.6	4.6	5.2	4.8	4.4	4.5	5.2			
Temp (°C)	25	25	26	26	26	24	26			
Conc.:										
pH										
D.O. (mg/L)										
Temp (°C)										
Date:	6/20/18	6/21/18	6/22/18	6/23/18	6/24/18	6/25/18	6/26/18			
Time:	1115	1505	1450	1510	1100	1040	1530			
Initials:	N	N	KS	N	NH	RJ	KS			

QA Form No. 055
Revision 3
Effective 02/14

DAILY TOXICITY TEST LOG

QA: DAP 7/12/18

Project Number:	14001-412-027
Test Species:	***Pimephales promelas***

General Comments	Random Chart: Zeta Min/Max Therm. #: M-14	Feeding 0.1 ml B.S. 3 x Daily	Initials/Date
Test Day 0	Test Solution Mixed at: 1600 Test Organisms Added at: 1615	Fed @ Δ 1650 CP	a 6/19/18
Test Day 1	Real Time Temp= 25 °C Range = 24-26 °C	Fed @ Δ0840MTM Δ 1155 CP Δ1640RJ	a 6/20/18
Test Day 2	Real Time Temp= 24 °C Range = 24-26 °C	Fed @ Δ0820MTM Δ1155 CP Δ1650MTM	a 6/21/18
Test Day 3	Real Time Temp= 24 °C Range = 24-26 °C	Fed @ Δ0840 RJ Δ 1155 CP Δ 1650 M	RJ 6/22/18
Test Day 4	Real Time Temp= 25 °C Range = 23-26 °C	Fed @ Δ 0835 CP Δ 1200 CP 1645 CP	a 6/23/18
Test Day 5	Real Time Temp= 25 °C Range = 24-26 °C	Fed @ 0715 MTM 1200 NH 1635 NH	NH 6/24/18
Test Day 6	Real Time Temp= 24 °C Range = 23-26 °C	Fed @ 0820MTM 1150MTM 1635 RJ	RJ 6/25/18
Test Day 7	Real Time Temp= 25 °C Range = 24-26 °C	NONE	RJ 6/26/18
Test Day 8			

Δ ½ feeding

QA Form No.010
Revision 6
Effective 02/14

QA: DAP 7/11/18

TEST ORGANISM LENGTHS, WEIGHTS, AND LOADING

Project Number: 14001-412-027
Species: P. promelas
Date/Time of Tare Wt.: 6/26/18 @ 0910

Test Substance: Effluent - Outfall 001
Analyst Tare: CP Analyst Gross: CP
Date/Time of Gross Wt.: 6/27/18 @ 1040

Comments:
Analytical Balance ID: Sart #1
Dried in Oven # 2 from Date: 6/26/18 Time: 1650
to Date: 6/27/18 Time: 0810

Weight Type (Circle): Wet Blot Dry Dry (>100°C) AFDW (>500°C)
Lot or Batch Number: 06/8/8

Boat No.	Treatment %	Rep.	Length Units:	Tare Weight (g)	Gross Weight (g)	Net Weight (g)	Adjusted Net Weight (g)[1]	No. of Orig. Organisms	Mean Wt. per Original Organism (mg)	Mean Wt. per Treatment (mg) (Original)	No. of Surv. Organisms	Mean Wt. per Surviving Organism (mg)	Mean Wt. per Treatment (mg) (Surviving)
	0	A		1.15709	1.16340	0.00631					10		
		B		1.13879	1.14502	0.00623					10		
		C		1.13091	1.13760	0.00669					10		
		D		1.12461	1.13095	0.00634					10		
	12.5	A		1.12336	1.12971	0.00635					10		
		B		1.14~~6~~700 ①	1.15308	0.00608					10		
		C		1.14940	1.15605	0.00665					10		
		D		1.15942	1.16482	0.00540					10		
	25	A		1.13367	1.13946	0.00579					10		
		B		1.13824	1.14437	0.00613					10		
		C		1.11598	1.12244	0.00646					10		
		D		1.14282	1.14914	0.00632					10		
Blank				1.14437	1.14438								
Range													
Mean													

Test Solution Volume:
Loading Rate:

[1] Add in weight loss of blank boat, if appropriate.

① CP 6/26/18 E

QA Form No.010
Revision 6
Effective 02/14

QA: DAP 7/11/18

TEST ORGANISM LENGTHS, WEIGHTS, AND LOADING

Project Number: 14001-412-027
Species: P. promelas
Date/Time of Tare Wt.: 6/26/18 @ 0910

Test Substance: Effluent - outfall 001
Analyst Tare: CP Analyst Gross: CP
Date/Time of Gross Wt.: 6/27/18 @ 1040

Comments:
Analytical Balance ID: Sart #1
Dried in Oven # 2 from Date: 6/26/18 Time: 1650
to Date: 6/27/18 Time: 0810

Weight Type (Circle): Wet Blot Dry Dry (>100°C) AFDW (>500°C)
Lot or Batch Number: 060818

Boat No.	Treatment %	Rep.	Length Units:	Tare Weight (g)	Gross Weight (g)	Net Weight (g)	Adjusted Net Weight (g)[1]	No. of Orig. Organisms	Mean Wt. per Original Organism (mg)	Mean Wt. per Treatment (mg) (Original)	No. of Surv. Organisms	Mean Wt. per Surviving Organism (mg)	Mean Wt. per Treatment (mg) (Surviving)
	50	A		1.13328	1.13912	0.00584					9		
		B		1.12616	1.13137	0.00521					10		
		C		1.12125	1.12678	0.00553					10		
		D		1.15158	1.15722	0.00564					10		
	75	A		1.13126	1.13621	0.00495					10		
		B		1.15583	1.16093	0.00510					10		
		C		1.12699	1.13150	0.00451					9*		
		D		1.15468	1.15980	0.00512					9		
	100	A		1.12914	1.13427	0.00513					10		
		B		1.13450	1.13933	0.00483					9		
		C		1.12143	1.12750	0.00607					10		
		D		1.13509	1.14065	0.00556					10		
Blank													
Range													
Mean													

Test Solution Volume:
Loading Rate:

[1] Add in weight loss of blank boat, if appropriate.

* 1 org lost during drying process

QA Form No. 010a
Revision 1
Effective 02/14

TEST ORGANISM LENGTHS, WEIGHTS, AND LOADING

Project Number: 14001-412-027 Species: Fathead minnow

06/27/18 QA: DAP 7/11/18

Treatment	Rep	Length Units:	Tare Weight (g)	Gross Weight (g)	Net Weight (g)	Adjusted Net Weight (g)	No of Orig. Organisms	Mean Wt./ Original Organism (mg)	Mean Wt./ Treatment (mg) (Original)	Number of Surv. Organisms	Mean Wt./ Surviving Organism (mg)	Mean Wt./ Treatment (mg) (Surviving)
MH	A		1.15709	1.16340	0.00631	0.00631	10	0.631	0.6392	10	0.631	0.6392
	B		1.13879	1.14502	0.00623	0.00623	10	0.623		10	0.623	
	C		1.13091	1.13760	0.00669	0.00669	10	0.669		10	0.669	
	D		1.12461	1.13095	0.00634	0.00634	10	0.634		10	0.634	
12.5%	A		1.12336	1.12971	0.00635	0.00635	10	0.635	0.6120	10	0.635	0.6120
	B		1.14700	1.15308	0.00608	0.00608	10	0.608		10	0.608	
	C		1.14940	1.15605	0.00665	0.00665	10	0.665		10	0.665	
	D		1.15942	1.16482	0.00540	0.00540	10	0.540		10	0.540	
25%	A		1.13367	1.13946	0.00579	0.00579	10	0.579	0.6175	10	0.579	0.6175
	B		1.13824	1.14437	0.00613	0.00613	10	0.613		10	0.613	
	C		1.11598	1.12244	0.00646	0.00646	10	0.646		10	0.646	
	D		1.14282	1.14914	0.00632	0.00632	10	0.632		10	0.632	
50%	A		1.13328	1.13912	0.00584	0.00584	10	0.584	0.5555	9	0.649	0.5717
	B		1.12616	1.13137	0.00521	0.00521	10	0.521		10	0.521	
	C		1.12125	1.12678	0.00553	0.00553	10	0.553		10	0.553	
	D		1.15158	1.15722	0.00564	0.00564	10	0.564		10	0.564	
75%	A		1.13126	1.13621	0.00495	0.00495	10	0.495	0.5045	10	0.495	0.5188
	B		1.15583	1.16093	0.00510	0.00510	10	0.510		10	0.510	
	C		1.12699	1.13150	0.00451	0.00451	9	0.501		9	0.501	
	D		1.15468	1.15980	0.00512	0.00512	10	0.512		9	0.569	
100%	A		1.12914	1.13427	0.00513	0.00513	10	0.513	0.5397	10	0.513	0.5532
	B		1.13450	1.13933	0.00483	0.00483	10	0.483		9	0.537	
	C		1.12143	1.12750	0.00607	0.00607	10	0.607		10	0.607	
	D		1.13509	1.14065	0.00556	0.00556	10	0.556		10	0.556	
Blank			1.14437	1.14438	0.00001							

vm 06/27/18

QA: RSP 7/11/18

Project Number: 14001-412-027 Species: Fathead minnow

Summary Statistics for Survival Data

Treatment	N	Min	Max	Mean	SD	C.V.
MH	4	1.0	1.0	1.0000	0.0000	0.000%
12.5%	4	1.0	1.0	1.0000	0.0000	0.000%
25%	4	1.0	1.0	1.0000	0.0000	0.000%
50%	4	0.9	1.0	0.9750	0.0500	5.128%
75%	4	0.9	1.0	0.9750	0.0500	5.128%
100%	4	0.9	1.0	0.9750	0.0500	5.128%

Summary Statistics for Growth Data (dry wt per original)

Treatment	N	Min	Max	Mean	SD	C.V.
MH	4	0.623	0.669	0.6392	0.0204	3.186%
12.5%	4	0.540	0.665	0.6120	0.0533	8.717%
25%	4	0.579	0.646	0.6175	0.0290	4.698%
50%	4	0.521	0.584	0.5555	0.0263	4.741%
75%	4	0.495	0.512	0.5045	0.0079	1.570%
100%	4	0.483	0.607	0.5397	0.0539	9.990%

Summary Statistics for Growth Data (dry wt per surviving organism)

Treatment	N	Min	Max	Mean	SD	C.V.
MH	4	0.623	0.669	0.6392	0.0204	3.186%
12.5%	4	0.540	0.665	0.6120	0.0533	8.717%
25%	4	0.579	0.646	0.6175	0.0290	4.698%
50%	4	0.521	0.649	0.5717	0.0546	9.547%
75%	4	0.495	0.569	0.5188	0.0340	6.552%
100%	4	0.513	0.607	0.5532	0.0400	7.225%

CETIS Analytical Report

Report Date: 27 Jun-18 15:16 (p 1 of 2)
Test Code: 412-027 | 05-7877-4290

Fathead Minnow 7-d Larval Survival and Growth Test — **TRE Environmental Strategies, LLC**

Analysis ID:	15-7942-4282	**Endpoint:**	Mean Dry Biomass-mg	**CETIS Version:**	CETISv1.8.7
Analyzed:	27 Jun-18 15:14	**Analysis:**	Parametric-Control vs Treatments	**Official Results:**	Yes

Batch ID:	06-5469-7829	**Test Type:**	Growth-Survival (7d)	**Analyst:**	Lab Tech
Start Date:	19 Jun-18 16:15	**Protocol:**	EPA/821/R-02-013 (2002)	**Diluent:**	Mod-Hard Synthetic Water
Ending Date:	26 Jun-18 15:45	**Species:**	Pimephales promelas	**Brine:**	Not Applicable
Duration:	6d 23h	**Source:**	In-House Culture	**Age:**	2 D

Sample ID:	19-5371-1080	**Code:**	747343E8	**Client:**	Sumitomo Mining (Pogo)
Sample Date:	18 Jun-18 09:05	**Material:**	Ambient Sample	**Project:**	WET Quarterly Compliance Test (2Q)
Receive Date:	19 Jun-18 16:00	**Source:**	Discharge Monitoring Report		
Sample Age:	31h (2.9 °C)	**Station:**	Effluent		

Data Transform	Zeta	Alt Hyp	Trials	Seed	PMSD	NOEL	LOEL	TOEL	TU
Untransformed	NA	C > T	NA	NA	9.58%	25	50	35.36	4

PMSD low but NOEC determination not affected

Dunnett Multiple Comparison Test

Control	vs	C-%	Test Stat	Critical	MSD	DF	P-Value	P-Type	Decision(α:5%)
Dilution Water		12.5	1.071	2.41	0.061	6	0.3909	CDF	Non-Significant Effect
		25	0.8549	2.41	0.061	6	0.4871	CDF	Non-Significant Effect
		50*	3.292	2.41	0.061	6	0.0084	CDF	Significant Effect
		75*	5.296	2.41	0.061	6	0.0001	CDF	Significant Effect
		100*	3.911	2.41	0.061	6	0.0022	CDF	Significant Effect

Test Acceptability Criteria

Attribute	Test Stat	TAC Limits	Overlap	Decision
Control Resp	0.6393	0.25 - NL	Yes	Passes Acceptability Criteria
PMSD	0.0958	0.12 - 0.3	Yes	Below Acceptability Criteria

ANOVA Table

Source	Sum Squares	Mean Square	DF	F Stat	P-Value	Decision(α:5%)
Between	0.055341	0.0110682	5	8.551	0.0003	Significant Effect
Error	0.02329973	0.00129443	18			
Total	0.07864073		23			

Distributional Tests

Attribute	Test	Test Stat	Critical	P-Value	Decision(α:1%)
Variances	Bartlett Equality of Variance	9.618	15.1	0.0868	Equal Variances
Distribution	Shapiro-Wilk W Normality	0.9783	0.884	0.8620	Normal Distribution

Mean Dry Biomass-mg Summary

C-%	Control Type	Count	Mean	95% LCL	95% UCL	Median	Min	Max	Std Err	CV%	%Effect
0	Dilution Water	4	0.6393	0.6068	0.6717	0.6325	0.623	0.669	0.01018	3.19%	0.0%
12.5		4	0.612	0.5271	0.6969	0.6215	0.54	0.665	0.02667	8.72%	4.26%
25		4	0.6175	0.5713	0.6637	0.6225	0.579	0.646	0.01451	4.7%	3.4%
50		4	0.5555	0.5136	0.5974	0.5585	0.521	0.584	0.01317	4.74%	13.1%
75		4	0.5045	0.4919	0.5171	0.5056	0.495	0.512	0.00396	1.57%	21.1%
100		4	0.5397	0.4539	0.6256	0.5345	0.483	0.607	0.02696	9.99%	15.6%

All are > 12%

Mean Dry Biomass-mg Detail

C-%	Control Type	Rep 1	Rep 2	Rep 3	Rep 4
0	Dilution Water	0.631	0.623	0.669	0.634
12.5		0.635	0.608	0.665	0.54
25		0.579	0.613	0.646	0.632
50		0.584	0.521	0.553	0.564
75		0.495	0.51	0.5011	0.512
100		0.513	0.483	0.607	0.556

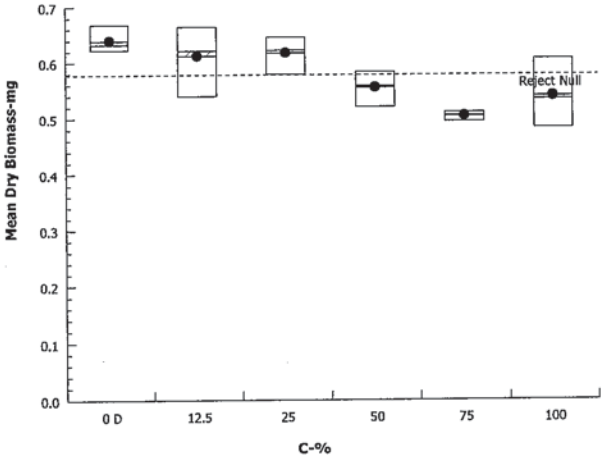
CETIS Analytical Report

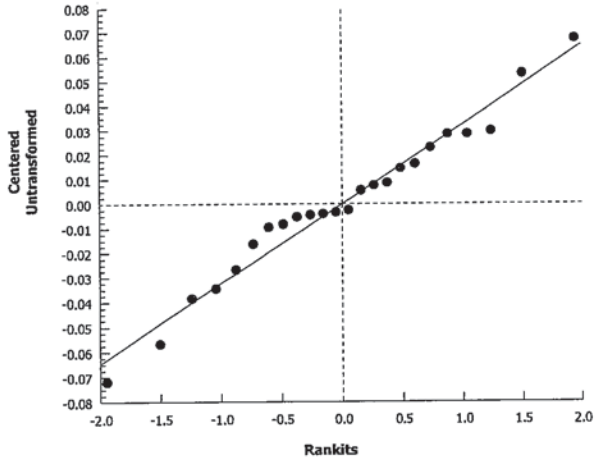
Report Date: 27 Jun-18 15:16 (p 2 of 2)
Test Code: 412-027 | 05-7877-4290

