Capstone MINTO MINE

Minto Mine

Water Licence QZ14-031

Quartz Mining Licence QML-0001

2016 Annual Report

Prepared by:
Minto Explorations Ltd.
Minto Mine

March 2017

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List of Acronyms

Acronym	Definition
ABA	Acid-Base Accounting
AMP	Adaptive Management Plan
AMMP	Adaptive Monitoring and Management Plan
AP	Acid Potential
CWTS	Constructed Wetland Treatment System
DSTSF	Dry Stack Tailings Storage Facility
EEM	Environmental Effects Monitoring
EMSRP	Environmental Monitoring, Surveillance and Reporting Plan
GCL	Geosynthetic Clay Liner
GPS	Global Positioning System
HDPE	High Density Polyethylene
LTF	Land Treatment Facility
MCDS	Minto Creek Detention Structure
Minto	Minto Explorations Ltd.
MMER	Metal Mining Effluent Regulations
MPTMF	Main Pit Tailings Management Facility
MVF	Mill Valley Fill
MVFE	Mill Valley Fill Extension
MWD	Main Waste Dump
NP	Neutralizing Potential
NPR	Neutralizing Potential Ratio

QA/QC	Quality Assurance and Quality Control
QML	Quartz Mining Licence QZ-0001
ROD	Reclamation Overburden Dump
SAT	Waste material destined for subaqueous long term storage
SECP	Sediment and Erosion Control Plan
SDD	South Diversion Ditch
SMP	Seepage Monitoring Plan
SOP	Standard Operating Procedure
SWD	Southwest Dump
TDD	Tailings Diversion Ditch
TDS	Total dissolved solids
TSS	Total suspended solids
UG	Underground
UTM	Universal Transverse Mercator
WGS 84	World Geodetic System 1984
WSP	Water Storage Pond
WUL	Water Use Licence QZ14-031
YWB	Yukon Water Board

List of Units

Unit	Definition
BCM	Bank cubic meter
BTU	British Thermal Unit
dmt	Dry metric tonnes
g/t	Gram per tonne
kg	kilogram
L	Litre
m	meter
m^2	Square meter
m^3	Cubic meter
mg/m^2	Milligrams per square meter
Mlb	Million pounds
Mt	Million tonnes
oz	ounce
V	Volt

1 Introduction

This Annual Report has been prepared by Minto Explorations Ltd. (Minto) for the 2016 calendar year, as required by Type A Water Use Licence (WUL) QZ14-031 and Quartz Mining Licence (QML) QML-0001. Specific requirements for the Annual Report, as outlined in the respective licences, are summarized in Table 1-1.

This report provides a summary of activities at Minto Mine for the reporting year, including production summaries, environmental monitoring studies, physical stability monitoring, progressive reclamation, water management and construction activities.

An aerial photo taken in September 2014, with updated site infrastructure labeled, is presented in Figure 1-1. For comparison, the preceding year's aerial photo is shown in Figure 1-2.

Table 1-1: Reporting Requirements as per WUL and QML (2016)

Licence	Section	Clause	Requirement	Annual Report Section
WUL QZ14-031				
WUL QZ14-031	16		Summary of the review of the *Spill Contingency Plan* including any changes needed.	2.5.4 App. B
WUL QZ14-031	18		Summary list of all spills for 2016.	2.5.3
WUL QZ14-031	25		The Licensee shall submit Annual Reports to the Board no later than March 31 of the year following the reporting period. The reporting period is January 1 to December 31 of each year.	All
WUL QZ14-031	26	a	Summary of all data collected as per the EMSRP, including analysis and interpretation by a qualified party and a discussion of any variances from baseline conditions, from previous years' data, and from expected performance.	5-8, 11-14
		b	Summary of actions as per the Operations Adaptive Management Plan, including analysis and interpretation by a qualified party and a discussion of any variances from baseline conditions, from previous years' data, and from expected performance.	10
		c	A record of any major maintenance carried out on any physical works.	2.2
		d	Detailed data on the volume of water used during the year including water withdrawal from each water source, water routed around and through the site as part of the water conveyance system, water diverted around the site, water routed for storage in the pits, water deposited with mine wastes in waste storage facilities, water routed to the Water Storage Pond, water routed to the treatment plant and water discharged to Minto Creek.	8

Licence	Section	Clause	Requirement	Annual Report Section
WUL QZ14-031		e	Detailed data on tailings deposition in each of the tailings management facilities, including volume and tonnage of tailings slurry deposited, cumulative volume of tailings solids stored in the pits, tailings solids surface elevation and pit water elevation.	2.3.3 2.3.4
		f	Details of updates to the Water Balance and Water Quality Model.	App. F
		g	Results and interpretations of the QA/QC Program.	5.12-5.14
		h	Any other reports that are required to be submitted as part of the Annual Report by this Licence.	Below
WUL QZ14-031	70		The Licensee shall monitor, sample. and report on the maintenance and performance of the Mill Water Pond, in accordance with the procedures that are detailed in the Physical Monitoring Program, and include in the Annual Report	9
WUL QZ14-031	86		The Licensee shall include data relating to the Surface Water Surveillance Program in the Monthly and Annual Reports.	5.3
WUL QZ14-031	89		The results of these studies and programs in clauses 87 and 88 shall be submitted to the Board as part of the Annual Report along with and any additional studies or revisions to studies required under the MMER.	11
WUL QZ14-031	93		The results of the seepage program shall be compared to the source terms used in the Water Balance and Water Quality Model Report and summarized in the Annual Report.	7 App. F
WUL QZ14-031	95		The Licensee shall implement the updated Geochemical Monitoring Program, including the Waste Rock Verification Program, and the results from this program are to be included in the Annual Report.	13
WUL QZ14-031	97	h	Reporting of all data obtained using physical monitoring instrumentation as a part of the Physical Monitoring Program in Monthly and Annual Reports.	9
WUL QZ14-031	98		The Physical Monitoring Program shall be updated annually to reflect the installation of new instrumentation, replacement of damaged instrumentation, and changes in monitoring methods and procedures. The updated Physical Monitoring Program shall be provided as part of the Annual Report, along with a summary table outlining revisions to the plan from previous versions.	9 App. I
	99	b	The Licensee shall submit these Geotechnical Engineer's Inspection and Data Reviews as part of the Annual Report.	9

Licence	Section	Clause	Requirement	Annual Report Section
WUL QZ14-031	100	f	For each operating year, the following information shall be provided as part of the Annual Report for the Physical Monitoring Program: i. interpretation of physical monitoring data, and summary of the stability, integrity and status of all of the inspected structures, works, and installations inspected by the Professional Engineer; ii. a list of each of the Professional Engineer's recommendations for remedial action; iii. an explanation of how and when each recommendation was addressed, including supporting documentation, and iv. a list of outstanding recommendations (including previous inspection reports) and associated approach and timelines to address them.	9.2 9.2 Table 9-1 Table 9-1
WUL QZ14-031	102		The Licensee shall review and evaluate the Aquatic Environmental Monitoring Program design every three (3) years and submit the findings to the Board, along with any recommendations for further refinements, as part of the Annual Report, starting in 2016.	11.4 App. L App. O
WUL QZ14-031	104		Results and interpretations of the QA/QC program shall be provided in the Annual Report.	5.1.2
WUL QZ14-031	108	a	The Licensee shall submit an updated Water Balance and Water Quality Model as part of the Annual Report. The updated models shall include without limitation all model assumptions.	App. F
		b	Updated site data collected as per the EMSRP including: i. water quality results and water levels from all groundwater monitoring wells; ii. the most current climatic, environmental and operational conditions and data; iii. surface water quality and quantity data; iv. seepage monitoring quality and quantity data, and v. geochemical source terms from tailings and waste rock.	6 12 5.3 7 13
		c	A comparison of the updated geochemistry for Phase V/VI tailings and waste rock with that of previously-produced tailings and waste rock, and a comparison of model source term chemistry with equivalent operation monitoring results.	13 App. Q App. F
		d	Updated predictions for operations and Permanent Closure water quality, including discussion of any variances identified and associated implications on site water management.	App. F
WUL QZ14-031	109		Specifications for the Annual Report to include but not be limited to: i. activities undertaken in relation to the Adaptive Management Plan; ii. trend analysis and water levels in Minto and McGinty creeks; iii. proposed updates and revisions to the Adaptive Management Plan, and iv. any other revisions necessary to comply with the conditions of this Licence.	10 8.5 10 Through out
WUL QZ14-031	114	a	Annual reporting on reclamation research activities.	16.3

Licence	Section	Clause	Requirement	Annual Report Section
QML-0001				
QML-0001	13.5		On or before March 31 of each year of the term of this License, the Licensee must submit an annual report, in writing, containing the information set out in Schedule D, covering the period of January 1 to December 31 of the prior year	This Report
QML-0001	D (Site Activities)	a	Summary of construction activities associated with the Undertaking	2.2
		b	Summary of mining activities	2.3
		c	Map showing the status of all structures, works, and installations associated with the Undertaking	Fig 1-1
		d	total amount of ore and waste removed from the underground workings and open pits for the year and for the life of the Undertaking	2.3
		e	Total amount and the average head grade of ore milled	2.3
		f	Total amount of concentrate produced and removed from the Undertaking	2.3.7
		g	Total amount of tailings deposited in each of the tailings facilities	2.3
		h	Total amount of waste rock removed from the mine and the amount deposited into each deposit location	2.3.3
		i	Total amount of waste rock stored in each waste rock storage facility;	2.3.3
		j	Details respecting any action taken as a result of the recommendations made by the engineer in relation to the inspection referred to in 13.2 of QML -0001	9.2
		k	Summary of any updates to estimates of ore reserves and the life of the mine, including reserve category, tonnage and grade	4
		l	Total amount and the average grade of each ore stockpiled	2.3.5
		m	remaining reserve life of the mine	4
QML-0001	D (As-built Drawings)	a	as-built drawings of the open pit and underground mines and of all engineered structures, works, and installations constructed or altered at the Undertaking during the year	2.2
		b	as-built drawing report of the 220 kW vertical stirred mill rougher/scavenger concentrate regrinding system the year following the installation	N/A
QML-0001	D (Environmental Monitoring)	a	Summary of the programs undertaken for environmental monitoring and surveillance as outlined in the *Environmental Monitoring, Surveillance and Reporting Plan* and the 2014 Wildlife Protection Plan, including an analysis of these data and any action taken or adaptive management strategies implemented to monitor or address any changes in environmental performance	5-9 11-14 10
		b	any update to the *Site Characterization Report* referred to in 13.1of QML-0001	15

Licence	Section	Clause	Requirement	Annual Report Section
		c	summary of invasive plants that have been identified on site and measures taken to control or remove invasive plants	14.3
		d	summary of spills and accidents that occurred at the site and measures taken respond to any spills or accidents	2.5
		e	summary of the level of traffic, access control issues, wildlife incidents and other accidents, and any upgrade or maintenance work planned for the upcoming year	2.4
QML-0001		f	summary of any site improvements undertaken to address sediment and erosion control	14.2
QML-0001	D	a	summary of any underground stability incidents	2.3.2
	(Physical Monitoring)	b	summary of data collected to date as part of the Physical Monitoring Program	9
		c	details of results, including data collected, for the physical monitoring program	9
QML-0001	D (Reclamation and Closure)	a	any temporary closure or permanent closure that has occurred during the year	16
		b	summary of activities related to care and maintenance of the Undertaking, including any temporary closure activities if applicable	16
		c	summary of progressive and ongoing reclamation activities	16
		d	summary of proposed development and production and reclamation activities for the coming year	16.4
		e	summary of reclamation research and results	16.3
QML-0001	D (Socio-Economic Monitoring)	a	summary of action taken by the Licensee with respect to implementation of "Minto Socio-Economic Monitoring Program Framework" (the "Framework')	17 App. U
		b	a copy of the annual report prepared by Minto Explorations Ltd., identified in paragraph 6.1 of the Framework	App. U
		c	a summary of action taken by the Licensee with respect to implementing an approved socio-economic adjustment measures plan, as identified in the Framework	App. U

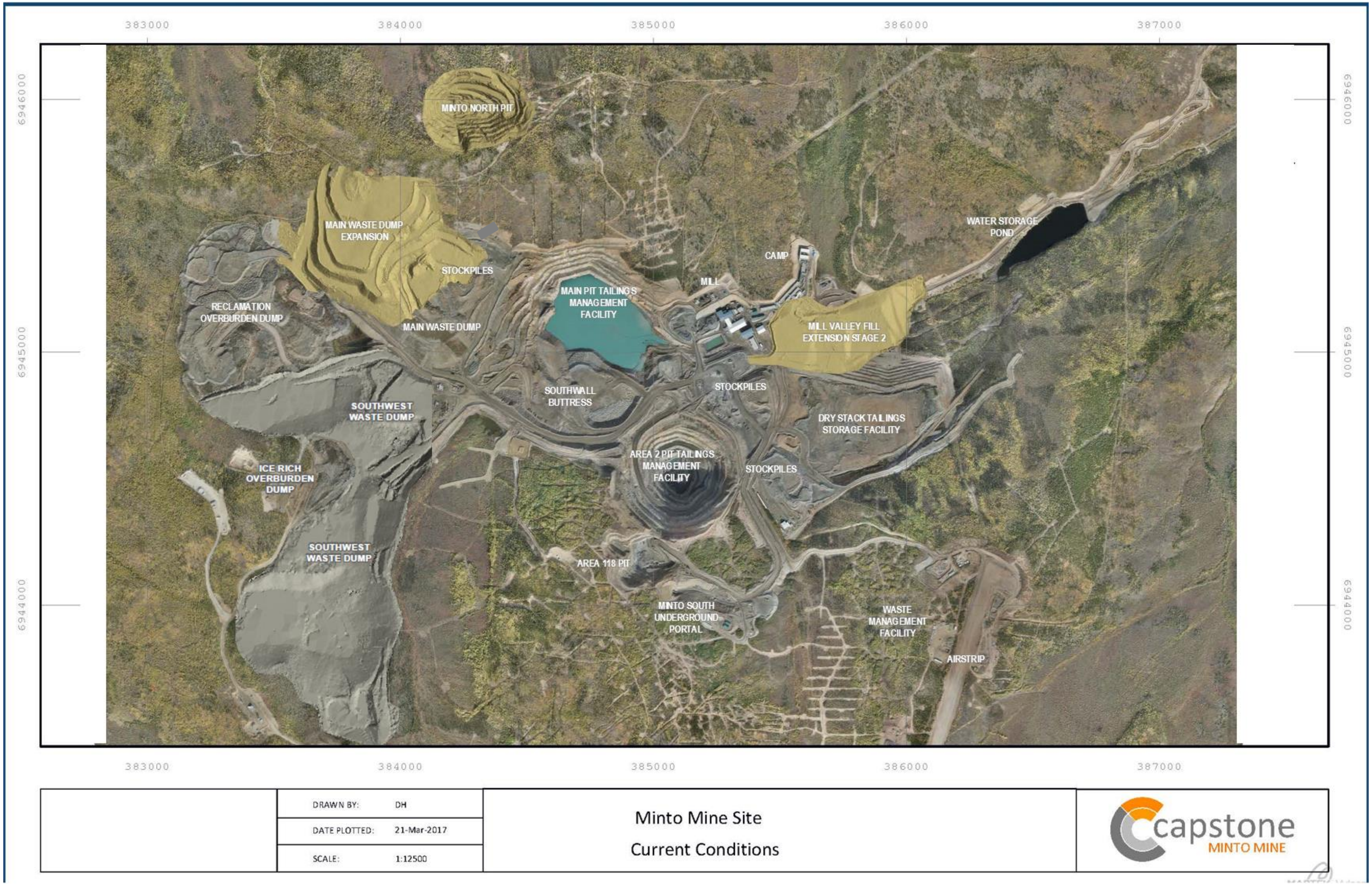


Figure 1-1: Site Layout (2016)

Figure 1-2: Site Layout (2015)

2 Site Activities

Operation of the Minto Mine continued in 2016, with the production of 69.3 million pounds (Mlb) of copper from the milling of 1.49 million tonnes (Mt) of ore.

Surface mining for the year totaled 2.69 M bank cubic meters (BCM). All surface mining was in the Minto North pit, which was completed in September 2016.

Underground mining of the Area 118 zone was completed in April 2016 and transitioned to the Area 2 zone for the remainder of the year. Both zones are in the Minto South Underground.

Waste rock produced from mining activities was hauled to either the Mill Valley Fill Extension Stage 2, Main Waste Dump Expansion, or the Main Pit Tailings Management Facility as per the Waste Rock and Overburden Management Plan. Milling was a combination of run-of-mine ore from both surface and underground operations, as well as ore stockpiled from previous mining.

Tailings produced from the milling process were deposited into the Area 2 Pit Tailings Management Facility as per the licensed Tailings Management Plan.

2.1 Exploration

Although no exploration drilling occurred at Minto in 2016, a total of 1,269 meters were drilled in eighteen holes in May and June for infill drilling with the intent of upgrading probable reserves to proven reserves and to provide geological confidence for the optimization of the mine design in the Area 2 underground. These totals include 1,143 meters of infill drilling in fifteen underground holes and two surface set-ups at Area 2 and 126 meters by a single hole at Minto North. The target at Area 2 was the mineralized upper and lower ore lenses currently under production, with two holes being drilled in the former and fifteen in the latter. Drilling at Minto North tested for mineralization at the very western extent of the Minto North Pit.

2.2 Maintenance, Infrastructure and Construction Projects

There were no major maintenance activities conducted in 2016 on the physical works. Two construction projects were completed in 2016, the Mill Valley Fill Extension Stage 2 and decommissioning of the Mill Pond. The following are summaries of the projects.

2.2.1 Mill Valley Fill Extension Stage 2

Construction of the Mill Valley Fill Extension Stage 2 (MVFE2) took place from October, 2015 to August, 2016. The MVFE2 was constructed as an extension to the original Mill Valley Fill Extension (MVFE1), completed in 2013. The original structure and the extension were created to buttress the Dry Stack Tailings Storage Facility (DSTSF), which has shown slow movement in the warm permafrost foundation since construction was completed.

As part of the MVFE2 construction, the Minto Creek Detention Structure (MCDS) was replaced with a new sump, the Mill Valley Fill Extension Stage 2 collection sump, further down valley at the toe of the MVFE2. The sump was constructed from November, 2015 to February, 2016.

As-built construction reports were submitted to the Yukon Water Board (YWB) and Energy Mines and Resources branch of the Yukon Government (EMR) in April, 2016 for the collection sump, and November, 2016 for the MVFE2.

2.2.2 Mill Pond Decommissioning

The mill pond, originally constructed in 2006 as the source of mill water feed, was decommissioned in April/May 2016. Mill water feed now comes directly from the Main Pit so the Mill Pond became obsolete. As part of decommissioning, the pond was emptied, slimes were removed, and the liner was removed. The pond was then backfilled to increase the area available around the mill stockpiles.

An as-built construction report was submitted to the EMR and the YWB in December, 2016.

2.3 Mining Activities

Section 2.3 discusses the mining activities for 2016 including open pit and underground mining, waste rock and tailings management, ore stockpiles, operating results, and concentrate shipments.

2.3.1 Open Pit Mining

In August 2015, mining operations in Minto North pit commenced. Mining in Minto North continued until October 1st 2016, releasing 4,022,000 BCM of waste rock and 630,000 BCM of ore over the life of the pit.

2016 total mined waste and ore quantities are summarized in Table 2-1, below.

Table 2-1: Open Pit Mined Quantities: Mining Waste Volume and Ore Volume (2016)

	Waste / Overburden (BCM)	Ore (BCM)	Ore (t)
Minto North Pit	2,139,423	550,168	1,505,650
Total	**2,139,423**	**550,168**	**1,505,650**

2.3.2 Underground Mining

Mining activities in the Minto South Underground continued throughout 2016. The Area 118 zone was completed in April. Development of an access to the Area 2 zone began in March, the ramp first intersected ore in May, and the first production blast was taken in July. See Appendix A for the underground development map. There were no underground stability incidents observed in 2016.

Total production for the year was 246,000 tonnes of ore and 99,000 tonnes of waste rock.

2.3.3 Waste Rock Management

Waste rock dump development continued in 2016, as per the *Minto Mine Waste Rock and Overburden Management Plan*. Table 2-2 summarizes the waste materials and ultimate destinations, and the volumes deposited. Current waste rock inventory in the various waste rock and overburden dumps at the Minto Mine site are summarized in Table 2-3.

Table 2-2: Waste Destination and Volumes – Unreconciled truck counts (2016)

Material Type	Destination	BCM
Waste - Construction Grade	Roads/Ramps	19,000
Waste - Mixed	Mill Valley Fill Extension 2	947,000
Waste - Mixed	Main Waste Dump Expansion	1,147,000
Waste - Mixed	Mill Pond Stockpile	55,000
Waste - Mixed	Rip Rap Pad	34,000
Waste Rock - SAT	Main Pit Buttress	96,000
Total		**2,298,000**

** "Waste – Mixed" does not contain SAT waste.*

Table 2-3: Waste Dump Location and Storage Volumes (2016)

Dump Location	Quantity Stored as of December 31, 2016 (m^3)
Main Pit Buttress	4,200,000
Southwest Dump	12,120,000
Mill Valley Fill Extension	1,440,000
Reclamation Overburden Dump	4,300,000
Main Waste Dump	8,170,000
Main Waste Dump Expansion	3,600,000
Mill Valley Fill Extension 2	1,360,000
Total Waste Dumped	35,190,000

2.3.4 Tailings Management

All tailings produced in 2016 were deposited in the Area 2 Pit Tailings Management Facility (A2PTMF). The following table lists the deposition schedule.

Table 2-4: Tailings Deposition Schedule in 2016

Tailings Management Facility	Date Range	Quantity Deposited (dry metric tonnes)
A2PTMF	January 1 – December 31	1,420,426
Total 2016 Tailings		**1,420,426**

A total of 1,420,426 dry metric tonnes (dmt) of tailings were discharged to the A2PTMF in 2016. Since November 2012, the Main Pit has received 3,347,000 tonnes of tailings. Since March 2015, the Area 2 Pit has received 2,354,000 tonnes of tailings.

Deposition to the A2PTMF is from a point at the northeast corner of the pit. A line runs from the pit crest at 808m elevation to a point on the highwall at the 777m elevation, past the overburden contact: this ensures that the tailings stream runs down solid rock and does not cause erosion. As of year-end, the tailings and water elevation in the pit was 756.0m.

Deposition in the MPTMF is possible from two locations, near the middle of the pit via a floating tailings line and near the north wall of the pit. The highest point of the tailings beach is at 787.5m elevation. At year-end, the water level was measured at 784.7 m.

Prior to the 2015 freshet season, Minto installed a pipeline and pump system to transfer water from the MPTMF to the A2PTMF. In summer 2015, a pipeline and pump were installed to transfer water from A2PTMF to MPTMF, capable of moving approximately 5,000 m^3/day. This allows supernatant water from the Area 2 pit to be returned to the Main pit, where the mill's process water intake is located.

As in previous years, tailings were not observed to remain ponded on the ice surface of either tailings management facility during the winter months. The relatively high tailings temperature, combined with the erosive effect of the tailings stream, melts through the ice at the discharge point.

As per the *Tailings Management Plan*, annual bathymetric surveys of the pits were completed in October 2016. The settled density of the tailings deposited in the MPTMF was 1.35 t/m^3 (dry density), and 1.33 t/m^3 in the A2PTMF.

Minto's filter press plant, previously used to prepare tailings for deposition to the Dry Stack Tailings Storage Facility (DSTSF), has been deactivated and did not operate in 2016. While the filtration equipment is still in place, a substantial portion of the building's electrical supply has been re-routed to the Minto South Portal. One of the facility's four air compressors was installed underground to provide compressed air for drilling operations.

2.3.5 Ore Stockpiles

Minto currently maintains six stockpiles, which are listed below and shown in Figure 2-1.

- Mill Pond stockpile – crushed ore stockpiles of various grade bins depending on the needs of the Mill.
- North stockpile – setup location for Minto's secondary crushing contractor. Short term storage location of all ore grades for imminent crushing.
- West stockpile – sulfide ore grading 1.0% - 2.0% Cu.
- East stockpile – sulfide ore grading 0.5% - 1.0% Cu.
- South stockpile – empty at end of 2016.
- Oxide stockpile – partially oxidized ore from the Main Pit.

In addition to the above, which are used for temporary storage of ore, Minto maintains a live pile of crushed ore, and a portal ore pad for short-term storage of ore trucked out of the Minto South Underground.

In order to provide predictable head grades to the mill and maximize revenue, Minto segregates ore into six categories, as defined below, with the stored quantities summarized in Table 2-5.

- Red: sulfide ore grading > 4.0% Cu.
- Yellow: sulfide ore grading 2.0 to 4.0% Cu.
- Green: sulfide ore grading 1.0% to 2.0% Cu.
- Blue: sulfide ore grading 0.50% to 1.0% Cu.
- POX: partially oxidized ore grading > 1.0% Cu.
- LGPOX: partially oxidized ore grading 0.50% to 1.0% Cu.

Table 2-5: Stockpile Inventory

	December 31, 2015			December 31, 2016		
	Mass (tonnes)	Cu (%)	Ag (g/t)	Mass (tonnes)	Cu (%)	Ag (g/t)
Red	0	-	-	33,235	5.54	24.27
Yellow	0	-	-	30,427	2.76	12.36
Green	41,839	1.24	4.50	71,477	1.44	6.28
Blue	92,121	0.68	2.32	245,851	0.73	2.76
POX	94,439	0.95	2.38	0	-	-
LG POX				56,809	0.91	2.24
Portal Ore Pad	24,364	2.22	8.35	29,259	1.58	7.81
Live Pile	22,660	1.13	4.18	22,230	2.07	8.63
Total Ore	**275,423**	**1.03**	**3.36**	**489,287**	**1.42**	**5.84**

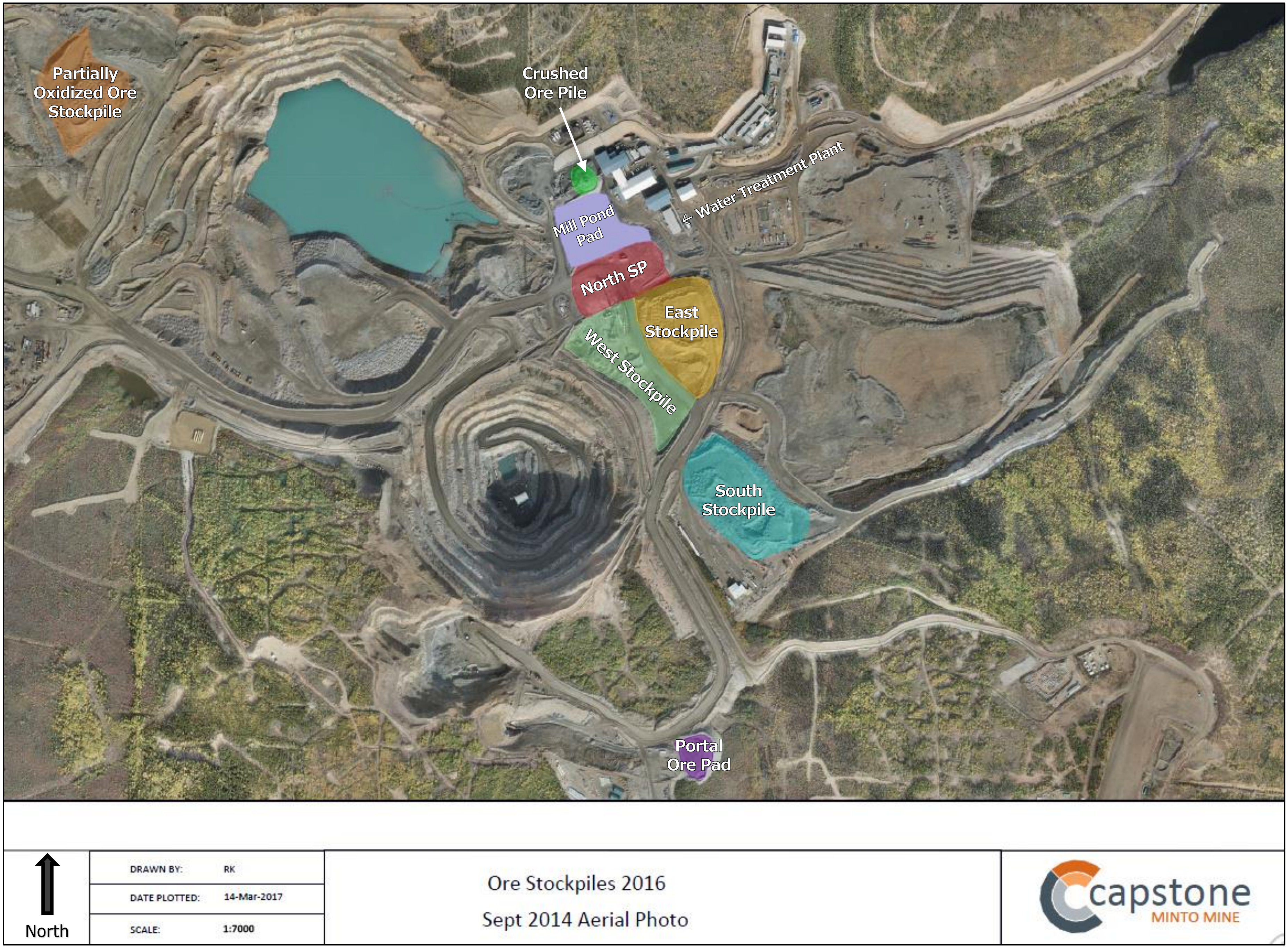


Figure 2-1: Minto Ore Stockpiles (2016)

2.3.6 Operating Results

Ore processing and metal production results for the 2016 calendar year are summarized in Table 2-6, below.

Table 2-6: Operating Results (2016)

Metal Production	Quantity
Copper (t)	31,425.5
Gold (kg)	1,588.31
Silver (kg)	11,091.6
Ore Milled	
Ore processed (t)	1,491,266
Copper grade (%)	2.21
Gold grade (g/t)	1.23
Silver grade (g/t)	8.43
Recoveries	
Copper (%)	95.2
Gold (%)	67
Silver (%)	87.8
Concentrates Produced	
Copper concentrate (dmt)	70,345.85
Copper (%)	44.7
Gold (g/t)	17.47
Silver (g/t)	157.05

2.3.7 Concentrate Shipments

Minto produced 77,252.2 wet metric tonnes of concentrate at 8.94% moisture content, which corresponds to 70,345.85 dmt. The average concentrate grades are listed in Table 2-6, above. 2,045 truckloads of concentrate were shipped from Minto in 2016: 584 via the winter ice bridge and 1,461 during the summer barge season.

2.4 Mine Access Road

2.4.1 Traffic

From January 7 to March 31st 2016, access across the Yukon River was over an ice bridge during which time, 1,522 heavy vehicles and 609 light vehicles travelled across the ice bridge. Between April 1st and June 3rd, 2016 there was no land access to the mine site. On June 3rd, 2016 the summer tug and barge operation started for the season. During the barge operating season, heavy trucks made 1844 round trips and light vehicles made 611 round trips to the Minto Mine via the mine access road. The barge operating season ended November 8, 2016. Establishment of the 2017 ice bridge started in December 2016.

2.4.2 Access Control Issues

No access control issues were experienced in 2016.

2.4.3 Planned Access Road Maintenance for 2017

Beyond routine maintenance work, no major projects or upgrades are planned for 2017 with regard to the access road.

2.5 Accidents and Incidents

2.5.1 Incidents

In 2016, Minto Mine experienced, one loss time accidents, five medical aids and three serious incidents reported to the Yukon Workers Compensation Health and Safety Board for the reporting period. In order to respond to incidents on site, Minto maintains a current Emergency Response Plan supported by a complement of emergency response personnel trained and certified in advanced first aid, firefighting and mine rescue along with equipment required for all response types. In addition, reporting and investigation of incidents is standard practice at the site.

2.5.2 Wildlife Incidents

The Conservation Officer was made aware of two events at Minto in 2016. The first incident was a fox that was discovered on the access road and appeared to have been run over by a vehicle on November 7, 2016. The second communication with the Conservation Officer was due to a deer-vehicle interaction that occurred on October 24, 2016 at km 12 on the access road. The deer was destroyed due to injuries sustained during the collision. The Conservation Officer (CO) was notified of the incident on November 9, 2016.

2.5.3 Reportable Spills

There were three reportable spills that occurred at Minto Mine during 2016. Volumes and causes are summarized in Table 2-7, below.

Table 2-7: Reportable Spills (2016)

Date	Volume (L)	Substance	Cause
January 2, 2016	20	Waste Oil	A mechanic was transferring waste oil a holding tank to a transfer tote. When the mechanic went to check the holding tank during the transfer he discovered the spill. The direct cause is linked to the waste oil level building up in the pipe because the pump was delivering product faster than it was draining from pipe into the tote as the pipe drains progressively slower when the volume in the tote increases.
June 19, 2016	65	Waste Oil	A worker was transferring waste oil from the storage totes to the lube truck for transport to the waste oil storage facility. The worker was distracted and did not monitor the levels in the tanks causing an overflow into the van body of the lube truck. The worker then proceeded to drive the lube truck to the waste oil tanker causing a small trail of waste oil from the transfer area to the tanker and back.
June 20, 2016	35	Glycol	As a loaded transport truck was travelling down the access road, a hose clamp broke near km 3, spilling an estimated 35 L of antifreeze (glycol) onto the ground.

The spills in Table 2-7, above were reported as per the *Spills Regulations* of the Yukon Environment Act. Additionally, non-reportable spills were tracked internally as per the WUL. Spills on site were cleaned up with a variety of methods including, but not limited to, absorbent spills pads, soil excavation, soil treatment in the LTF, and in-situ remediation supplemented with a bioremediation product (Gator).

2.5.4 Spill Contingency Plan Review

An update to the Minto Mine Spill Contingency Plan is required annually as part of the Annual Report and the updated 2017 Minto Mine Spill Contingency Plan is provided in Appendix B.

3 Proposed Mining for 2017

Section 3 discusses the proposed mining for 2017 at the Minto Mine, including open pit and underground mining.

3.1 Proposed Open Pit Mining for 2017

2017 will see the completion of a smaller than assessed and licenced Area 2 Stage 3 pit. The exact completion date will depend on productivity and operational decisions but it is expected to be in summer 2017.

The current mine plan does not include any further open-pit mining. The mine plan will be revisited whenever key inputs such as copper price, exchange rate, or fuel price change significantly.

3.2 Proposed Underground Mining for 2017

Mining of the Area 2 zone will continue, with completion expected in Q4. A production decision on the next deposit, Minto East, will be made in Q2; if mining proceeds, development of an access ramp, ventilation raise, and escape way will be undertaken in Q2 and Q3, with first ore production expected in Q4.

4 Mineral Resources and Reserves

Minto Mine's 2016 updated mineral resources and reserves are provided in Tables 4-1 and 4-2 respectively, below.

Table 4-1: 2016 Updated Mineral Resources for Minto Mine.

Classification	Tonnes (kt)	Copper (%)	Silver (g/t)	Gold (g/t)	Contained Copper (kt)	Contained Silver (koz)	Contained Gold (koz)
Minto South Deposit (MSD) (Open Pit and Underground)							
Measured	3,466	1.09	3	0.41	38	374	45.2
Indicated	17,723	1.08	3	0.37	192	1,893	212
Total Measured + Indicated	21,189	1.09	3	0.38	230	2,268	257.2
Inferred	12,445	0.8	2	0.22	100	969	89.3
Ridgetop (Open Pit)							
Measured	1,531	0.98	2	0.25	15	105	12.3
Indicated	3,534	0.87	3	0.3	31	326	34.1
Total Measured + Indicated	5,065	0.9	3	0.28	46	431	46.4
Inferred	318	0.75	2	0.13	2	16	1.3
Minto North (Open Pit)							
Measured	221	0.94	3	0.21	2	20	1.5
Indicated	257	1	6	0.61	3	46	5
Total Measured + Indicated	477	0.97	4	0.42	5	67	6.5
Inferred	28	0.7	3	0.32	0	3	0.3
Minto East (Underground)							
Measured	-	-	-	-	-	-	-
Indicated	919	2.35	7	1.01	22	204	29.8
Total Measured + Indicated	919	2.35	7	1.01	22	204	29.8
Inferred	124	1.48	5	0.6	2	20	2.5
Minto East 2 (Underground)							
Measured	-	-	-	-	-	-	-
Indicated	2,778	1.72	7	0.8	48	629	71.8
Total Measured + Indicated	2,778	1.72	7	0.8	48	629	71.8
Inferred	1,889	1.38	4	0.5	26	247	30.1

Classification	Tonnes (kt)	Copper (%)	Silver (g/t)	Gold (g/t)	Contained Copper (kt)	Contained Silver (koz)	Contained Gold (koz)
Minto North 2 (formerly Inferno North)							
Measured	-	-	-	-	-	-	-
Indicated	-	-	-	-	-	-	-
Total Measured + Indicated	-	-	-	-	-	-	-
Inferred	1,419	1.42	5	0.51	20	214	23.3
Stockpiles							
Measured	489	1.42	5	0.41	7	92	6.4
Total Mineral Resources							
Total Measured	5,707	1.09	3	0.36	62	592	65.5
Total Indicated	25,211	1.17	4	0.44	295	3,098	352.7
Total Measured + Indicated Resources	**30,918**	**1.15**	**4**	**0.42**	**357**	**3,690**	**418.2**
Total Inferred Resources	**16,223**	**0.93**	**3**	**0.28**	**150**	**1,470**	**146.8**

Table 4-2: 2016 Updated Mineral Reserves for Minto Mine.

Classification	Tonnes (kt)	Copper (%)	Silver (g/t)	Gold (g/t)	Contained Copper (kt)	Contained Silver (koz)	Contained Gold (koz)
Minto North Open Pit							
Proven	-	-	-	-	-	-	-
Probable	-	-	-	-	-	-	-
Total	**-**	**-**	**-**	**-**	**-**	**-**	**-**
MSD - Area 2 Open Pit							
Proven	-	-	-	-	-	-	-
Probable	807	1.21	1	0.41	10	26	10.6
Total	**807**	**1.21**	**1**	**0.41**	**10**	**26**	**10.6**
Minto East Underground							
Proven	-	-	-	-	-	-	-
Probable	625	2.07	6	0.89	13	120	17.9
Total	**625**	**2.07**	**6**	**0.89**	**13**	**120**	**17.9**

Classification	Tonnes (kt)	Copper (%)	Silver (g/t)	Gold (g/t)	Contained Copper (kt)	Contained Silver (koz)	Contained Gold (koz)
MSD - Area 2/118 Underground							
Proven	-	-	-	-	-	-	-
Probable	381	2.06	8	0.87	8	103	10.7
Total	**381**	**2.06**	**8**	**0.87**	**8**	**103**	**10.7**
MSD - Copper Keel Underground							
Proven	-	-	-	-	-	-	-
Probable	1,616	1.73	6	0.63	28	315	32.5
Total	**1,616**	**1.73**	**6**	**0.63**	**28**	**315**	**32.5**
MSD -Wildfire Underground							
Proven	-	-	-	-	-	-	-
Probable	-	-	-	-	-	-	-
Total	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Stockpiles							
Proven	489	1.42	6	0.41	7	92	6.4
Total	**489**	**1.42**	**6**	**0.41**	**7**	**92**	**6.4**
Total Mineral Reserves							
Proven	489	1.42	6	0.41	7	92	6.4
Probable	3,429	1.71	5	0.65	59	563	71.7
Total Mineral Reserves	**3,919**	**1.67**	**5**	**0.62**	**65**	**655**	**78.2**

5 Surface Water Quality Monitoring

Environmental monitoring programs are outlined in the *Environmental Monitoring, Surveillance and Reporting Plan* (EMSRP2016-02) and the results for the surface water quality monitoring conducted in 2016 are provided in this section. Where possible, the 2016 results have been compared to historical results to identify trends and compare 2016 values with previous values.

5.1 Surface Water Quality Program

Details of the Surface Water Surveillance Program, including sampling station locations and monitoring frequency, are outlined in the EMSRP2016-02 and the results are presented in this section for water quality stations outlined in the WUL. Water quality result statistics including the mean, minimum and maximum are presented in summary tables. For the purposes of calculating the mean, minimum and maximum concentrations, values less than the detection limit were taken to be half of the detection limit.

The WUL effluent quality standards were compared to the water quality result statistic summaries at stations W16, W16A, W17, W50 and RO. The WUL water quality objectives were compared to the water quality result statistic summary at station W2 and at W50 when W35 and W15 are frozen.

As water quality stations may be adjusted from year-to-year as a result of environmental changes or modifications to infrastructure, an update to the water quality station locations listed in the WUL is provided in Table 5-1 below. All surveillance monitoring sites in use in 2016 are confirmed with a Global Positioning System (GPS) unit to determine current UTM coordinates. Coordinates presented in Table 5-1 are associated with the World Geodetic System 1984 (WGS 84) coordinate system.

Table 5-1: Water Quality Site Descriptions and UTM Coordinates

Station	Description	UTM Coordinates – Zone 8	
		Easting	Northing
W1	Lower Reach of Minto Creek	392445	6948251
W2	Minto Creek, upstream of the Minto Creek/Yukon River confluence where the access road crosses Minto Creek	392584	6948402
W3	Minto Creek, at the federal MMER compliance point	387000	6945778
W4	Yukon River, upstream of the confluence with Minto Creek	394070	6948203
W5	Yukon River, downstream of the confluence with Minto Creek	392583	6949119
W6	Tributary on the North side of Minto Creek	387583	6946392
W7	Mouth of the tributary on the south side of Minto Creek, approximately 0.8 km downstream of W3	387546	6946034
W8	Western collection sump from the DSTSF	385629	6945076
W8A	Eastern collection sump from the DSTSF	385716	6945012
W10	Headwaters of Minto Creek (south-west fork at headwaters)	383855	6943364
W12	Main Pit and Main Pit Tailings Management Facility	384544	6945137
W12A	Discharge from Main pit	*	*
W14	Tailings thickener overflow	385223	6945089
W15	Upper Minto Creek storm water collection sump, downstream of the overburden dump, just upstream of Main Pit	384181	6944708
W16	Water Storage Pond	386402	6945559
W16A	Discharge from the Water Storage Pond	386679	6945664
W17	Water Storage Pond dam seepage	386679	6945664
W30	Headwaters Minto Creek (north-west fork)	383693	6945026
W33	Up-gradient of South Diversion Ditch	385351	6944072
W35	South Diversion Ditch	385223	6944427
W36	Minto Creek detention structure (MCDS) – Decommissioned in 2015	385892	6945191
W37	100 m downstream of MCDS (W36 collection sump) and upstream of Water Storage Pond – Decommissioned in 2015	386180	6945294
W45	Area 2 Pit and Area 2 Pit Tailings Management Facility	384912	6944068
W46	Minto Creek, downstream of W7 and W6 tributaries	387873	6946301
W47	Area 118 Pit water	384775	6944153
W50	Minto Creek, approximately 50 m downstream of the toe of the Water Storage Pond Dam and downstream of the inflow of the treated water	386747	6945682
MC-1	Minto Creek upstream of Canyon	390967	6947528
WTP	Treated water from water treatment plant when RO not operating	385126	6945154
RO	Treated water from RO	385126	6945154
W51	Area 2 Stage 3 Pit	*	*

Station	Description	UTM Coordinates – Zone 8	
		Easting	Northing
W52	Ridgetop North Pit and Ridgetop North Pit Tailings Management Facility	*	*
W53	Ridgetop South Pit	*	*
W54	Main Dam seepage	*	*
W55	Tailings Diversion Ditch	386209	6945007
W62	MVFES2 Collection Sump	386079	6945335
C4	Tributary on the south side of Minto Creek, downstream of W3	388407	6946571
C10	Tributary on the south side of Minto Creek, downstream of W3	391868	6947914
MN	Minto North pit water	384342	6946090
MN-0.2	Upper west arm of McGinty Creek (Reference Station)	382267	6947299
MN-0.5	West arm of McGinty Creek just upstream of the confluence with the east arm	385251	6951262
MN-1.5	Upper east arm of McGinty Creek downstream of the Minto North deposit	384473	6947055
MN-2.5	East arm of McGinty Creek just upstream of confluence with the west arm	385493	6950788
MN-4.5	Lower mainstream McGinty Creek near confluence with Yukon River	386231	6952851
UG 1	Minto South underground mine dewatering	384916	6944098
UG 2	Wildfire underground mine dewatering	*	*
UG 3	Copper Keel underground mine dewatering	*	*
UG 4	Minto East underground mine dewatering	*	*

*Water quality sites not developed

5.1.1 Water Quality Monitoring Conformance

2016 conformance with the external water sampling requirements is summarized in Table 5-2, below. Flow monitoring at water quality surveillance sites is highly variable as a result of site and seasonal conditions and is not presented in Table 5-2, however, full details were provided in the Monthly Reports submitted to the YWB. Additionally, the specifics of non-conformance in relation to external and internal water sampling requirements are included in the Monthly Reports. Quality Assurance and Quality Control (QA/QC) sampling is not included in sampling events described in Table 5-2, but is provided in section 5.1.2.

Table 5-2: Water Quality Sampling Monitoring Conformance Summary (2016)

Site Name	2016 WQ sampling events*	2016 Reason(s) for non-conformance events
W1	N/A	N/A
W2	35	Site was frozen during the first and fourth quarter. Sampled as per schedule for remainder of 2016.
W3	88	Sampled as per schedule.
W4	4	Sampled as per schedule.
W5	3	Inaccessible due to ice conditions in the first quarter. Sampled as per schedule for remainder of 2016.
W6	8	Site frozen for 4 months of the year. Sampled as per schedule for remainder of 2016.
W7	12	Site frozen for 2 months of the year. Sampled as per schedule for remainder of 2016.
W8	0	Site dry for all of 2016.
W8a	29	Site inaccessible due to construction of MVF during first 2 months of the year and dry from March until June. Sampled as per schedule otherwise.
W10	12	Sampled as per schedule.
W12	12	Sampled as per schedule.
W12A	0	No discharge from W12A in 2016.
W14	12	Sampled as per schedule.
W15	15	Site frozen for 2 months of the year. Sampled as per schedule otherwise.
W16	31	One weekly sample missed in June. Sampled as per schedule for remainder of 2016.
W16a	33	Sampled as per schedule.
W17	53	Sampled as per schedule.
W30	12	Sampled as per schedule.
W33	6	Site frozen for 6 months of the year. Sampled as per schedule otherwise.
W35	8	Site dry for 6 months of 2016. Sampled as per schedule otherwise.
W36	0	Decommissioned in 2015.
W37	0	Decommissioned in 2015.
W45	11	Site was inaccessible due to geotechnical concerns for 3 months. Sampled as per schedule for remainder of 2016.
W46	9	Site frozen for first quarter. Sampled as per schedule for remainder of 2016.
W47	1	Site dry for first quarter. Inaccessible due to geotechnical concerns for second and third quarter. Site frozen for fourth quarter. One sample collected end of September.
W50	31	Site dry while not discharging. Sampled as per schedule during discharge in 2016.
MC-1	36	Site frozen for 4 months. Sampled as per schedule for remainder of 2016.
WTP **RO**	17	Sampled as per schedule.
W51	0	Site not established.
W52	0	Site not established.
W53	0	Site not established.
W54	0	Site not established.
W55	2	Flow present in April and May. Site dry for remainder of 2016.
W62	11	Sampled as per schedule. July not sampled due to ongoing pumping issues
C4	8	Seasonal conditions (site frozen).
C10	4	Seasonal conditions (site frozen).
MN	8	Sampled when water present.
MN-0.2	7	Seasonal conditions (site frozen).
MN-0.5	9	Seasonal conditions (site frozen).
MN-1.5	6	Seasonal conditions (site frozen).
MN-2.5	8	Seasonal conditions (site frozen).
MN-4.5	8	Seasonal conditions (site frozen).
UG1	14	Sampled as per schedule.

5.1.2 Quality Assurance and Quality Control Program

As required by Clause 104 of the WUL, Minto is required to submit the results and interpretations of the Quality Assurance and Quality Control Program (QA/QC Program). The QA/QC program is directed through the EMSRP. Implementation of the Minto QA/QC Program occurred in November 2012.

The primary objective of the QA/QC Program is to ensure that data collected, analyzed and evaluated through the environmental monitoring programs at Minto are representative of the environmental conditions present at the time of sampling. The QA/QC Program has been developed using recognized QA/QC protocols. Specific procedures for data collection at the Minto Mine are detailed in Standard Operating Procedures (SOPs). SOPs are internal documents to the Minto Mine that may be modified or improved as required.

The main components of the QA/QC Program presented in the following sections include QA/QC with regards to water quality monitoring, external and on-site laboratory reporting, and environmental programs monitoring. QA/QC results and interpretations are presented in each Monthly Report.

5.1.2.1 Water Quality QA/QC

Procedures for water quality monitoring at the Minto Mine are described in the EMSRP and further detailed in the Minto Mine Surface Water Quality Monitoring Standard Operating Procedure. The SOP is reviewed at the start of each field season and signed off by Minto Environment department staff to help ensure consistency in sampling procedures.

In 2016, 606 water quality samples (surface and groundwater) were collected for the water quality monitoring programs. QC samples represented 15.3% of the total number of samples collected in 2016, and included 34 field duplicates, 12 field blanks, 8 trip blanks, and 39 field splits. The Minto Mine Surface Water Quality Monitoring Standard Operating Procedure describes a 1:10 quality control to routine sampling ratio and this ratio was achieved in 2016.

5.1.2.2 External Laboratory QA/QC

The 2016 external laboratory water quality analysis were performed by ALS Environmental in Burnaby, BC. As described in the EMSRP, all results provided by the external laboratory were accompanied by a Quality Control Report. If procedural deviations or exceedances in standard holding time occurred, the details of such nonconformities were included in each report. Additionally, each report contained QC batch numbers enhancing sample result traceability.

5.1.2.3 On-site Laboratory QA/QC

Procedures for analyzing water samples at the on-site laboratory are detailed in a variety of SOPs such as, but not limited to: the Laboratory QA/QC Guidelines SOP; Preparation of Dissolved and Total Metals (Cu, Al, Cd) SOP; Preparation of Dissolved and Total Selenium SOP; and Total Dissolved Solids SOP. All on-site laboratory equipment was calibrated according to manufacturer's specifications in 2016.

2016 on-site laboratory analysis of water quality samples occurred at W3, W8A, W16, W16A, W17 and W50 as per the WUL Schedule 1 – Part 2 monitoring requirements, as environmental conditions allowed.

No internal samples were provided to the internal laboratory from W8 as the site remained dry throughout 2016. Additionally, the on-site laboratory analyzed water from sites W15, W35, RO, and WTP intake daily during discharge conditions in order to inform day-to-day discharge-related decisions. Samples from W2, MC-1, and W62 were also analyzed.

The 2016 QC procedures performed by the on-site laboratory included spiked blanks and calibration checks. In the event that two or more QC failures occurred, the 2016 QC procedures involved re-analyzing the entire batch of samples. Additionally, one replicate sample is analyzed for each batch analysis. In the event the replicate sample results do not match, the entire batch is reanalyzed.

On-site and external laboratory water quality results for water quality sites W3, W8A, W16, W16A and W50 are presented in each Monthly Report submitted to the Water Board. In monthly reports it was noted that discrepancies in results from the external and on-site laboratories occurred and were likely a result of different methods and/or equipment utilized in analyzing water samples, different processing times between sampling and processing the samples, and the associated use of non-preserved versus preserved samples.

5.2 Compliance

5.2.1 Discharge Compliance – WQ Effluent Standards

5.2.1.1 W16A – EQS Compliance Point

The station W16A copper, aluminum, cadmium and selenium concentrations, with corresponding standards (WUL Clause 9) are displayed in Table 5-3. This is shown graphical in Figure 5-1 and Figure 5-2.