Fathead Minnow 7-d Larval Survival and Growth Test — **TRE Environmental Strategies, LLC**

Analysis ID:	15-7942-4282	**Endpoint:**	Mean Dry Biomass-mg	**CETIS Version:**	CETISv1.8.7
Analyzed:	27 Jun-18 15:14	**Analysis:**	Parametric-Control vs Treatments	**Official Results:**	Yes

Graphics





CETIS Analytical Report

Report Date:	27 Jun-18 15:16 (p 1 of 2)
Test Code:	412-027 | 05-7877-4290

Fathead Minnow 7-d Larval Survival and Growth Test — **TRE Environmental Strategies, LLC**

Analysis ID:	04-5068-5620	**Endpoint:**	Mean Dry Biomass-mg	**CETIS Version:**	CETISv1.8.7
Analyzed:	27 Jun-18 15:16	**Analysis:**	Linear Interpolation (ICPIN)	**Official Results:**	Yes

Batch ID:	06-5469-7829	**Test Type:**	Growth-Survival (7d)	**Analyst:**	Lab Tech
Start Date:	19 Jun-18 16:15	**Protocol:**	EPA/821/R-02-013 (2002)	**Diluent:**	Mod-Hard Synthetic Water
Ending Date:	26 Jun-18 15:45	**Species:**	Pimephales promelas	**Brine:**	Not Applicable
Duration:	6d 23h	**Source:**	In-House Culture	**Age:**	2 D

Sample ID:	19-5371-1080	**Code:**	747343E8	**Client:**	Sumitomo Mining (Pogo)
Sample Date:	18 Jun-18 09:05	**Material:**	Ambient Sample	**Project:**	WET Quarterly Compliance Test (2Q)
Receive Date:	19 Jun-18 16:00	**Source:**	Discharge Monitoring Report		
Sample Age:	31h (2.9 °C)	**Station:**	Effluent		

Linear Interpolation Options

X Transform	Y Transform	Seed	Resamples	Exp 95% CL	Method
Linear	Linear	1520325	200	Yes	Two-Point Interpolation

Test Acceptability Criteria

Attribute	Test Stat	TAC Limits	Overlap	Decision
Control Resp	0.6393	0.25 - NL	Yes	Passes Acceptability Criteria

Point Estimates

Level	%	95% LCL	95% UCL	TU	95% LCL	95% UCL
IC5	28.15	N/A	39.48	3.553	2.533	NA
IC10	41.64	21.1	58.52	2.402	1.709	4.739
IC15	59.1	37.1	N/A	1.692	NA	2.695
IC20	>100	N/A	N/A	<1	NA	NA
IC25	>100	N/A	N/A	<1	NA	NA
IC40	>100	N/A	N/A	<1	NA	NA
IC50	>100	N/A	N/A	<1	NA	NA

Mean Dry Biomass-mg Summary

			Calculated Variate						
C-%	Control Type	Count	Mean	Min	Max	Std Err	Std Dev	CV%	%Effect
0	Dilution Water	4	0.6393	0.623	0.669	0.01018	0.02037	3.19%	0.0%
12.5		4	0.612	0.54	0.665	0.02667	0.05335	8.72%	4.26%
25		4	0.6175	0.579	0.646	0.01451	0.02901	4.7%	3.4%
50		4	0.5555	0.521	0.584	0.01317	0.02634	4.74%	13.1%
75		4	0.5045	0.495	0.512	0.00396	0.007921	1.57%	21.1%
100		4	0.5397	0.483	0.607	0.02696	0.05392	9.99%	15.6%

Mean Dry Biomass-mg Detail

C-%	Control Type	Rep 1	Rep 2	Rep 3	Rep 4
0	Dilution Water	0.631	0.623	0.669	0.634
12.5		0.635	0.608	0.665	0.54
25		0.579	0.613	0.646	0.632
50		0.584	0.521	0.553	0.564
75		0.495	0.51	0.5011	0.512
100		0.513	0.483	0.607	0.556

CETIS Analytical Report

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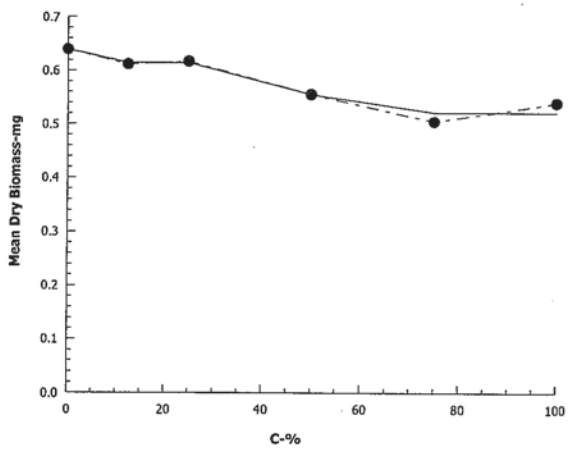
Graphics



BIOASSAY REPORT

CHRONIC
BIOASSAY CONDUCTED
June 19 through 26, 2018

Prepared for

SUMITOMO METAL MINING-POGO MINE
DELTA JUNCTION, ALASKA

Prepared by

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING
ASL

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NELAC #OR100022
State of Washington Department of Ecology (WDOE), Lab ID C1233
California State Environmental Laboratory Accreditation Program, Certificate No.: 1726

Report Date: July 11, 2018
Lab I.D. No. B4026

CONTENTS

Section **Page**

INTRODUCTION 1

OVERVIEW OF REGULATORY GUIDANCE 1

SUMMARY OF TEST RESULTS 2
- ACRONYM DEFINITIONS 2

METHODS AND MATERIALS 3
- TEST METHODS 3
- DEVIATIONS FROM PROTOCOLS 3
- TEST DESIGN 3
- DILUTION WATER 4
- SAMPLE COLLECTION AND STORAGE 4
- SAMPLE PREPARATION 4
- DATA ANALYSIS 4

RESULTS AND DISCUSSION 5
- CHRONIC BIOASSAYS 5
- REFERENCE TOXICANT TESTS 6

APPENDIX A. RAW DATA SHEETS
APPENDIX B. REFERENCE TOXICANT DATA SHEETS
APPENDIX C. CHAIN OF CUSTODY

INTRODUCTION

TestAmerica ASL (TA-ASL) Aquatic Toxicology Laboratory conducted a chronic bioassay from June 19 through 26, 2018 on samples provided by Sumitomo Metal Mining – Pogo Mine, Delta Junction, and Alaska. The test was conducted using the Fathead minnow (*Pimephales promelas*).

OVERVIEW OF REGULATORY GUIDANCE

The following provides an overview and excerpts of applicable permit specifics, regulatory guidance, and other relevant information. This is intended only as a helpful guide, from a laboratory perspective, for understanding test outcomes. The final responsibility for interpretation of results remains with the client and/or regulatory agency.

The following guidance is taken from TA-ASL reading of the NPDES permit for Sumitomo - Pogo (permit #AK0053341, effective July 1, 2017, expires June 30, 2022).

Whole Effluent Toxicity Testing (WET) Requirements:

- "1.7.2 Chronic toxicity testing must be conducted on grab sample of effluent."
- "1.7.3 Chronic Test Species and Methods"
  - "1.7.3.1 For Outfall 001, chronic tests must be conducted annually prior to August 1."
  - "1.7.3.2 … using the fathead minnow, *Pimephales promelas.* "
  - "1.7.3.3 The presence of chronic toxicity must be determined as specified in *Short-Term Methods for Estimating the Chronic Toxicity of Effluents and Receiving Waters to Freshwater Organisms*, Fourth Edition (EPA/821-R-02-013, October 2002)."
  - "1.7.3.4 Results must be reported in TU_c, where $TU_c = 100/IC_{25}$."
- 1.7.4 Quality Assurance
  - 1.7.4.3.1 If organisms are not cultured in-house, concurrent testing with reference toxicants must be conducted. If organisms are cultured in-house, monthly reference toxicant testing is sufficient. Reference toxicant tests must be conducted using the same test conditions as the effluent toxicity tests.
- "1.7.5 A trigger for chronic toxicity of 2 TUc shall apply for the purposes of determining compliance with Permit Part 1.7.6 [accelerated testing] and 1.7.7 [TIE/TRE]."

SUMMARY OF TEST RESULTS

Exhibit 1 provides a summary of the final test results.

EXHIBIT 1
Summary of Chronic Test Results

Species	NOEC (%)	LOEC (%)	IC_{25} (%)	TUc	Was chronic toxicity demonstrated (a TUc value > 2.0)?
P. promelas	100	> 100	> 100	< 1	No

Note: acronyms are as defined below.

From the NPDES permit: "Compliance with the effluent limit for chronic toxicity means the results … show no statistically significant difference in response between the control and the CCEC (8.4% effluent)."

More detailed information is provided in the Results and Discussion section.

ACRONYM DEFINITIONS (from EPA guidance):

NOEC = No Observed Effect Concentration: The highest test concentration that causes no observable adverse effects on the test organisms (i.e. no statistically significant reduction from the control).
LOEC = Low Observed Effect Concentration: The lowest test concentration that does cause an observable adverse effect on the test organisms (i.e. is statistically significant reduction from the control).
IC_{25} = Inhibition Concentration (25%): A point estimate of the test concentration that would cause a 25 percent reduction of a non-quantal biological measurement (i.e. growth, reproduction, etc.) for the test population.
TUc = Toxic Units (Chronic): Calculated as 100% sample divided by the chronic IC_{25} value.

METHODS AND MATERIALS

TEST METHODS

The chronic test methods were performed according to: *Short-Term Methods for Estimating the Chronic Toxicity of Effluents and Receiving Waters to Freshwater Organisms*, Fourth Edition, (EPA 2002), EPA-821-R-02-013.

Additional guidance was provided by:

- *Method Guidance and Recommendations for Whole Effluent Toxicity (WET) Testing* (40 CFR Part 136), (EPA August 2000), EPA 821-B-00-004.

DEVIATIONS FROM PROTOCOLS

Deviations from required procedures in the test methods:

- Due to a mechanical failure with the *P. promelas* chronic test, some of the instantaneous temperature readings fell outside of the recommended range of 25±1 °C. Also, the required test condition of a temperature deviation (i.e. maximum minus minimum) of no more than 3 °C was not met. This situation is detailed further in the Results and Discussion section of this report.

Deviations from recommended procedures in the test methods:

- None noted.

TEST DESIGN

The following summarizes the conditions used for both overall testing and the specifics for each test (observations and notations can be found on the datasheets in Appendix A):

Overall Test Design:

Chronic tests: 12.5, 25, 50, 75, and 100 percent sample + dilution water for the control.

Test Organism Conditions**:**

All organisms tested were fed and maintained during culturing, acclimation, and testing as prescribed by the EPA (2002).

The test organisms appeared vigorous and in good condition prior to testing.

P. promelas chronic test:

- Source: Aquatox Inc., Hot Springs, Arkansas
- Age: Less than 48 hours old and within an 24 hour age range
- Design: Four test vessels per concentration, ten organisms per vessel
- Test Solution Renewal: Daily

- Monitoring:
    - Daily: Survival
    - Daily: DO and pH in pre and post-renewal solutions, all concentrations
    - Daily: Temperature in pre-renewal solutions, all concentrations
    - With each new sample: Conductivity in post-renewal solutions, control and highest sample concentration
- Termination: 7 days after test initiation.
- Endpoints: Survival and Growth (average dry weight per organism added @ initiation)
- Acute Dual-Endpoint: 48 hour Survival (from the 2 day chronic exposure data)

DILUTION WATER

The dilution water used was the standard culture water used by TA-ASL:

- Reconstituted, moderately hard water (as per EPA protocol) with a total hardness of 80 to 100 mg/L as $CaCO_3$ and an alkalinity of 60 to 70 mg/L as $CaCO_3$.

SAMPLE COLLECTION AND STORAGE

Samples were collected by Sumitomo-Pogo personnel. The samples were accepted as scheduled by TA-ASL. Chain of Custody and Sample Receipt Records are provided in Appendix C.

- All samples were received within the EPA recommended 0 to 6 ^{o}C range.
- All samples were initially used for test initiation or test solution renewal within the EPA recommended maximum holding time of 36 hours of sample collection.
- All subsequent uses of a sample occurred within the EPA recommended maximum holding time of 72 hours past the time of initial use of that sample.
- Following receipt, the samples were stored in the dark at 0 to 6 °C until test solutions were prepared and tested.

SAMPLE PREPARATION

Samples used during these tests were:

- Temperature adjusted prior to test initiation and each daily renewal.

DATA ANALYSIS

The statistical analyses performed for the chronic test were those outlined in *Short-Term Methods for Estimating the Chronic Toxicity of Effluents and Receiving Waters to Freshwater Organisms*, USEPA Office of Water, Fourth Edition (EPA 2002), EPA-821-R-02-013, CETIS.

- The specific statistical analysis and CETIS version used for each endpoint evaluation is listed with the statistical outputs included with each test in Appendix A.
- If any additional analysis methods were also used, an explanation of the rationale and reference to the source method is included with the presentation of those results below.

RESULTS AND DISCUSSION

The raw data sheets for all tests are presented in Appendix A.

CHRONIC BIOASSAY

Table 1 summarizes the survival and reproduction data for the *P. promelas* chronic test.

Table 1
Summary of Chronic Results
P. promelas

Sample Concentration (%)	Percent Survival	Mean Dry Weight per Organism Added (mg)
Control	97.5	0.988
6.25	100	0.993
8.40	100	0.941
25.0	100	0.991
56.5	97.5	1.010
100	97.5	1.026

Statistical analysis in accordance with the EPA protocol results in:

- NOEC = 100 %
- LOEC > 100 %
- IC_{25} > 100 %
- TUc < 1

From the NPDES permit - *Chronic Toxicity Trigger*: "Toxicity Triggers. Since data does not exist to support the development of a WET limit at this time, a target level for chronic toxicity of 2 TUc shall apply …"

- The TUc (calculated as = $100/IC_{25}$) <u>did not</u> exceed 2.0.

EPA guidance recommends test temperature to remain at 25±1°C for the *P. promelas* chronic test. On day 5, there was a mechanical breakdown of the heating unit attached to the waterbath where this test was being run. As a result, the instantaneous temperatures in the test concentrations were outside of this range at 20.0 to 20.1 °C. Also, the <u>required</u> test

condition of a temperature deviation (i.e. maximum minus minimum) over the entire test period of no more than 3 °C was not met (25.3 – 20.0 = 5.3°C). The EPA chronic manual Section 4.9.2 states: "An individual test may be conditionally acceptable if the temperature, DO, and other specified conditions fall outside specifications, depending on the degree of departure and the objectives of the tests. The acceptability of the test would depend on the experience and professional judgment of the laboratory investigator and the reviewing staff of the regulatory authority". It is the laboratory's professional judgment that the deviation in the test temperature from the required conditions did not appear to affect the test results (good organism survival and growth rates) and the test should be accepted.

The dissolved oxygen levels in the chronic tests remained above 4.0 mg/L. Other than noted, test temperatures remained at 25±1 °C.

The test meets Test Acceptability Criteria (TAC) for a minimum 80 percent control survival and a minimum weight of 0.250 mg per surviving control organism. Except as referenced above, the *P. promelas* chronic test proceeded without any noted deviations or interruptions that could have affected test results. The testing should be considered "conditionally acceptable".

REFERENCE TOXICANT TESTS

Reference toxicant (reftox) testing is performed to document both initial and ongoing laboratory performance of the test method(s). While the health of the test organisms is primarily evaluated by the performance of the laboratory control, reftox test results also may be used to assess the health and sensitivity of the test organisms. Reftox test results within their respective cumulative summary (Cusum) chart limits are indicative of consistent laboratory performance and normal test organism sensitivity.

The results of the reftox tests indicate that the test organisms were within their respective cusum chart limits based on EPA guidelines. This demonstrates ongoing laboratory proficiency of the test methods and suggests normal test organism sensitivity in the associated client testing.

The *P. promelas* reftox test was conducted using potassium chloride. The data sheets for the reference toxicant tests are provided in Appendix B.

Table 2 summarizes the reference toxicant test results and Cusum chart limits.

Table 2
Chronic Reference Toxicant Tests (g/L)

Species	IC_{25}	Cusum Chart Limits
P. promelas (survival)	0.63	0.57 to 0.64
P. promelas (growth)	0.57	0.45 to 0.73

APPENDIX A

RAW DATA SHEETS

TestAmerica

FRESHWATER TOXICITY TEST: SAMPLE AND DILUTION WATER DATA

Client: Sumitomo Metal Mining - Pogo

Contact: Stacy Staley and James Ward 1.907.895.2761

SDG # B 4026

Test Initiation: Date 6-19-18

Test Termination: Date 6-26-18

Sample ID Number	Field ID	Collected Date (mm/dd/yy)	Collected Time (Pacific Zone)	Received Date (mm/dd/yy)	Received Time (Pacific Zone)	Temp (°C) as Rc'vd	Total Residual Chlorine (mg/l) ☐ Dechlorination allowed as Rc'vd / after Dechlor.	Ammonia NH_3-N mg/l as Rc'vd	Hardness mg/l as $CaCO_3$ as Rc'vd	Alkalinity mg/l as $CaCO_3$ as Rc'vd	DO (mg/L) as Rc'vd	pH as Rc'vd	Cond. (uS) as Rc'vd	60 um filtered prior to use?
B4026 -01	Outfall 001 Wet	06/18/18	08:55	06/19/18	13:15	2.7	0.02 / -	0.74	75	-	-	-	-	☑
-02	Outfall 001	6/20/18	08:51	6/21/18	13:40	2.8	<0.02 / -	0.80	80	-	-	-	-	☑
-03	Outfall 001	6/22/18	08:57	6/23/18	13:00	2.7	<0.02 / -	0.82	80	-	-	-	-	☑
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							/							
			Reporting Limits:			na	0.02 mg/L	0.10 mg/L	5 mg/L	5 mg/L	na	na	na	na

Note: "-" Indicates data collection or dechlorination not needed. Any other adjustments to samples prior to use are documented in Comments below or on Dilutions page.

Dilution Water	ID#	Hardness mg/l as $CaCO_3$	Alkalinity mg/l as $CaCO_3$
Recon MH (FHM)	4678	86	64
	~~4677~~	~~98~~	~~70~~ Not used RMB 7-1-18
	4680	92	68
	4681	90	65

Comments: ☑ Indicates the action was taken, (☐= action not taken): " - " = sample not dechlorinated, or analyte not collected/needed.

Water Quality Meters Used/ID#: Dissolved Oxygen # 4 pH # 11 Conductivity # 2

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

FRESHWATER TOXICITY TEST: TEST ORGANISM INFORMATION

Client Sumitomo Metal Mining - Pogo

Sample Designation (SDG): B 4026

Test Species Information	FHM # 1989 *Pimephales promelas* Chronic				
Organism Age at Initiation	<48 hrs, all within a 24 hour window				
Test Container Size	400 ml				
Test Volume	500 ml				
Feeding: Type and Amount	0.15 ml *Artemia*, 2 x Daily				
Aeration: In Test Chambers via Slow Bubble :	☒ None ☐ Prior to use ☐ @ _____ hrs				
Acclimation Period	<24 hrs				
Organism Source	Aquatox				
Size	-				
Loading Rate	-				

Dissolved Oxygen aeration justifications (in test chambers):

Test(s): ☐ All ☐ _____

Date:

Comments:

Test Solution Preparation and Dilution Record

Client: Sumitomo Metal Mining - Pogo

Note: ☐ Indicates task not done, ☑ Indicates task was done. Temp adj. = Temperature adjusted to ambient or test temp

Ditto marks ('') indicate that the same SDG, batch of dilution water, or food as the previous day's entry was used.

Fathead minnow - Chronic

Test Concentration (%)	Sample Volume (mls)		Final Volume (mls)	Test Day	Sample ID Used	Daily Sample Preparation (prior to dilution)	Dilution Water Used	Date	Time	Initials
				0 (Initiation)	B 4626-01	☐ Temp adj, ☐ Aerated	ID # 4678	6/19/2018	14:05	BAM
Control	0.00	→	2000	1	B -01	☐ Temp adj, ☐ Aerated	ID # 4678	6/20/18	09:05	
12.5	250	→	2000	2	B -02	☐ Temp adj, ☐ Aerated	ID # 4680	6/21"	14:00	
25	500	→	2000	3	B -02	☐ Temp adj, ☐ Aerated	ID # 4682	6/22"	08:35	
50	1,000	→	2000	4	B -03	☐ Temp adj, ☐ Aerated	ID # 4681	6/23"	13:15	
75	1,500	→	2000	5	B -03	☐ Temp adj, ☐ Aerated	ID # 4681	6/24/18	08:30	BAM
100	2,000	→	2000	6	B -03	☐ Temp adj, ☐ Aerated	ID # 4681	6/25"	08:45	

Total Sample volume needed per day = 5250 mls

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

FATHEAD MINNOW 7-DAY SURVIVAL AND WATER QUALITY DATA

Random Template Used: 6 conc. x 4 reps. # 3 | Waterbath/incubator Used: # 3 | Date Initiated 6/19/2018 Time 15:45
Initial sample ID B 4026 - 01 | Date Terminated 6/26/2018 Time 15:00

Client: Sumitomo Metal Mining - Pogo | Sample Description: Outfall 001

Tech: Day 0 BAM Day 1 BAM Day 2 BAM/O Day 3 MB/BAM Day 4 O Day 5 BAM Day 6 MB/BAM Day 7 BAM
Time: Day 0 1545 Day 1 1415 Day 2 1535 Day 3 1445 Day 4 1440 Day 5 1220 Day 6 1430 Day 7 1500

Conc. or Percent	Day	Number of Live Organisms A	B	C	D	Dissolved O_2 (mg/l) Pre	Post	pH Pre	Post	Temp. (°C) Pre	Therm. ID #	Conductivity (µS) Post (1st use)
Control	0	10	10	10 ~~10~~ 9	10		8.0		7.6	Post: 25.1	252	340
	1	10	10	9 AAF	10	6.8	7.6	8.2	8.2	25.1	252	
	2	10	10	9	10	5.8	7.8	7.4	7.8	25.1	252	328
	3	10	10	9	10	6.9	7.8	7.5	8.0	25.3	252	
	4	10	10	9	10	6.2	7.8	7.3	7.9	24.8	252	307
	5	10	10	9	10	7.0	8.0	7.9	7.9	20.1 *	252	
	6	10	10	9	10	7.1	7.8	7.6	7.9	25.0	252	
	7	10	10	9	10	6.8		8.0		24.6	252	
12.5 %	0	10	10	10	10		8.0		7.6	Post: 24.9		
	1	10	10	10	10	6.8	8.1	8.2	8.2	25.0		
	2	10	10	10	10	5.8	7.8	7.4	7.8	25.1		
	3	10	10	10	10	7.0	7.6	7.5	8.1	25.0		
	4	10	10	10	10	6.4	8.0	7.3	7.9	24.8		
	5	10	10	10	10	6.9	8.2	7.8	8.0	20.0 *		
	6	10	10	10	10	7.0	8.1	7.6	7.8	25.0		
	7	10	10	10	10	6.8		8.0		24.6		
25 %	0	10	10	10	10		8.1		7.6	Post: 25.0		
	1	10	10	10	10	6.7	8.0	8.1	8.1	25.0		
	2	10	10	10	10	5.9	8.0	7.3	7.8	25.1		
	3	10	10	10	10	7.0	7.8	7.5	8.2	25.1		
	4	10	10	10	10	6.5	8.1	7.3	7.9	24.8		
	5	10	10	10	10	6.9	8.3	7.8	8.0	20.0 *		
	6	10	10	10	10	7.0	8.2	7.5	7.7	24.9		
	7	10	10	10	10	6.9		7.9		24.6		
50 %	0	10	10	10	10		8.2		7.5	Post: 24.7		
	1	10	10	10	10	6.7	8.3	8.0	8.0	25.0		
	2	10	10	10	10	5.8	8.2	7.3	7.6	24.8		
	3	10	9	10	10	7.0	8.0	7.6	7.9	25.0		
	4	10	10	10	10	6.2	8.2	7.3	7.8	24.7		
	5	10	10	10	10	6.8	8.3	7.7	7.9	20.1 *		
	6	10	10	10	10	7.1	8.3	7.5	7.6	24.8		
	7	10	10	10	10	6.8		7.9		24.5		
75 %	0	10	10	10	10		8.3		7.4	Post: 24.8		
	1	10	10	10	10	6.6	8.3	7.9	7.8	24.9		
	2	10	10	10	10	5.8	8.3	7.2	7.4	24.9		
	3	10	10	10	10	7.0	8.1	7.7	7.7	25.0		
	4	9	10	10	10	6.2	8.2	7.3	7.6	24.7		
	5	9	10	10	10	6.8	8.3	7.6	7.8	20.1 *		
	6	9	10	10	10	7.2	8.3	7.5	7.5	24.9		
	7	9	10	10	10	6.7		7.8		24.5		
100 %	0	10	10	10	10		8.3		7.2	Post: 24.8		199
	1	10	10	10	10	6.7	8.3	7.8	7.7	24.9		
	2	10	10	10	9	5.9	8.3	7.1	7.2	25.1		232
	3	10	10	10	9	6.8	8.2	8.0	7.6	25.0		
	4	10	10	10	9	6.2	8.2	7.2	7.4	24.8		232
	5	10	10	10	9	6.8	8.3	7.5	7.6	20.1 *		
	6	10	10	10	9	7.1	8.3	7.4	7.5	24.7		
	7	10	10	10	9	6.6		7.7		24.6		

✓ Indicates one organism inadvertently poured off during solution renewal, replaced into container.
"M" = organism missing, start count reduced. "Inj" = organism injured, remove from stats.
"F" = fungus noted on dead organisms.
☐ Aeration in test chambers begun @ _____ (Note observations on Test Organism Info sheet)

Pre = Pre-renewal solutions. Post = Post-renewal solutions.
Day 0 Temperatures = Post-renewals
Therm ID# = Thermometer ID used for all measurements that day.
(23.8) = Temp. out of recommended range

*Remcor stopped heating. Turned off, then back on. Heating started again.
BAM 6-24-18

FATHEAD MINNOW 7-DAY GROWTH DATA

Client: Sumitomo Pogo Tins Labeled As: SUM

Lab ID: B4026 Start Date: 6/19/2018

Sample Description:

Technician:	BAM	MB
Date:	7/3/2018	6/25/2018
Balance Serial #:	B328543647	B328543647

Percent	Replicate	Total Weight (mg)	Tare Weight (mg)	No. of Fish
Control	A	1085.94	1076.83	10
	B	1111.15	1101.06	10
	C	1097.48	1087.79	9
	D	1103.48	1092.86	10
12.5 %	A	1108.84	1099.03	10
	B	1108.29	1098.77	10
	C	1114.78	1105.06	10
	D	1105.43	1094.78	10
25 %	A	1109.98	1100.11	10
	B	1099.42	1090.42	10
	C	1080.75	1071.33	10
	D	1111.79	1102.46	10
50 %	A	1106.07	1096.53	10
	B	1086.89	1076.17	10
	C	1100.12	1090.07	10
	D	1078.14	1068.82	10
75 %	A	1088.64	1078.59	9
	B	1132.40	1122.46	10
	C	1078.64	1068.65	10
	D	1102.32	1091.89	10
100 %	A	1078.39	1068.16	10
	B	1108.04	1097.75	10
	C	1100.69	1089.87	10
	D	1096.71	1087.01	9
	A			
	B			
	C			
	D			

weigh to 0.01 mg

FATHEAD MINNOW 7-DAY GROWTH DATA

Client: Sumitomo Pogo Tins Labeled As: SUM

Lab ID: B4026 Start Date: 6/19/2018

Sample Description:

Technician:		MB
Date:		6/25/2018
Balance Serial #:	B328543647	B328543647

Percent	Replicate	Total Weight (mg)	Tare Weight (mg)	No. of Fish
Control	A		1076.83	10
	B		1101.06	10
	C		1087.79	9
	D		1092.86	10
12.5 %	A		1099.03	10
	B		1098.77	10
	C		1105.06	10
	D		1094.78	10
25 %	A		1100.11	10
	B		1090.42	10
	C		1071.33	10
	D		1102.46	10
50 %	A		1096.53	10
	B		1076.17	10
	C		1090.07	10
	D		1068.82	10
75 %	A		1078.59	9
	B		1122.46	10
	C		1068.65	10
	D		1091.89	10
100 %	A		1068.16	10
	B		1097.75	10
	C		1089.87	10
	D		1087.01	9
	A			
	B			
	C			
	D			

weigh to 0.01 mg

CETIS Summary Report

Report Date:	09 Jul-18 15:43 (p 1 of 2)
Test Code:	B402601ppc | 17-3330-0813

Fathead Minnow 7-d Larval Survival and Growth Test — **TestAmerica - ASL**

Batch ID:	04-1763-3414	**Test Type:**	Growth-Survival (7d)	**Analyst:**	Brett Muckey
Start Date:	19 Jun-18 15:45	**Protocol:**	EPA/821/R-02-013 (2002)	**Diluent:**	Mod-Hard Synthetic Water
Ending Date:	26 Jun-18 15:00	**Species:**	Pimephales promelas	**Brine:**	
Duration:	6d 23h	**Source:**	Aquatox, AR	**Age:**	

Sample ID:	00-4395-0576	**Code:**	B4026-01 ✓	**Client:**	
Sample Date:	18 Jun-18 08:55	**Material:**	Mining Discharge/Runoff	**Project:**	
Receive Date:	19 Jun-18 13:15	**Source:**	Sumitomo Mining - Pogo (AK0053341) ✓		
Sample Age:	31h	**Station:**			

Comparison Summary

Analysis ID	Endpoint	NOEL	LOEL	TOEL	PMSD	TU	Method
13-5008-4505	7d Survival Rate	100	>100	NA	6.25%	1	Steel Many-One Rank Sum Test
09-8625-9445	Mean Dry Biomass-mg	100	>100	NA	8.41%	1	Dunnett Multiple Comparison Test

Point Estimate Summary

Analysis ID	Endpoint	Level	%	95% LCL	95% UCL	TU	Method
19-7402-0181	Mean Dry Biomass-mg	IC25	>100	N/A	N/A	<1	Linear Interpolation (ICPIN)

Test Acceptability

Analysis ID	Endpoint	Attribute	Test Stat	TAC Limits	Overlap	Decision
13-5008-4505	7d Survival Rate	Control Resp	0.975	0.8 - NL	Yes	Passes Acceptability Criteria
09-8625-9445	Mean Dry Biomass-mg	Control Resp	0.9877	0.25 - NL	Yes	Passes Acceptability Criteria
19-7402-0181	Mean Dry Biomass-mg	Control Resp	0.9877	0.25 - NL	Yes	Passes Acceptability Criteria ✓
09-8625-9445	Mean Dry Biomass-mg	PMSD	0.08413	0.12 - 0.3	Yes	Below Acceptability Criteria OK

7d Survival Rate Summary

C-%	Control Type	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	%Effect
0	Dilution Water	4	0.975	0.8954	1	0.9	1	0.025	0.05	5.13%	0.0%
12.5		4	1	1	1	1	1	0	0	0.0%	-2.56%
25		4	1	1	1	1	1	0	0	0.0%	-2.56%
50		4	1	1	1	1	1	0	0	0.0%	-2.56%
75		4	0.975	0.8954	1	0.9	1	0.025	0.05	5.13%	0.0%
100		4	0.975	0.8954	1	0.9	1	0.025	0.05	5.13%	0.0%

Mean Dry Biomass-mg Summary

C-%	Control Type	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	%Effect
0	Dilution Water	4	0.9877	0.8862	1.089	0.911	1.062	0.03189	0.06379	6.46%	0.0%
12.5		4	0.9925	0.9132	1.072	0.952	1.065	0.02492	0.04983	5.02%	-0.48%
25		4	0.9405	0.8834	0.9976	0.9	0.987	0.01794	0.03587	3.81%	4.78%
50		4	0.9908	0.8918	1.09	0.932	1.072	0.0311	0.0622	6.28%	-0.3%
75		4	1.01	0.9748	1.046	0.994	1.043	0.01114	0.02229	2.21%	-2.28%
100		4	1.026	0.9531	1.099	0.97	1.082	0.02289	0.04579	4.46%	-3.87%

Fathead Minnow 7-d Larval Survival and Growth Test — **TestAmerica - ASL**

7d Survival Rate Detail

C-%	Control Type	Rep 1	Rep 2	Rep 3	Rep 4
0	Dilution Water	1	1	0.9	1
12.5		1	1	1	1
25		1	1	1	1
50		1	1	1	1
75		0.9	1	1	1
100		1	1	1	0.9