Table 5-3: W16A Water Quality Results Summary (2012-2016)

W16A	Effluent Quality Standards (WUL Clause 9)	2012 - 2015 Summary Statistics			2016 Summary Statistics		
Parameters		Mean	Min	Max	Mean	Min	Max
pH	6.0-9.0	8.03	6.86	8.32	7.9	7.56	8.25
TSS (mg/L)	15	6.2	1	**55.1**	3.9	3	8
Nutrients (mg/L)							
Ammonia Nitrogen	0.75	0.064	0.0169	0.26	0.1947	0.0293	0.43
Nitrite Nitrogen	0.18	0.0169	0.005	0.0586	0.0399	0.0035	0.092
Nitrate Nitrogen	27.3	3.416	0.549	5.2	3.278	0.79	6.3
Dissolved Metals (mg/L)							
Aluminum	0.3	0.0124	0.003	0.0732	0.0095	0.0016	0.0224
Arsenic	0.015	0.00041	0.00025	0.001	0.00033	0.00023	0.0004
Cadmium	0.00015	0.00002	0.00001	0.000089	0.0000072	0.000005	0.0000127
Chromium	0.003	0.00099	0.0005	0.001	0.00012	0.0001	0.00021
Copper	0.039	0.02327	0.00793	0.0349	0.01674	0.00949	0.023
Iron	3.3	0.0718	0.0105	0.301	0.051	0.017	0.086
Lead	0.012	0.0003	0.0002	0.00159	0.000079	0.00005	0.000299
Molybdenum	0.219	0.0052	0.001	0.0098	0.00334	0.00274	0.00408
Nickel	0.33	0.0011	0.001	0.005	0.0007	0.00055	0.00125
Selenium	0.006	0.00134	0.00019	0.0021	0.00111	0.000406	0.00186
Zinc	0.09	0.005	0.005	0.005	0.0017	0.001	0.0059

Bold values indicate exceedances of the WUL standards

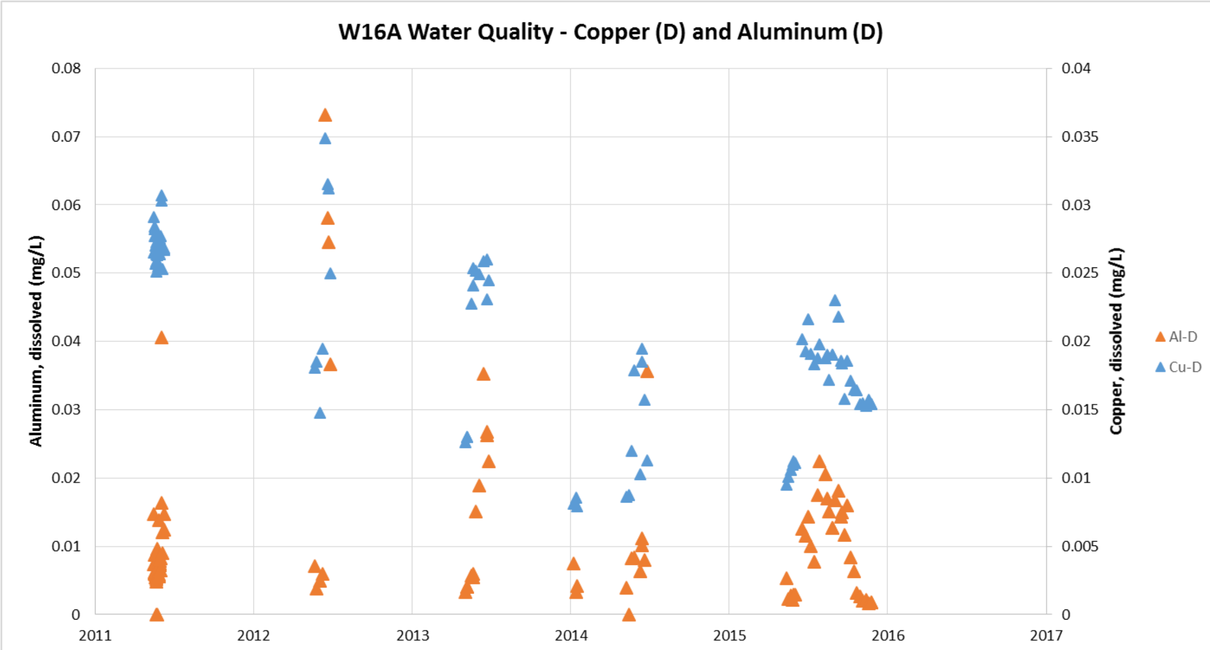
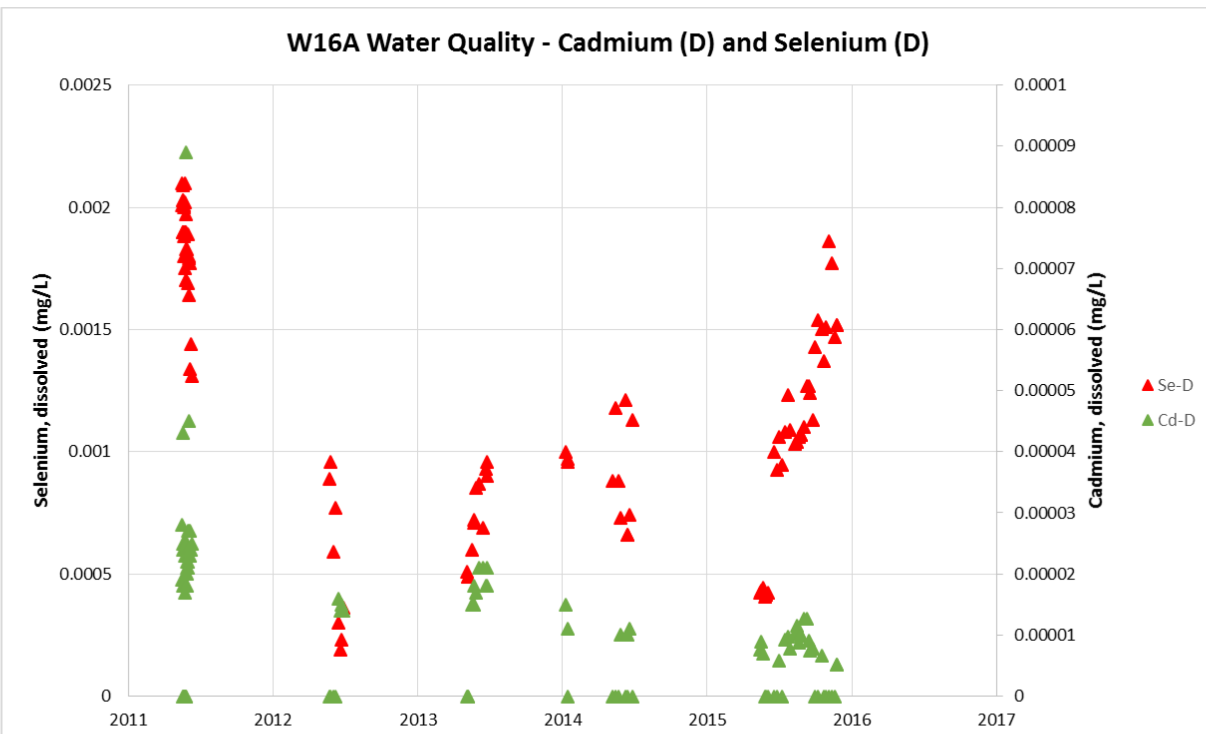


Figure 5-1: W16A Copper and Aluminum Concentrations (2012-2016)



*Note that the cadmium standard is based on a hardness of 63 mg/L which is a conservative estimate of hardness at the WQO station.

Figure 5-2: W16A Cadmium and Selenium Concentrations (2012-2016)

5.2.1.2 W50 – EQS Compliance Point

The Effluent Quality Standards (EQS) (Clause 9 of the WUL) were applied and met at W50 from the period of April 3rd to October 10th. The water quality statistics in the period (April 3rd to October 10th) where W50 was the EQS compliance point are summarized below in Table 5-4.

Table 5-4: W50 Water Quality Results Summary (2016)

W50	Effluent Quality Standards (WUL Clause 9)	W50 2016 Summary Statistics		
Parameters		Mean	Min	Max
pH	6.0-9.0	7.91	7.41	8.27
TSS (mg/L)	15	3.8	3	8
Nutrients (mg/L)				
Ammonia Nitrogen	0.75	0.1264	0.0173	0.33
Nitrite Nitrogen	0.18	0.0354	0.0037	0.0896
Nitrate Nitrogen	27.3	2.418	0.793	5.01
Dissolved Metals (mg/L)				
Aluminum	0.3	0.0087	0.0014	0.0168
Arsenic	0.015	0.00028	0.00012	0.00041
Cadmium	0.00015	0.0000061	0.000005	0.000011
Chromium	0.003	0.00012	0.0001	0.00024
Copper	0.039	0.01431	0.00354	0.0218
Iron	3.3	0.04	0.01	0.078
Lead	0.012	0.000074	0.00005	0.000291
Molybdenum	0.219	0.00284	0.00103	0.00393
Nickel	0.33	0.00064	0.0005	0.00086
Selenium	0.006	0.000834	0.000339	0.00146
Zinc	0.09	0.0014	0.001	0.0045

5.2.2 Discharge Compliance – Bioassays

Monthly and quarterly bioassays are conducted at several surface water quality sites, as per WUL requirements. These tests are to ensure the water is not toxic for aquatic organisms.

Toxicity testing at W16A and W50 were conducted according to the WUL requirements, all tests passed in 2016 for both sample sites. Lab results were submitted with the monthly reports.

Bioassay compliance testing, as per the WUL requirements, were conducted at W3 during 2016. During the June monthly sampling event, the LT50 Rainbow Trout test was not completed due to lab error. The sample was re-collected and conducted on July 12, 2016. This information was submitted in the monthly WUL reports. All toxicity tests conducted in 2016 for W3 passed.

Bioassays were not completed in the first quarter of 2016, as the water quality station became ice-free with very low flows in the last week of March 2016. This low water level and late availability did not allow for the monthly samples or the quarterly 30-day CT test to be conducted. In Q3 the W2 30-day CT samples were collected and sent to the lab for testing; however, at the end of the test the lab discovered the quality control component of the test failed and no results could be provided. The test was re-run in October for the fourth quarter just prior to the station becoming frozen. This information was submitted in the monthly WUL reports. All other toxicity tests conducted in 2016 passed.

5.2.3 Discharge Compliance – RO

Discharge from the RO to Minto Creek began on September 9, 2016 and was shut down on October 9, 2016.

The Water Quality Objectives (WQO) (Clause 10 of the WUL) were met at the RO during discharge to Minto Creek in 2016. The water quality statistics for RO in 2016 are summarized below in Table 5-5.

Table 5-5: RO Water Quality Results Summary (2016)

RO	Water Quality Objective (WUL Clause 11)	2016 Summary Statistics		
Parameters		Mean	Min	Max
pH	6.0-9.0	7.09	6.81	7.37
TSS (mg/L)		3	3	3
Nutrients (mg/L)				
Ammonia Nitrogen	0.25	0.0371	0.0266	0.0562
Nitrite Nitrogen	0.06	0.0116	0.0067	0.0138
Nitrate Nitrogen	9.1	0.704	0.643	0.776
Dissolved Metals (mg/L)				
Aluminum	0.1	0.0011	0.001	0.0014
Arsenic	0.005	0.0001	0.0001	0.0001
Cadmium	0.00015*	0.000005	0.000005	0.000005
Chromium	0.001	0.0001	0.0001	0.0001
Copper	0.013	0.00046	0.00038	0.00054
Iron	1.1	0.01	0.01	0.01
Lead	0.004	0.00005	0.00005	0.00005
Molybdenum	0.073	0.000181	0.00013	0.000252
Nickel	0.11	0.0005	0.0005	0.0005
Selenium	0.002	0.000081	0.000005	0.000144
Zinc	0.03	0.0013	0.001	0.0015

5.2.4 Water Quality Objectives Compliance – Minto Creek

5.2.4.1 W2 – WQO Compliance Point

As of April 3rd, W15 and W35 were no longer frozen and W2 became the WQO station until W15 and W35 froze again on October 10, 2016. Following the date in October, W50 became the WQO station.

The Water Quality Objectives (WQO) (Clause 10 of the WUL) were met at the W2 during the period between April 3rd and October 10th, 2016. The water quality statistics during the period where W2 was the WQO compliance point are summarized below in Table 5-6.

Table 5-6: **W2 Water Quality Results Summary (2016)**

W2	Water Quality Objective (WUL Clause 11)	2016 Summary Statistics		
Parameters		Mean	Min	Max
pH	6.0-9.0	8.16	7.74	8.29
TSS (mg/L)		14.7	3	106
Nutrients (mg/L)				
Ammonia Nitrogen	0.25	0.0074	0.005	0.0269
Nitrite Nitrogen	0.06	0.0012	0.001	0.0023
Nitrate Nitrogen	9.1	0.2791	0.005	0.879
Dissolved Metals (mg/L)				
Aluminum	0.1	0.0105	0.004	0.0597
Arsenic	0.005	0.00051	0.00037	0.00068
Cadmium	0.00015*	0.000005	0.000005	0.0000134
Chromium	0.001	0.00024	0.00015	0.00072
Copper	0.013	0.00284	0.00183	0.00796
Iron	1.1	0.113	0.029	0.189
Lead	0.004	0.00005	0.00005	0.00005
Molybdenum	0.073	0.001418	0.00046	0.00197
Nickel	0.11	0.00114	0.00086	0.00169
Selenium	0.002	0.000158	0.000103	0.000292
Zinc	0.03	0.0017	0.001	0.0095

5.2.4.2 W50 – WQO Compliance Point

From January 1st until April 3rd, W15 and W35 were frozen and W50 was the WQO station. Following April 3rd until October 10th, W2 was then the WQO station. After which, W15 and W35 froze and W50 once again became the WQO station.

The Water Quality Objectives (WQO) (Clause 10 of the WUL) were met at the W50 during the first and fourth quarter, when W50 was the WQO station. The water quality statistics in periods where W50 was the WQO compliance point are summarized below in Table 5-7.

Table 5-7: W50 Water Quality Results Summary (2016)

W50	Water Quality Objective (WUL Clause 11)	2016 Summary Statistics		
Parameters		Mean	Min	Max
pH	6.0-9.0	8.1	8.03	8.19
TSS (mg/L)		3.2	3	4
Nutrients (mg/L)				
Ammonia Nitrogen	0.25	0.0512	0.0308	0.073
Nitrite Nitrogen	0.06	0.0188	0.017	0.0209
Nitrate Nitrogen	9.1	5.45	5.13	5.65
Dissolved Metals (mg/L)				
Aluminum	0.1	0.0021	0.0013	0.0029
Arsenic	0.005	0.00033	0.00031	0.00038
Cadmium	0.00037	0.000005	0.000005	0.0000076
Chromium	0.001	0.0001	0.0001	0.00011
Copper	0.020	0.015	0.0146	0.0156
Iron	1.1	0.044	0.026	0.065
Lead	0.004	0.000118	0.00005	0.000175
Molybdenum	0.073	0.0036	0.0035	0.0038
Nickel	0.11	0.00062	0.00058	0.00067
Selenium	0.002	0.00162	0.00147	0.00171
Zinc	0.03	0.0011	0.001	0.0015

5.3 Surface Water Quality Surveillance Stations

5.3.1 W2 – Minto Creek at Lower Road Crossing Water Quality

The water quality statistics for W2 from 2007 to 2016 are summarized below in Table 5-8. A total of 35 routine samples were collected from station W2 during the 2016 monitoring period. The results for dissolved copper, dissolved aluminum, dissolved cadmium, and dissolved selenium for W2 from 2007 to 2016 are also presented in Figure 5-3 to Figure 5-4 below.

Table 5-8: W2 Water Quality Results Summary (2007-2016)

W2	Water Quality Objective (WUL Clause 11)	2007 - 2015 Summary Statistics			2016 Summary Statistics		
Parameters		Mean	Min	Max	Mean	Min	Max
pH	6.0-9.0	8.11	7.03	8.46	8.17	7.74	8.36
TSS (mg/L)		55.2	1	2600	13	3	106
Nutrients (mg/L)							
Ammonia Nitrogen	0.25	0.0427	0.001	**0.83**	0.007	0.005	0.0269
Nitrite Nitrogen	0.06	0.0128	0.001	**0.36**	0.0012	0.001	0.0023
Nitrate Nitrogen	9.1	1.6842	0.005	**9.4**	0.4394	0.005	2.16
Dissolved Metals (mg/L)							
Aluminum	0.1	0.0204	0.003	0.201	0.0094	0.0028	0.0597
Arsenic	0.005	0.00053	0.0002	0.0018	0.00048	0.00026	0.00068
Cadmium	0.00015*	0.000042	0.00001	**0.00104**	0.0000056	0.000005	0.0000134
Chromium	0.001	**0.0012**	0.0004	**0.0031**	0.00023	0.00012	0.00072
Copper	0.013	0.00321	0.001	**0.0227**	0.00283	0.00161	0.00796
Iron	1.1	0.1763	0.019	0.905	0.099	0.021	0.189
Lead	0.004	0.0002	0.0001	0.0009	0.00005	0.00005	0.00005
Molybdenum	0.073	0.00296	0.00018	0.015	0.001436	0.00046	0.00203
Nickel	0.11	0.0012	0.0005	0.004	0.00108	0.00071	0.00169
Selenium	0.002	0.0007	0.0001	**0.0026**	0.000192	0.000103	0.000588
Zinc	0.03	0.0063	0.001	0.02	0.0017	0.001	0.0095

Bold values indicate exceedances of the WUL standards

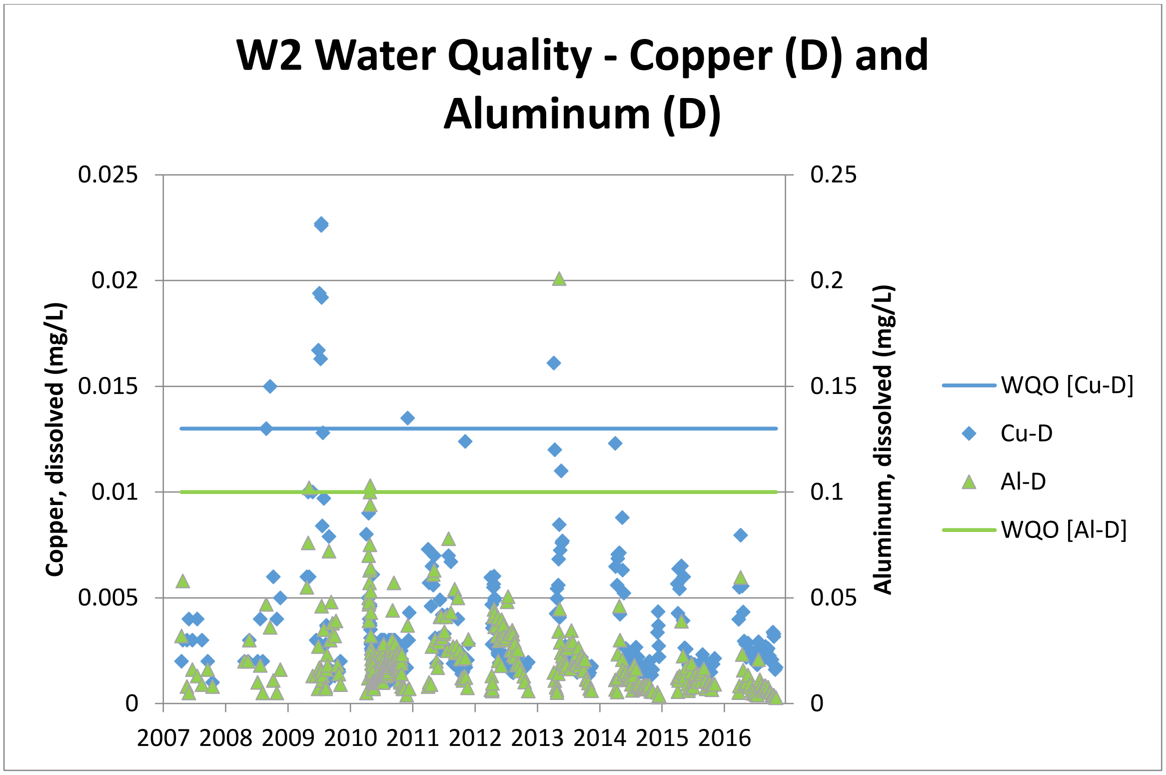


Figure 5-3: W2 Copper and Aluminum Concentrations (2007-2016)

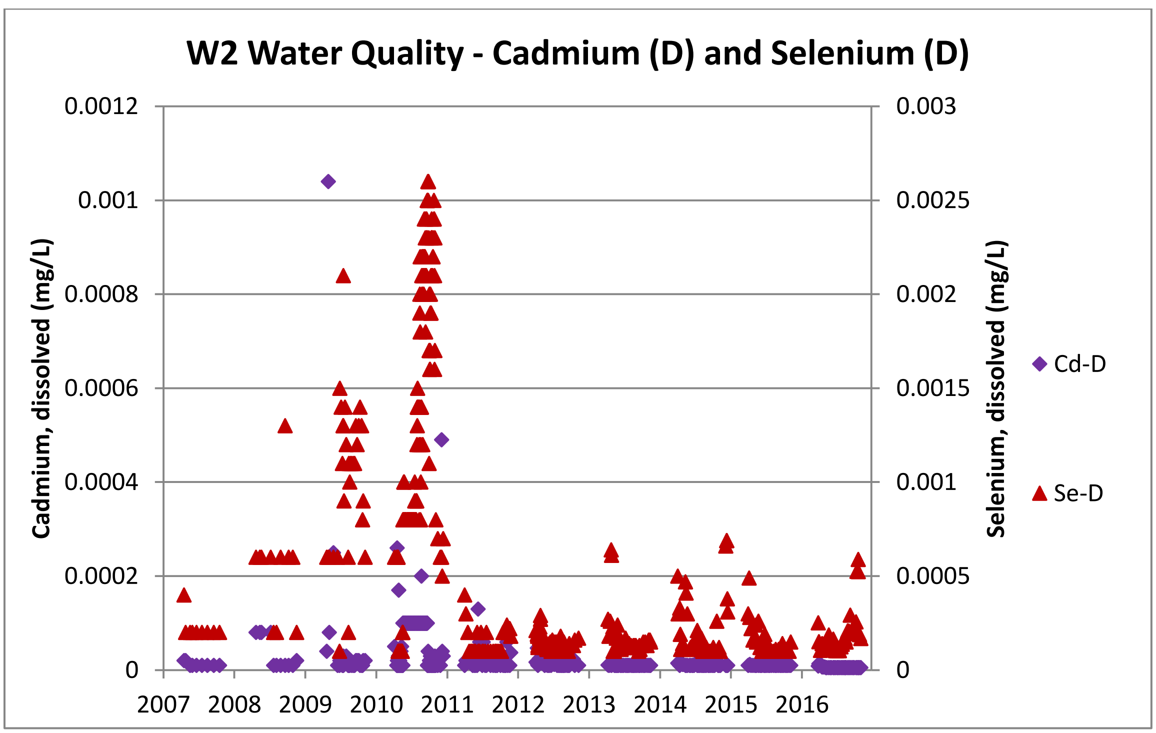


Figure 5-4: W2 Cadmium and Selenium Concentrations (2007-2016)

5.3.2 W3 – Minto Creek, at the Federal (MMER) Compliance Point

The water quality statistics for W3 from 2007 to 2016 are summarized below in Table 5-9. A total of 88 routine samples were collected from station W3 during the 2016 monitoring period. The results for dissolved copper, dissolved aluminum, dissolved cadmium, and dissolved selenium for W3 from 2007 to 2016 are also presented in Figure 5-5 and Figure 5-6 below.

Table 5-9: W3 Water Quality Results Summary (2007-2016)

W3	2007 - 2015 Summary Statistics			2016 Summary Statistics		
Parameters	**Mean**	**Min**	**Max**	**Mean**	**Min**	**Max**
pH	8.09	7.4	8.6	8.14	7.81	8.46
TSS (mg/L)	7.7	1	985	3.9	1	30
Nutrients (mg/L)						
Ammonia Nitrogen	0.0591	-0.01	0.62	0.0223	0.005	0.168
Nitrite Nitrogen	0.0479	0.001	4.13	0.0056	0.001	0.0429
Nitrate Nitrogen	3.035	0.02	18.7	1.156	0.168	4.61
Dissolved Metals (mg/L)						
Aluminum	0.0218	0.0024	0.373	0.0095	0.0013	0.054
Arsenic	0.000351	0.00019	0.0014	0.00028	0.00015	0.00046
Cadmium	0.0009254	0.000005	0.565	0.0000068	0.000005	0.0000186
Chromium	0.00113	0.0001	0.004	0.00033	0.0001	0.001
Copper	0.00534	0.001	0.067	0.00604	0.00161	0.0154
Iron	0.046	0.005	0.75	0.0326	0.01	0.095
Lead	0.000287	0.000009	0.0603	0.000087	0.00005	0.0002
Molybdenum	0.00584	0.00066	0.103	0.00406	0.0019	0.0067
Nickel	0.001159	0.0005	0.006	0.00094	0.0005	0.00169
Selenium	0.001078	0.0001	0.0348	0.000527	0.00024	0.00133
Zinc	0.00641	0.00067	0.143	0.0024	0.001	0.0078

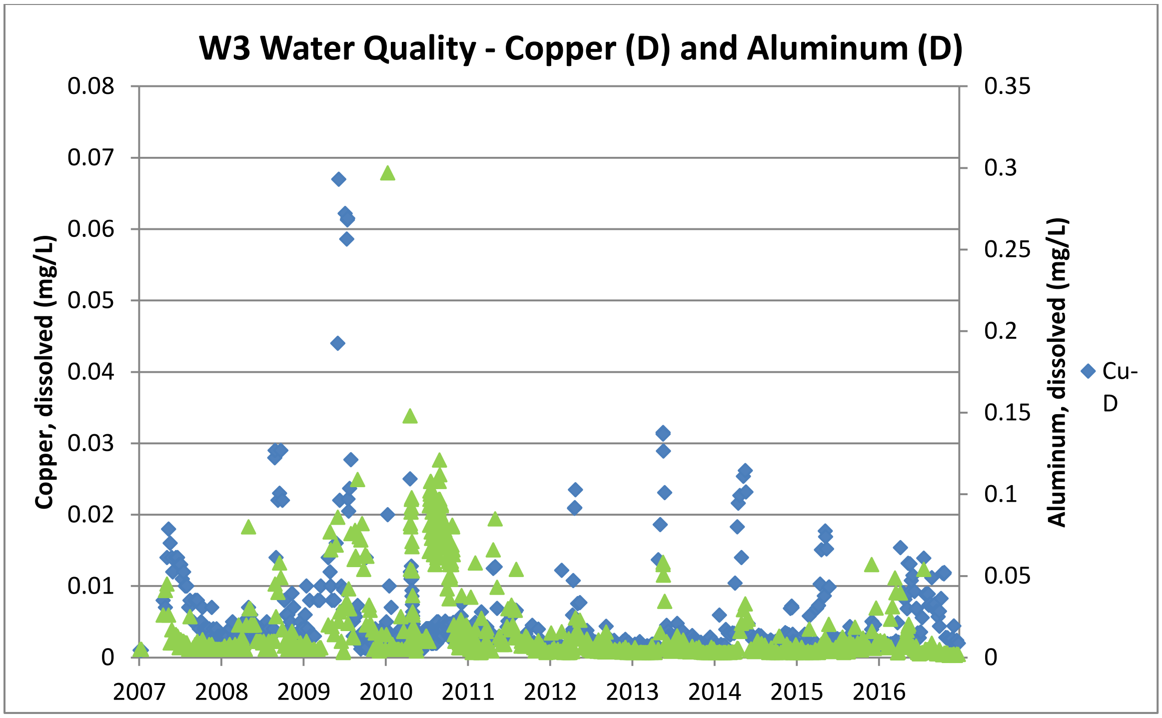


Figure 5-5: W3 Copper and Aluminum Concentrations (2007-2016)

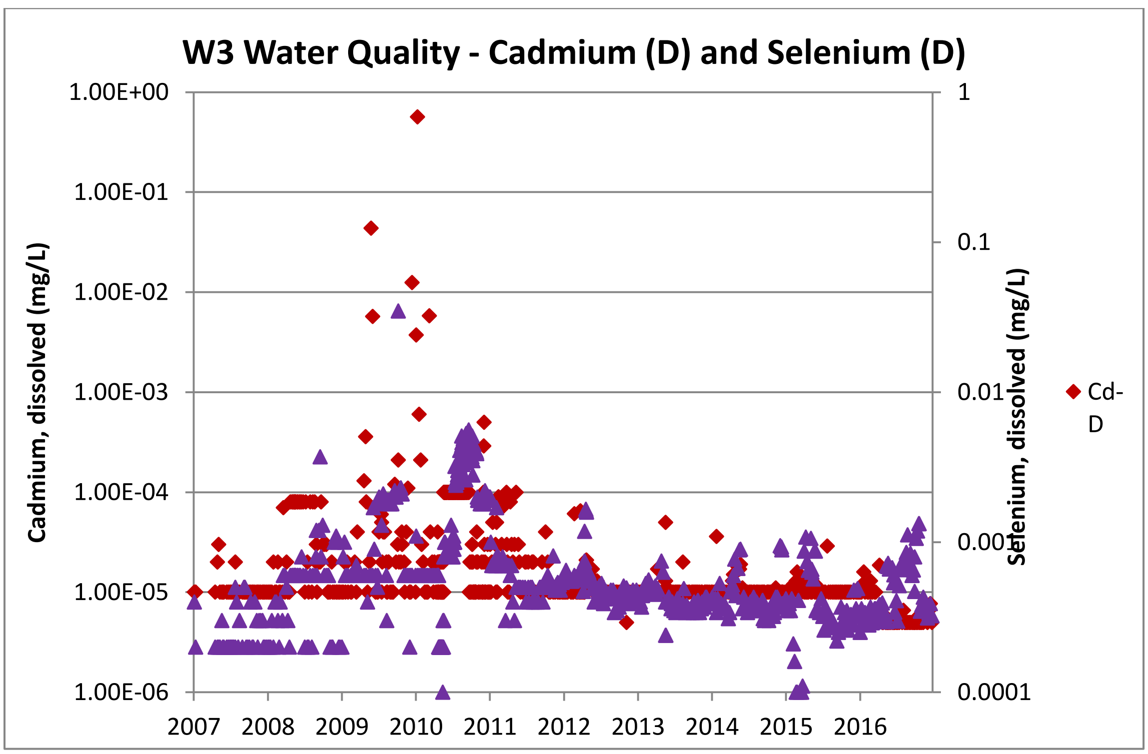


Figure 5-6: W3 Cadmium and Selenium Concentrations (2007-2016)

5.3.3 W4 – Yukon River, Upstream of the confluence with Minto Creek

The water quality statistics for W4 from 2009 to 2016 are summarized below in Table 5-10. A total of four routine samples were collected from station W4 during the 2016 monitoring period.