Mean Dry Biomass-mg Detail

C-%	Control Type	Rep 1	Rep 2	Rep 3	Rep 4
0	Dilution Water	0.911	1.009	0.969	1.062
12.5		0.981	0.952	0.972	1.065
25		0.987	0.9	0.942	0.933
50		0.954	1.072	1.005	0.932
75		1.005	0.994	0.999	1.043
100		1.023	1.029	1.082	0.97

7d Survival Rate Binomials

C-%	Control Type	Rep 1	Rep 2	Rep 3	Rep 4
0	Dilution Water	10/10	10/10	9/10	10/10
12.5		10/10	10/10	10/10	10/10
25		10/10	10/10	10/10	10/10
50		10/10	10/10	10/10	10/10
75		9/10	10/10	10/10	10/10
100		10/10	10/10	10/10	9/10

CETIS Analytical Report

Fathead Minnow 7-d Larval Survival and Growth Test — **TestAmerica - ASL**

Analysis ID:	13-5008-4505	**Endpoint:**	7d Survival Rate	**CETIS Version:**	CETISv1.8.8
Analyzed:	09 Jul-18 15:42	**Analysis:**	Nonparametric-Control vs Treatments	**Official Results:**	Yes

Batch ID:	04-1763-3414	**Test Type:**	Growth-Survival (7d)	**Analyst:**	Brett Muckey
Start Date:	19 Jun-18 15:45	**Protocol:**	EPA/821/R-02-013 (2002)	**Diluent:**	Mod-Hard Synthetic Water
Ending Date:	26 Jun-18 15:00	**Species:**	Pimephales promelas	**Brine:**	
Duration:	6d 23h	**Source:**	Aquatox, AR	**Age:**	

Sample ID:	00-4395-0576	**Code:**	B4026-01	**Client:**	
Sample Date:	18 Jun-18 08:55	**Material:**	Mining Discharge/Runoff	**Project:**	
Receive Date:	19 Jun-18 13:15	**Source:**	Sumitomo Mining - Pogo (AK0053341)		
Sample Age:	31h	**Station:**			

Data Transform	Zeta	Alt Hyp	Trials	Seed	PMSD	NOEL	LOEL	TOEL	TU
Angular (Corrected)	NA	C > T	NA	NA	6.25%	100	>100	NA	1

Steel Many-One Rank Sum Test

Control	vs	C-%	Test Stat	Critical	Ties	DF	P-Value	P-Type	Decision(α:5%)
Dilution Water		12.5	20	10	1	6	0.9516	Asymp	Non-Significant Effect
		25	20	10	1	6	0.9516	Asymp	Non-Significant Effect
		50	20	10	1	6	0.9516	Asymp	Non-Significant Effect
		75	18	10	2	6	0.8333	Asymp	Non-Significant Effect
		100	18	10	2	6	0.8333	Asymp	Non-Significant Effect

ANOVA Table

Source	Sum Squares	Mean Square	DF	F Stat	P-Value	Decision(α:5%)
Between	0.009959749	0.00199195	5	0.6	0.7006	Non-Significant Effect
Error	0.0597585	0.003319917	18			
Total	0.06971824		23			

Distributional Tests

Attribute	Test	Test Stat	Critical	P-Value	Decision(α:1%)
Variances	Mod Levene Equality of Variance	0.6	4.248	0.7006	Equal Variances
Variances	Levene Equality of Variance	5.4	4.248	0.0033	Unequal Variances
Distribution	Shapiro-Wilk W Normality	0.6694	0.884	<0.0001	Non-normal Distribution

7d Survival Rate Summary

C-%	Control Type	Count	Mean	95% LCL	95% UCL	Median	Min	Max	Std Err	CV%	%Effect
0	Dilution Water	4	0.975	0.8954	1	1	0.9	1	0.025	5.13%	0.0%
12.5		4	1	1	1	1	1	1	0	0.0%	-2.56%
25		4	1	1	1	1	1	1	0	0.0%	-2.56%
50		4	1	1	1	1	1	1	0	0.0%	-2.56%
75		4	0.975	0.8954	1	1	0.9	1	0.025	5.13%	0.0%
100		4	0.975	0.8954	1	1	0.9	1	0.025	5.13%	0.0%

Angular (Corrected) Transformed Summary

C-%	Control Type	Count	Mean	95% LCL	95% UCL	Median	Min	Max	Std Err	CV%	%Effect
0	Dilution Water	4	1.371	1.242	1.501	1.412	1.249	1.412	0.04074	5.94%	0.0%
12.5		4	1.412	1.412	1.412	1.412	1.412	1.412	0	0.0%	-2.97%
25		4	1.412	1.412	1.412	1.412	1.412	1.412	0	0.0%	-2.97%
50		4	1.412	1.412	1.412	1.412	1.412	1.412	0	0.0%	-2.97%
75		4	1.371	1.242	1.501	1.412	1.249	1.412	0.04074	5.94%	0.0%
100		4	1.371	1.242	1.501	1.412	1.249	1.412	0.04074	5.94%	0.0%

Fathead Minnow 7-d Larval Survival and Growth Test — **TestAmerica - ASL**

Analysis ID:	13-5008-4505	**Endpoint:**	7d Survival Rate	**CETIS Version:**	CETISv1.8.8
Analyzed:	09 Jul-18 15:42	**Analysis:**	Nonparametric-Control vs Treatments	**Official Results:**	Yes

7d Survival Rate Detail

C-%	Control Type	Rep 1	Rep 2	Rep 3	Rep 4
0	Dilution Water	1	1	0.9	1
12.5		1	1	1	1
25		1	1	1	1
50		1	1	1	1
75		0.9	1	1	1
100		1	1	1	0.9

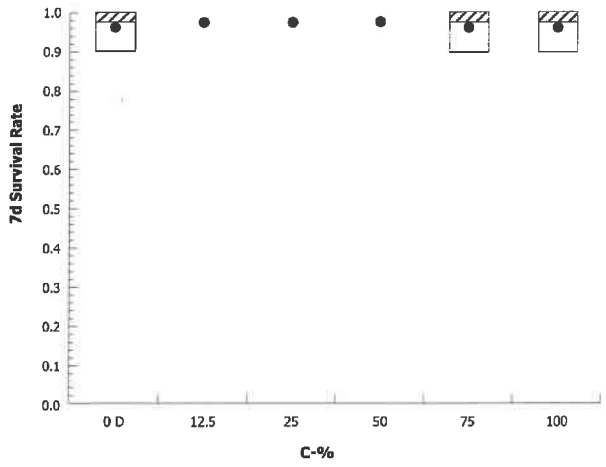
Angular (Corrected) Transformed Detail

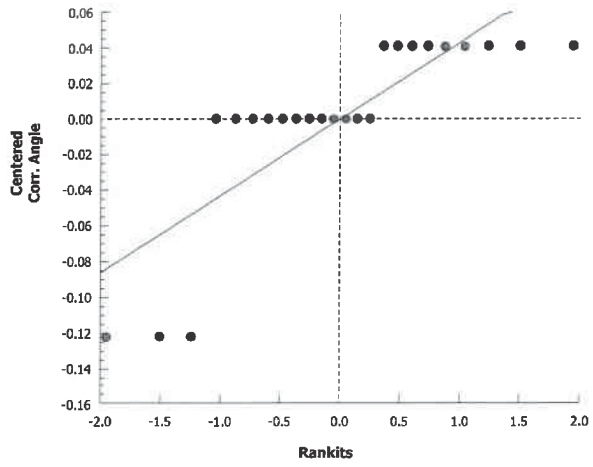
C-%	Control Type	Rep 1	Rep 2	Rep 3	Rep 4
0	Dilution Water	1.412	1.412	1.249	1.412
12.5		1.412	1.412	1.412	1.412
25		1.412	1.412	1.412	1.412
50		1.412	1.412	1.412	1.412
75		1.249	1.412	1.412	1.412
100		1.412	1.412	1.412	1.249

7d Survival Rate Binomials

C-%	Control Type	Rep 1	Rep 2	Rep 3	Rep 4
0	Dilution Water	10/10	10/10	9/10	10/10
12.5		10/10	10/10	10/10	10/10
25		10/10	10/10	10/10	10/10
50		10/10	10/10	10/10	10/10
75		9/10	10/10	10/10	10/10
100		10/10	10/10	10/10	9/10

Graphics





Fathead Minnow 7-d Larval Survival and Growth Test — **TestAmerica - ASL**

Analysis ID:	09-8625-9445	**Endpoint:**	Mean Dry Biomass-mg	**CETIS Version:**	CETISv1.8.8
Analyzed:	09 Jul-18 15:42	**Analysis:**	Parametric-Control vs Treatments	**Official Results:**	Yes

Batch ID:	04-1763-3414	**Test Type:**	Growth-Survival (7d)	**Analyst:**	Brett Muckey
Start Date:	19 Jun-18 15:45	**Protocol:**	EPA/821/R-02-013 (2002)	**Diluent:**	Mod-Hard Synthetic Water
Ending Date:	26 Jun-18 15:00	**Species:**	Pimephales promelas	**Brine:**	
Duration:	6d 23h	**Source:**	Aquatox, AR	**Age:**	

Sample ID:	00-4395-0576	**Code:**	B4026-01	**Client:**	
Sample Date:	18 Jun-18 08:55	**Material:**	Mining Discharge/Runoff	**Project:**	
Receive Date:	19 Jun-18 13:15	**Source:**	Sumitomo Mining - Pogo (AK0053341)		
Sample Age:	31h	**Station:**			

Data Transform	Zeta	Alt Hyp	Trials	Seed	PMSD	NOEL	LOEL	TOEL	TU
Untransformed	NA	C > T	NA	NA	8.41%	100	>100	NA	1

Dunnett Multiple Comparison Test

Control	vs	C-%	Test Stat	Critical	MSD	DF	P-Value	P-Type	Decision(α:5%)
Dilution Water		12.5	-0.1376	2.407	0.083	6	0.8706	CDF	Non-Significant Effect
		25	1.369	2.407	0.083	6	0.2727	CDF	Non-Significant Effect
		50	-0.08699	2.407	0.083	6	0.8577	CDF	Non-Significant Effect
		75	-0.6519	2.407	0.083	6	0.9578	CDF	Non-Significant Effect
		100	-1.108	2.407	0.083	6	0.9872	CDF	Non-Significant Effect

ANOVA Table

Source	Sum Squares	Mean Square	DF	F Stat	P-Value	Decision(α:5%)
Between	0.01663114	0.003326228	5	1.396	0.2727	Non-Significant Effect
Error	0.04290357	0.002383532	18			
Total	0.05953471		23			

Distributional Tests

Attribute	Test	Test Stat	Critical	P-Value	Decision(α:1%)
Variances	Bartlett Equality of Variance	3.327	15.09	0.6497	Equal Variances
Distribution	Shapiro-Wilk W Normality	0.9601	0.884	0.4396	Normal Distribution

Mean Dry Biomass-mg Summary

C-%	Control Type	Count	Mean	95% LCL	95% UCL	Median	Min	Max	Std Err	CV%	%Effect
0	Dilution Water	4	0.9877	0.8862	1.089	0.989	0.911	1.062	0.03189	6.46%	0.0%
12.5		4	0.9925	0.9132	1.072	0.9765	0.952	1.065	0.02492	5.02%	-0.48%
25		4	0.9405	0.8834	0.9976	0.9375	0.9	0.987	0.01794	3.81%	4.78%
50		4	0.9908	0.8918	1.09	0.9795	0.932	1.072	0.0311	6.28%	-0.3%
75		4	1.01	0.9748	1.046	1.002	0.994	1.043	0.01114	2.21%	-2.28%
100		4	1.026	0.9531	1.099	1.026	0.97	1.082	0.02289	4.46%	-3.87%

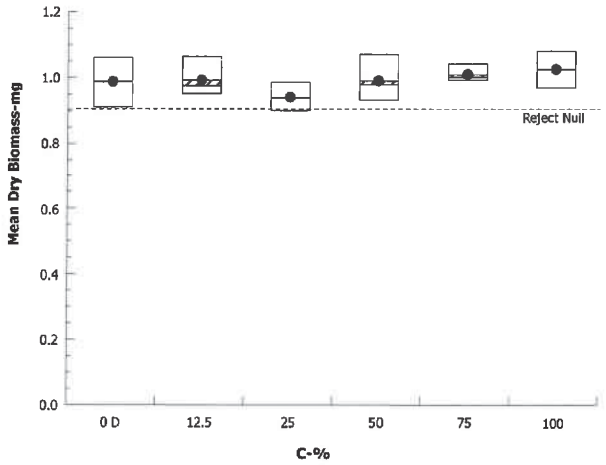
Mean Dry Biomass-mg Detail

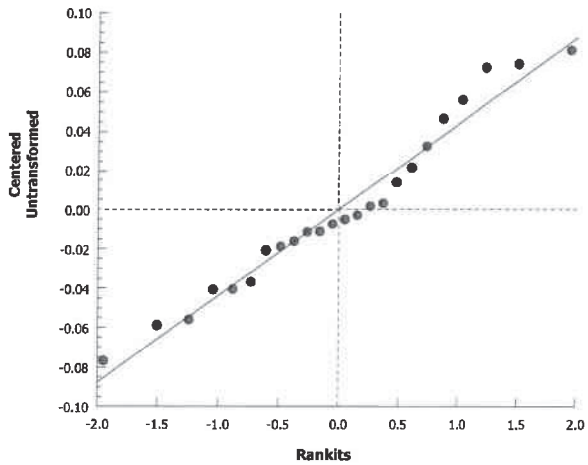
C-%	Control Type	Rep 1	Rep 2	Rep 3	Rep 4
0	Dilution Water	0.911	1.009	0.969	1.062
12.5		0.981	0.952	0.972	1.065
25		0.987	0.9	0.942	0.933
50		0.954	1.072	1.005	0.932
75		1.005	0.994	0.999	1.043
100		1.023	1.029	1.082	0.97

Fathead Minnow 7-d Larval Survival and Growth Test **TestAmerica - ASL**

Analysis ID:	09-8625-9445	**Endpoint:**	Mean Dry Biomass-mg	**CETIS Version:**	CETISv1.8.8
Analyzed:	09 Jul-18 15:42	**Analysis:**	Parametric-Control vs Treatments	**Official Results:**	Yes

Graphics





CETIS Analytical Report

Report Date:	09 Jul-18 15:43 (p 1 of 1)
Test Code:	B402601ppc | 17-3330-0813

Fathead Minnow 7-d Larval Survival and Growth Test — **TestAmerica - ASL**

Analysis ID:	19-7402-0181	**Endpoint:**	Mean Dry Biomass-mg	**CETIS Version:**	CETISv1.8.8
Analyzed:	09 Jul-18 15:42	**Analysis:**	Linear Interpolation (ICPIN)	**Official Results:**	Yes

Batch ID:	04-1763-3414	**Test Type:**	Growth-Survival (7d)	**Analyst:**	Brett Muckey
Start Date:	19 Jun-18 15:45	**Protocol:**	EPA/821/R-02-013 (2002)	**Diluent:**	Mod-Hard Synthetic Water
Ending Date:	26 Jun-18 15:00	**Species:**	Pimephales promelas	**Brine:**	
Duration:	6d 23h	**Source:**	Aquatox, AR	**Age:**	

Sample ID:	00-4395-0576	**Code:**	B4026-01	**Client:**	
Sample Date:	18 Jun-18 08:55	**Material:**	Mining Discharge/Runoff	**Project:**	
Receive Date:	19 Jun-18 13:15	**Source:**	Sumitomo Mining - Pogo (AK0053341)		
Sample Age:	31h	**Station:**			

Linear Interpolation Options

X Transform	Y Transform	Seed	Resamples	Exp 95% CL	Method
Log(X+1)	Linear	1947857	200	Yes	Two-Point Interpolation