Table 5-10: W4 Water Quality Results Summary (2011-2016)

W4	2009 - 2015 Summary Statistics			2016 Summary Statistics		
Parameters	Mean	Min	Max	Mean	Min	Max
pH	7.93	5.48	8.26	7.96	7.87	8.02
TSS (mg/L)	20.7	1	270	10	3	24
Nutrients (mg/L)						
Ammonia Nitrogen	0.0375	0.005	2.4	0.005	0.005	0.005
Nitrite Nitrogen	0.0063	0.005	0.05	0.001	0.001	0.001
Nitrate Nitrogen	0.076	0.02	0.849	0.0347	0.0099	0.0773
Dissolved Metals (mg/L)						
Aluminum	0.0137	0.003	0.167	0.0088	0.0017	0.0176
Arsenic	0.00045	0.0001	0.00105	0.00046	0.00038	0.00055
Cadmium	0.000017	0.00001	0.0014	0.0000051	0.000005	0.0000055
Chromium	0.001	0.001	0.002	0.00011	0.0001	0.00012
Copper	0.00106	0.0002	0.004	0.00082	0.00047	0.00109
Iron	0.0363	0.005	0.307	0.016	0.01	0.023
Lead	0.0002	0.0002	0.0004	0.00005	0.00005	0.00005
Molybdenum	0.0011	0.001	0.0021	0.00119	0.00103	0.00152
Nickel	0.001	0.001	0.002	0.0005	0.0005	0.0005
Selenium	0.00014	0.0001	0.00044	0.00015	0.000133	0.00016
Zinc	0.0052	0.005	0.0278	0.001	0.001	0.001

5.3.4 W5 – Yukon River, Downstream of the Confluence with Minto Creek

The water quality statistics for W5 from 2009 to 2016 are summarized below in Table 5-11. A total of three routine samples were collected from station W5 during the 2016 monitoring period.

Table 5-11: W5 Water Quality Results Summary (2011-2016)

W5	2009 - 2015 Summary Statistics			2016 Summary Statistics		
Parameters	Mean	Min	Max	Mean	Min	Max
pH	7.96	7.58	8.25	7.96	7.88	8.01
TSS (mg/L)	36.9	1	340	13.4	5.3	28.7
Nutrients (mg/L)						
Ammonia Nitrogen	0.0252	0.005	0.382	0.0054	0.005	0.0063
Nitrite Nitrogen	0.0064	0.005	0.05	0.001	0.001	0.001
Nitrate Nitrogen	0.06	0.02	0.4	0.0253	0.0091	0.055
Dissolved Metals (mg/L)						
Aluminum	0.0142	0.003	0.0588	0.0104	0.0034	0.0179
Arsenic	0.0005	0.00036	0.00086	0.00048	0.0004	0.00057
Cadmium	0.000011	0.00001	0.000031	0.000005	0.000005	0.000005
Chromium	0.001	0.001	0.001	0.00011	0.0001	0.00012
Copper	0.00133	0.00047	0.00694	0.00077	0.00054	0.00097
Iron	0.09	0.009	0.712	0.021	0.015	0.026
Lead	0.0002	0.0002	0.0002	0.00005	0.00005	0.00005
Molybdenum	0.0012	0.001	0.0018	0.001125	0.000984	0.00121
Nickel	0.001	0.001	0.002	0.0005	0.0005	0.0005
Selenium	0.00015	0.0001	0.00029	0.000144	0.000102	0.000171
Zinc	0.0053	0.005	0.0355	0.001	0.001	0.001

5.3.5 W6 – Tributary on the North side of Minto Creek

The water quality statistics for W6 from 2007 to 2016 are summarized below in Table 5-12. A total of eight routine samples were collected from station W6 during the 2016 monitoring period.

Table 5-12: W6 Water Quality Results Summary (2007-2016)

W6	2007 - 2015 Summary Statistics			2016 Summary Statistics		
Parameters	**Mean**	**Min**	**Max**	**Mean**	**Min**	**Max**
pH	8.01	7.34	8.4	7.95	7.7	8.19
TSS (mg/L)	85.8	1	1160	30.1	3	102
Nutrients (mg/L)						
Ammonia Nitrogen	0.0539	0.005	0.5	0.0066	0.005	0.009
Nitrite Nitrogen	0.0085	0.005	0.07	0.001	0.001	0.001
Nitrate Nitrogen	0.371	0.01	8.09	0.0072	0.005	0.017
Dissolved Metals (mg/L)						
Aluminum	0.0138	0.003	0.097	0.0097	0.005	0.0219
Arsenic	0.00045	0.0002	0.001	0.00047	0.00039	0.00054
Cadmium	0.000042	0.00001	0.00023	0.0000051	0.000005	0.0000058
Chromium	0.0013	0.0004	0.002	0.00024	0.00018	0.00035
Copper	0.00281	0.0008	0.043	0.00151	0.00096	0.00316
Iron	0.0646	0.01	0.2	0.089	0.013	0.138
Lead	0.00021	0.0001	0.0005	0.00005	0.00005	0.00005
Molybdenum	0.0015	0.00027	0.015	0.000458	0.000247	0.000546
Nickel	0.0011	0.001	0.003	0.0014	0.00118	0.00158
Selenium	0.00043	0.0001	0.002	0.000077	0.000057	0.000089
Zinc	0.0072	0.002	0.049	0.0017	0.001	0.0041

5.3.6 W7 – North Flowing Tributary to Minto Creek

The water quality statistics for W7 from 2007 to 2016 are summarized below in Table 5-13. A total of twelve routine samples were collected from station W7 during the 2016 monitoring period.

Table 5-13: W7 Water Quality Results Summary (2007-2016)

W7	2007 - 2015 Summary Statistics			2016 Summary Statistics		
Parameters	Mean	Min	Max	Mean	Min	Max
pH	7.97	5.51	8.41	8.06	7.8	8.24
TSS (mg/L)	32.8	1	400	43.8	3	229
Nutrients (mg/L)						
Ammonia Nitrogen	0.037	0.005	0.34	0.0195	0.005	0.0373
Nitrite Nitrogen	0.0177	0.005	0.14	0.0014	0.001	0.005
Nitrate Nitrogen	0.112	0.02	0.324	0.1073	0.0063	0.185
Dissolved Metals (mg/L)						
Aluminum	0.0204	0.003	0.096	0.0087	0.0039	0.0219
Arsenic	0.00045	0.0002	0.001	0.00042	0.00031	0.00052
Cadmium	0.000033	0.00001	0.0001	0.0000062	0.000005	0.0000131
Chromium	0.0012	0.0004	0.002	0.00028	0.00013	0.001
Copper	0.00209	0.00074	0.0154	0.00136	0.00063	0.00368
Iron	0.2059	0.0102	1.06	0.1138	0.0138	0.193
Lead	0.00021	0.0001	0.0017	0.000063	0.00005	0.0002
Molybdenum	0.00128	0.00013	0.002	0.001294	0.000664	0.00163
Nickel	0.0013	0.0005	0.004	0.00098	0.00067	0.00135
Selenium	0.00035	0.0001	0.0022	0.000176	0.000092	0.00032
Zinc	0.0058	0.001	0.01	0.0019	0.001	0.005

5.3.7 W10 – Minto Creek Headwaters (South-West Fork)

The water quality statistics for W10 from 2007 to 2016 are summarized below in Table 5-14. A total of eleven routine samples were collected from station W10 during the 2016 monitoring period.

Table 5-14: W10 Water Quality Results Summary (2007-2016)

W10	2007 - 2015 Summary Statistics			2016 Summary Statistics		
Parameters	**Mean**	**Min**	**Max**	**Mean**	**Min**	**Max**
pH	7.41	6	8.57	7.55	6.84	8.11
TSS (mg/L)	9.4	1	77	56.5	3	366
Nutrients (mg/L)						
Ammonia Nitrogen	0.0796	0.0057	1.1	0.4247	0.005	1.3
Nitrite Nitrogen	0.0135	0.005	0.05	0.0318	0.001	0.148
Nitrate Nitrogen	0.067	0.01	0.801	2.1934	0.005	6.59
Dissolved Metals (mg/L)						
Aluminum	0.1397	0.003	0.418	0.0247	0.0035	0.0777
Arsenic	0.00045	0.0001	0.002	0.00071	0.0001	0.00248
Cadmium	0.000049	0.00001	0.0007	0.0000066	0.000005	0.0000108
Chromium	0.0011	0.0004	0.002	0.00033	0.0001	0.001
Copper	0.03803	0.0002	0.138	0.00321	0.00032	0.0143
Iron	1.3437	0.005	38.2	10.443	0.026	41.7
Lead	0.00022	0.0001	0.0022	0.000095	0.00005	0.00044
Molybdenum	0.00088	0.00003	0.0015	0.000637	0.000076	0.001
Nickel	0.0016	0.001	0.0038	0.00127	0.0005	0.00395
Selenium	0.00029	0.0001	0.001	0.000119	0.00005	0.000323
Zinc	0.0085	0.005	0.062	0.0026	0.001	0.006

5.3.8 W12 – Water in the Main Pit

The water quality statistics for W12 from 2007 to 2016 are summarized below in Table 5-15. A total of twelve routine samples were collected from station W12 during the 2016 monitoring period.

Table 5-15: W12 Water Quality Results Summary (2007-2016)

W12	2007 - 2015 Summary Statistics			2016 Summary Statistics		
Parameters	**Mean**	**Min**	**Max**	**Mean**	**Min**	**Max**
pH	8.07	6.2	10.6	8.07	7.9	8.34
TSS (mg/L)	19.1	1	251	13.2	2.2	67.2
Nutrients (mg/L)						
Ammonia Nitrogen	2.1933	0.005	24	3.28	2.32	4.72
Nitrite Nitrogen	0.6151	0.005	8.78	2.139	0.641	4.33
Nitrate Nitrogen	20.061	0.01	141	26.4	23.6	29.4
Dissolved Metals (mg/L)						
Aluminum	0.0241	0.0016	0.124	0.0112	0.0058	0.0176
Arsenic	0.00073	0.0001	0.003	0.00044	0.00032	0.0005
Cadmium	0.000052	0.00001	0.00049	0.0000175	0.000005	0.0000342
Chromium	0.001	0.0004	0.0025	0.00032	0.0001	0.001
Copper	0.06032	0.00046	0.476	0.0277	0.0174	0.0526
Iron	0.0448	0.005	0.386	0.0126	0.0097	0.022
Lead	0.00021	0.0001	0.0005	0.000088	0.00005	0.0002
Molybdenum	0.0399	0.001	0.0972	0.0797	0.069	0.0866
Nickel	0.0015	0.0005	0.0038	0.00181	0.0014	0.00253
Selenium	0.00624	0.0001	0.0207	0.0148	0.0129	0.0171
Zinc	0.0058	0.001	0.031	0.0038	0.0022	0.0061

5.3.9 W12A – Discharge in the Main Pit

There was no discharge from the Main Pit in 2016 and no discharge from the Main Pit in previous years.

5.3.10 W14 – Tailings Thickener Overflow

The water quality statistics for W14 from 2007 to 2016 are summarized below in Table 5-16. A total of twelve routine samples were collected from station W14 during the 2016 monitoring period.

Table 5-16: W14 Water Quality Results Summary (2007-2016)

W14	2007 - 2015 Summary Statistics			2016 Summary Statistics		
Parameters	**Mean**	**Min**	**Max**	**Mean**	**Min**	**Max**
pH	7.96	7.29	8.69	8.22	7.97	8.39
TSS (mg/L)	130.8	5	1120	53.9	14	148
Nutrients (mg/L)						
Ammonia Nitrogen	2.94	0.05	13	4.56	2.2	9.58
Nitrite Nitrogen	0.8064	0.0183	3.06	2.011	0.21	4.3
Nitrate Nitrogen	35.1	12.3	86.7	40	26.2	55.2
Dissolved Metals (mg/L)						
Aluminum	0.1322	0.0337	1.91	0.0517	0.0078	0.25
Arsenic	0.00064	0.0002	0.0052	0.00042	0.00031	0.00046
Cadmium	0.000049	0.00001	0.0003	0.0000085	0.000005	0.000015
Chromium	0.001	0.0004	0.0036	0.00033	0.0001	0.001
Copper	0.01617	0.0002	0.723	0.00237	0.00038	0.0162
Iron	0.1009	0.005	4.8	0.0101	0.0056	0.02
Lead	0.00022	0.0001	0.0011	0.000095	0.00005	0.0002
Molybdenum	0.0967	0.0458	0.181	0.0984	0.059	0.122
Nickel	0.0013	0.0005	0.0082	0.00193	0.00077	0.0041
Selenium	0.03482	0.00166	0.229	0.0177	0.0106	0.0244
Zinc	0.0054	0.001	0.028	0.0022	0.001	0.005

5.3.11 W15 – Upper Minto Creek Stormwater Collection Point

The water quality statistics for W15 from 2007 to 2016 are summarized below in Table 5-17. A total of fifteen routine samples were collected from station W15 during the 2016 monitoring period. The results for dissolved copper, dissolved aluminum, dissolved cadmium, and dissolved selenium for W15 from 2007 to 2016 are also presented in Figure 5-7 and Figure 5-8 below.

Table 5-17: W15 Water Quality Results Summary (2007-2016)

W15	2007 - 2015 Summary Statistics			2016 Summary Statistics		
Parameters	Mean	Min	Max	Mean	Min	Max
pH	7.92	6.11	8.48	8.08	7.75	8.28
TSS (mg/L)	17.7	1	370	10.7	3	86.6
Nutrients (mg/L)						
Ammonia Nitrogen	0.1236	0.005	5.3	0.0489	0.0051	0.174
Nitrite Nitrogen	0.1019	0.005	3.78	0.0377	0.0093	0.113
Nitrate Nitrogen	11.626	0.01	265	20.17	5.95	39.3
Dissolved Metals (mg/L)						
Aluminum	0.0555	0.003	2.65	0.0088	0.0019	0.0383
Arsenic	0.000549	0.0001	0.0022	0.00033	0.00015	0.00047
Cadmium	0.000045	0.00001	0.00234	0.0000206	0.000005	0.000108
Chromium	0.0011	0.00022	0.0053	0.00021	0.0001	0.001
Copper	0.02365	0.0002	0.415	0.02281	0.00779	0.0853
Iron	0.423	0.005	6.48	0.0542	0.01	0.238
Lead	0.000217	0.000031	0.0027	0.000061	0.00005	0.0002
Molybdenum	0.0041	0.0001	0.113	0.00333	0.00104	0.005
Nickel	0.001343	0.0009	0.008	0.00077	0.0005	0.0011
Selenium	0.00255	0.0001	0.0504	0.00483	0.00168	0.00963
Zinc	0.00596	0.001	0.041	0.002	0.001	0.0055

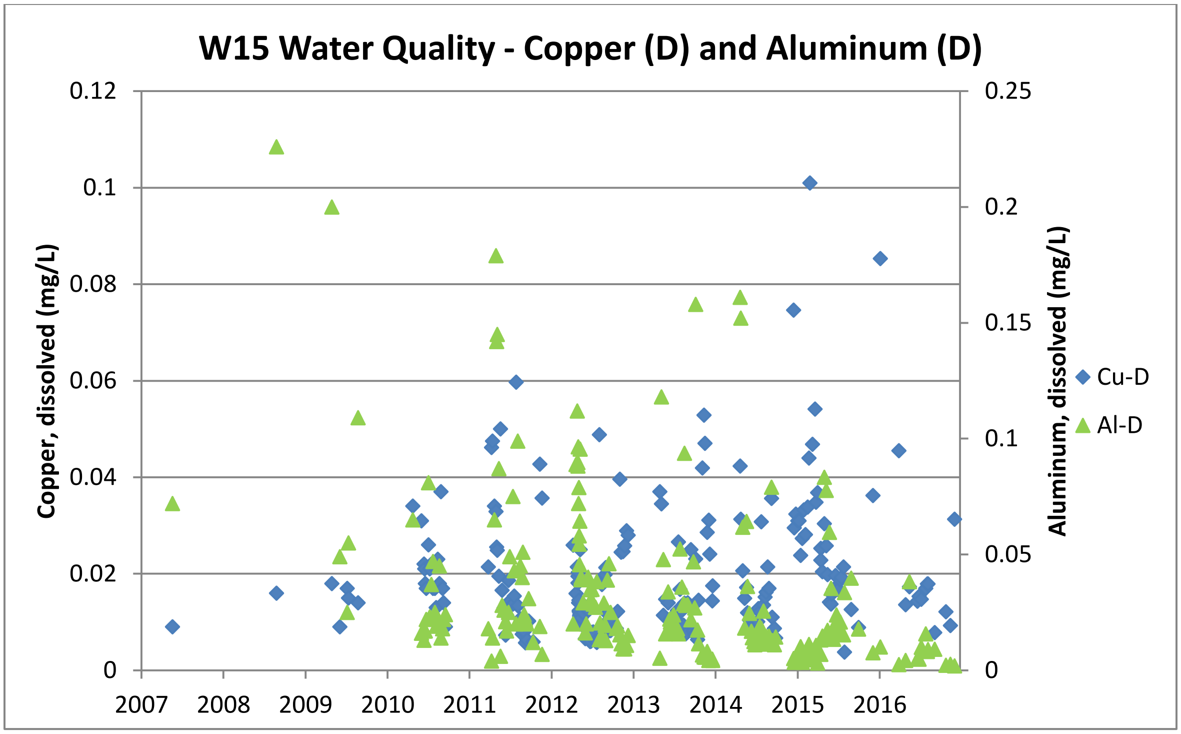


Figure 5-7: W15 Copper and Aluminum Concentrations (2007-2016)

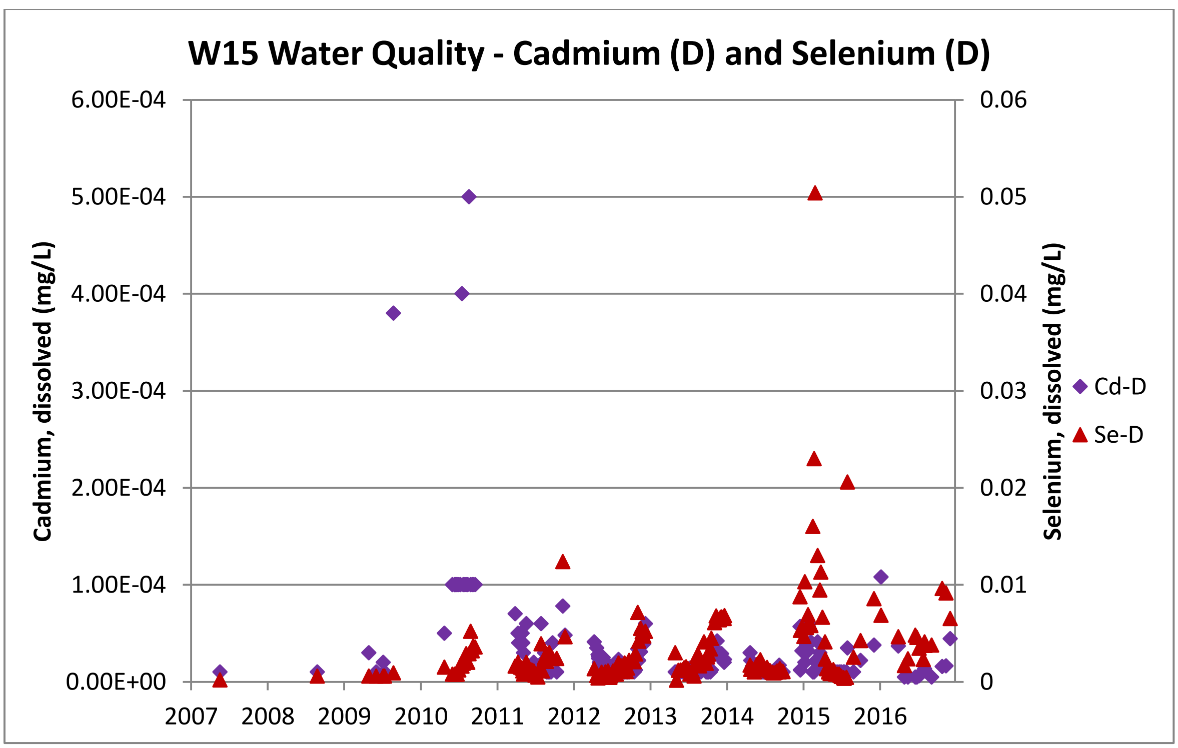


Figure 5-8: W15 Cadmium and Selenium Concentrations (2007-2016)

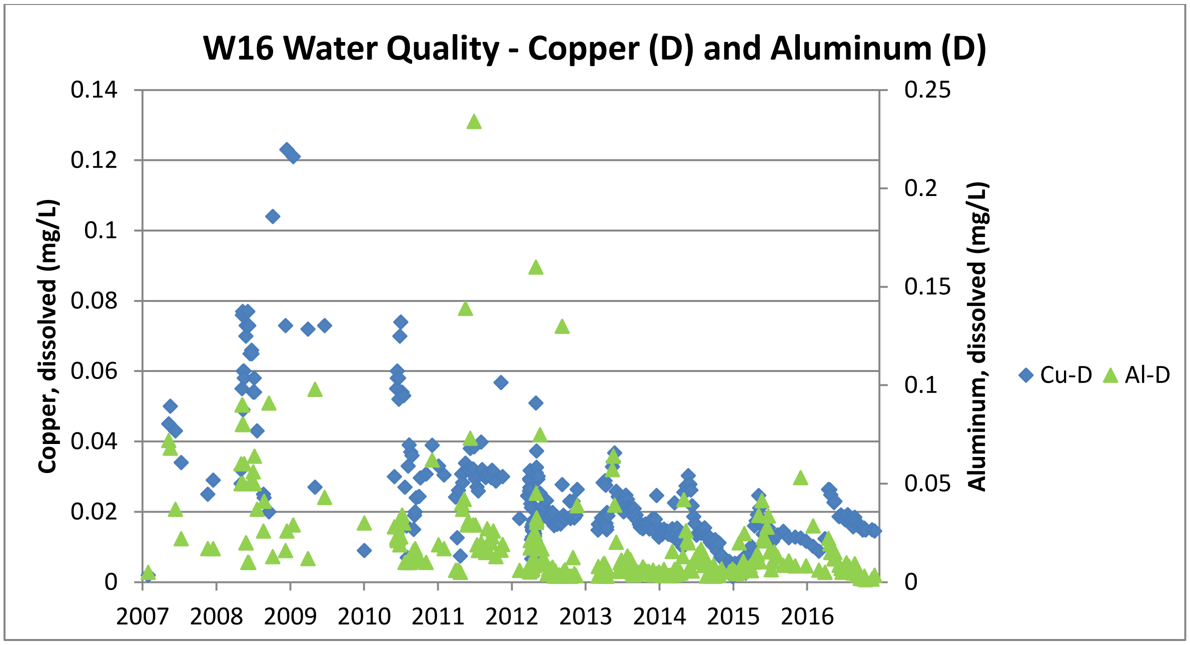
5.3.12 W16 – Water Storage Pond

The water quality statistics for W16 from 2007 to 2016 are summarized below in Table 5-18. A total of 31 routine samples were collected from station W16 during the 2016 monitoring period. The results for dissolved copper, dissolved aluminum, dissolved cadmium, and dissolved selenium for W16 from 2007 to 2016 are also presented in Figure 5-9 and Figure 5-10 below.

Table 5-18: W16 Water Quality Results Summary (2007-2016)

W16	Effluent Quality Standards (WUL Clause 9)	2007 - 2015 Summary Statistics			2016 Summary Statistics		
Parameters		Mean	Min	Max	Mean	Min	Max
pH	6.0-9.0	7.98	6.74	8.76	8.15	7.65	8.81
TSS (mg/L)	15	7.8	1	181	5	1.2	14.8
Nutrients (mg/L)							
Ammonia Nitrogen	0.75	0.1515	0.005	2	0.06	0.0125	0.311
Nitrite Nitrogen	0.18	0.1101	0.0012	8.62	0.0349	0.0059	0.0936
Nitrate Nitrogen	27.3	3.519	0.01	35	4.179	0.805	5.73
Dissolved Metals (mg/L)							
Aluminum	0.3	0.01852	0.003	0.234	0.0079	0.0013	0.0285
Arsenic	0.015	0.000419	0.0001	0.0015	0.00035	0.00012	0.00088
Cadmium	0.00015	0.000045	0.000007	0.00557	0.0000085	0.000005	0.000017
Chromium	0.003	0.00112	0.00013	0.0172	0.00019	0.0001	0.001
Copper	0.039	0.02445	0.00158	0.123	0.01743	0.00881	0.0264
Iron	3.3	0.1287	0.0066	1.36	0.0312	0.01	0.07
Lead	0.012	0.00022	0.00002	0.001	0.000067	0.00005	0.0002
Molybdenum	0.219	0.00608	0.00074	0.0271	0.0036	0.0024	0.0051
Nickel	0.33	0.001332	0.0005	0.009	0.00069	0.0005	0.001
Selenium	0.006	0.001201	0.0001	0.0064	0.001246	0.00041	0.00164
Zinc	0.09	0.00695	0.001	0.0828	0.0023	0.001	0.0063

Bold values indicate exceedances of the WUL standards



*Note that the cadmium standard is based on a hardness of 63 mg/L which is a conservative estimate of hardness at the WQO station.

Figure 5-9: W16 Copper and Aluminum Concentrations (2007-2016)

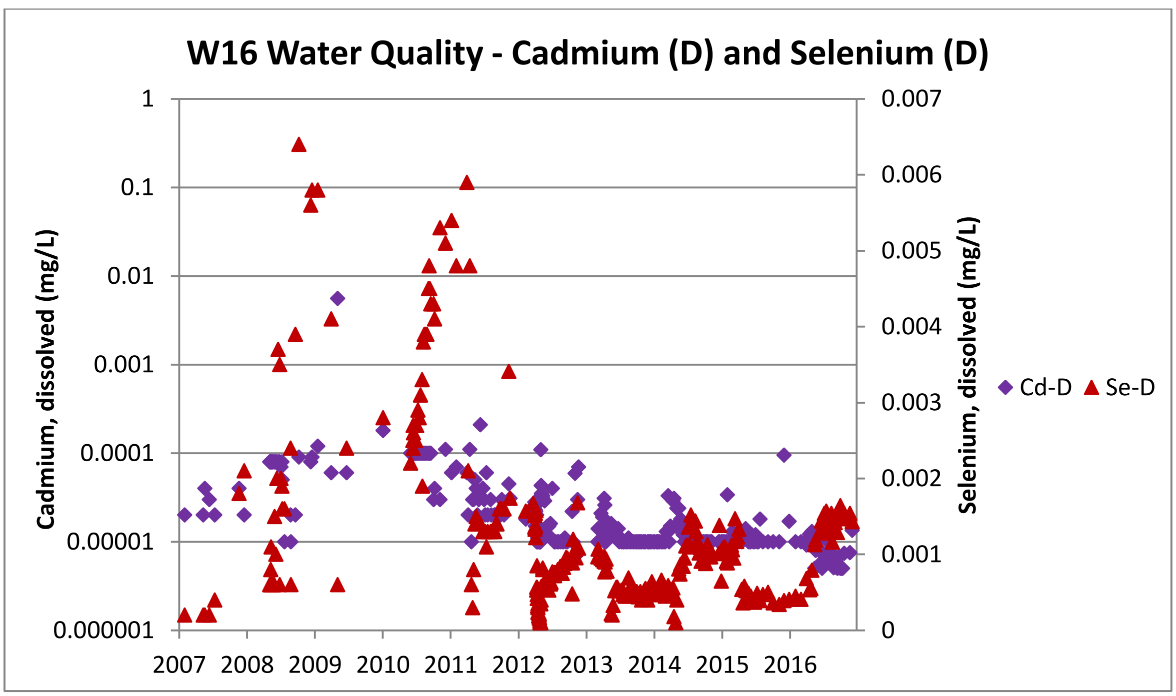


Figure 5-10: W16 Cadmium and Selenium Concentrations (2007-2016)

5.3.13 W30 – Headwaters Minto Creek (northwest fork)

The water quality statistics for W30 from 2009 to 2016 are summarized below in Table 5-19. A total of twelve routine samples were collected from station W30 during the 2016 monitoring period.

Table 5-19: W30 Water Quality Results Summary (2009-2016)

W30	2009 - 2015 Summary Statistics			2016 Summary Statistics		
Parameters	Mean	Min	Max	Mean	Min	Max
pH	7.7	6.15	8.34	8.18	7.94	8.43
TSS (mg/L)	19.9	1	1110	7.7	3	22
Nutrients (mg/L)						
Ammonia Nitrogen	0.102	0.005	0.56	0.2023	0.0064	0.85
Nitrite Nitrogen	0.0346	0.005	0.579	0.0216	0.001	0.0682
Nitrate Nitrogen	3.51	0.01	78.6	5.017	0.719	13.2
Dissolved Metals (mg/L)						
Aluminum	0.0687	0.001	0.217	0.006	0.0013	0.0206
Arsenic	0.00119	0.00024	0.054	0.00053	0.00034	0.00068
Cadmium	0.001729	0.00001	0.143	0.0000289	0.000005	0.000091
Chromium	0.0012	0.0004	0.0149	0.00031	0.0001	0.001
Copper	0.0348	0.0067	0.179	0.032	0.0192	0.059
Iron	0.246	0.001	0.783	0.047	0.014	0.14
Lead	0.00022	0.0001	0.001	0.000085	0.00005	0.0002
Molybdenum	0.00204	0.0002	0.0098	0.00257	0.00184	0.0035
Nickel	0.0013	0.001	0.024	0.00071	0.0005	0.0013
Selenium	0.00595	0.0004	0.343	0.00266	0.00138	0.00407
Zinc	0.0059	0.001	0.013	0.0045	0.001	0.0164

5.3.14 W33 – Above Tailings Diversion Ditches

The water quality statistics for W33 from 2009 to 2016 are summarized below in Table 5-20. A total of six routine samples were collected from station W33 during the 2016 monitoring period.

Table 5-20: W33 Water Quality Results Summary (2009-2016)

W33	2009 - 2015 Summary Statistics			2016 Summary Statistics		
Parameters	Mean	Min	Max	Mean	Min	Max
pH	7.63	5.98	8.25	7.72	7.48	8.17
TSS (mg/L)	10.7	1	218	4.5	3	12
Nutrients (mg/L)						
Ammonia Nitrogen	0.0622	0.005	0.5	0.0097	0.0065	0.0151
Nitrite Nitrogen	0.0173	0.005	0.251	0.0054	0.001	0.0133
Nitrate Nitrogen	2.664	0.01	60.4	5.114	0.309	19.4
Dissolved Metals (mg/L)						
Aluminum	0.0487	0.003	0.31	0.0283	0.0158	0.0434
Arsenic	0.00036	0.0001	0.001	0.00036	0.00033	0.00043
Cadmium	0.000033	0.00001	0.0001	0.0000066	0.000005	0.0000149
Chromium	0.0012	0.0004	0.0022	0.00043	0.00039	0.0005
Copper	0.01357	0.0002	0.106	0.01231	0.00808	0.0171
Iron	0.1611	0.005	0.956	0.093	0.038	0.138
Lead	0.00021	0.0001	0.0007	0.000052	0.00005	0.000062
Molybdenum	0.00099	0.0002	0.003	0.000809	0.000423	0.00136
Nickel	0.0015	0.001	0.003	0.00152	0.00119	0.00183
Selenium	0.00043	0.0001	0.006	0.000152	0.000101	0.000313
Zinc	0.0061	0.002	0.01	0.0023	0.001	0.0052

5.3.15 W35 – Storm Water Collection Point – South Diversion Ditch

The water quality statistics for W35 from 2009 to 2016 are summarized below in Table 5-21. A total of eight routine samples were collected from station W35 during the 2016 monitoring period. The results for dissolved copper, dissolved aluminum, dissolved cadmium, and dissolved selenium for W35 from 2007 to 2016 are also presented in Figure 5-11 and Figure 5-12 below.

Table 5-21: W35 Water Quality Results Summary (2009-2016)

W35	2009 - 2015 Summary Statistics			2016 Summary Statistics		
Parameters	Mean	Min	Max	Mean	Min	Max
pH	7.89	6.77	8.26	7.93	7.6	8.2
TSS (mg/L)	28.5	1	465	3.7	3	5.3
Nutrients (mg/L)						
Ammonia Nitrogen	0.0492	0.011	0.19	0.057	0.0059	0.303
Nitrite Nitrogen	0.0374	0.005	0.335	0.0334	0.0025	0.0836
Nitrate Nitrogen	4.094	0.02	21.6	10.93	3.32	28.7
Dissolved Metals (mg/L)						
Aluminum	0.0302	0.0091	0.104	0.0151	0.0061	0.0333
Arsenic	0.00033	0.00023	0.00048	0.00038	0.00035	0.00042
Cadmium	0.000013	0.00001	0.000046	0.000008	0.000005	0.0000171
Chromium	0.001	0.001	0.001	0.00029	0.00021	0.00038
Copper	0.0323	0.017	0.0533	0.0369	0.0237	0.0551
Iron	0.1007	0.0144	0.323	0.043	0.016	0.081
Lead	0.0002	0.0002	0.0002	0.000051	0.00005	0.000057
Molybdenum	0.0015	0.001	0.0055	0.001129	0.000783	0.00173
Nickel	0.0012	0.001	0.0016	0.00102	0.00064	0.00139
Selenium	0.00023	0.0001	0.00048	0.000309	0.000163	0.000475
Zinc	0.005	0.005	0.005	0.0027	0.001	0.0068

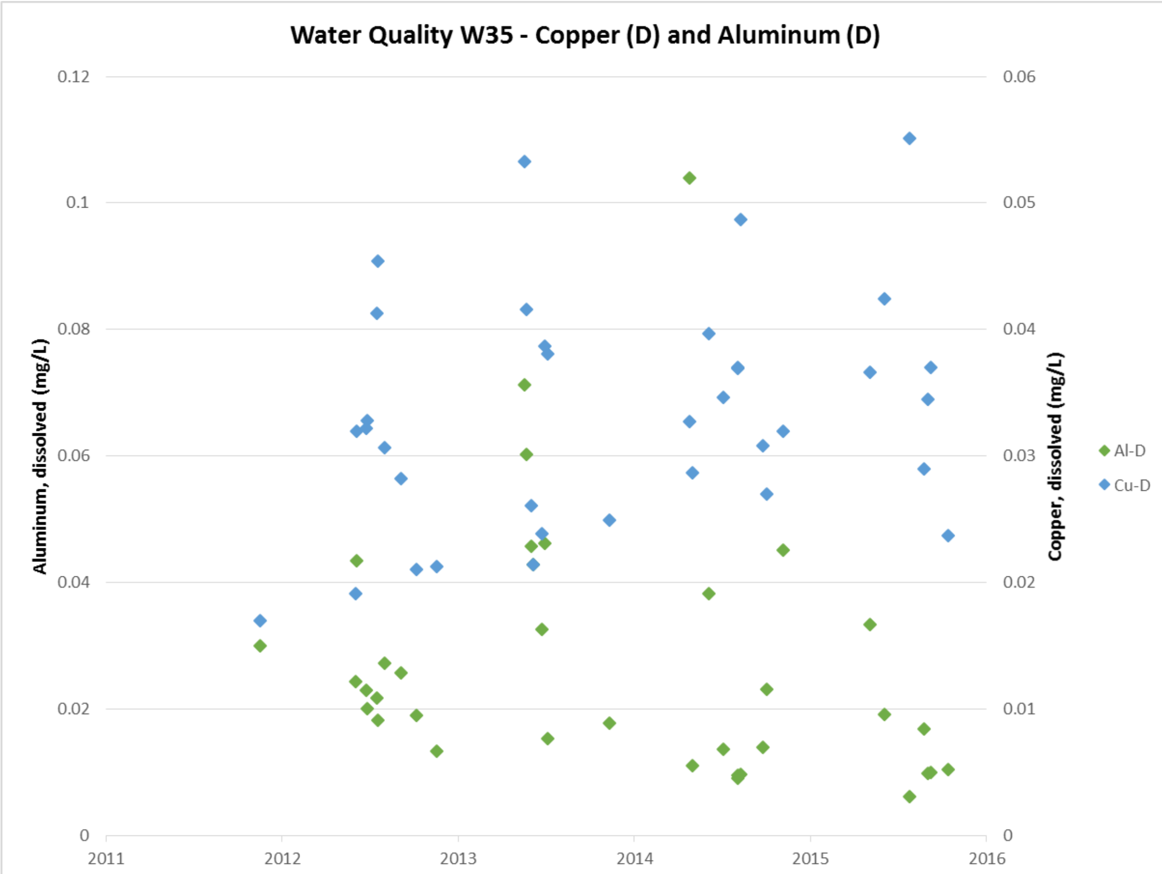


Figure 5-11: W35 Copper and Aluminum Concentrations (2007-2016)

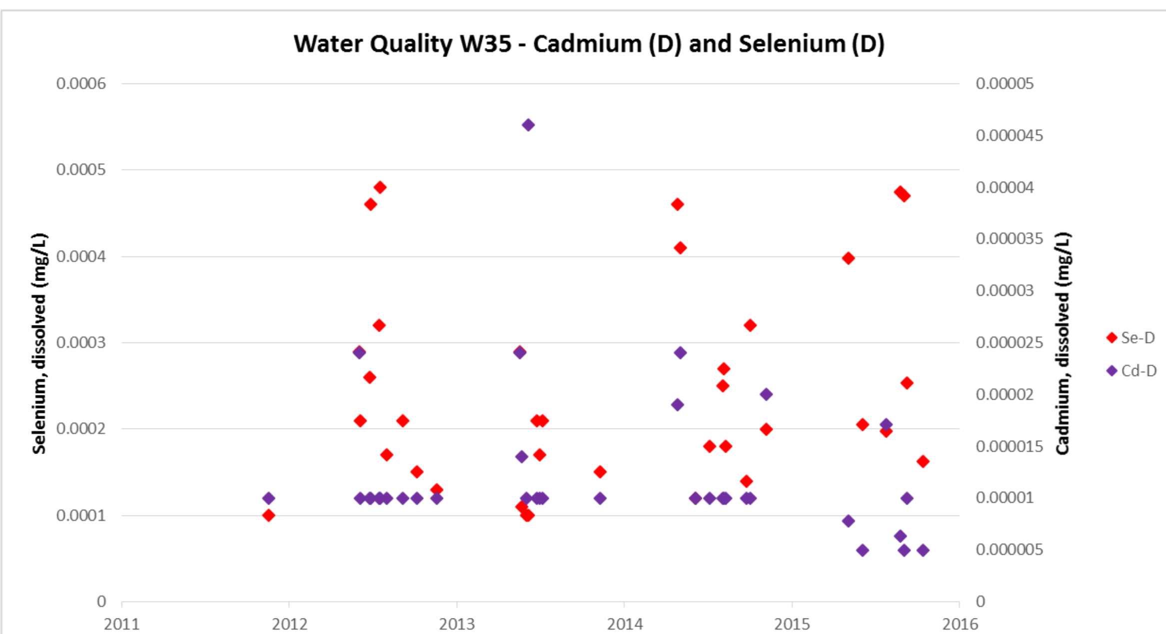


Figure 5-12: W35 Cadmium and Selenium Concentrations (2007-2016)

5.3.16 W36 – Minto Creek Detention Structure Pond

W36 was decommissioned during the construction of the Mill Valley Fill Extension Phase 2 (MVFE2) in 2015. As such, no samples were taken in 2016.

5.3.17 W45– Area 2 Pit

The water quality statistics for W45 from 2012 to 2016 are summarized below in Table 5-22. A total of ten routine samples were collected from station W45 during the 2016 monitoring period.

Table 5-22: W45 Water Quality Results Summary (2012-2016)

W45	2012 - 2015 Summary Statistics			2016 Summary Statistics		
Parameters	Mean	Min	Max	Mean	Min	Max
pH	8.04	7.86	8.27	8.1	7.87	8.21
TSS (mg/L)	32.1	1	291	15.4	6	41
Nutrients (mg/L)						
Ammonia Nitrogen	6.431	0.072	37	3.72	2.26	5.75
Nitrite Nitrogen	0.9824	0.0223	2.53	3.87	1.64	7.6
Nitrate Nitrogen	21.25	1.65	77.2	29.3	23.1	32.9
Dissolved Metals (mg/L)						
Aluminum	0.0223	0.0032	0.337	0.0141	0.0096	0.0219
Arsenic	0.00123	0.00036	0.00234	0.00041	0.00032	0.00053
Cadmium	0.000146	0.00001	0.000517	0.0000197	0.000005	0.000075
Chromium	0.001	0.001	0.001	0.00021	0.0001	0.001
Copper	0.08397	0.00109	0.276	0.00408	0.00025	0.0163
Iron	0.0792	0.005	0.726	0.036	0.01	0.188
Lead	0.00022	0.0002	0.00066	0.000077	0.00005	0.0002
Molybdenum	0.0371	0.0033	0.117	0.0939	0.0877	0.1
Nickel	0.0014	0.001	0.0033	0.00305	0.0016	0.00472
Selenium	0.0058	0.00048	0.0298	0.0185	0.0173	0.0195
Zinc	0.014	0.005	0.0673	0.0019	0.001	0.005

5.3.18 W46 – Minto Creek, Downstream of W7 and W6

The water quality statistics for W46 from 2012 to 2016 are summarized below in Table 5-23. A total of nine routine samples were collected from station W46 during the 2016 monitoring period.

Table 5-23: W46 Water Quality Results Summary (2012-2016)

W46	2012 - 2015 Summary Statistics			2016 Summary Statistics		
Parameters	**Mean**	**Min**	**Max**	**Mean**	**Min**	**Max**
pH	8.11	7.61	8.33	7.98	7.49	8.22
TSS (mg/L)	17.9	1	78.1	36.5	3	175
Nutrients (mg/L)						
Ammonia Nitrogen	0.0326	0.0099	0.16	0.016	0.0062	0.0352
Nitrite Nitrogen	0.0057	0.005	0.0242	0.0021	0.001	0.0042
Nitrate Nitrogen	0.302	0.02	2.46	0.7033	0.0335	3.28
Dissolved Metals (mg/L)						
Aluminum	0.0102	0.003	0.0449	0.0082	0.0032	0.0176
Arsenic	0.00047	0.0003	0.00078	0.00042	0.00034	0.00054
Cadmium	0.000011	0.00001	0.000019	0.0000072	0.000005	0.0000163
Chromium	0.001	0.001	0.001	0.0002	0.00011	0.00046
Copper	0.0025	0.00089	0.0108	0.00336	0.00176	0.00534
Iron	0.192	0.0183	0.646	0.112	0.063	0.219
Lead	0.0002	0.0002	0.00022	0.000051	0.00005	0.000064
Molybdenum	0.0021	0.001	0.007	0.00207	0.00137	0.00284
Nickel	0.0011	0.001	0.0021	0.00102	0.00068	0.0013
Selenium	0.00021	0.0001	0.00068	0.000296	0.000111	0.000887
Zinc	0.0053	0.005	0.015	0.0017	0.001	0.0029

5.3.19 W47 – Area 118 Pit Water

The water quality statistics for W47 from 2015 and 2016 are summarized below in Table 5-24. Only one routine sample was collected from station W47 during the 2016 monitoring period.

Table 5-24: W47 Water Quality Results Summary (2015-2016)

W47	2015 Summary Statistics			2016 Summary
Parameters	Mean	Min	Max	
pH	8.06	8.02	8.1	7.98
TSS (mg/L)	29.7	2.3	86.8	12.6
Nutrients (mg/L)				
Ammonia Nitrogen	18	16	25	0.188
Nitrite Nitrogen	1.049	0.857	1.5	0.136
Nitrate Nitrogen	37.5	30.3	60.1	30
Dissolved Metals (mg/L)				
Aluminum	0.0115	0.0057	0.0275	0.0018
Arsenic	0.00226	0.00111	0.00259	0.00048
Cadmium	0.000011	0.00001	0.000015	0.0000473
Chromium	0.001	0.001	0.001	0.0001
Copper	0.02703	0.00614	0.0931	0.0337
Iron	0.0227	0.005	0.0799	0.01
Lead	0.0002	0.0002	0.0002	0.00005
Molybdenum	0.0201	0.0153	0.0331	0.0324
Nickel	0.0021	0.0019	0.0023	0.0005
Selenium	0.00123	0.00094	0.00185	0.0244
Zinc	0.0051	0.005	0.0057	0.0053

5.3.20 W50 – Minto Creek, 50m Downstream of the Toe of the Water Storage Pond Dam

The water quality statistics for W50 from 2008 to 2016 are summarized below in Table 5-25. A total of 31 routine samples were collected from station W50 during the 2016 monitoring period. The results for dissolved copper, dissolved aluminum, dissolved cadmium, and dissolved selenium for W50 from 2008 to 2016 are also presented in Figure 5-13 and Figure 5-14 below.

Table 5-25: W50 Water Quality Results Summary (2008-2016)

W50	Effluent Quality Standards (WUL Clause 9)	2008 - 2015 Summary Statistics			2016 Summary Statistics		
Parameters		Mean	Min	Max	Mean	Min	Max
pH	6.0-9.0	8.05	6.82	8.4	7.93	7.41	8.27
TSS (mg/L)	15	6.2	1	42	3.8	3	8
Nutrients (mg/L)							
Ammonia Nitrogen	0.75	0.0807	0.005	1	0.1183	0.0173	0.33
Nitrite Nitrogen	0.18	0.0215	0.005	0.158	0.0336	0.0037	0.0896
Nitrate Nitrogen	27.3	4.205	0.02	16.2	2.746	0.793	5.65
Dissolved Metals (mg/L)							
Aluminum	0.3	0.0186	0.003	0.12	0.008	0.0013	0.0168
Arsenic	0.015	0.00044	0.00023	0.0031	0.00029	0.00012	0.00041
Cadmium	0.00015	0.000023	0.00001	0.00028	0.0000061	0.000005	0.000011
Chromium	0.003	0.00101	0.0004	0.002	0.00011	0.0001	0.00024
Copper	0.039	0.01555	0.001	0.075	0.01439	0.00354	0.0218
Iron	3.3	0.0542	0.005	0.3	0.04	0.01	0.078
Lead	0.012	0.00026	0.0001	0.001	0.000079	0.00005	0.000291
Molybdenum	0.219	0.00698	0.001	0.019	0.00292	0.00103	0.00393
Nickel	0.33	0.0012	0.001	0.005	0.00064	0.0005	0.00086
Selenium	0.006	0.0013	0.0001	0.0049	0.000919	0.000339	0.00171
Zinc	0.09	0.0054	0.001	0.018	0.0014	0.001	0.0045

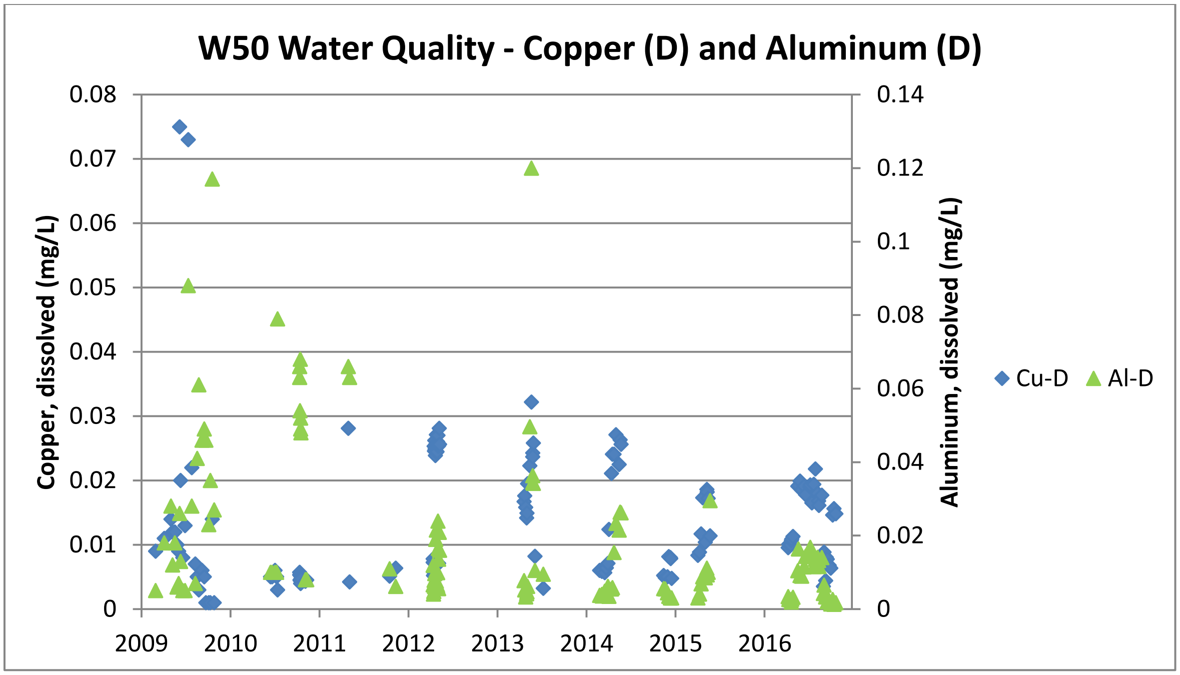


Figure 5-13: W50 Copper and Aluminum Concentrations (2007-2016)

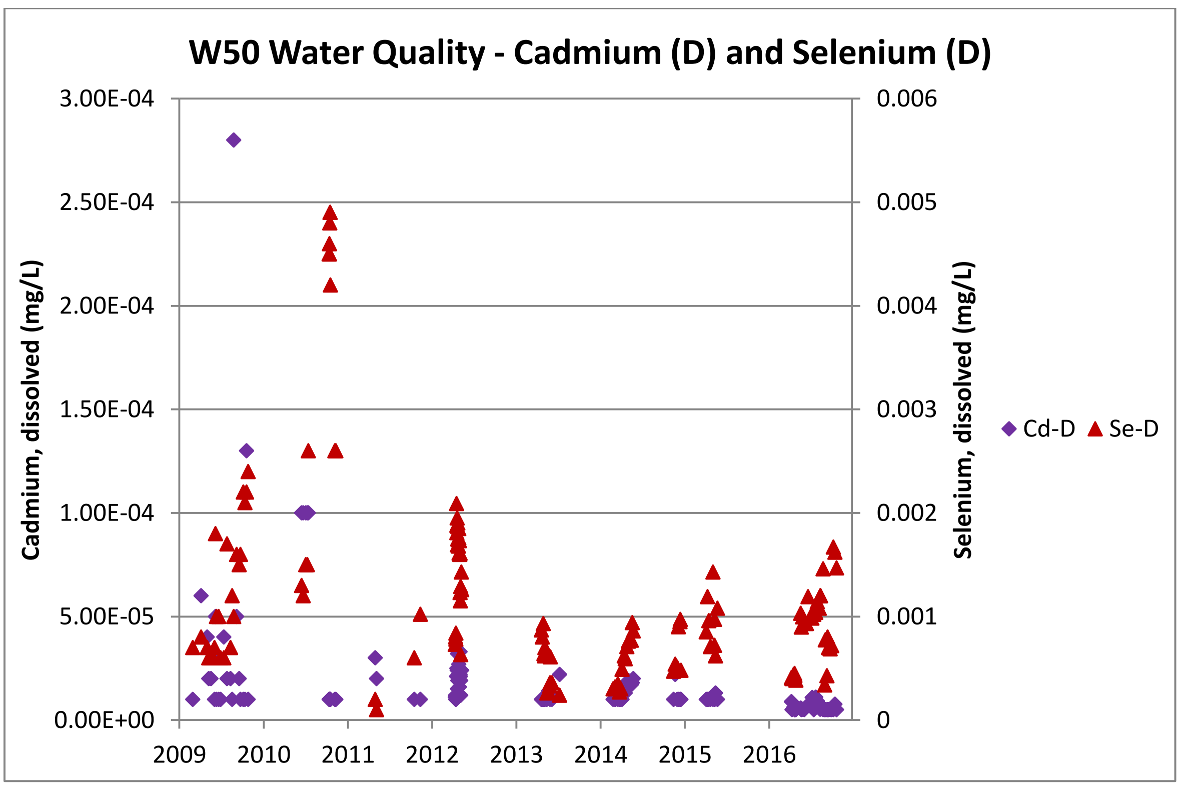


Figure 5-14: W50 Cadmium and Selenium Concentrations (2007-2016)

5.3.21 W51 – Area 2 Stage 3 Pit

The Area 2 Stage 3 Pit was not developed in 2016; therefore, water quality results are not available.

5.3.22 W52 – Ridgetop North Pit

The Ridgetop North Pit was not developed in 2016; therefore, water quality results are not available.

5.3.23 W53 – Ridgetop South Pit

The Ridgetop South Pit was not developed in 2016; therefore, water quality results are not available.

5.3.24 W54 – Main Pit Dam Seepage

The Main Pit Dam was not developed in 2016; therefore, water quality results are not available.

5.3.25 W55 – Tailings Diversion Ditch

The water quality statistics for W55 from 2016 are summarized below in Table 5-26. Two routine sample were collected from station W55 during the 2016 monitoring period, and no historical data exists for this station.

Table 5-26: W55 Water Quality Results Summary (2016)

W55	2016 Summary Statistics		
Parameters	Mean	Min	Max
pH	7.63	7.52	7.74
TSS (mg/L)	4.2	3	5.3
Nutrients (mg/L)			
Ammonia Nitrogen	0.0155	0.0131	0.0178
Nitrite Nitrogen	0.0015	0.001	0.0021
Nitrate Nitrogen	0.0126	0.0065	0.0187
Dissolved Metals (mg/L)			
Aluminum	0.0612	0.0585	0.064
Arsenic	0.0006	0.0006	0.00061
Cadmium	0.0000175	0.0000132	0.0000219
Chromium	0.00034	0.00033	0.00034
Copper	0.0743	0.0567	0.092
Iron	0.128	0.128	0.128
Lead	0.000065	0.00005	0.00008
Molybdenum	0.001047	0.000784	0.00131
Nickel	0.00205	0.00192	0.00219
Selenium	0.000202	0.000185	0.000219
Zinc	0.0013	0.0011	0.0014

5.3.26 W62 – Mill Valley Fill Extension Phase 2 Collection Sump

The water quality statistics for W62 from 2016 are summarized below in Table 5-27. A total of eleven routine samples were collected from station W62 during the 2016 monitoring period, and no historical data exists for this station as it was established in 2016. Because W62 replaced the decommissioned W37, historical data for W37 has been presented with the 2016 data for W62.

Table 5-27: W37/W62 Water Quality Results Summary (2009-2016)

W37/W62	W37 2009 - 2015 Summary Statistics			W62 2016 Summary Statistics		
Parameters	Mean	Min	Max	Mean	Min	Max
pH	8.15	6.8	8.5	8.18	7.9	8.37
TSS (mg/L)	86.4	1	2100	12.1	3	58
Nutrients (mg/L)						
Ammonia Nitrogen	0.1849	0.0062	1.4	0.0354	0.005	0.23
Nitrite Nitrogen	0.1293	0.005	0.51	0.0298	0.001	0.119
Nitrate Nitrogen	11.771	0.02	24.8	7.6491	0.0084	11.3
Dissolved Metals (mg/L)						
Aluminum	0.0204	0.003	0.134	0.005	0.0022	0.0144
Arsenic	0.00047	0.0001	0.001	0.00036	0.00011	0.00044
Cadmium	0.000062	0.00001	0.000104	0.0000207	0.000005	0.0000383
Chromium	0.0012	0.0004	0.002	0.00028	0.0001	0.001
Copper	0.0454	0.0022	0.128	0.04048	0.00195	0.0629
Iron	0.0571	0.0053	0.264	0.0436	0.0113	0.072
Lead	0.00022	0.0001	0.0012	0.000073	0.00005	0.0002
Molybdenum	0.0139	0.001	0.053	0.006067	0.00042	0.00822
Nickel	0.0013	0.001	0.003	0.00109	0.00082	0.00161
Selenium	0.00447	0.0001	0.0179	0.003461	0.000095	0.00485
Zinc	0.007	0.001	0.0585	0.2251	0.0018	0.799

5.3.27 MC-1 – Minto Creek Upstream of Canyon near Km 8 on Mine Access Road

The water quality statistics for MC-1 from 2009 to 2016 are summarized below in Table 5-28. A total of 36 routine samples were collected from station MC-1 during the 2016 monitoring period.