Point Estimates

Level	%	95% LCL	95% UCL	TU	95% LCL	95% UCL
IC25	>100	N/A	N/A	<1	NA	NA

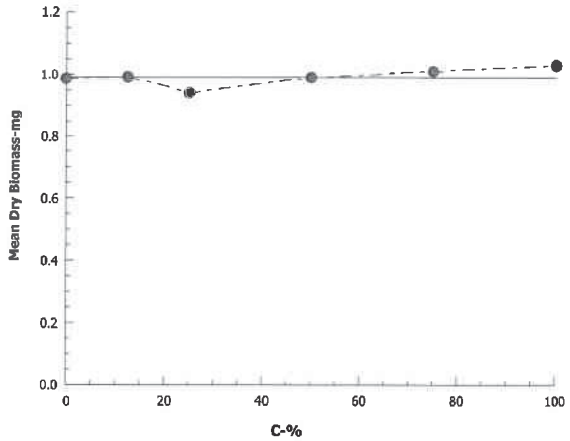
Mean Dry Biomass-mg Summary

			Calculated Variate						
C-%	**Control Type**	**Count**	**Mean**	**Min**	**Max**	**Std Err**	**Std Dev**	**CV%**	**%Effect**
0	Dilution Water	4	0.9877	0.911	1.062	0.03189	0.06379	6.46%	0.0%
12.5		4	0.9925	0.952	1.065	0.02492	0.04983	5.02%	-0.48%
25		4	0.9405	0.9	0.987	0.01794	0.03587	3.81%	4.78%
50		4	0.9908	0.932	1.072	0.0311	0.0622	6.28%	-0.3%
75		4	1.01	0.994	1.043	0.01114	0.02229	2.21%	-2.28%
100		4	1.026	0.97	1.082	0.02289	0.04579	4.46%	-3.87%

Mean Dry Biomass-mg Detail

C-%	Control Type	Rep 1	Rep 2	Rep 3	Rep 4
0	Dilution Water	0.911	1.009	0.969	1.062
12.5		0.981	0.952	0.972	1.065
25		0.987	0.9	0.942	0.933
50		0.954	1.072	1.005	0.932
75		1.005	0.994	0.999	1.043
100		1.023	1.029	1.082	0.97

Graphics



APPENDIX B

REFERENCE TOXICANT DATA SHEETS

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

FATHEAD MINNOW 7-DAY SURVIVAL AND WATER QUALITY DATA

Random Template Used: 6 conc. x 4 reps. # 1

Stock Sol. ID 2 B 0 6 8 - 07

Organism ID: FHM 1989

Waterbath/incubator Used: # 4

Date Initiated 6 / 19 / 20 18 Time 16:00

Date Terminated 6 / 26 / 20 18 Time 16:00

Test Container Size: 800 ml

Solution Volume / rep: 500 ml

Client QA / QC - RefTox

Sample Description KCl (50 g/L stock)

Tech: Day 0 BAM Day 1 BAM Day 2 BAM Day 3 MB/CA Day 4 BM Day 5 BAM Day 6 MB/CA Day 7 O

Time Day 0 1600 Day 1 1340 Day 2 1515 Day 3 1340 Day 4 1020 Day 5 1140 Day 6 1320 Day 7 1600

Conc. or Percent	Day	Number of Live Organisms A	B	C	D	Dissolved O2 (mg/l) Pre	Post	pH Pre	Post	Temp. (°C) Pre	Therm. ID #	Conductivity (µS) Post (daily)
Control	0	10	10	~~10~~ 9	10		7.9		7.4	Post: 25.2	252	343
	1	10	10	~~10~~ 9	10	6.8	7.5	7.4	8.0	25.2	252	317
	2	10	10	9 inj	10	6.3	7.7	7.3	7.8	25.2	252	341
	3	10	9	9	10	6.7	7.7	7.0	7.7	25.2	252	330
	4	10	9	9	10	6.9	7.9	7.4	8.0	25.3	252	~~250~~ 331
	5	10	9	9	10	6.9	7.8	7.4	7.8	25.1	252	307
	6	10	9	9	10	7.0	7.7	7.1	7.7	24.7	252	318
	7	10	9	9	9	7.1		7.6		24.5	252	
0.25 g/L	0	10	10	10	10		7.8		7.5	Post: 25.0		722
	1	10	10	10	10	6.8	7.8	7.4	8.0	25.1		761
	2	10	10	10	10	6.2	7.7	7.3	7.9	25.1		820
	3	10	10	9	10	6.8	7.8	7.1	7.7	25.1		793
	4	10	10	9	10	6.7	7.9	7.5	8.0	25.1		812
	5	10	10	9	10	6.9	8.0	7.5	8.0	25.0		811
	6	10	10	9	10	6.9	8.0	7.0	7.6	24.8		788
	7	10	10	9	10	7.3		7.6		24.5		
0.50 g/L	0	10	~~10~~ 9	10	10		7.9		7.6	Post: 25.1		1176
	1	10	~~10~~ 9	10	10	6.7	8.0	7.5	8.0	25.1		1170
	2	10	~~10~~ 9	10	10	6.0	7.8	7.4	7.9	25.1		1289
	3	10	~~10~~ 9	10	10	6.8	7.9	7.3	7.9	25.1		1246
	4	10	~~10~~ 9	10	10	6.6	7.8	7.5	8.1	25.1		1286
	5	9	~~10~~ 9	10	10	6.7	8.1	7.5	8.2	25.0		1207
	6	9	9 inj	10	10	7.1	8.1	7.1	7.7	24.9		1251
	7	9	9	10	10	7.2		7.5		24.5		
1.0 g/L	0	10	10	10	10		7.9		7.6	Post: 25.1		2040
	1	6	3	6	7	6.9	8.0	7.6	8.0	25.1		2150
	2	5	3	5	6	6.0	7.8	7.4	8.0	25.1		2170
	3	5	3	5	5	6.6	7.9	7.3	7.9	25.2		2150
	4	2	3	4	5	6.6	7.9	7.6	8.2	25.1		2170
	5	1	2	2	4	6.6	8.2	7.6	8.2	25.0		2080
	6	1	2	2	3	7.0	8.2	7.2	7.8	24.9		2140
	7	0	2	1	3	7.1		7.6		24.2		
2.0 g/L	0	10	10	10	10		8.0		7.7	Post: 25.0		3850
	1	0	0	0	0	6.9	7.9	7.6	8.0	25.1		4030
	2											
	3											
	4											
	5											
	6											
	7											
4.0 g/L	0	10	10	10	10		8.0		7.7	Post: 25.1		7090
	1	0	0	0	0	7.0		7.6		25.1		
	2											
	3											
	4											
	5											
	6											
	7											

✓ Indicates one organism inadvertently poured off during solution renewal, replaced into container.

"M" = organism missing, start count reduced. "Inj" = organism injured, remove from stats.

"F" = fungus noted on dead organisms.

Pre =Pre-renewal solutions. Post =Post-renewal solutions.

Day 0 Temperatures = Post-renewals

Therm ID# = Thermometer ID used for all measurements that day.

(23.8) = Temp. out of recommended range

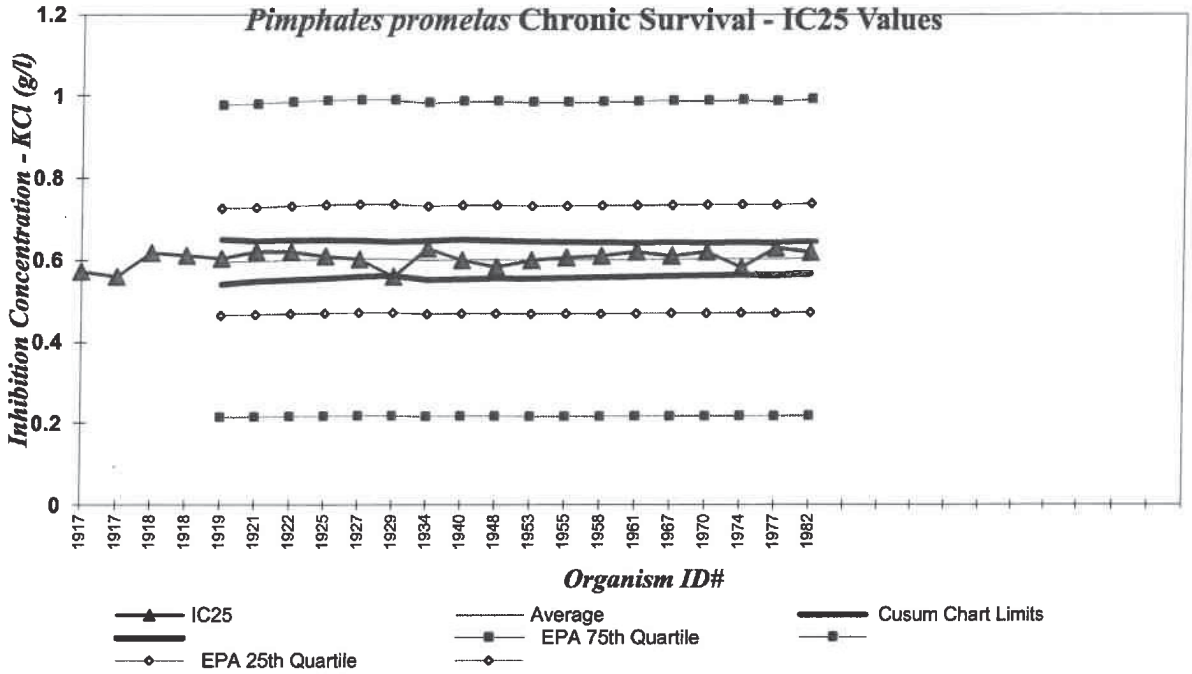
Endpoint	IC25	Cusum Chart Limits
Survival	0.63	0.57 to 0.64
Growth	0.57	0.45 to 0.73

Task Manager

Project Manager

QA Officer 6-28-18

REFERENCE TOXICANT CUMLATIVE SUMMARY (CUSUM) CHART



Pimephales promelas **- Chronic (EPA Test Method 1000.0)**

POTASSIUM CHLORIDE (g/L)

Endpoint: Chronic Survival

Stats Method: Linear Interpolation

Test Conditions: Recon MH, 25 oC

From EPA 833-R-00-003:

10th Quartile CV (*control limit*) = 0.03

25th Quartile CV (*warning limit*) = 0.11

75th Quartile CV (*warning limit*) = 0.32

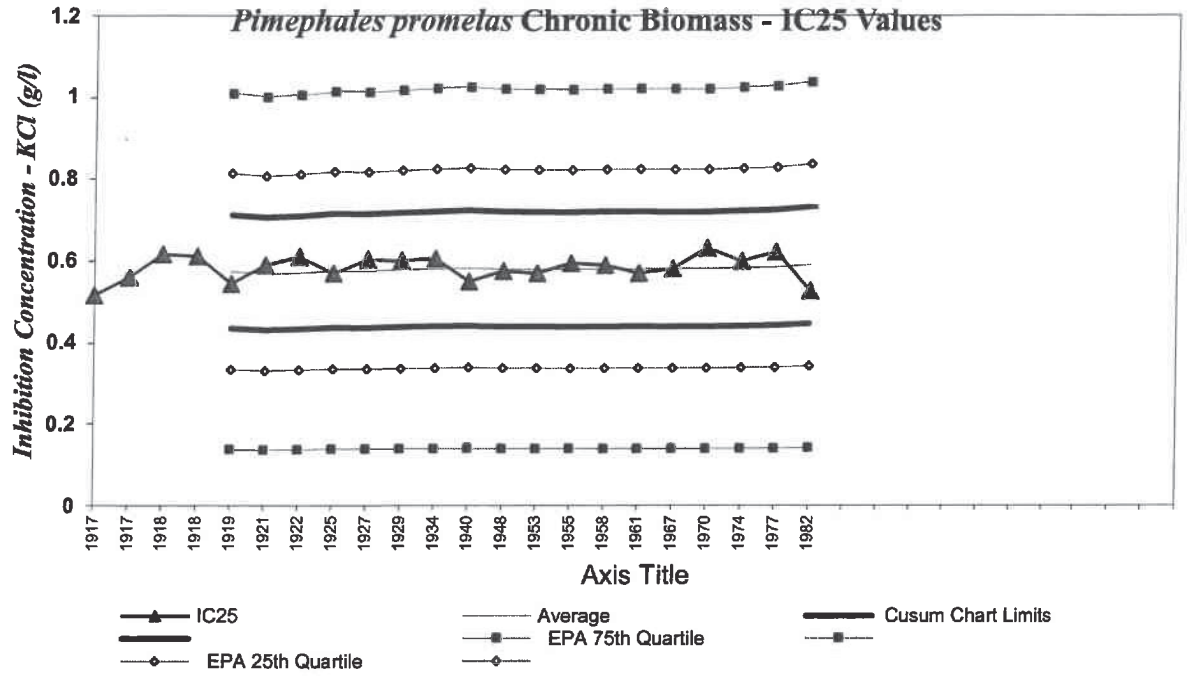
90th Quartile CV (*control limit*) = 0.52

Intralab CV is compared to EPA ***Warning limits*** *(25th and 75th CV's) and* ***Control limits*** *(10th and 90th CV's),*

If lab CV is outside EPA Control limits, the EPA Control limits are used to set Cusum chart limits.

Event #	FHM ID #	Test Start Date	IC25	Running Average	Running SD	Cusum Chart Limits AVG-2SD	Cusum Chart Limits AVG+2SD	Intralab CV
13	1940	08/01/17	**0.60**	0.6	0.02	**0.55**	**0.65**	0.04
14	1948	09/12/17	**0.58**	0.6	0.02	**0.56**	**0.65**	0.04
15	1953	10/10/17	**0.60**	0.6	0.02	**0.56**	**0.65**	0.04
16	1955	11/07/17	**0.61**	0.6	0.02	**0.56**	**0.64**	0.04
17	1958	12/12/17	**0.61**	0.6	0.02	**0.56**	**0.64**	0.04
18	1961	01/17/18	**0.62**	0.6	0.02	**0.56**	**0.64**	0.03
19	1967	02/06/18	**0.61**	0.6	0.02	**0.56**	**0.64**	0.03
20	1970	02/27/18	**0.62**	0.6	0.02	**0.56**	**0.64**	0.03
21	1974	03/20/18	**0.58**	0.6	0.02	**0.56**	**0.64**	0.03
22	1977	04/03/18	**0.63**	0.6	0.02	**0.56**	**0.64**	0.03
23	1982	05/02/18	**0.62**	0.6	0.02	**0.57**	**0.64**	0.03
24	1984	06/19/18	**0.63**	0.6	0.02	**0.57**	**0.64**	0.03
25								
26								
27								

REFERENCE TOXICANT CUMLATIVE SUMMARY (CUSUM) CHART



Pimephales promelas - Chronic (EPA Test Method 1000.0)

POTASSIUM CHLORIDE (g/L)

Endpoint: Chronic Growth (Biomass)

Stats Method: Linear Interpolation

Test Conditions: Recon MH, 25 oC

From EPA 833-R-00-003:

10th Quartile CV (*control limit*) = 0.12

25th Quartile CV (*warning limit*) = 0.21

75th Quartile CV (*warning limit*) = 0.38

90th Quartile CV (*control limit*) = 0.45

Intralab CV is compared to EPA ***Warning limits*** *(25th and 75th CV's) and* ***Control limits*** *(10th and 90th CV's),*

If lab CV is outside EPA Control limits, the EPA Control limits are used to set Cusum chart limits.