Table 5-28: MC-1 Water Quality Results Summary (2009-2016)

MC-1	2009 - 2015 Summary Statistics			2016 Summary Statistics		
Parameters	Mean	Min	Max	Mean	Min	Max
pH	8.15	7.5	8.54	8.13	5.27	8.41
TSS (mg/L)	58.2	1	727	31.7	3	453
Nutrients (mg/L)						
Ammonia Nitrogen	0.0373	0.005	0.36	0.0094	0.005	0.0362
Nitrite Nitrogen	0.0084	0.001	0.05	0.0013	0.001	0.0053
Nitrate Nitrogen	0.4651	0.005	7.3	0.3887	0.005	2.55
Dissolved Metals (mg/L)						
Aluminum	0.0174	0.0033	0.07	0.01	0.001	0.0523
Arsenic	0.0006	0.0003	0.00125	0.00051	0.0001	0.00067
Cadmium	0.000026	0.00001	0.0002	0.0000061	0.000005	0.000028
Chromium	0.0011	0.0004	0.0021	0.00023	0.0001	0.001
Copper	0.00273	0.001	0.00992	0.00287	0.0002	0.0084
Iron	0.2531	0.024	1.11	0.115	0.01	0.343
Lead	0.00021	0.0002	0.0005	0.000054	0.00005	0.0002
Molybdenum	0.0018	0.0003	0.008	0.001544	0.00005	0.00241
Nickel	0.0013	0.001	0.004	0.00107	0.0005	0.00159
Selenium	0.00034	0.0001	0.0022	0.0002	0.00005	0.00066
Zinc	0.006	0.001	0.0334	0.0018	0.001	0.0081

5.3.28 WTP and RO – Treated Water

Water quality sites WTP and RO represent water treated through the water treatment plant (WTP) and through the WTP with the RO, respectively. Minto utilized the water treatment plant with the RO in 2016. Water treated in 2016 was conveyed water to the Water Storage Pond from March 21, 2016 to September 2, 2016. From September 3, 2016 to October 9, 2016, water from the RO was discharged directly to Minto Creek.

The water quality statistics for the WTP and RO from 2009 to 2016 are summarized below in Table 5-29. A total of 17 routine samples were collected from the WTP and RO during the 2016 monitoring period. The results for dissolved copper, dissolved aluminum, dissolved cadmium, and dissolved selenium from 2009 to 2016 are also presented in Figure 5-15 and Figure 5-16 below.

Table 5-29: Treated Water Quality Results Summary (2009-2016)

WTP and RO	Effluent Quality Standards (WUL Clause 9)	WTP 2009 - 2015 Summary Statistics			RO 2016 Summary Statistics		
Parameters		Mean	Min	Max	Mean	Min	Max
pH	6.0-9.0	7.43	5.25	8.24	7.1	6.66	8.1
TSS (mg/L)	15	2.1	1	30.6	3.3	3	6.7
Nutrients (mg/L)							
Ammonia Nitrogen	0.75	0.3306	0.0058	2.5	0.4427	0.0266	2.56
Nitrite Nitrogen	0.18	0.1123	0.005	1.74	0.2104	0.0067	0.992
Nitrate Nitrogen	27.3	3.44	0.375	9.88	5.425	0.643	25
Dissolved Metals (mg/L)							
Aluminum	0.3	0.0201	0.003	0.14	0.0104	0.001	0.088
Arsenic	0.015	0.00014	0.0001	0.0005	0.00013	0.0001	0.0004
Cadmium	0.00015	0.000024	0.00001	0.000937	0.0000066	0.000005	0.0000283
Chromium	0.003	0.001	0.0004	0.001	0.0001	0.0001	0.0001
Copper	0.039	0.00175	0.0002	0.049	0.00081	0.0002	0.00631
Iron	3.3	0.0211	0.005	0.98	0.01	0.01	0.016
Lead	0.012	0.0002	0.0001	0.00041	0.000059	0.00005	0.000147
Molybdenum	0.219	0.0094	0.001	0.0762	0.008411	0.00013	0.0694
Nickel	0.33	0.0011	0.001	0.0033	0.0006	0.0005	0.00155
Selenium	0.006	0.00108	0.0001	0.00987	0.001747	0.00005	0.0138
Zinc	0.09	0.0054	0.003	0.0137	0.0023	0.001	0.0045

Bold values indicate exceedances of the WUL standards

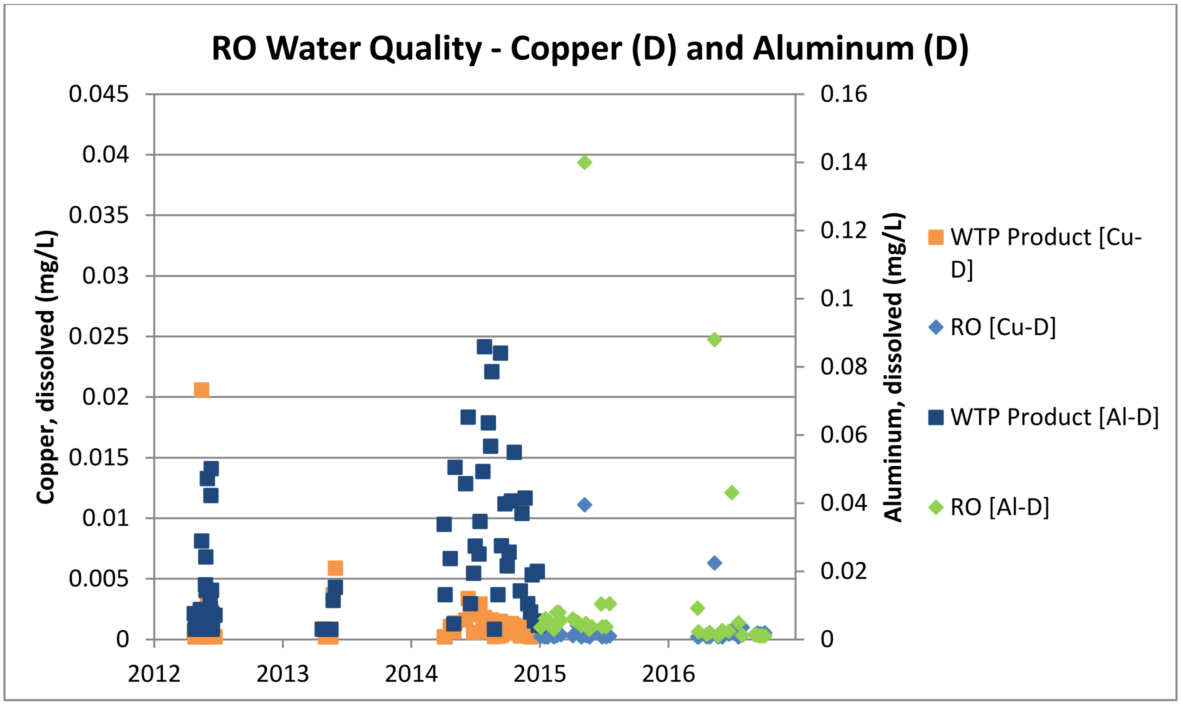
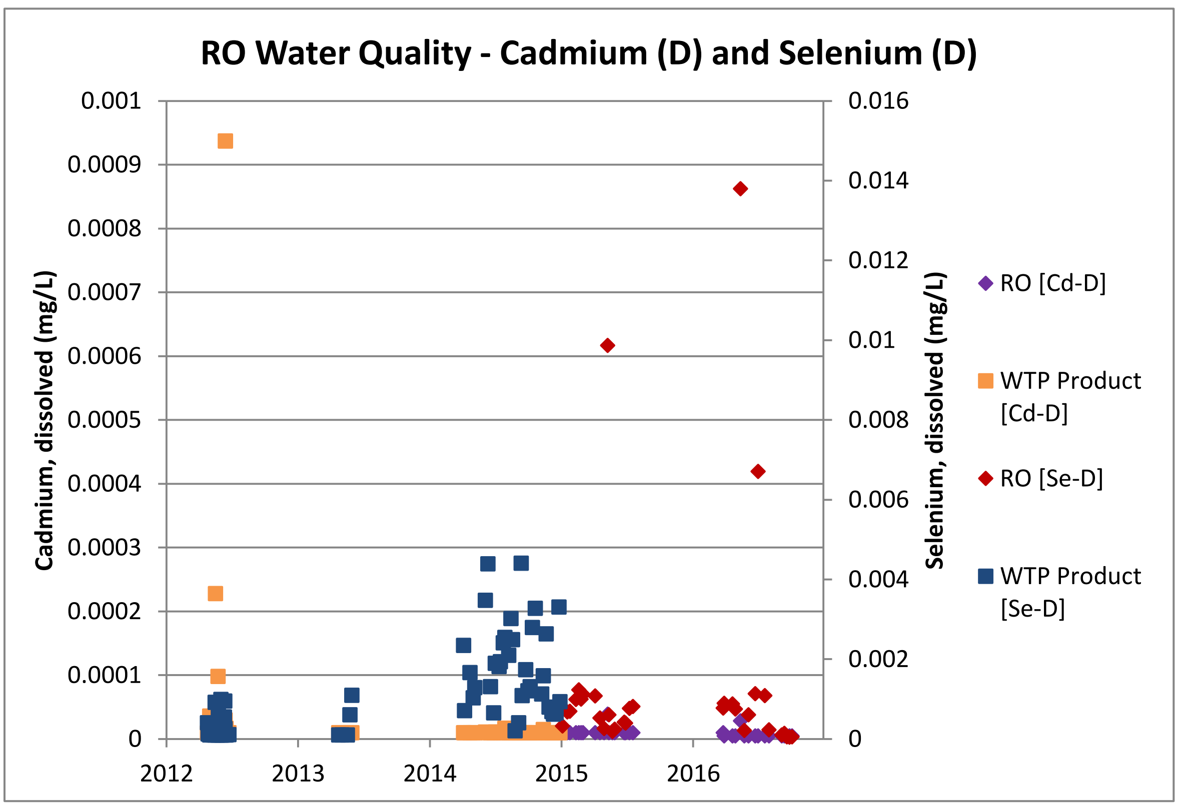


Figure 5-15: Treated Water Copper and Aluminum Concentrations (2012-2016)



*Removed one outlier concentration of cadmium from June 13, 2012 of 0.0009 mg/L*Note that the cadmium standard is based on a hardness of 63 mg/L which is a conservative estimate of hardness at the WQO station.

Figure 5-16: Treated Water Cadmium and Selenium Concentrations (2012-2016)

5.3.29 C4 – Tributary on the south side of Minto Creek

The water quality statistics for C4 from 2012 to 2016 are summarized below in Table 5-30. A total of eight routine samples were collected from station C4 during the 2016 monitoring period.

Table 5-30: C4 Water Quality Results Summary (2012-2016)

C4	2012 - 2015 Summary Statistics			2016 Summary Statistics		
Parameters	Mean	Min	Max	Mean	Min	Max
pH	8.05	7.59	8.29	7.98	7.65	8.24
TSS (mg/L)	275.8	2.3	1260	35	5.8	84.6
Nutrients (mg/L)						
Ammonia Nitrogen	0.113	0.005	0.36	0.0345	0.009	0.127
Nitrite Nitrogen	0.0091	0.005	0.05	0.0014	0.001	0.0024
Nitrate Nitrogen	0.162	0.02	2.31	0.0267	0.005	0.0659
Dissolved Metals (mg/L)						
Aluminum	0.0291	0.0088	0.0622	0.0143	0.0085	0.0376
Arsenic	0.00149	0.00029	0.00559	0.00119	0.00055	0.00256
Cadmium	0.000012	0.00001	0.000029	0.0000071	0.000005	0.0000122
Chromium	0.001	0.001	0.0013	0.00046	0.00037	0.00065
Copper	0.00195	0.00095	0.00952	0.00153	0.00105	0.00323
Iron	1.545	0.056	14.2	1.242	0.416	5.16
Lead	0.0002	0.0002	0.00022	0.00005	0.00005	0.00005
Molybdenum	0.0014	0.001	0.0068	0.000786	0.000379	0.000992
Nickel	0.0024	0.001	0.0061	0.00228	0.00188	0.00309
Selenium	0.00013	0.0001	0.00068	0.000102	0.000076	0.000161
Zinc	0.005	0.005	0.005	0.0016	0.001	0.0029

5.3.30 C10 – Tributary on the south side of Minto Creek

The water quality statistics for C10 from 2012 to 2016 are summarized below in Table 5-31. A total of four routine samples were collected from station C10 during the 2016 monitoring period.

Table 5-31: C10 Water Quality Results Summary (2012-2016)

C10	2012 - 2015 Summary Statistics			2016 Summary Statistics		
Parameters	Mean	Min	Max	Mean	Min	Max
pH	8.13	7.73	8.37	8.15	7.79	8.35
TSS (mg/L)	406.7	1	2210	12.8	3.3	29.3
Nutrients (mg/L)						
Ammonia Nitrogen	0.0821	0.005	0.2	0.0416	0.006	0.147
Nitrite Nitrogen	0.0126	0.005	0.05	0.0037	0.001	0.0092
Nitrate Nitrogen	0.143	0.02	0.417	0.0662	0.0178	0.137
Dissolved Metals (mg/L)						
Aluminum	0.351	0.0091	5.84	0.0118	0.0093	0.0141
Arsenic	0.00138	0.0004	0.00551	0.00104	0.00081	0.00116
Cadmium	0.00003	0.00001	0.000344	0.000005	0.000005	0.000005
Chromium	0.0015	0.001	0.0093	0.00037	0.00028	0.00041
Copper	0.00335	0.00091	0.0339	0.00139	0.00095	0.00211
Iron	1.919	0.141	19.9	0.714	0.496	0.86
Lead	0.00065	0.0002	0.00772	0.00005	0.00005	0.00005
Molybdenum	0.0011	0.001	0.0019	0.00075	0.000697	0.000823
Nickel	0.0031	0.001	0.0215	0.00192	0.00154	0.00227
Selenium	0.00011	0.0001	0.00014	0.00008	0.000066	0.000096
Zinc	0.0084	0.005	0.0603	0.0013	0.001	0.0021

5.3.31 MN – Minto North Pit Water

The water quality statistics for MN from 2015 and 2016 are summarized below in Table 5-32. A total of eight routine samples were collected from station MN during the 2016 monitoring period.

Table 5-32: MN Water Quality Results Summary (2015-2016)

MN	2015 Summary Statistics			2016 Summary Statistics		
Parameters	**Mean**	**Min**	**Max**	**Mean**	**Min**	**Max**
pH	7.8	7.63	7.96	7.85	7.56	8.16
TSS (mg/L)	122	101	142	49	3	134
Nutrients (mg/L)						
Ammonia Nitrogen	28.7	6.4	51	10.48	1.45	25.2
Nitrite Nitrogen	10.04	8.17	11.9	4.359	0.345	14.7
Nitrate Nitrogen	262	183	342	124.5	14.2	300
Dissolved Metals (mg/L)						
Aluminum	0.0166	0.009	0.0241	0.007	0.0025	0.0266
Arsenic	0.00028	0.0002	0.00036	0.00072	0.00041	0.00142
Cadmium	0.000022	0.00001	0.000035	0.0000694	0.00001	0.000283
Chromium	0.001	0.001	0.001	0.00022	0.0001	0.001
Copper	0.1853	0.0945	0.276	0.1553	0.0119	0.562
Iron	0.345	0.241	0.449	0.051	0.01	0.221
Lead	0.0002	0.0002	0.0002	0.000078	0.00005	0.0002
Molybdenum	0.0121	0.0077	0.0164	0.0226	0.0112	0.0384
Nickel	0.0028	0.0014	0.0041	0.00105	0.0005	0.00261
Selenium	0.0088	0.00421	0.0134	0.01658	0.00385	0.0627
Zinc	0.0058	0.005	0.0066	0.0048	0.001	0.0159

5.3.32 MN-0.2 – Upper West Arm of McGinty Creek

The water quality statistics for MN-0.2 from 2015 and 2016 are summarized below in Table 5-33. A total of seven routine samples were collected from station MN-0.2 during the 2016 monitoring period.

Table 5-33: MN-0.2 Water Quality Results Summary (2015-2016)

MN-0.2	2015 Summary Statistics			2016 Summary Statistics		
Parameters	Mean	Min	Max	Mean	Min	Max
pH	7.48	7.32	7.67	7.26	6.95	7.6
TSS (mg/L)	19.4	1.2	60	5.6	3	13.6
Nutrients (mg/L)						
Ammonia Nitrogen	0.054	0.02	0.11	0.0092	0.0052	0.0192
Nitrite Nitrogen	0.0162	0.005	0.05	0.001	0.001	0.001
Nitrate Nitrogen	0.065	0.02	0.2	0.0051	0.005	0.0056
Dissolved Metals (mg/L)						
Aluminum	0.1075	0.0715	0.137	0.0947	0.0714	0.137
Arsenic	0.00131	0.0004	0.00388	0.0006	0.00035	0.00095
Cadmium	0.00001	0.00001	0.00001	0.0000051	0.000005	0.0000056
Chromium	0.001	0.001	0.0011	0.00056	0.00043	0.00071
Copper	0.0022	0.00168	0.00323	0.00286	0.00142	0.00454
Iron	2.934	0.208	10.3	0.662	0.335	1.36
Lead	0.0002	0.0002	0.0002	0.00005	0.00005	0.00005
Molybdenum	0.001	0.001	0.001	0.000203	0.000112	0.000352
Nickel	0.0016	0.0012	0.0019	0.00161	0.00132	0.00183
Selenium	0.0001	0.0001	0.00012	0.000088	0.000074	0.000107
Zinc	0.005	0.005	0.005	0.0014	0.001	0.0027

5.3.33 MN-0.5 – West Arm of McGinty Creek

The water quality statistics for MN-0.5 from 2015 and 2016 are summarized below in Table 5-34. A total of nine routine samples were collected from station MN-0.5 during the 2016 monitoring period.

Table 5-34: MN-0.5 Water Quality Results Summary (2015-2016)

MN-0.5	2015 Summary Statistics			2016 Summary Statistics		
Parameters	**Mean**	**Min**	**Max**	**Mean**	**Min**	**Max**
pH	7.9	7.73	8.06	7.98	7.85	8.08
TSS (mg/L)	28.1	3	106	9.5	3	43.3
Nutrients (mg/L)						
Ammonia Nitrogen	0.023	0.011	0.043	0.0061	0.005	0.0142
Nitrite Nitrogen	0.005	0.005	0.005	0.001	0.001	0.001
Nitrate Nitrogen	0.058	0.021	0.084	0.0669	0.005	0.14
Dissolved Metals (mg/L)						
Aluminum	0.0272	0.0101	0.0652	0.0111	0.0036	0.026
Arsenic	0.00043	0.00037	0.00061	0.0004	0.00029	0.0005
Cadmium	0.000011	0.00001	0.000014	0.0000053	0.000005	0.0000091
Chromium	0.001	0.001	0.001	0.0002	0.00013	0.00036
Copper	0.00258	0.00139	0.00441	0.00145	0.00084	0.00212
Iron	0.139	0.104	0.254	0.056	0.016	0.132
Lead	0.0002	0.0002	0.0002	0.00005	0.00005	0.00005
Molybdenum	0.001	0.001	0.0011	0.001047	0.000798	0.00134
Nickel	0.0011	0.001	0.0017	0.0009	0.00058	0.00133
Selenium	0.00015	0.0001	0.00021	0.000207	0.00016	0.000272
Zinc	0.005	0.005	0.005	0.0013	0.001	0.0021

5.3.34 MN-1.5 – Upper East Arm of McGinty Creek

The water quality statistics for MN-1.5 from 2015 and 2016 are summarized below in Table 5-35. A total of six routine samples were collected from station MN-1.5 during the 2016 monitoring period.

Table 5-35: MN-1.5 Water Quality Results Summary (2015-2016)

MN-1.5	2015 Summary Statistics			2016 Summary Statistics		
Parameters	**Mean**	**Min**	**Max**	**Mean**	**Min**	**Max**
pH	7.46	7.19	7.78	7.56	7.38	7.72
TSS (mg/L)	89.6	9.6	165	16	3	89.4
Nutrients (mg/L)						
Ammonia Nitrogen	0.068	0.051	0.081	0.0107	0.005	0.0182
Nitrite Nitrogen	0.0283	0.005	0.053	0.001	0.001	0.001
Nitrate Nitrogen	0.111	0.02	0.2	0.0116	0.005	0.0299
Dissolved Metals (mg/L)						
Aluminum	0.1701	0.0835	0.259	0.0739	0.0309	0.142
Arsenic	0.00078	0.00037	0.00113	0.00049	0.00033	0.00061
Cadmium	0.00001	0.00001	0.000011	0.0000051	0.000005	0.000006
Chromium	0.001	0.001	0.001	0.00053	0.0004	0.00073
Copper	0.00743	0.00468	0.00958	0.00584	0.00321	0.00983
Iron	0.925	0.56	1.19	0.491	0.311	0.771
Lead	0.0002	0.0002	0.0002	0.00005	0.00005	0.00005
Molybdenum	0.001	0.001	0.001	0.000375	0.000195	0.000488
Nickel	0.0012	0.001	0.0014	0.00128	0.00113	0.00145
Selenium	0.0001	0.0001	0.0001	0.000093	0.000062	0.000127
Zinc	0.005	0.005	0.005	0.0016	0.001	0.0028

5.3.35 MN-2.5 – East Arm of McGinty Creek

The water quality statistics for MN-2.5 from 2015 and 2016 are summarized below in Table 5-36. A total of eight routine samples were collected from station MN-2.5 during the 2016 monitoring period.

Table 5-36: MN-2.5 Water Quality Results Summary (2015-2016)

MN-2.5	2015 Summary Statistics			2016 Summary Statistics		
Parameters	**Mean**	**Min**	**Max**	**Mean**	**Min**	**Max**
pH	8.02	7.77	8.28	7.86	7.67	8.01
TSS (mg/L)	80.1	2.3	341	55.2	3	165
Nutrients (mg/L)						
Ammonia Nitrogen	0.0218	0.0098	0.04	0.0187	0.0083	0.0483
Nitrite Nitrogen	0.005	0.005	0.005	0.001	0.001	0.001
Nitrate Nitrogen	0.048	0.02	0.122	0.0255	0.005	0.0596
Dissolved Metals (mg/L)						
Aluminum	0.0176	0.0091	0.0351	0.0132	0.006	0.0357
Arsenic	0.00038	0.0003	0.00049	0.0004	0.00032	0.00055
Cadmium	0.00001	0.00001	0.00001	0.0000054	0.000005	0.000007
Chromium	0.001	0.001	0.001	0.00024	0.00017	0.00036
Copper	0.00193	0.00071	0.00338	0.00184	0.00121	0.00349
Iron	0.1429	0.0225	0.288	0.147	0.06	0.332
Lead	0.0002	0.0002	0.0002	0.00005	0.00005	0.00005
Molybdenum	0.001	0.001	0.0011	0.000732	0.000412	0.000949
Nickel	0.0011	0.001	0.0015	0.00123	0.00086	0.00143
Selenium	0.00012	0.0001	0.00019	0.000081	0.000056	0.000113
Zinc	0.005	0.005	0.005	0.0015	0.001	0.0031

5.3.36 MN-4.5 – McGinty Creek near confluence with Yukon River

The water quality statistics for MN-4.5 from 2015 and 2016 are summarized below in Table 5-37. A total of eight routine samples were collected from station MN-4.5 during the 2016 monitoring period.

Table 5-37: MN-4.5 Water Quality Results Summary (2015-2016)

MN-4.5	2015 Summary Statistics			2016 Summary Statistics		
Parameters	**Mean**	**Min**	**Max**	**Mean**	**Min**	**Max**
pH	7.96	7.85	8.04	7.97	7.92	8.02
TSS (mg/L)	32.5	1	94.6	3.9	3	8.7
Nutrients (mg/L)						
Ammonia Nitrogen	0.02	0.011	0.037	0.0055	0.005	0.0087
Nitrite Nitrogen	0.005	0.005	0.005	0.001	0.001	0.0014
Nitrate Nitrogen	0.046	0.027	0.081	0.0959	0.005	0.323
Dissolved Metals (mg/L)						
Aluminum	0.0273	0.0162	0.0494	0.0103	0.0044	0.0229
Arsenic	0.00041	0.0003	0.0006	0.00034	0.00025	0.00042
Cadmium	0.000011	0.00001	0.000013	0.0000055	0.000005	0.0000093
Chromium	0.001	0.001	0.001	0.00018	0.00013	0.00027
Copper	0.00232	0.00142	0.00377	0.0017	0.00118	0.0024
Iron	0.1291	0.0681	0.234	0.041	0.01	0.109
Lead	0.0002	0.0002	0.0002	0.00005	0.00005	0.00005
Molybdenum	0.001	0.001	0.0011	0.000899	0.000611	0.00103
Nickel	0.0012	0.001	0.0017	0.00097	0.00054	0.0016
Selenium	0.00017	0.00012	0.00023	0.000155	0.000122	0.000214
Zinc	0.005	0.005	0.005	0.0015	0.001	0.0033

5.3.37 UG1 – Minto South Underground Mine Dewatering

The water quality statistics for MN-4.5 from 2013 to 2016 are summarized below in Table 5-38. A total of 14 routine samples were collected from station MN-4.5 during the 2016 monitoring period.

Table 5-38: UG1 Water Quality Results Summary (2013-2016)

UG1	2013 - 2015 Summary Statistics			2016 Summary Statistics		
Parameters	Mean	Min	Max	Mean	Min	Max
pH	7.9	6.01	8.28	7.9	7.7	8.13
TSS (mg/L)	461.4	1	10500	73.7	3.8	153
Nutrients (mg/L)						
Ammonia Nitrogen	31.12	0.0081	230	24.22	9.98	62
Nitrite Nitrogen	2.30	0.005	12.5	1.31	0.666	3.18
Nitrate Nitrogen	61.88	0.02	484	41.50	15.2	73.6
Dissolved Metals (mg/L)						
Aluminum	0.0152	0.003	0.51	0.0168	0.007	0.0709
Arsenic	0.00200	0.00051	0.00612	0.00106	0.0006	0.00259
Cadmium	3.8127E-05	0.00001	0.000486	0.000101	0.00001	0.00038
Chromium	0.00101	0.001	0.002	0.00038	0.0002	0.001
Copper	0.01760	0.00039	0.178	0.01831	0.00425	0.057
Iron	0.03058	0.005	1.16	0.01380	0.0064	0.02
Lead	0.00022	0.0002	0.00204	0.00013	0.0001	0.0002
Molybdenum	0.02104	0.0057	0.0585	0.01950	0.0129	0.0336
Nickel	0.00307	0.001	0.0158	0.00240	0.0011	0.007
Selenium	0.00167	0.0001	0.031	0.00106	0.00022	0.00509
Zinc	0.01535	0.005	0.185	0.02460	0.002	0.134

5.3.38 UG2 – Wildfire Underground Mine Dewatering

This station was not established in 2016.

5.3.39 UG3 – Copper Keel Underground Mine Dewatering

This station was not established in 2016.

5.3.40 UG4 – Minto East Underground Mine Dewatering

This station was not established in 2016.

6 Groundwater Monitoring Program

Groundwater monitoring program details are provided in section 2.2 of the Minto Mine Environmental Monitoring, Surveillance and Reporting Plan. The primary monitoring objective of the groundwater monitoring program is to identify potential impacts on groundwater from the Minto

Mine components include, but are not limited to the DSTSF, Mill area, Main Pit, Area 2 Pit, Minto North Pit, waste rock dumps, and the Water Storage Pond. Additionally, groundwater monitoring of hydrogeological conditions in areas of proposed future mine components including the Ridgetop North Pit and Ridgetop South Pit is also conducted. The Groundwater Monitoring Program is comprised of operational and baseline monitoring. Water quality samples for the program are collected according to standard procedures such as those summarized in the ASTM (2007*) Standard Guide for Sampling Ground-Water Monitoring Wells*. The main components of the groundwater monitoring program include groundwater quality, vibrating wire piezometers, and ground temperature cable monitoring.

In 2016 there was also a groundwater tracer study was conducted. Samples were collected and the data analysis is still underway at the writing of this report. Appendix C is a memo from SRK which provides a status update of tracer study with a path forward and work completed to date.

6.1 Groundwater Quality Monitoring Conformance

Minto's 2016 conformance with groundwater sampling requirements is summarized in Table 6-1, below. Quality Assurance and Quality Control (QA/QC) sampling is not included in sampling events described in Table 6-1, but is described in Section 6-2.

Sampling of Q1 was not required under the previous EMSRP and GW plan that was in effect until late March 2016. The EMSRP version 2016-01 was approved in late March 2016 and it was not logistically possible to complete a groundwater program for Q1; therefore, the EMSRP 2016-01 was effective as of Q2. Groundwater sites were then sampled quarterly, as per the EMSRP and GW Plan 2016-01 requirements.

Table 6-1: Groundwater Quality Monitoring Conformance Summary (2016)

Mine Project Component	Monitoring Installation	Quality	Level	Monitoring Frequency	2016 Reason(s) for non-conformance events
Up-gradient of Mine Activities	MW16-08	X	X	Quarterly	Site not established
Southwest Waste Dump	MW12-DP1	X	X	Quarterly	Site dry during 2016 sampling events
	MW12-DP2	X	X	Quarterly	Site dry during 2016 sampling events
	MW12-DP3	X	X	Quarterly	Site dry during 2016 sampling events
	MW16-09	X	X	Quarterly	Site not established
Main Waste Dump	MW09-01-01	X	X	Quarterly	Site dry during 2016 sampling events
	MW09-01-02	X	X	Quarterly	Site dry during 2016 sampling events
	MW09-01-03	X	X	Quarterly	Site dry during 2016 sampling events
	MW16-10	X	X	Quarterly	Site not established
Dry Stack Tailings Storage Facility and Mill Valley Fill Expansion	MW12-06-01		X	Quarterly	Sampled as per schedule
	MW12-06-02	X	X	Quarterly	Sampled as per schedule
	MW12-06-03		X	Quarterly	Sampled as per schedule
	MW12-06-04	X	X	Quarterly	Sampled as per schedule. Glycol present in all 2016 samples
	MW12-06-05		X	Quarterly	Sampled as per schedule
	MW12-06-06	X	X	Quarterly	Sampled as per schedule
Main Pit	MW12-07-01	X	X	Quarterly	Sampled as per schedule
	MW12-07-02	X	X	Quarterly	Sampled as per schedule
	MW12-07-03		X	Quarterly	Sampled as per schedule
Minto North Pit	MW09-03-01	X	X	Quarterly	Sampled as per schedule
	MW09-03-02	X	X	Quarterly	Sampled as per schedule
	MW09-03-03	X	X	Quarterly	Site dry during 2016 sampling events
	MW16-11	X	X	Quarterly	Site not established
Water Storage Pond	MW12-05-01	X	X	Quarterly	Sampled as per schedule
	MW12-05-02	X	X	Quarterly	Sampled as per schedule
	MW12-05-03	X	X	Quarterly	Sampled as per schedule
	MW12-05-04	X	X	Quarterly	Sampled as per schedule
	MW12-05-05	X	X	Quarterly	Sampled as per schedule
	MW12-05-06	X	X	Quarterly	Sampled as per schedule
	MW12-05-07	X	X	Quarterly	Sampled as per schedule
	MW16-12	X	X	Quarterly	Site not established

6.2 Groundwater Quality Control and Assurance

In 2016, 88 groundwater samples were taken at Minto. QC samples represented 4.5% of the total number of samples collected in 2016, and included three field duplicates and one field blank.

The EMSRP recommends field duplicate sampling be conducted at a frequency of one field duplicate sample per ten groundwater monitoring samples. The recommended rate of field duplicate sampling was not achieved in 2016.

Minto currently employs compliance management system software to track programs and actions that meet license requirements. In order to achieve the QA/QC objective of 1:10 samples, the compliance system has been updated to ensure that environmental staff complete the required field duplicates.

6.3 Groundwater Monitoring Stations

The EMSRP details the groundwater wells at the Minto Mine, including operative and inoperative wells. Figure 6-1 shows a location map of the operative wells, as well as planned wells that have not been established. No new groundwater stations were added during 2016. Stations that were collected more than three times in 2016 have results presented as follows: Mean, Minimum and Maximum values.

Wells MW09-01, MW11-01A, MW11-02, MW11-03, MW12-DP1, MW12-DP2, and MW12-DP3 did not produce enough water during 2016 sampling events to sample, thus no results are presented. Zone 3 of well MW09-03 also did not produce enough water to sample during 2016 sampling events.

Complete results for the 2016 Groundwater Monitoring Program groundwater wells are presented in Appendix D.

Figure 6-1: Minto Mine Groundwater Well Locations (2016)

6.3.1 MW09-01

Groundwater well MW09-01 was dry during 2016, thus no results are presented. Historically, this is consistent with sampling data from that well, as there have only been two sampled successfully drawn from MW09-01 since 2013.

6.3.2 MW09-03

Groundwater well MW09-03 water quality results from 2016 are summarized in Table 6-2 and Table 6-3, and compared to historical data. MW09-03 produced results from sampling zones 01 and 02, while zone 03 produced no water during 2016. As such, only results for zones 01 and 02 are presented.

Table 6-2: MW09-03-01 Water Quality Results Summary (2012 - 2016)

MW09-03-01	2009 - 2015 Summary Statistics			2016 Summary Statistics		
Parameters	Mean	Min	Max	Mean	Min	Max
pH	7.94	8.23	8.12	8.41	8.19	8.86
TDS (mg/L)	146	652	196	200	179	264
Sulfate-dissolved (mg/L)	0.53	117	20.04	19.7	11.3	22.4
Nutrients (mg/L)						
Ammonia Nitrogen	0.024	0.17	0.047	0.0626	0.0392	0.124
Nitrate Nitrogen	0.01	0.669	0.067	0.0147	0.0025	0.0455
Nitrite Nitrogen	0.0742	1.63	0.1648	2.674	0.155	9.27
Dissolved Metals (mg/L)						
Calcium	38.8	152	45.9	42.9	40.4	44.9
Cadmium	0.000005	0.000683	0.000034	0.0000125	0.0000025	0.000029
Copper	0.0001	0.019	0.00057	0.00056	0.0001	0.00155
Iron	0.0025	23.5	0.0095	0.155	0.005	0.324
Selenium	0.00005	0.008	0.000077	0.000222	0.000025	0.00077

Table 6-3: MW09-03-02 Water Quality Results Summary (2012 - 2016)

MW09-03-02	2009 - 2015 Summary Statistics			2016 Summary Statistics		
Parameters	Mean	Min	Max	Mean	Min	Max
pH	7.59	8.2	8	7.93	7.64	8.18
TDS (mg/L)	172	716	523	283	199	351
Sulfate-dissolved (mg/L)	0.25	110	1.37	6.89	2.08	9.82
Nutrients (mg/L)						
Ammonia Nitrogen	0.031	0.33	0.184	0.0869	0.0116	0.149
Nitrate Nitrogen	0.01	0.1	0.017	0.702	0.0025	1.77
Nitrite Nitrogen	0.0429	0.215	0.0854	0.3115	0.0873	0.776
Dissolved Metals (mg/L)						
Calcium	40.5	166	120.8	79.8	59.1	96.3
Cadmium	0.000005	0.00072	0.000022	0.0000147	0.0000025	0.0000267
Copper	0.0001	0.022	0.00156	0.00142	0.00056	0.00245
Iron	0.005	23.8	4.5326	5.635	0.005	10.8
Selenium	0.00005	0.0067	0.00026	0.000185	0.00006	0.000279

6.3.3 MW11-02

MW11-02 was dry during the 2016 sampling events, thus water quality results are not presented.

6.3.4 MW11-03

MW11-03 was dry during the 2016 sampling events, thus water quality results are not presented.

6.3.5 MW11-04A

One full round sample was collected from MW11-04A during the 2016 sample season. The results for the single 2016 sample, as well as historical results, are presented in Table 6-4.

Table 6-4: MW11-04A Water Quality Results Summary (2012 – 2016)

MW11-04A	2012 - 2015 Summary Statistics			2016 Summary
Parameters	Mean	Max	Min	
pH	10.3	11.7	11.2	11.46
TDS (mg/L)	148	396	191	203
Sulfate-dissolved (mg/L)	2.5	7.7	4.48	5
Nutrients (mg/L)				
Ammonia Nitrogen	0.058	1.5	0.174	0.0604
Nitrate Nitrogen	1	1.64	1.28	1.24
Nitrite Nitrogen	0.0071	0.0234	0.0137	0.0121
Dissolved Metals (mg/L)				
Calcium	49.6	170	71	100
Cadmium	0.000005	0.000045	0.000009	0.0000025
Copper	0.0119	0.137	0.0558	0.0937
Iron	0.0025	0.0198	0.0067	0.005
Selenium	0.00175	0.00334	0.00221	0.00271

6.3.6 MW12-DP1

Drivepoint well MW12-DP1 was dry or frozen during the 2016 sampling events, thus water quality results are not presented.

6.3.7 MW12-DP2

Drivepoint well MW12-DP2 was dry or frozen during the 2016 sampling events, thus water quality results are not presented.

6.3.8 MW12-DP3

Drivepoint well MW12-DP3 was dry or frozen during the 2016 sampling events, thus water quality results are not presented.

6.3.9 MW12-05

Groundwater well MW12-05 water quality results from 2016 are summarized in Table 6-5 through Table 6-11, and compared to historical data. Zones 02, 04, and 06 were not sampled prior to 2016, thus no historical data is available for those zones. All zones (01 through 07) were sampled during 2016.

Table 6-5: MW12-05-01 Water Quality Results Summary (2012 - 2016)

MW12-05-01	2012 - 2015 Summary Statistics			2016 Summary Statistics		
Parameters	**Mean**	**Max**	**Min**	**Mean**	**Min**	**Max**
pH	7.83	8.31	8.07	7.9	7.69	8.08
TDS (mg/L)	706	1540	1207	1622	1550	1700
Sulfate-dissolved (mg/L)	350	895	686	1031	958	1090
Nutrients (mg/L)						
Ammonia Nitrogen	0.0025	0.37	0.0847	0.1399	0.0117	0.602
Nitrate Nitrogen	0.01	0.368	0.018	0.015	0.005	0.025
Nitrite Nitrogen	0.0277	0.195	0.0618	0.1326	0.053	0.427
Dissolved Metals (mg/L)						
Calcium	117	254	205	304	293	318
Cadmium	0.000005	0.00014	0.000009	0.0000033	0.0000025	0.000005
Copper	0.0001	0.00737	0.00019	0.00149	0.0001	0.00836
Iron	0.0085	0.0804	0.0241	0.029	0.018	0.046
Selenium	0.00005	0.0009	0.00018	0.000448	0.00005	0.00144

Table 6-6: MW12-05-02 Water Quality Results Summary (2016)

MW12-05-02	2016 Summary Statistics		
Parameters	**Mean**	**Min**	**Max**
pH	8.18	7.9	8.43
TDS (mg/L)	1147	389	1750
Sulfate-dissolved (mg/L)	622.8	41.2	1090
Nutrients (mg/L)			
Ammonia Nitrogen	0.1512	0.0095	0.642
Nitrate Nitrogen	0.0135	0.0025	0.025
Nitrite Nitrogen	0.1352	0.02	0.377
Dissolved Metals (mg/L)			
Calcium	220.5	84.3	324
Cadmium	0.000003	0.0000025	0.000005
Copper	0.00012	0.0001	0.0002
Iron	0.054	0.02	0.176
Selenium	0.000182	0.000025	0.00061

Table 6-7: MW12-05-03 Water Quality Results Summary (2012 - 2016)

MW12-05-03	2012 - 2015 Summary Statistics			2016 Summary Statistics		
Parameters	**Mean**	**Max**	**Min**	**Mean**	**Min**	**Max**
pH	7.81	8.22	8.08	7.97	7.72	8.16
TDS (mg/L)	880	1570	1296	1362	1340	1390
Sulfate-dissolved (mg/L)	456	812	697	789	773	828
Nutrients (mg/L)						
Ammonia Nitrogen	0.015	0.11	0.044	0.0233	0.0025	0.043
Nitrate Nitrogen	0.01	0.068	0.015	0.015	0.005	0.025
Nitrite Nitrogen	0.0252	0.132	0.0538	0.1604	0.054	0.372
Dissolved Metals (mg/L)						
Calcium	110	215	187	223	209	235
Cadmium	0.000005	0.000324	0.000009	0.0000025	0.0000025	0.0000025
Copper	0.0001	0.00266	0.00025	0.0001	0.0001	0.0001
Iron	0.0981	4.14	1.5367	0.473	0.021	1.13
Selenium	0.00005	0.000364	0.000074	0.000086	0.000057	0.000146

Table 6-8: MW12-05-04 Water Quality Results Summary (2016)

MW12-05-04	2016 Summary Statistics		
Parameters	**Mean**	**Min**	**Max**
pH	8.06	7.87	8.21
TDS (mg/L)	286	280	290
Sulfate-dissolved (mg/L)	39.6	32.5	47.3
Nutrients (mg/L)			
Ammonia Nitrogen	0.0349	0.0025	0.144
Nitrate Nitrogen	0.0301	0.0025	0.0569
Nitrite Nitrogen	0.1218	0.0309	0.32
Dissolved Metals (mg/L)			
Calcium	48.5	47.4	50.4
Cadmium	0.0000031	0.0000025	0.0000063
Copper	0.0002	0.0001	0.00048
Iron	0.028	0.005	0.054
Selenium	0.000067	0.000025	0.000127

Table 6-9: MW12-05-05 Water Quality Results Summary (2012 - 2016)

MW12-05-05	2012 - 2015 Summary Statistics			2016 Summary Statistics		
Parameters	**Mean**	**Max**	**Min**	**Mean**	**Min**	**Max**
pH	7.89	8.35	8.18	8.02	7.82	8.14
TDS (mg/L)	252	338	288	278	275	283
Sulfate-dissolved (mg/L)	33.3	62.4	44.4	44.9	42.4	47.7
Nutrients (mg/L)						
Ammonia Nitrogen	0.013	0.054	0.023	0.008	0.0025	0.0143
Nitrate Nitrogen	0.2	0.817	0.413	0.24	0.196	0.317
Nitrite Nitrogen	0.03	0.195	0.0681	0.2133	0.0616	0.398
Dissolved Metals (mg/L)						
Calcium	41.8	47.6	45.6	49.1	46.6	52.9
Cadmium	0.000005	0.00003	0.00001	0.0000044	0.0000025	0.0000091
Copper	0.00043	0.00154	0.00084	0.00114	0.00034	0.0036
Iron	0.0152	0.0457	0.0271	0.009	0.005	0.017
Selenium	0.00005	0.00017	0.000089	0.0001	0.000072	0.000139

Table 6-10: MW12-05-06 Water Quality Results Summary (2016)

MW12-05-06	2016 Summary Statistics		
Parameters	**Mean**	**Min**	**Max**
pH	8.08	7.98	8.2
TDS (mg/L)	277	268	302
Sulfate-dissolved (mg/L)	43.1	41.9	45
Nutrients (mg/L)			
Ammonia Nitrogen	0.0025	0.0025	0.0025
Nitrate Nitrogen	0.341	0.271	0.433
Nitrite Nitrogen	0.0388	0.023	0.0663
Dissolved Metals (mg/L)			
Calcium	47.9	45.6	51.6
Cadmium	0.0000133	0.0000076	0.0000179
Copper	0.00102	0.00087	0.00121
Iron	0.005	0.005	0.005
Selenium	0.000136	0.0001	0.000176

Table 6-11: MW12-05-07 Water Quality Results Summary (2012 - 2016)

MW12-05-07	2012 - 2015 Summary Statistics			2016 Summary Statistics		
Parameters	**Mean**	**Max**	**Min**	**Mean**	**Min**	**Max**
pH	8.06	8.45	8.28	8.1	7.76	8.32
TDS (mg/L)	260	362	302	280	252	302
Sulfate-dissolved (mg/L)	11.4	45.2	28.7	23.8	16.7	26.8
Nutrients (mg/L)						
Ammonia Nitrogen	0.068	0.24	0.103	0.0899	0.0025	0.465
Nitrate Nitrogen	0.01	0.1	0.013	0.0336	0.0025	0.189
Nitrite Nitrogen	0.0025	2.91	0.0286	0.128	0.0005	0.7
Dissolved Metals (mg/L)						
Calcium	47.2	54.6	51.1	55	52.1	58.2
Cadmium	0.0000025	0.000019	0.0000058	0.0000025	0.0000025	0.0000025
Copper	0.0001	0.00158	0.000244	0.00012	0.0001	0.00021
Iron	0.0602	0.928	0.2322	0.076	0.022	0.139
Selenium	0.00005	0.00034	0.000124	0.000373	0.000025	0.00075

6.3.10 MW12-06

Groundwater well MW12-06 water quality results from 2016 are summarized in Table 6-12 through Table 6-14, and compared to historical data. Zones 02, 04, and 06 were sampled and analyzed during 2016.

Table 6-12: MW12-06-02 Water Quality Results Summary (2012 - 2016)

MW12-06-02	2012 - 2015 Summary Statistics			2016 Summary Statistics		
Parameters	Mean	Max	Min	Mean	Min	Max
pH	7.67	8.2	8.06	7.67	8.2	8.06
TDS (mg/L)	612	686	642	612	686	642
Sulfate-dissolved (mg/L)	177	227	202	177	227	202
Nutrients (mg/L)						
Ammonia Nitrogen	0.0074	0.075	0.0368	0.0074	0.075	0.0368
Nitrate Nitrogen	0.025	0.25	0.069	0.025	0.25	0.069
Nitrite Nitrogen	0.0882	0.834	0.2418	0.0882	0.834	0.2418
Dissolved Metals (mg/L)						
Calcium	97.4	142	123.8	97.4	142	123.8
Cadmium	0.000005	0.000047	0.00001	0.000005	0.000047	0.00001
Copper	0.0001	0.00115	0.000251	0.0001	0.00115	0.000251
Iron	0.454	1.67	1.001	0.454	1.67	1.001
Selenium	0.00005	0.00028	0.000097	0.00005	0.00028	0.000097

Table 6-13: MW12-06-04 Water Quality Results Summary (2012 - 2016)

MW12-06-04	2012 - 2015 Summary Statistics			2016 Summary Statistics		
Parameters	Mean	Max	Min	Mean	Min	Max
pH	7.81	8.23	8.1	7.81	8.23	8.1
TDS (mg/L)	594	644	618	594	644	618
Sulfate-dissolved (mg/L)	159	182	168	159	182	168
Nutrients (mg/L)						
Ammonia Nitrogen	0.0059	0.028	0.0171	0.0059	0.028	0.0171
Nitrate Nitrogen	0.022	0.324	0.06	0.022	0.324	0.06
Nitrite Nitrogen	0.0998	1.12	0.2198	0.0998	1.12	0.2198
Dissolved Metals (mg/L)						
Calcium	96.8	105	100.9	96.8	105	100.9
Cadmium	0.000005	0.000039	0.000008	0.000005	0.000039	0.000008
Copper	0.0001	0.0722	0.000305	0.0001	0.0722	0.000305
Iron	0.531	0.767	0.693	0.531	0.767	0.693
Selenium	0.00005	0.00014	0.000068	0.00005	0.00014	0.000068

Table 6-14: MW12-06-04 Water Quality Results Summary (2012 - 2016)

MW12-06-06	2012 - 2015 Summary Statistics			2016 Summary Statistics		
Parameters	Mean	Max	Min	Mean	Min	Max
pH	7.87	8.26	8.14	7.87	8.26	8.14
TDS (mg/L)	472	538	502	472	538	502
Sulfate-dissolved (mg/L)	143	171	152	143	171	152
Nutrients (mg/L)						
Ammonia Nitrogen	0.0093	0.085	0.0202	0.0093	0.085	0.0202
Nitrate Nitrogen	0.45	1.13	0.883	0.45	1.13	0.883
Nitrite Nitrogen	0.0521	0.102	0.0714	0.0521	0.102	0.0714
Dissolved Metals (mg/L)						
Calcium	73	82.7	77.5	73	82.7	77.5
Cadmium	0.000005	0.000124	0.00001	0.000005	0.000124	0.00001
Copper	0.0001	0.00155	0.000318	0.0001	0.00155	0.000318
Iron	0.0081	0.0833	0.0191	0.0081	0.0833	0.0191
Selenium	0.00015	0.000511	0.000217	0.00015	0.000511	0.000217

6.3.11 MW12-07

Groundwater well MW12-07 water quality results from 2016 are summarized in Table 6-15 and Table 6-16, and compared to historical data. Both zones (01 and 02) were sampled and analyzed during 2016.

Table 6-15: MW12-07-01 Water Quality Results Summary (2012 - 2016)

MW12-07-01	2012 - 2015 Summary Statistics			2016 Summary Statistics		
Parameters	Mean	Max	Min	Mean	Min	Max
pH	7.38	8.38	7.99	7.94	7.56	8.13
TDS (mg/L)	774	1400	989	863	763	1080
Sulfate-dissolved (mg/L)	185	640	329	211	105	312
Nutrients (mg/L)						
Ammonia Nitrogen	0.0025	1.6	0.2517	0.61	0.212	1.13
Nitrate Nitrogen	0.109	53.5	1.281	0.308	0.088	0.69
Nitrite Nitrogen	0.025	4.96	0.8525	0.713	0.203	1.71
Dissolved Metals (mg/L)						
Calcium	154	266	195	210	198	217
Cadmium	0.000005	0.000633	0.000022	0.000006	0.0000025	0.0000282
Copper	0.0001	0.077	0.00158	0.00021	0.0001	0.0004
Iron	0.0699	0.705	0.2623	0.043	0.022	0.064
Selenium	0.00005	0.0347	0.00195	0.001901	0.000405	0.00407

Table 6-16: MW12-07-02 Water Quality Results Summary (2012 - 2016)

MW12-07-02	2012 - 2015 Summary Statistics			2016 Summary Statistics		
Parameters	Mean	Max	Min	Mean	Min	Max
pH	7.68	8.11	7.95	8	7.79	8.08
TDS (mg/L)	782	1160	1080	1072	748	1140
Sulfate-dissolved (mg/L)	283	702	627	671	356	733
Nutrients (mg/L)						
Ammonia Nitrogen	0.0025	0.61	0.1083	0.0338	0.0025	0.0643
Nitrate Nitrogen	0.075	21.3	0.211	0.153	0.08	0.399
Nitrite Nitrogen	0.148	1.47	0.401	0.377	0.191	0.969
Dissolved Metals (mg/L)						
Calcium	140	232	198	220	217	227
Cadmium	0.000005	0.000269	0.000006	0.0000043	0.0000025	0.000011
Copper	0.0001	0.0217	0.00044	0.00017	0.0001	0.00023
Iron	0.0069	1.3	0.2075	0.137	0.01	0.226
Selenium	0.00005	0.0148	0.00015	0.000153	0.000055	0.00037

6.4 Vibrating Wire Piezometers

There are currently 22 operating vibrating wire piezometers installed on site, listed in Table 6-17. DSP-9 became inoperative in March 2016, there were no other changes to the operational status of any piezometers in 2016. Summaries of data collected from each piezometer are provided in the following sections.

Table 6-17: Vibrating Wire Piezometer Summary (2016)

Vibrating Wire Piezometer	Location	Operational Status
DSP-1	DSTSF	Destroyed (2011)
DSP-2	DSTSF	Destroyed (2011)
DSP-3	DSTSF	Destroyed (2012)
DSP-4	DSTSF	Inoperative (2011)
DSP-5	DSTSF	Operational
DSP-6	DSTSF	Operational
DSP-7	DSTSF	Operational
DSP-8	DSTSF	Operational
DSP-9	DSTSF	Inoperative (2016)
DSP-10	DSTSF	Operational
SDP-2	Southwest Dump	Operational
SDP-3	Southwest Dump	Operational
SDP-4	Southwest Dump	Operational
WDP-2	Water Storage Pond Dam	Operational
WDP-3A	Water Storage Pond Dam	Operational
WDP-3	Water Storage Pond Dam	Operational
WDP-4	Water Storage Pond Dam	Operational
WDP-5	Water Storage Pond Dam	Operational
WDP-6	Water Storage Pond Dam	Operational
WDP-7	Water Storage Pond Dam	Operational
WDP-8	Water Storage Pond Dam	Operational
WDP-9	Water Storage Pond Dam	Operational
WDP-10	Water Storage Pond Dam	Operational
WDP-11	Water Storage Pond Dam	Operational
WDP-12	Water Storage Pond Dam	Operational
WDP-13	Water Storage Pond Dam	Operational

6.4.1 DSTSF Piezometers

Data collected from DSTSF vibrating wire piezometers are presented in Figure 6-2 to Figure 6-5. Sensor DSP-6A is reading negative pressures and has not been included in the figure.

Pore water pressures in DSP-5A and DSP-5B have been gradually increasing since installation in 2013. Analysis carried out by SRK Consulting in 2015 to consider the increasing pressures indicated high FOS values (FOS>2) even without consideration of the constructed MVFE2. DSP-7 and DSP-8 water pressures in have been gradually increasing since installation in late 2015. Review of the data by SRK consulting in 2016 identified no stability concern with the MVFE2 construction progression at these locations. DSP-10 water pressures increased significantly upon installation, and the trend has gradually been slowing as MVFE2 construction progressed.

DSP-05 and DSP-06 data are collected monthly, DSP-07 and DSP-08 data are collected bi-monthly, and DSP-10 data are collected weekly.