Event #	FHM ID #	Test Start Date	IC25	Running Average	Running SD	Cusum Chart Limits AVG-2SD	Cusum Chart Limits AVG+2SD	Intralab CV
13	1940	8/1/2017	**0.55**	0.58	0.03	**0.44**	**0.72**	0.05
14	1948	9/12/2017	**0.58**	0.58	0.03	**0.44**	**0.72**	0.05
15	1953	10/10/2017	**0.57**	0.58	0.03	**0.44**	**0.72**	0.05
16	1955	11/7/2017	**0.59**	0.58	0.03	**0.44**	**0.72**	0.05
17	1958	12/12/17	**0.59**	0.58	0.03	**0.44**	**0.72**	0.05
18	1961	01/17/18	**0.57**	0.58	0.03	**0.44**	**0.72**	0.05
19	1967	02/06/18	**0.58**	0.58	0.03	**0.44**	**0.72**	0.05
20	1970	02/27/18	**0.63**	0.58	0.03	**0.44**	**0.72**	0.05
21	1974	03/20/18	**0.60**	0.58	0.03	**0.44**	**0.72**	0.05
22	1977	04/03/18	**0.62**	0.58	0.03	**0.44**	**0.72**	0.04
23	1982	05/02/18	**0.53**	0.59	0.02	**0.45**	**0.73**	0.05
24	1984	06/19/18	**0.57**	0.59	0.03	**0.45**	**0.73**	0.05
25								
26								

APPENDIX C

CHAIN OF CUSTODY

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

Sample Receipt Record

Batch Number: B40216A

Date Received: 6/19/18

Client/Project: Sumitomo Metal Mining

Received By: RC

Were custody seals intact?	☒ Yes	☐ No	☐ N/A
Packing Material:	☒ Ice	☐ Blue Ice	☐ Box
Temp OK? (<6C) Therm ID: TH173 Exp. 7/18/18 2.7 °C	☒ Yes	☐ No	☐ N/A
Was a Chain of Custody (CoC) Provided?	☒ Yes	☐ No	☐ N/A
Was the CoC correctly filled out (If No, document below)	☒ Yes	☐ No	☐ N/A
Were the sample containers in good condition (not broken or leaking)?	☒ Yes	☐ No	☐ N/A
Are all samples within 36 hours of collection?	☒ Yes	☐ No	☐ N/A

Method of Shipment: ☐ Hand Delivered ☐ FedEx ☐ UPS ☐ Greyhound ☒ Other: Courier ☐ N/A

Sample Exception Report (The following exceptions were noted)

Client was notified on: Client contact:

Resolution to Exception:

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

CHAIN OF CUSTODY RECORD FOR NPDES COMPLIANCE BIOMONITORING

Client: SMM POGO
Address: Mile 50 Pogo Road
Delta Junction, AK
99737

Contact Person: Stacy Staley
Phone:

Project #: (907)895-2761

NPDES#: AK0053341
Composite Sample Information:

Samples/Hour: 1/hr
Volume/Sample: 5 gal
Total Hours: 1
Total Volume: 5 gal
Initiated: Date 6/18/18 Time 0850
Ended: Date 6/18/18 Time 0855
Chilled During Collection: yes

Ship Samples to:
PO#

TestAmerica ASL
Attention: Aquatic Toxicology Laboratory
1100 NE Circle Blvd, Suite 310
Corvallis, OR 97330
Phone: 541.243.6137

Check Chlorine (Y/N)
Temp. Upon Arrival (°C)
Check Ammonia (Y/N) Dechlorinated (Y/N)

Analysis Required / Comments

Sample ID	Date	Time	Sample Type: Comp.	Sample Type: Grab	# of Containers	Lab ID#	Fathead Acute	Fathead Chronic	Cerio Acute	Cerio Chronic	Daphnia Acute	Trout Acute	SHM Acute	SHM Chronic	MB Acute	MB Chronic	MYS Acute	MYS Chronic	Algae	Haz Waste				Concentration and/or Comments
OUTFALL00 INLET	06/18/18	0855		✓	2	B40260-01	✓	✓																

Sampled By & Title (Please sign and print name): Martin Weiser Env. Specialist	Date/Time: 6/18/18 11:20	Relinquished By (Please sign and print name): Jillian VanPatten	Date/Time: 06/18/18 11:20
Received By (Please sign and print name): Jillian VanPatten	Date/Time: 06/18/18 11:20	Relinquished By (Please sign and print name): Jillian VanPatten	Date/Time: 06/18/18 4:00pm
Received By (Please sign and print name): TA AK	Date/Time: 6/19/18 1315	Relinquished By (Please sign and print name):	Date/Time:
Received By (Please sign and print name):	Date/Time:	Shipped Via: UPS Bis Fed-Ex Hand Other	Shipping #:
Work Authorized By (Please sign and print name):	Remarks: B340260A ice TH173 Obs: 3.7 Cor: 2.7		

COC_Bioassay.xls
Doc Control ID: ASL612-0717

027 FAI 6043 9083

027-6043 9083

Shipper's Name and Address
Sumitomo Metal Mining Po
Mile 50 Pogo Mile Road
Delta Junction, AK 99737
USA
Tel: 907-895-2841

Shipper's Account Number
27442319143

Customer's ID Number
10659

Not Negotiable
Air Waybill
Issued By
Alaska. AIR CARGO
P.O. BOX 68900 SEATTLE, WA 98168
800-225-2752 ALASKACARGO.COM

Consignee's Name and Address
TESTAMERICA ASL
1100 NE CRICLE BLVD SUITE 310
CORVALLIS, OREGON 97330
USA
Tel: 5412430976

Consignee's Account Number

Also notify
Tel:

Issuing Carrier's Agent and City

Accounting Information 10659
Sumitomo Metal Mining Pogo LLC
Mile 50 Pogo Mile Road
Delta Junction, AK 99737
USA

GoldStreak

Agent's IATA Code

Account No.

Airport of Departure (Addr. of First Carrier) and Requested Routing
Fairbanks

To	By First Carrier	To / By		To / By		Currency		WT/VAL		Other		Declared Value For Carriage	Declared Value For Customs
SEA	Alaska Airlines	PDX	AS			USD	PX	X		X		NVD	NCV

Airport of Destination	Flight/Date	Flight/Date	Amount of Insurance
Portland	AS 124/18	AS 2041/19	XXX

Handling Information
PERISHABLE CARGO (NON - FOOD)

SCI

No of Pieces	Gross Weight	kg lb			Commodity Item No.	Chargeable Weight	Rate / Charge	Total	Nature and Quantity of Goods (Incl. Dimensions or Volume)
1	76.0	L		Q		76.0	1.74	132.24	NON HAZARDOUS WATER SAMPLES Dims: 24 x 13 x12 x 1 GSX PER
1	76.0							132.24	Volume: 2.167

Prepaid Weight Charge **Collect**
132.24

Valuation Charge

Tax
2.26

Total Other Charges Due Agent

Total Other Charges Due Carrier

Other Charges
XBC 0.00

Shipper certifies that the particulars on the face hereof are correct and that **insofar as any part of the consignment contains dangerous goods, such part is properly described by name and is in proper condition for carriage by air according to the applicable Dangerous Goods Regulations. I consent to the inspection of this cargo.**

For: Sumitomo Metal Mining Pogo LLC

Signature of Shipper or his Agent

☑ THIS SHIPMENT DOES NOT CONTAIN DANGEROUS GOODS

☐ THIS SHIPMENT DOES CONTAIN DANGEROUS GOODS

Total Prepaid	Total Collect
134.50	

18 Jun 2018 15:58 Fairbanks Alaska Airlines

Executed On (Date) at (Place) Signature of Issuing Carrier or its Agent

027-6043 9083

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

Sample Receipt Record

Batch Number: BH026-02 Date Received: 6-21-18

Client/Project: Sumitomo Received By: [illegible]

Were custody seals intact?	☐ Yes	☐ No	☐ N/A
Packing Material:	☐ Ice	☐ Blue Ice	☐ Box
Temp OK? (<6C) Therm ID: TH173 Exp. 7-18-18 obs 3.2°C act 2.8°C °C	☐ Yes	☐ No	☐ N/A
Was a Chain of Custody (CoC) Provided?	☐ Yes	☐ No	☐ N/A
Was the CoC correctly filled out (If No, document below)	☐ Yes	☐ No	☐ N/A
Were the sample containers in good condition (not broken or leaking)?	☐ Yes	☐ No	☐ N/A
Are all samples within 36 hours of collection?	☐ Yes	☐ No	☐ N/A

Method of Shipment: ☐ Hand Delivered ☐ FedEx ☐ UPS ☐ Greyhound ☐ Other: _____ ☐ N/A

Sample Exception Report (The following exceptions were noted)

Client was notified on: Client contact:

Resolution to Exception:

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

CHAIN OF CUSTODY RECORD FOR NPDES COMPLIANCE BIOMONITORING

Client: SMM Pogo
Address: Mile 50 Pogo Road
Delta Junction, AK
99737

Contact Person: Stacy Staley
Phone: (907) 895-2761

Project #

NPDES#: AK0053341
Composite Sample Information:

Samples/Hour: 1/hr Volume/Sample: 5 gal
Total Hours: 1 Total Volume: 5 gal
Initiated: Date 06/20 Time 0947
Ended: Date 06/20 Time 0951
Chilled During Collection: Yes

Ship Samples to: TestAmerica ASL
PO#
Attention: Aquatic Toxicology Laboratory
1100 NE Circle Blvd, Suite 310
Corvallis, OR 97330
Phone: 541.243.6137

Check Chlorine (Y/N)
Temp. Upon Arrival (°C)
Check Ammonia (Y/N) Dechlorinated (Y/N)

Analysis Required / Comments

Sample ID	Date	Time	Sample Type: Comp.	Sample Type: Grab	# of Containers	Lab ID#	Fathead Acute	Fathead Chronic	Cerio Acute	Cerio Chronic	Daphnia Acute	Trout Acute	SHM Acute	SHM Chronic	MB Acute	MB Chronic	MYS Acute	MYS Chronic	Algae	Haz Waste				Concentration and/or Comments
OUTFALL001WET	6/20/18	0851		✓	2	B406060	X	X																

Sampled By & Title (Please sign and print name): Martin Weiner Env. Specialist	Date/Time 6/20/18 12:10	Relinquished By (Please sign and print name): Jillian VanPatten	Date/Time 06/20/18 4:00
Received By (Please sign and print name): Jillian VanPatten	Date/Time 6/20/18 12:10	Relinquished By (Please sign and print name):	Date/Time
Received By (Please sign and print name): M. Otten TA-ASL	Date/Time 6-21-18 1340	Relinquished By (Please sign and print name):	Date/Time
Received By (Please sign and print name):	Date/Time	Shipped Via: UPS Bis Fed-Ex Hand Other	Shipping #
Work Authorized By (Please sign and print name):	Remarks		

COC_Bioassay.xls
Doc Control ID: ASL612-0717

027 FAI 6044 6606

027-6044 6606

Shipper's Name and Address
Sumitomo Metal Mining Po
Mile 50 Pogo Mile Road
Delta Junction, AK 99737
USA
Tel: 907-895-2841

Shipper's Account Number
27442319143

Customer's ID Number
10659

Not Negotiable

Air Waybill

Issued By

Alaska. AIR CARGO

P.O. BOX 68900 SEATTLE, WA 98168
800-225-2752 ALASKACARGO.COM

Consignee's Name and Address
TESTAMERICA ASL
1100 NE CIRCLE BLVD SUITE 310
CORVALLIS, OREGON 97330
USA
Tel: 5102436137

Consignee's Account Number

Also notify
N
Tel:

Issuing Carrier's Agent and City

Agent's IATA Code

Account No.

Accounting Information
10659
Sumitomo Metal Mining Pogo LLC
Mile 50 Pogo Mile Road
Delta Junction, AK 99737
USA

GoldStreak

Airport of Departure (Addr. of First Carrier) and Requested Routing
Fairbanks

To	By First Carrier	To / By		To / By		Currency		WT/VAL		Other		Declared Value For Carriage	Declared Value For Customs
SEA	Alaska Airlines	PDX	AS			USD	PX	X		X		NVD	NCV

Airport of Destination	Flight/Date	Flight/Date	Amount of Insurance
Portland	AS 124/20	AS 2317/21	XXX

Handling Information
KEEP COOL

SCI

No of Pieces	Gross Weight	kg lb			Commodity Item No.		Chargeable Weight		Rate / Charge	Total	Nature and Quantity of Goods (Incl. Dimensions or Volume)
1	84.0	L		Q			84.0			AS AGREED	WATER SAMPLES CHILL Dims: 24 x 13 x14 x 1
1	84.0									AS AGREED	Volume: 2.528

Prepaid	Weight Charge	Collect
	AS AGREED	

Valuation Charge

Tax

Other Charges
XBC 0.00

Total Other Charges Due Agent

Total Other Charges Due Carrier

Shipper certifies that the particulars on the face hereof are correct and that **insofar as any part of the consignment contains dangerous goods, such part is properly described by name and is in proper condition for carriage by air according to the applicable Dangerous Goods Regulations. I consent to the inspection of this cargo.**

For: Sumitomo Metal Mining Pogo LLC

Signature of Shipper or his Agent

☐ THIS SHIPMENT DOES NOT CONTAIN DANGEROUS GOODS

☐ THIS SHIPMENT DOES CONTAIN DANGEROUS GOODS

Total Prepaid	Total Collect
AS AGREED	

20 Jun 2018 16:06 — Executed On (Date)

Fairbanks — at (Place)

Alaska Airlines — Signature of Issuing Carrier or its Agent

027-6044 6606

TestAmerica

THE LEADER IN ENVIRONMENTAL TESTING

Sample Receipt Record

Batch Number: B4026-03

Date Received: 6/23/18

Client/Project: Sumitomo Pojo

Received By: B

Were custody seals intact?	☒ Yes	☐ No	☐ N/A
Packing Material:	☒ Ice	☐ Blue Ice	☐ Box
Temp OK? (<6C) Therm ID: TH173 Exp. 7/18/18 observed: 2.9°C Actual 2.7°C °C	☒ Yes	☐ No	☐ N/A
Was a Chain of Custody (CoC) Provided?	☒ Yes	☐ No	☐ N/A
Was the CoC correctly filled out (If No, document below)	☒ Yes	☐ No	☐ N/A
Were the sample containers in good condition (not broken or leaking)?	☒ Yes	☐ No	☐ N/A
Are all samples within 36 hours of collection?	☒ Yes	☐ No	☐ N/A

Method of Shipment: ☐ Hand Delivered ☐ FedEx ☐ UPS ☐ Greyhound ☐ Other: _____ ☐ N/A

Sample Exception Report (The following exceptions were noted)

Client was notified on: Client contact:

Resolution to Exception:

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

CHAIN OF CUSTODY RECORD FOR NPDES COMPLIANCE BIOMONITORING

Client: Pogo
Address: Mile 50 Pogo RD
Delta Junction AK
99737

Contact Person: Stacy Staley
Phone:

Project #

NPDES#: AK0053341
Composite Sample Information:

Samples/Hour: 1 Volume/Sample: 5
Total Hours: 1 Total Volume: 5
Initiated: Date 6/22/18 Time 0805
Ended: Date 6/22/18 Time 0807
Chilled During Collection: Y

Ship Samples to:
PO#

TestAmerica ASL
Attention: Aquatic Toxicology Laboratory
1100 NE Circle Blvd, Suite 310
Corvallis, OR 97330
Phone: 541.243.6137

Check Chlorine (Y/N)
Temp. Upon Arrival (°C)
Check Ammonia (Y/N) Dechlorinated (Y/N)

Analysis Required / Comments

Sample ID	Date	Time	Sample Type: Comp.	Sample Type: Grab	# of Containers	Lab ID#	Fathead Acute	Fathead Chronic	Cerio Acute	Cerio Chronic	Daphnia Acute	Trout Acute	SHM Acute	SHM Chronic	MB Acute	MB Chronic	MYS Acute	MYS Chronic	Algae	Haz Waste				Concentration and/or Comments
OUTFALL001WET	6/22/18	0807		✓	2	402603	✓	✓																

Sampled By & Title (Please sign and print name)	Date/Time	Relinquished By (Please sign and print name)	Date/Time
Martin Weiser ENV POGO	6/22/18 8:45	Jillian VanPatten	06/22/18 1:00pm
Received By (Please sign and print name): Jillian VanPatten	Date/Time 6/22/18 8:45	Relinquished By (Please sign and print name)	Date/Time
Received By (Please sign and print name)	Date/Time	Relinquished By (Please sign and print name)	Date/Time
Received By (Please sign and print name): Robert Mulkey TA-ASL	Date/Time 6/23/18 1300	Shipped Via: UPS Bis Fed-Ex Hand Other Courier Delivery	Shipping #
Work Authorized By (Please sign and print name)	Remarks		

COC_Bioassay.xls
Doc Control ID: ASL612-0717

027 FAI 6045 0740 -03 027-6045 0740

Shipper's Name and Address	Shipper's Account Number	Not Negotiable
Sumitomo Metal Mining Po Mile 50 Pogo Mile Road Delta Junction, AK 99737 USA Tel: 907-895-2841	27442319143 Customer's ID Number 10659	**Air Waybill** Issued By Alaska. AIR CARGO P.O. BOX 68900 SEATTLE, WA 98168 800-225-2752 ALASKACARGO.COM
Consignee's Name and Address	Consignee's Account Number	Also notify
TESTAMERICA ASL 1100 NE CIRCLE BLVD SUITE 310 CORVALLIS, OREGON 97330 USA Tel: 5102436137		Tel:
Issuing Carrier's Agent and City		Accounting Information 10659 Sumitomo Metal Mining Pogo LLC Mile 50 Pogo Mile Road Delta Junction, AK 99737 USA
Agent's IATA Code	Account No.	
Airport of Departure (Addr. of First Carrier) and Requested Routing Fairbanks		GoldStreak

To	By First Carrier	To / By		To / By		Currency		WT/VAL		Other		Declared Value For Carriage	Declared Value For Customs
SEA	Alaska Airlines	PDX	AS			USD	PX	X		X		NVD	NCV

Airport of Destination	Flight/Date	Flight/Date	Amount of Insurance
Portland	AS 124/22	AS 2059/23	XXX

Handling Information

SCI

No of Pieces	Gross Weight	kg lb			Commodity Item No.	Chargeable Weight	Rate / Charge	Total	Nature and Quantity of Goods (Incl. Dimensions or Volume)
1	74.0	L		Q		74.0		AS AGREED	WATER SAMPLES CHILL Dims: 24 x 13 x14 x 1 GSX
1	74.0							AS AGREED	Volume: 2.528

Prepaid	Weight Charge	Collect	Other Charges
	AS AGREED		XBC 0.00
	Valuation Charge		
	Tax		
	Total Other Charges Due Agent		
	Total Other Charges Due Carrier		
Total Prepaid		Total Collect	
AS AGREED			

Shipper certifies that the particulars on the face hereof are correct and that **insofar as any part of the consignment contains dangerous goods, such part is properly described by name and is in proper condition for carriage by air according to the applicable Dangerous Goods Regulations. I consent to the inspection of this cargo.**

For: Sumitomo Metal Mining Pogo LLC

Signature of Shipper or his Agent

☑ THIS SHIPMENT DOES NOT CONTAIN DANGEROUS GOODS

☐ THIS SHIPMENT DOES CONTAIN DANGEROUS GOODS

Executed On (Date)	at (Place)	Signature of Issuing Carrier or its Agent
22 Jun 2018 13:45	Fairbanks	Alaska Airlines

027-6045 0740

APPENDIX E – 2018 Laboratory MDL Studies

ENERGY LABORATORIES
Trust our People. Trust our Data.
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HELENA, MT
Toll Free: 877.472.0711 • 406.442.0711 • F: 406.442.0712
PO Box 5688, Helena, MT 59604-5688 • 3161 E. Lyndale Ave (59601)

2018 Dissolved Metals MDL (ICP)

Analyte	Channel	MDL	Units
Aluminum	Al1670	0.0065	mg/L
Aluminum	Al3961	0.0381	mg/L
Antimony	Sb2068	0.0152	mg/L
Antimony	Sb2175	0.0372	mg/L
Arsenic	As1890	0.0166	mg/L
Arsenic	As1937	0.2386	mg/L
Barium	Ba4554	0.0006	mg/L
Beryllium	Be3130	0.0003	mg/L
Beryllium	Be3131	0.0004	mg/L
Boron	B_2089	0.0058	mg/L
Boron	B_2497	0.0065	mg/L
Cadmium	Cd2144	0.0008	mg/L
Cadmium	Cd2265	0.0132	mg/L
Calcium	Ca3179	0.0653	mg/L
Calcium	Ca3181	0.8474	mg/L
Chromium	Cr2055	0.0133	mg/L
Chromium	Cr2666	0.0330	mg/L
Chromium	Cr2677	0.0087	mg/L
Cobalt	Co2286	0.0212	mg/L
Cobalt	Co2388	0.0064	mg/L
Copper	Cu2199	0.0214	mg/L
Copper	Cu3247	0.0118	mg/L
Copper	Cu3273	0.0323	mg/L
Gold	Au2427	0.0200	mg/L
Gold	Au2675	0.0692	mg/L
Iron	Fe2332	0.0171	mg/L
Iron	Fe2599	0.0107	mg/L
Lead	Pb2169	0.1073	mg/L
Lead	Pb2203	0.0394	mg/L
Lithium	Li6707	0.0023	mg/L
Magnesium	Mg2798	0.1336	mg/L
Magnesium	Mg2852	0.0141	mg/L
Manganese	Mn2576	0.0015	mg/L
Manganese	Mn2593	0.0025	mg/L
Mercury	Hg1849	0.0025	mg/L
Mercury	Hg1942	0.0918	mg/L
Molybdenum	Mo2020	0.0046	mg/L
Molybdenum	Mo2816	0.0164	mg/L
Nickel	Ni2216	0.0027	mg/L
Nickel	Ni2303	0.0593	mg/L
Nickel	Ni2316	0.0058	mg/L
Phosphorus	P_1774	0.1250	mg/L
Phosphorus	P_2149	0.0277	mg/L
Potassium	K_7664	0.0632	mg/L

2018 Total Metals MDL (ICP)

Analyte	Channel	MDL	Units
Aluminum	Al1670	0.0042	mg/L
Aluminum	Al3961	0.0272	mg/L
Antimony	Sb2068	0.0280	mg/L
Antimony	Sb2175	0.0502	mg/L
Arsenic	As1890	0.0186	mg/L
Arsenic	As1937	0.1837	mg/L
Barium	Ba4554	0.0009	mg/L
Beryllium	Be3130	0.0003	mg/L
Beryllium	Be3131	0.0003	mg/L
Boron	B_2089	0.0049	mg/L
Boron	B_2497	0.0049	mg/L
Cadmium	Cd2144	0.0008	mg/L
Cadmium	Cd2265	0.0124	mg/L
Calcium	Ca3179	0.0894	mg/L
Calcium	Ca3181	0.6763	mg/L
Chromium	Cr2055	0.0078	mg/L
Chromium	Cr2666	0.0464	mg/L
Chromium	Cr2677	0.0093	mg/L
Cobalt	Co2286	0.0331	mg/L
Cobalt	Co2388	0.0080	mg/L
Copper	Cu2199	0.0257	mg/L
Copper	Cu3247	0.0121	mg/L
Copper	Cu3273	0.0362	mg/L
Gold	Au2427	0.0276	mg/L
Gold	Au2675	0.1162	mg/L
Iron	Fe2332	0.0121	mg/L
Iron	Fe2599	0.0057	mg/L
Lead	Pb2169	0.0695	mg/L
Lead	Pb2203	0.0259	mg/L
Lithium	Li6707	0.0022	mg/L
Magnesium	Mg2798	0.1588	mg/L
Magnesium	Mg2852	0.0086	mg/L
Manganese	Mn2576	0.0016	mg/L
Manganese	Mn2593	0.0031	mg/L
Manganese	Mn4033	0.1857	mg/L
Molybdenum	Mo2020	0.0067	mg/L
Molybdenum	Mo2816	0.0160	mg/L
Nickel	Ni2216	0.0033	mg/L
Nickel	Ni2316	0.0044	mg/L
Phosphorus	P_1774	0.0695	mg/L
Phosphorus	P_2149	0.0259	mg/L
Potassium	K_7664	0.0594	mg/L
Selenium	Se1960	0.0244	mg/L
Selenium	Se2039	0.0565	mg/L

ENERGY LABORATORIES
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HELENA, MT
Toll Free: 877.472.0711 • 406.442.0711 • F: 406.442.0712
PO Box 5688, Helena, MT 59604-5688 • 3161 E. Lyndale Ave (59601)

2018 Dissolved Metals MDL (ICP)

Analyte	Channel	MDL	Units
Potassium	K_7698	0.3373	mg/L
Selenium	Se1960	0.0482	mg/L
Selenium	Se2039	0.0728	mg/L
Silicon	Si2516	0.0174	mg/L
Silicon	Si2881	0.0532	mg/L
Silver	Ag3280	0.0162	mg/L
Silver	Ag3382	0.0611	mg/L
Sodium	Na5895	0.0151	mg/L
Sodium	Na8183	0.8122	mg/L
Strontium	Sr3464	0.0185	mg/L
Strontium	Sr4077	0.0002	mg/L
Sulfur	S_1820	0.0149	mg/L
Tellurium	Te2142	0.1219	mg/L
Thallium	Tl1908	0.1156	mg/L
Tin	Sn1899	0.0370	mg/L
Titanium	Ti3349	0.0025	mg/L
Titanium	Ti3361	0.0034	mg/L
Uranium	U_3670	0.1664	mg/L
Uranium	U_3859	0.6207	mg/L
Vanadium	V_29240	0.0043	mg/L
Vanadium	V_3102	0.0058	mg/L
Zinc	Zn2062	0.0020	mg/L
Zinc	Zn2138	0.0029	mg/L
Zinc	Zn3345	0.3580	mg/L

2018 Total Metals MDL (ICP)

Analyte	Channel	MDL	Units
Silicon	Si2516	0.0375	mg/L
Silicon	Si2881	0.0364	mg/L
Silver	Ag3280	0.0184	mg/L
Silver	Ag3382	0.0609	mg/L
Sodium	Na5895	0.0330	mg/L
Sodium	Na8183	0.5936	mg/L
Strontium	Sr3464	0.0109	mg/L
Strontium	Sr4077	0.0002	mg/L
Sulfur	S_1820	0.0239	mg/L
Tellurium	Te2142	0.1348	mg/L
Thallium	Tl1908	0.1246	mg/L
Tin	Sn1899	0.0364	mg/L
Titanium	Ti3349	0.0025	mg/L
Titanium	Ti3361	0.0045	mg/L
Uranium	U_3670	0.3110	mg/L
Uranium	U_3859	0.5771	mg/L
Vanadium	V_29240	0.0054	mg/L
Vanadium	V_3102	0.0065	mg/L
Zinc	Zn2062	0.0032	mg/L
Zinc	Zn2138	0.0046	mg/L
Zinc	Zn3345	0.3914	mg/L

Energy Laboratories, Inc Helena
ICPMS EPA200.8 2018 MDLs
Reported in mg/L

Dissolved

Analyte	Channel	MDL
Aluminum	Al 27	**0.00327**
Antimony	Sb 121	**0.00009069**
Arsenic	As 75	**0.0000352**
Barium	Ba 137	**0.0000248**
Beryllium	Be 9	**0.000107**
Boron	B 11	**0.003175**
Cadmium	Cd 111	**0.00002766**
Calcium	Ca 40	**0.143**
Chromium	Cr 52	**0.0001882**
Cobalt	Co 59	**0.0000877**
Copper	Cu 63	**0.00014**
Iron	Fe 56	**0.00187**
Lead	Pb 208	**0.00002662**
Magnesium	Mg 24	**0.003694**
Manganese	Mn 55	**0.000288**
Mercury	Hg 201	**0.00000828**
Molybdenum	Mo 98	**0.00002472**
Nickel	Ni 60	**0.0002144**
Potassium	K 39	**0.00986**
Selenium	Se 78	**0.00001929**
Silicon	Si 28	**0.013**
Silver	Ag 107	**0.00002471**
Sodium	Na 23	**0.01366**
Strontium	Sr 88	**0.000112**
Thallium	Tl 205	**0.0000131**
Thorium	Th 232	**0.0000575**
Tin	Sn 118	**0.00002952**
Titanium	Ti 47	**0.0003481**
Uranium	U 238	**0.00001086**
Vanadium	V 51	**0.00006626**
Zinc	Zn 66	**0.000259**

Total

Analyte	Channel	MDL
Aluminum	Al 27	**0.002653**
Antimony	Sb 121	**0.000127**
Arsenic	As 75	**0.0000398**
Barium	Ba 137	**0.0000897**
Beryllium	Be 9	**0.00006077**
Boron	B 11	**0.001741**
Cadmium	Cd 111	**0.00002594**
Calcium	Ca 40	**0.3168**
Chromium	Cr 52	**0.000102**
Cobalt	Co 59	**0.0000572**
Copper	Cu 63	**0.0001718**
Iron	Fe 56	**0.00355**
Lead	Pb 208	**0.0000364**
Magnesium	Mg 24	**0.0115**
Manganese	Mn 55	**0.0002836**
Mercury	Hg 202	
Molybdenum	Mo 98	**0.00001825**
Nickel	Ni 60	**0.0001446**
Potassium	K 39	**0.01027**
Selenium	Se 78	**0.0000466**
Silicon	Si 28	**0.0068**
Silver	Ag 107	**0.00000869**
Sodium	Na 23	**0.0112**
Strontium	Sr 88	**0.0002757**
Thallium	Tl 205	**0.0000356**
Thorium	Th 232	**0.0000465**
Tin	Sn 118	**0.000254**
Titanium	Ti 47	**0.0003442**
Uranium	U 238	**0.00000919**
Vanadium	V 51	**0.00002398**
Zinc	Zn 66	**0.0012**

Energy Laboratories, Inc.
Determination of Method Detection Limits (MDL)
40 CFR, Part 136, AppendixB, Rev 2 (EPA 821-R-16-006)

Study Number: 1339

Analyst: Scott R. Wunderlich
Study Date: 03/30/2018
Study Type: Unknown

Instrument ID: PHSC_101-H
Matrix: Aqueous
Test Code: Not Recorded

Method: A2320 B
Zero Type: Unknown
Units: Not Recorded

Analyte	Analyte Data							
Alkalinity, Total as CaCO3	**MDL**	**Ver MDL**	**Rpt Limit**	**Source**	**Prv MDL**	**Rev2Cmpl**	**tValue**	**MBLK Used**
	2.00	MDLb	4	Verified	Unknown	Yes	N/A	Last 50
	Average	**Avg Rec**	**Stnd Dev**	**MDLs**	**MDLb**	**Conc**	**Prep Mthd**	
	1.846	MDLb	0.06294	N/A	N/A	MDLb		
	Analyte Comments:							
Bicarbonate as HCO3	**MDL**	**Ver MDL**	**Rpt Limit**	**Source**	**Prv MDL**	**Rev2Cmpl**	**tValue**	**MBLK Used**
	2.00	MDLb	4	Verified	Unknown	Yes	N/A	Last 50
	Average	**Avg Rec**	**Stnd Dev**	**MDLs**	**MDLb**	**Conc**	**Prep Mthd**	
	1.764	MDLb	0.07691	N/A	N/A	MDLb		
	Analyte Comments:							

Energy Laboratories, Inc.
Determination of Method Detection Limits (MDL)
40 CFR, Part 136, AppendixB, Rev 2 (EPA 821-R-16-006)

Study Number: 1310

Analyst: Cole Mergenthaler
Study Date: 03/14/2018
Study Type: Unknown

Instrument ID: FIA203-HE
Matrix: Aqueous
Test Code: Not Recorded

Method: E350.1
Zero Type: Unknown
Units: Not Recorded

Analyte	Analyte Data							
Nitrogen, Ammonia as N	**MDL**	**Ver MDL**	**Rpt Limit**	**Source**	**Prv MDL**	**Rev2Cmpl**	**tValue**	**MBLK Used**
	0.0200	MDLs	0.05	Verified	Unknown	Yes	N/A	Last 50
	Average	**Avg Rec**	**Stnd Dev**	**MDLs**	**MDLb**	**Conc**	**Prep Mthd**	
	0.02902	96.74	0.007755	N/A	N/A	0.03		
	Analyte Comments:							

Energy Laboratories, Inc.
Determination of Method Detection Limits (MDL)
40 CFR, Part 136, AppendixB, Rev 2 (EPA 821-R-16-006)

Study Number: 1336

Analyst: Scott R. Wunderlich **Study Date:** 03/30/2018 **Study Type:** Unknown

Instrument ID: IC Metrohm **Matrix:** Aqueous **Test Code:** Not Recorded

Method: E300.0 **Zero Type:** Unknown **Units:** Not Recorded

Analyte	Analyte Data							
Bromide	**MDL**	**Ver MDL**	**Rpt Limit**	**Source**	**Prv MDL**	**Rev2Cmpl**	**tValue**	**MBLK Used**
	0.00200	MDLs	0.5	Verified	Unknown	Yes	N/A	Last 50
	Average	**Avg Rec**	**Stnd Dev**	**MDLs**	**MDLb**	**Conc**	**Prep Mthd**	
	0.008375	67	0.0005175	N/A	N/A	0.0125		
	Analyte Comments:							
Chloride	**MDL**	**Ver MDL**	**Rpt Limit**	**Source**	**Prv MDL**	**Rev2Cmpl**	**tValue**	**MBLK Used**
	0.00900	MDLb	1	Verified	Unknown	Yes	N/A	Last 50
	Average	**Avg Rec**	**Stnd Dev**	**MDLs**	**MDLb**	**Conc**	**Prep Mthd**	
	0.002286	MDLb	0.002138	N/A	N/A	MDLb		
	Analyte Comments:							
Fluoride	**MDL**	**Ver MDL**	**Rpt Limit**	**Source**	**Prv MDL**	**Rev2Cmpl**	**tValue**	**MBLK Used**
	4.00E-10	MDLs	0.1	Verified	Unknown	Yes	N/A	Last 50
	Average	**Avg Rec**	**Stnd Dev**	**MDLs**	**MDLb**	**Conc**	**Prep Mthd**	
	0.009	72	1.245E-10	N/A	N/A	0.0125		
	Analyte Comments:							
	Using MDL from Testcode.							
Nitrogen, Nitrate as N	**MDL**	**Ver MDL**	**Rpt Limit**	**Source**	**Prv MDL**	**Rev2Cmpl**	**tValue**	**MBLK Used**
	0.00800	MDLs	0.125	Verified	Unknown	Yes	N/A	Last 50
	Average	**Avg Rec**	**Stnd Dev**	**MDLs**	**MDLb**	**Conc**	**Prep Mthd**	
	0.004625	37	0.002504	N/A	N/A	0.0125		
	Analyte Comments:							
Nitrogen, Nitrite as N	**MDL**	**Ver MDL**	**Rpt Limit**	**Source**	**Prv MDL**	**Rev2Cmpl**	**tValue**	**MBLK Used**
	0.00300	MDLs	0.05	Verified	Unknown	Yes	N/A	Last 50
	Average	**Avg Rec**	**Stnd Dev**	**MDLs**	**MDLb**	**Conc**	**Prep Mthd**	
	0.00125	25	0.001165	N/A	N/A	0.005		
	Analyte Comments:							

Energy Laboratories, Inc.
Determination of Method Detection Limits (MDL)
40 CFR, Part 136, AppendixB, Rev 2 (EPA 821-R-16-006)

Study Number: 1336

Analyst: Scott R. Wunderlich **Study Date:** 03/30/2018 **Study Type:** Unknown

Instrument ID: IC Metrohm **Matrix:** Aqueous **Test Code:** Not Recorded

Method: E300.0 **Zero Type:** Unknown **Units:** Not Recorded

Analyte	Analyte Data							
Phosphorus, Dissolved Orthophosphate as P	**MDL**	**Ver MDL**	**Rpt Limit**	**Source**	**Prv MDL**	**Rev2Cmpl**	**tValue**	**MBLK Used**
	0.0200	MDLb	0.25	Verified	Unknown	Yes	N/A	Last 50
	Average	**Avg Rec**	**Stnd Dev**	**MDLs**	**MDLb**	**Conc**	**Prep Mthd**	
	0.014	MDLb	0.001155	N/A	N/A	MDLb		
	Analyte Comments:							
Sulfate	**MDL**	**Ver MDL**	**Rpt Limit**	**Source**	**Prv MDL**	**Rev2Cmpl**	**tValue**	**MBLK Used**
	0.0100	MDLs	1	Verified	Unknown	Yes	N/A	Last 50
	Average	**Avg Rec**	**Stnd Dev**	**MDLs**	**MDLb**	**Conc**	**Prep Mthd**	
	0.066	66	0.00487	N/A	N/A	0.1		
	Analyte Comments:							

Energy Laboratories, Inc.
Determination of Method Detection Limits (MDL)
40 CFR, Part 136, AppendixB, Rev 2 (EPA 821-R-16-006)

Study Number: 5706

Analyst: Jason P. Van Cleave **Study Date:** 02/04/2019 **Study Type:** Initial

Instrument ID: SFA-201-B **Matrix:** Aqueous **Test Code:** CN-DIST-W-T

Method: E335.4 **Zero Type:** Numeric **Units:** mg/L

Analyte	Analyte Data							
Cyanide, Total	**MDL**	**Ver MDL**	**Rpt Limit**	**Source**	**Prv MDL**	**Rev2Cmpl**	**tValue**	**MBLK Used**
	0.00347	Previous	0.005	Previous	0.00347	Yes	3.143	Last 50
	Average	**Avg Rec**	**Stnd Dev**	**MDLs**	**MDLb**	**Conc**	**Prep Mthd**	
	0.001214	MDLb	0.0007707	0.00207	0.00364	MDLb	E335.4	
	Analyte Comments:							

Energy Laboratories, Inc.
Determination of Method Detection Limits (MDL)
40 CFR, Part 136, AppendixB, Rev 2 (EPA 821-R-16-006)

Study Number: 5621

Analyst: Mark A Spitzer
Study Date: 11/05/2018
Study Type: Initial

Instrument ID: SFA-201-B
Matrix: Aqueous
Test Code: Not Recorded

Method: Kelada-01
Zero Type: Numeric
Units: Not Recorded

Analyte	Analyte Data							
Cyanide, Total	**MDL**	**Ver MDL**	**Rpt Limit**	**Source**	**Prv MDL**	**Rev2Cmpl**	**tValue**	**MBLK Used**
	0.00244	MDLb	0.005	Verified	Unknown	Yes	N/A	Last 50
	Average	**Avg Rec**	**Stnd Dev**	**MDLs**	**MDLb**	**Conc**	**Prep Mthd**	
	0.0003286	MDLb	0.0006726	N/A	N/A	MDLb		
	Analyte Comments:							

Energy Laboratories, Inc.
Determination of Method Detection Limits (MDL)
40 CFR, Part 136, AppendixB, Rev 2 (EPA 821-R-16-006)

Study Number: 5661

Analyst: Jason P. Van Cleave **Study Date:** 01/16/2019 **Study Type:** On-Going

Instrument ID: SFA-201-B **Matrix:** Aqueous **Test Code:** CN-DIST-W-WAD

Method: D2036C **Zero Type:** Numeric **Units:** mg/L

Analyte	Analyte Data							
Cyanide, Weak Acid Dissociable	**MDL**	**Ver MDL**	**Rpt Limit**	**Source**	**Prv MDL**	**Rev2Cmpl**	**tValue**	**MBLK Used**
	0.00293	MDLb	0.005	Verified	0.00275	Yes	2.405	Last 50
	Average	**Avg Rec**	**Stnd Dev**	**MDLs**	**MDLb**	**Conc**	**Prep Mthd**	
	0.000683	MDLb	0.0009342	0.00160	0.00293	MDLb	D2036C	
	Analyte Comments:							

Energy Laboratories, Inc.
Determination of Method Detection Limits (MDL)
40 CFR, Part 136, AppendixB, Rev 2 (EPA 821-R-16-006)

Study Number: 5622

Analyst: Mark A Spitzer
Study Date: 11/07/2018
Study Type: Initial

Instrument ID: SFA-201-B
Matrix: Aqueous
Test Code: Not Recorded

Method: Kelada-01
Zero Type: Numeric
Units: Not Recorded

Analyte	Analyte Data							
Cyanide, Weak Acid Dissociable	**MDL**	**Ver MDL**	**Rpt Limit**	**Source**	**Prv MDL**	**Rev2Cmpl**	**tValue**	**MBLK Used**
	0.00365	MDLb	0.005	Verified	Unknown	Yes	N/A	Last 50
	Average	**Avg Rec**	**Stnd Dev**	**MDLs**	**MDLb**	**Conc**	**Prep Mthd**	
	0.0004	MDLb	0.001033	N/A	N/A	MDLb		
	Analyte Comments:							

Energy Laboratories, Inc.
Determination of Method Detection Limits (MDL)
40 CFR, Part 136, AppendixB, Rev 2 (EPA 821-R-16-006)

Study Number: 1137

Analyst: Scott R. Wunderlich
Study Date: 01/16/2018
Study Type: Unknown

Instrument ID: PHSC_101-H
Matrix: Aqueous
Test Code: Not Recorded

Method: A2510 B
Zero Type: Unknown
Units: Not Recorded

Analyte	Analyte Data							
Conductivity @ 25 C	**MDL**	**Ver MDL**	**Rpt Limit**	**Source**	**Prv MDL**	**Rev2Cmpl**	**tValue**	**MBLK Used**
	1.06	MDLs	1	Verified	Unknown	No	N/A	Last 50
	Average	**Avg Rec**	**Stnd Dev**	**MDLs**	**MDLb**	**Conc**	**Prep Mthd**	
	14.8	148	0.354562104171281	N/A	N/A			
	Analyte Comments:							

Energy Laboratories, Inc.
Determination of Method Detection Limits (MDL)
40 CFR, Part 136, AppendixB, Rev 2 (EPA 821-R-16-006)

Study Number: 1147

Analyst: Scott R. Wunderlich
Study Date: 01/22/2018
Study Type: Unknown

Instrument ID: Mantech 2
Matrix: Aqueous
Test Code: Not Recorded

Method: A4500-F C
Zero Type: Unknown
Units: Not Recorded

Analyte	Analyte Data							
Fluoride	**MDL**	**Ver MDL**	**Rpt Limit**	**Source**	**Prv MDL**	**Rev2Cmpl**	**tValue**	**MBLK Used**
	0.0107	MDLs	0.1	Verified	Unknown	No	N/A	Last 50
	Average	**Avg Rec**	**Stnd Dev**	**MDLs**	**MDLb**	**Conc**	**Prep Mthd**	
	0.057	95	0.003585685828003 25	N/A	N/A			
	Analyte Comments:							

Energy Laboratories, Inc.
Determination of Method Detection Limits (MDL)
40 CFR, Part 136, AppendixB, Rev 2 (EPA 821-R-16-006)

Study Number: 1355

Analyst: Dustin C. Kono
Study Date: 11/30/2018
Study Type: Initial

Instrument ID: HGCV202-H
Matrix: Aqueous
Test Code: Not Recorded

Method: E245.1
Zero Type: Numeric
Units: Not Recorded

Analyte	Analyte Data							
Mercury	**MDL**	**Ver MDL**	**Rpt Limit**	**Source**	**Prv MDL**	**Rev2Cmpl**	**tValue**	**MBLK Used**
	0.000909	MDLb	0.005	Verified	Unknown	Yes	N/A	Last 50
	Average	**Avg Rec**	**Stnd Dev**	**MDLs**	**MDLb**	**Conc**	**Prep Mthd**	
	9.625E-05	MDLb	0.0002711	N/A	N/A	MDLb	E245.1	
	Analyte Comments:							

Energy Laboratories, Inc.
Determination of Method Detection Limits (MDL)
40 CFR, Part 136, AppendixB, Rev 2 (EPA 821-R-16-006)

Study Number: 1324

Analyst: Cole Mergenthaler
Study Date: 03/27/2018
Study Type: Unknown

Instrument ID: FIA203-HE
Matrix: Aqueous
Test Code: Not Recorded

Method: E353.2
Zero Type: Unknown
Units: Not Recorded

Analyte	Analyte Data							
Nitrogen, Nitrate+Nitrite as N	**MDL**	**Ver MDL**	**Rpt Limit**	**Source**	**Prv MDL**	**Rev2Cmpl**	**tValue**	**MBLK Used**
	0.00900	MDLb	0.01	Verified	Unknown	Yes	N/A	Last 50
	Average	**Avg Rec**	**Stnd Dev**	**MDLs**	**MDLb**	**Conc**	**Prep Mthd**	
	-0.006874	MDLb	0.002909	N/A	N/A	MDLb		
	Analyte Comments:							

Energy Laboratories, Inc.
Determination of Method Detection Limits (MDL)
40 CFR, Part 136, AppendixB, Rev 2 (EPA 821-R-16-006)

Study Number: 1337

Analyst: Scott R. Wunderlich
Study Date: 03/30/2018
Study Type: Unknown

Instrument ID: Accu-124 (14410200)
Matrix: Aqueous
Test Code: Not Recorded

Method: A2540 C
Zero Type: Unknown
Units: Not Recorded

Analyte	Analyte Data							
Solids, Total Dissolved TDS @ 180 C	**MDL**	**Ver MDL**	**Rpt Limit**	**Source**	**Prv MDL**	**Rev2Cmpl**	**tValue**	**MBLK Used**
	10.0	MDLb	10	Verified	Unknown	Yes	N/A	Last 50
	Average	**Avg Rec**	**Stnd Dev**	**MDLs**	**MDLb**	**Conc**	**Prep Mthd**	
	2.571	MDLb	2.573	N/A	N/A	MDLb		
	Analyte Comments:							

Energy Laboratories, Inc.
Determination of Method Detection Limits (MDL)
40 CFR, Part 136, AppendixB, Rev 2 (EPA 821-R-16-006)

Study Number: 1354

Analyst: Kristine M. Devault
Study Date: 11/11/2018
Study Type: Initial

Instrument ID: FIA202-HE
Matrix: Aqueous
Test Code: Not Recorded

Method: E351.2
Zero Type: Numeric
Units: Not Recorded

Analyte	Analyte Data							
Nitrogen, Kjeldahl, Total as N	**MDL**	**Ver MDL**	**Rpt Limit**	**Source**	**Prv MDL**	**Rev2Cmpl**	**tValue**	**MBLK Used**
	0.126	MDLb	0.5	Verified	Unknown	Yes	N/A	Last 50
	Average	**Avg Rec**	**Stnd Dev**	**MDLs**	**MDLb**	**Conc**	**Prep Mthd**	
	0.005273	MDLb	0.03831	N/A	N/A	MDLb	A4500 N-C	
	Analyte Comments:							

Energy Laboratories, Inc.
Determination of Method Detection Limits (MDL)
40 CFR, Part 136, AppendixB, Rev 2 (EPA 821-R-16-006)

Study Number: 1338

Analyst: Scott R. Wunderlich
Study Date: 03/30/2018
Study Type: Unknown

Instrument ID: Accu-124 (14410200)
Matrix: Aqueous
Test Code: Not Recorded

Method: A2540 D
Zero Type: Unknown
Units: Not Recorded

Analyte	Analyte Data							
Solids, Total Suspended TSS @ 105 C	**MDL**	**Ver MDL**	**Rpt Limit**	**Source**	**Prv MDL**	**Rev2Cmpl**	**tValue**	**MBLK Used**
	0.300	MDLb	10	Verified	Unknown	Yes	N/A	Last 50
	Average	**Avg Rec**	**Stnd Dev**	**MDLs**	**MDLb**	**Conc**	**Prep Mthd**	
	-0.2	MDLb	0.08165	N/A	N/A	MDLb		
	Analyte Comments:							

Energy Laboratories, Inc.
Determination of Method Detection Limits (MDL)
40 CFR, Part 136, AppendixB, Rev 2 (EPA 821-R-16-006)

Study Number: 1334

Analyst: Scott R. Wunderlich
Study Date: 03/30/2018
Study Type: Unknown

Instrument ID: HACH 2100P
Matrix: Aqueous
Test Code: Not Recorded

Method: A2130 B
Zero Type: Unknown
Units: Not Recorded

Analyte	Analyte Data							
Turbidity	**MDL**	**Ver MDL**	**Rpt Limit**	**Source**	**Prv MDL**	**Rev2Cmpl**	**tValue**	**MBLK Used**
	0.200	MDLb	0.2	Verified	Unknown	Yes	N/A	Last 50
	Average	**Avg Rec**	**Stnd Dev**	**MDLs**	**MDLb**	**Conc**	**Prep Mthd**	
	0.1229	MDLb	0.01113	N/A	N/A	MDLb		
	Analyte Comments:							

Pollen Environmental, LLC
3536 International Street
Fairbanks, AK 99701
907-479-8368

Analyst	Jerry Pollen		
Analyte	Nitrate	Verified MDL	0.131
Method	Hach TNT 10206	(greater of MDLspiked and MDLblank)	
Instrument	Harch DR3900	Background Check	FAIL
Spike Concentration	0.50		
Units	mg/L		
Date Range	8/23/2018		
EXISTING MDL	0.1	Change Existing MDL?	no

Replicate 1	0.57	Mean	0.57
Replicate 2	0.57	Std. Dev.	0.020
Replicate 3	0.59	MDLspiked	0.060
Replicate 4	0.60	LOQ	0.200
Replicate 5	0.55		
Replicate 6	0.54		
Replicate 7	0.56	High Spike Check	Pass
Replicate 8	0.58	Low Spike Check	Pass
Replicate 9		S/N	28.500
Replicate 10		S/N ratio should be between 2.5 to 10.	
Replicate 11			
Replicate 12			
Replicate 13		number of reps	8
Replicate 14		t-value used	2.998
Replicate 15			
Replicate 16			
Replicate 17			
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Pollen Environmental, LLC
3536 International Street
Fairbanks, AK 99701
907-479-8368

Analyst	Jerry Pollen
Analyte	Nitrate
Method	Hach TNT 10206
Instrument	Harch DR3900
Spike Con.	0
Units	mg/L
Date Range	1/26/18 - 6/6/18

Blank 1	0.07	Mean	0.09
Blank 2	0.09	Std. Dev.	0.013
Blank 3	0.1	MDL	0.131
Blank 4	0.11		
Blank 5	0.1		
Blank 6	0.08		
Blank 7	0.09		
Blank 8	0.1		
Blank 9		number of blanks	8
Blank 10		t-value used	2.998
Blank 11			
Blank 12			
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Blank 14			
Blank 15			
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Number of replicates	Degrees of freedom (n-1)	t (n-1, 0.99)
7	6	3.143
8	7	2.998
9	8	2.896
10	9	2.821
11	10	2.764
16	15	2.602
21	20	2.528
26	25	2.485
31	30	2.457
32	31	2.453
48	47	2.408
50	49	2.405
61	60	2.390
64	63	2.387
80	79	2.374
96	95	2.366
100	99	2.365

APPENDIX G –

ELECTRONIC MONITORING DATA

[SUBMITTED ELECTRONICALLY VIA ALASKA ZENDTO (STATE OF ALASKA)]

2018 MONITORING DATA
2018 QUALIFIED DATA
ALL HISTORIC DATA