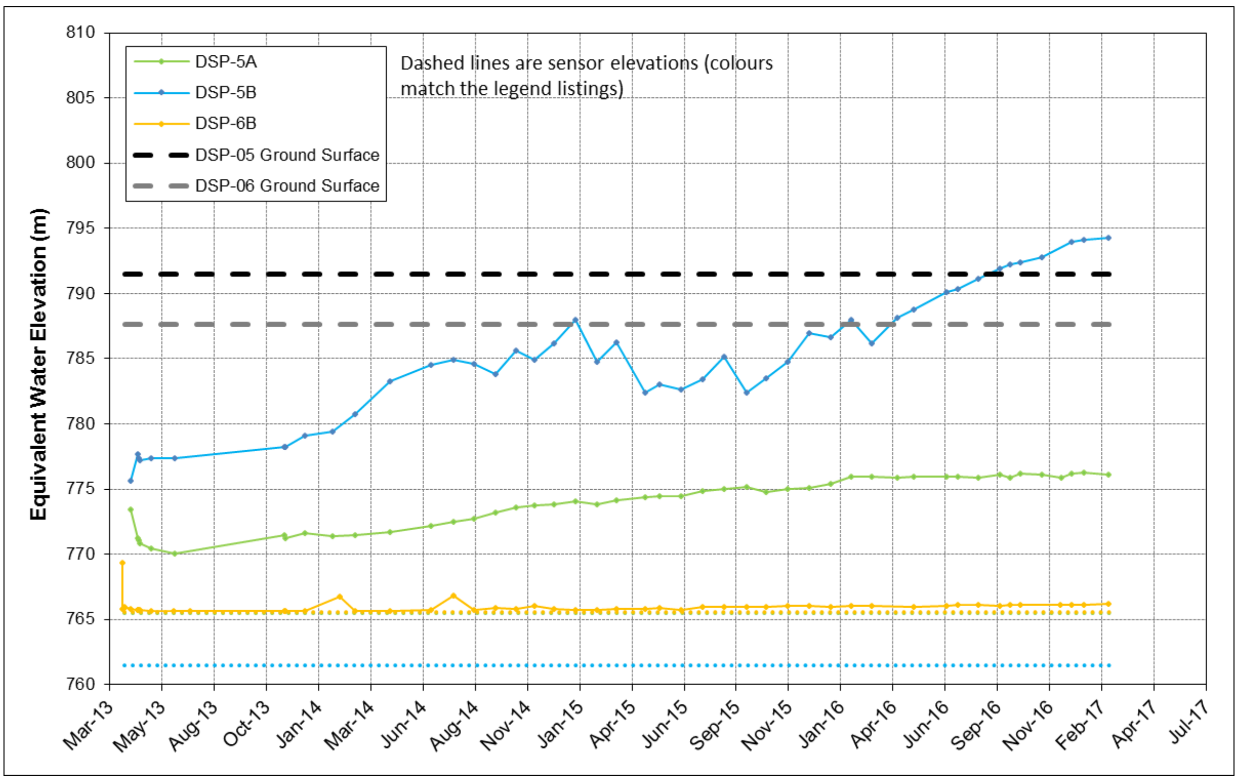


Figure 6-2: DSTSF Piezometer Data – DSP-05 and DSP-06 (2013-2016)

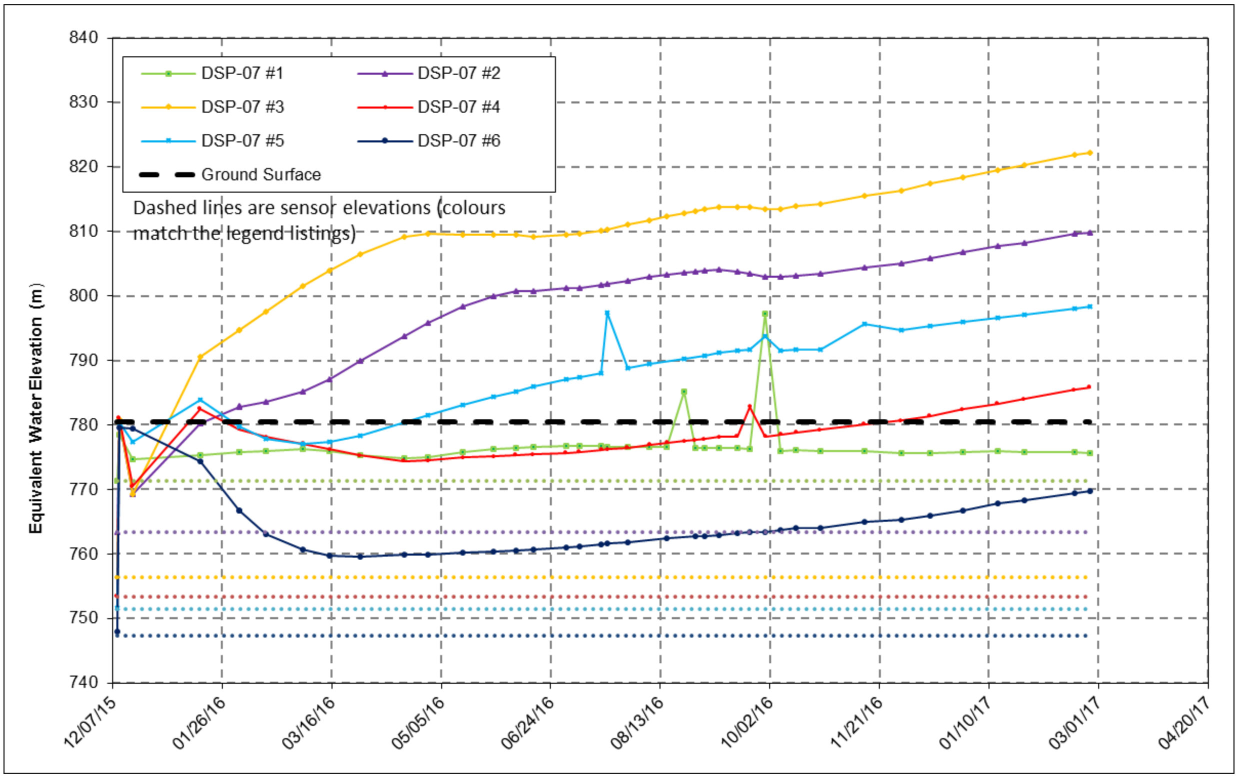


Figure 6-3: DSTSF Piezometer Data – DSP-07 (2015-2016)

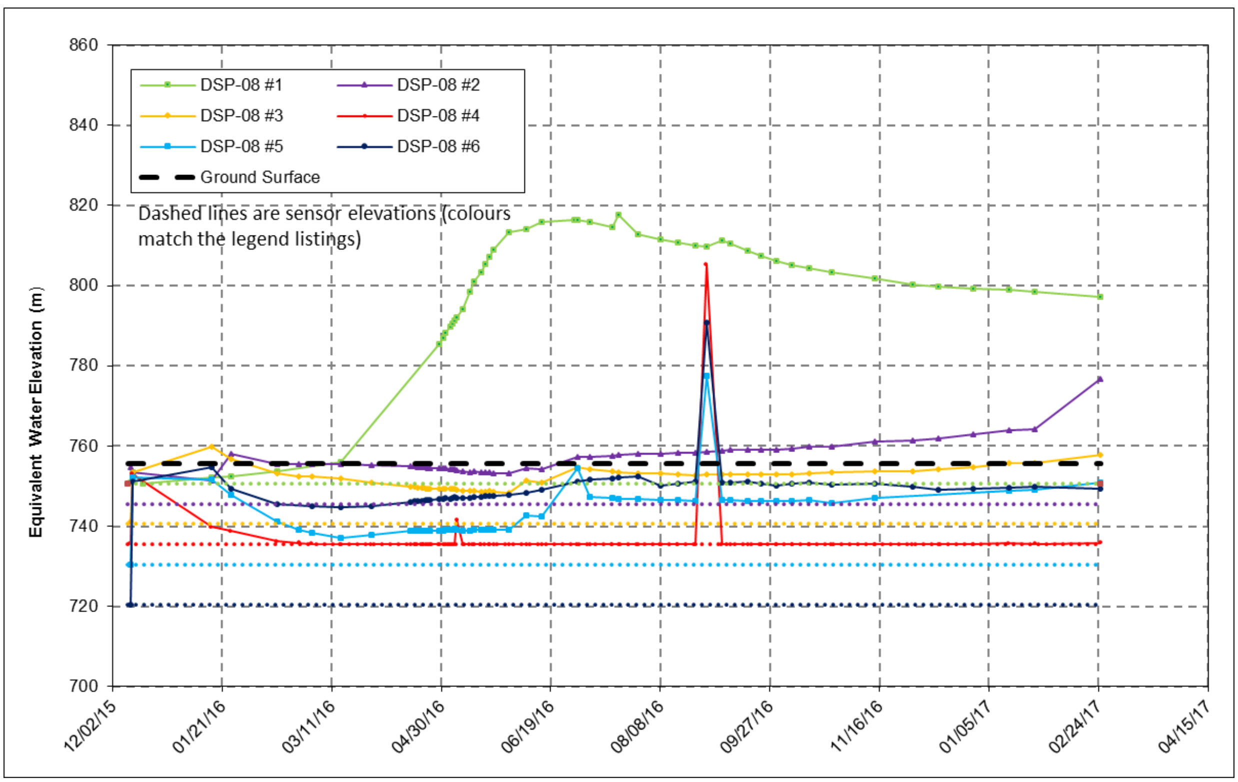


Figure 6-4: DSTSF Piezometer Data – DSP-08 (2015-2016)

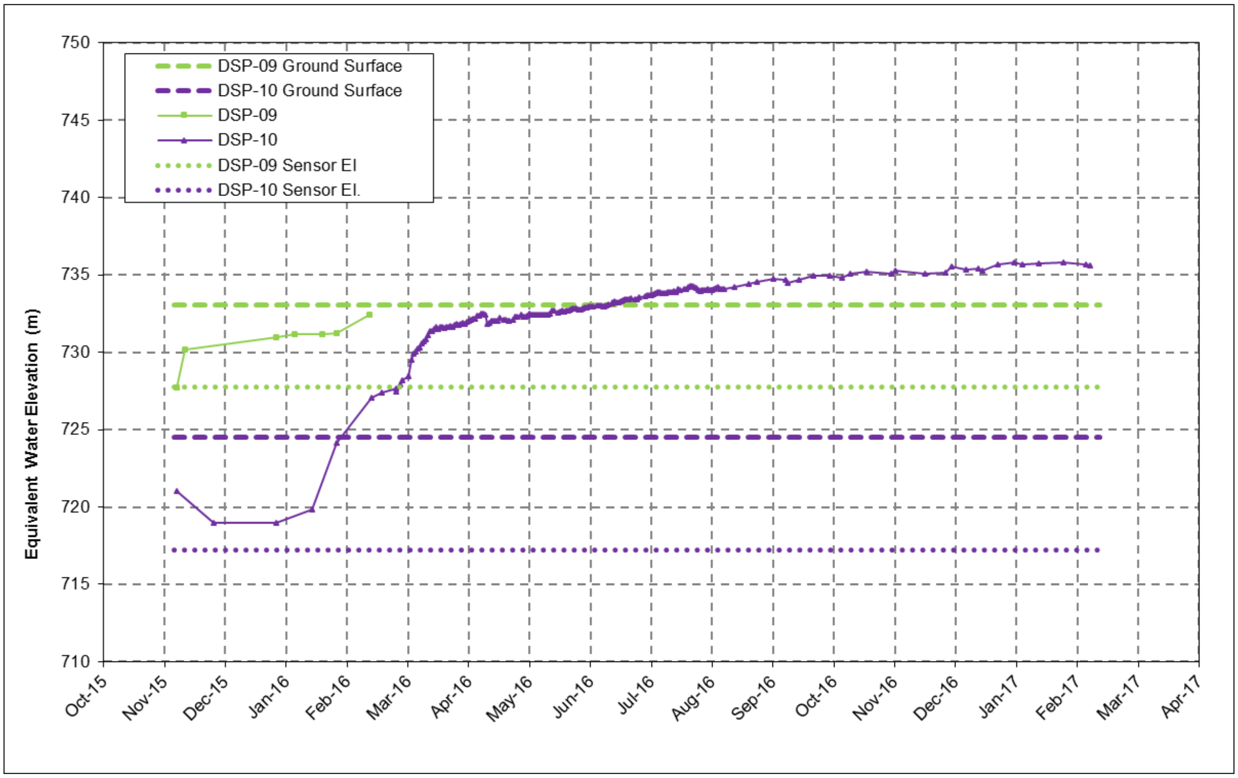


Figure 6-5: DSTSF Piezometer Data – DSP-09 and DSP-10 (2015-2016)

6.4.2 Southwest Dump Piezometers

Data collected from Southwest Dump vibrating wire piezometers are presented in Figure 6-6. Sensors SDP-3A and SDP-3B are reading negative pressures and have not been included in the figure. Data are collected monthly. Data indicate relatively consistent, or slightly decreasing pressures, in 2016. Work on the dump in 2016 consisted primarily of resloping for closure

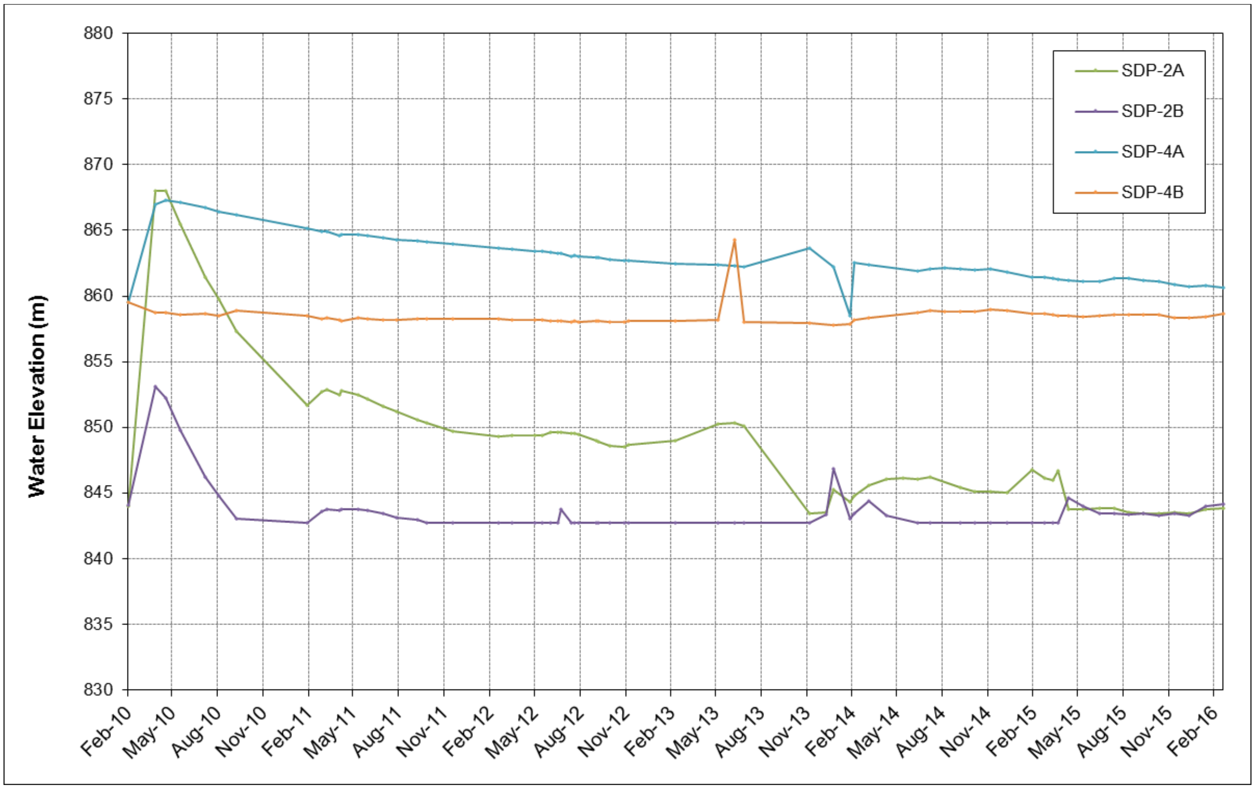


Figure 6-6: Southwest Dump Piezometer Data (2010-2016)

6.4.3 Water Storage Pond Dam Piezometers

Data collected from WSP Dam vibrating wire piezometers are presented in Figure 6-7. WDP-2, WDP-3, WDP-5, and WDP-11 are reading negative pressures and have not been included in the figure. Data are collected monthly. Pressures in 2016 generally followed the trend of the water level in the water storage pond as in previous years.

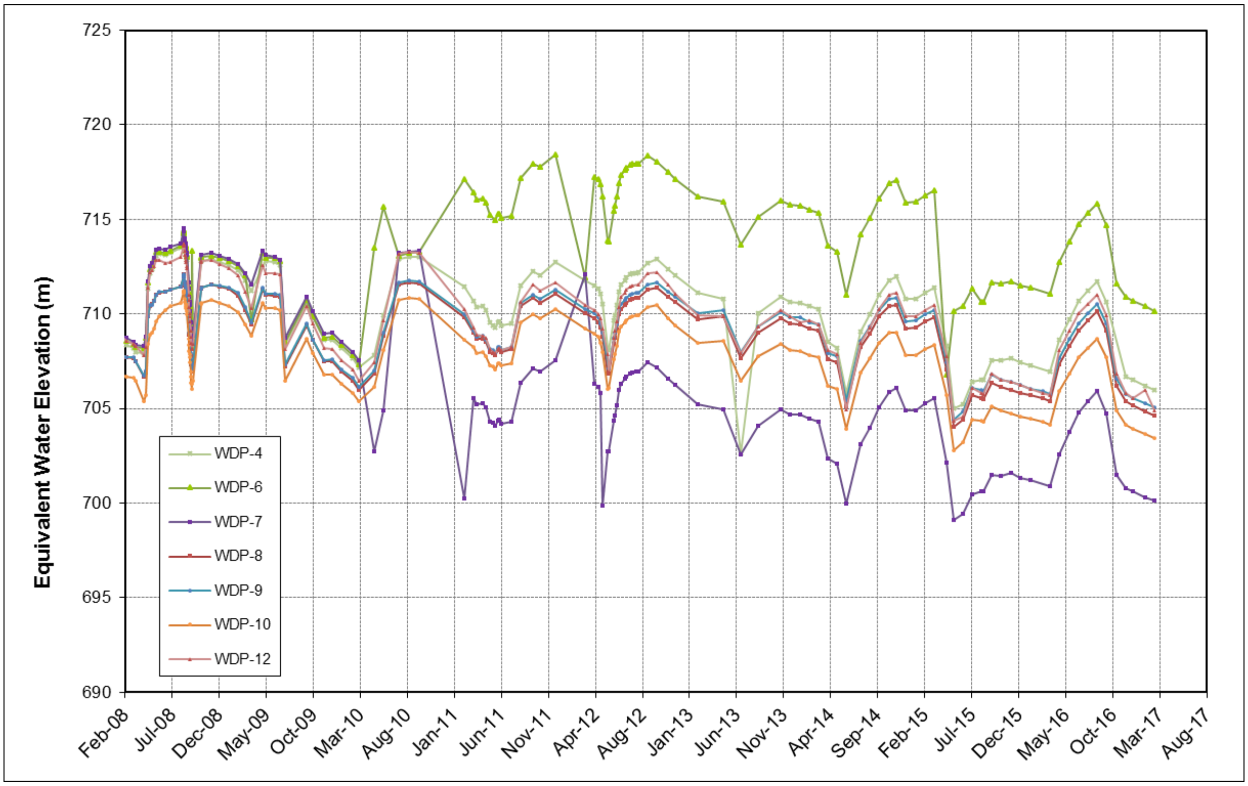


Figure 6-7: WSP Dam Piezometer Data (2007-2016)

6.5 Ground Temperature Cables

There are currently twenty-two operating thermistors (ground temperature cables) installed on site, listed in Table 6-18. MWPT1, MWPT2, and MW11-01A were destroyed during the decommissioning of the mill water pond in April 2016. There were no other changes to the operational status of any of the existing thermistors in 2016. Summaries of data collected from each thermistor are contained in the following sections.

Table 6-18: Thermistor Summary (2016)

Thermistor	Location	Operational Status
A2T-1	DSTSF	Operational
DST-1	DSTSF	Destroyed (2011)
DST-2	DSTSF	Destroyed (2011)
DST-3	DSTSF	Destroyed (2012)
DST-4	DSTSF	Inoperative (2012)
DST-5	DSTSF	Destroyed (2011)
DST-6	DSTSF	Destroyed (2011)
DST-7	DSTSF	Destroyed (2010)
DST-8	DSTSF	Destroyed (2011)
DST-9	DSTSF	Destroyed (2011)
DST-10	DSTSF	Operational
DST-11	DSTSF	Operational
DST-12	DSTSF	Inoperative (2012)
DST-13	DSTSF	Operational
DST-14	DSTSF	Operational
DST-15	DSTSF	Operational
MWPT1	Mill Water Pond	Destroyed (2016)
MWPT2	Mill Water Pond	Destroyed (2016)
MW11-01A	Mill Water Pond	Destroyed (2016)
MPDT-1	Main Pit Dam	Operational
MPDT-2	Main Pit Dam	Operational
MW-11-02	Ridgetop	Operational
MW-11-03	Ridgetop	Operational
SDT-1	Southwest Dump	Operational
SDT-2	Southwest Dump	Operational
SDT-3	Southwest Dump	Operational
SDT-4	Southwest Dump	Operational
08SWC271	Southwest Dump	Destroyed (2010)
08SWC274	Southwest Dump	Destroyed (2011)
08SWC275	Southwest Dump	Destroyed (2008)
08SWC277	Southwest Dump	Destroyed (2008)

Thermistor	Location	Operational Status
08SWC278	Southwest Dump	Destroyed (2008)
08SWC280	Southwest Dump	Destroyed (2008)
WDT – 1	Water Storage Pond Dam	Operational
WDT – 2	Water Storage Pond Dam	Operational
WDT – 3	Water Storage Pond Dam	Operational
WDT – 4	Water Storage Pond Dam	Operational
WDT – 5	Water Storage Pond Dam	Operational
WDT – 6	Water Storage Pond Dam	Operational
WDT – 7	Water Storage Pond Dam	Operational
WDT – 8	Water Storage Pond Dam	Operational

6.5.1 DSTSF Thermistors

Data collected from DSTSF thermistors are presented in Figure 6-8 through Figure 6-13. Data are collected quarterly. No major changes to ground temperatures at the DSTSF were observed in 2016.

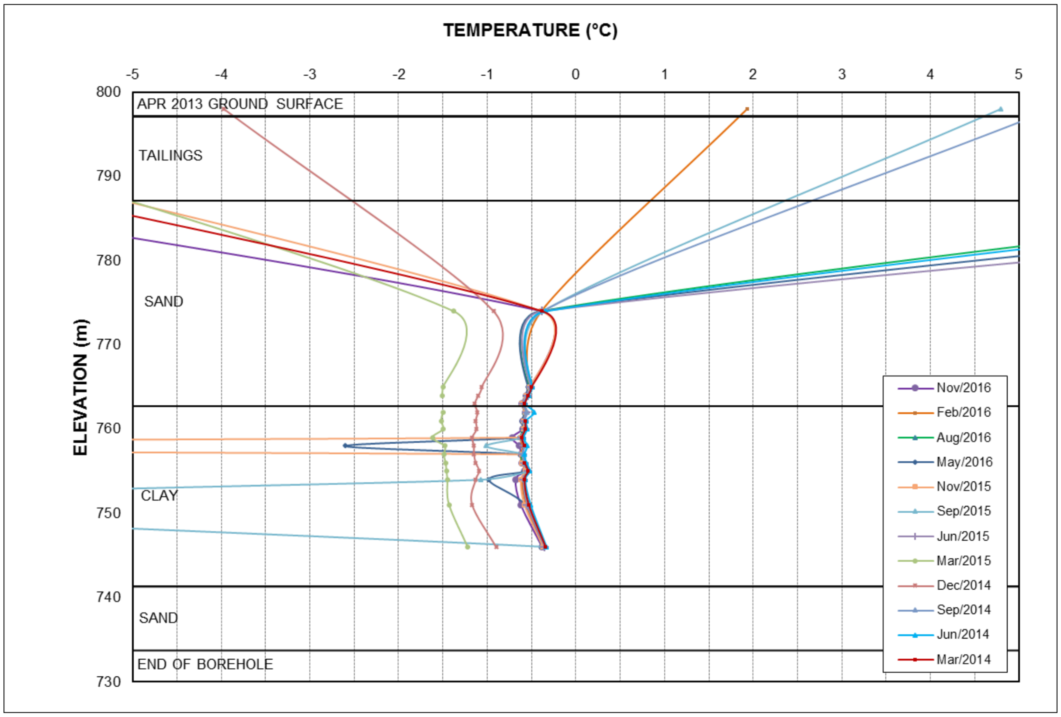


Figure 6-8: Thermistor DST-10 (2014-2016)

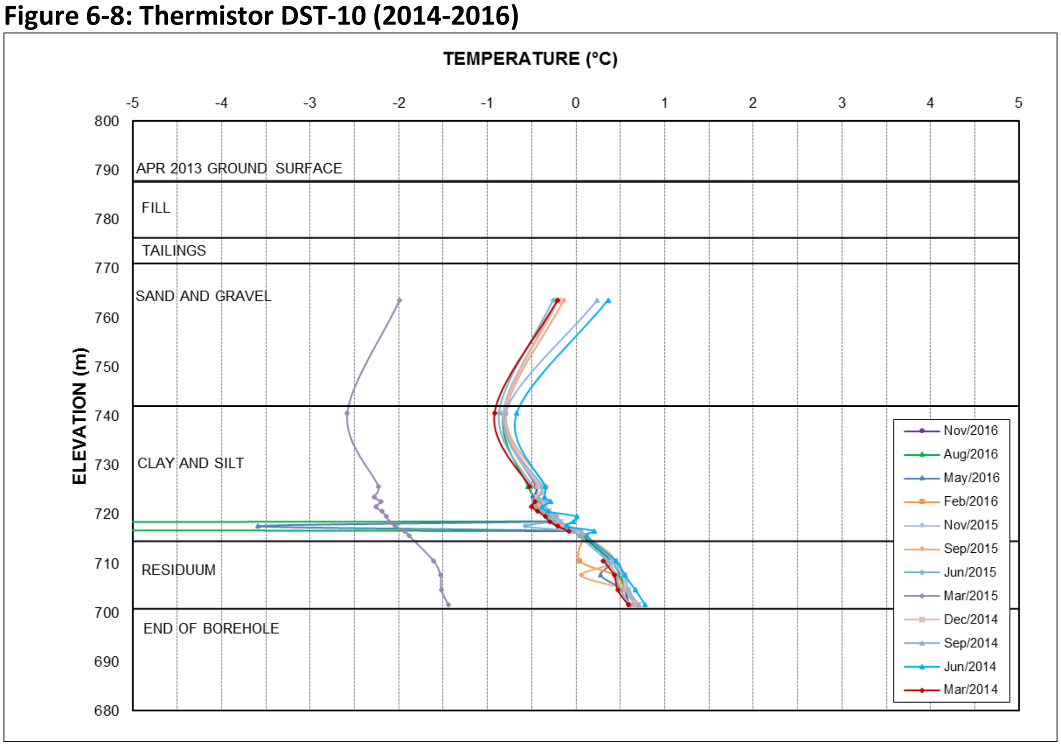


Figure 6-9: Thermistor DST-11 (2013-2015)

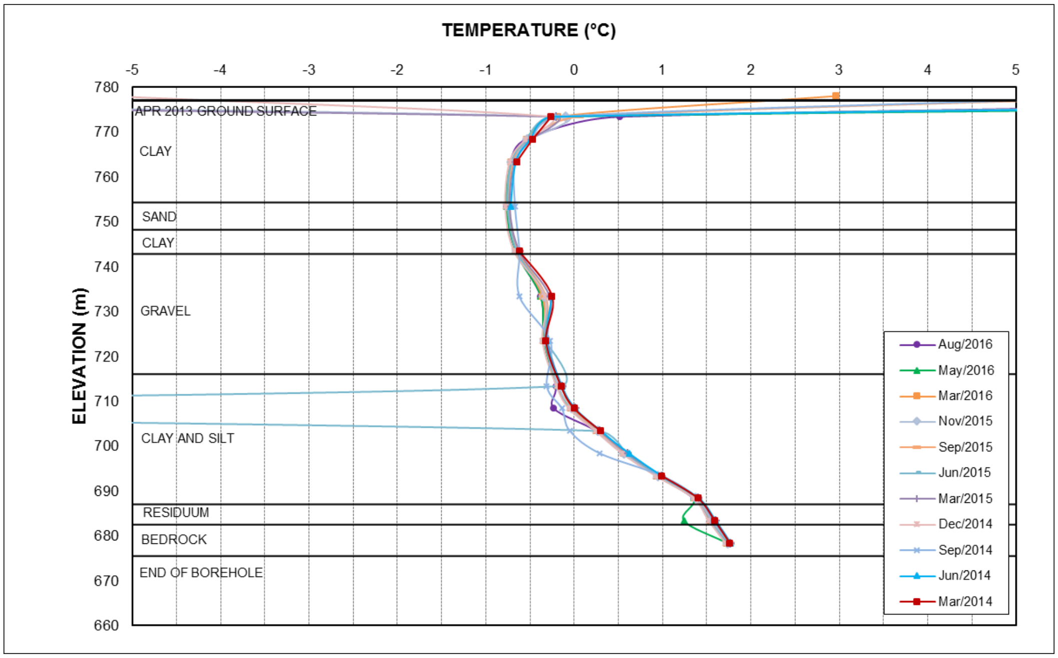


Figure 6-10: Thermistor DST-13 (2014-2016)

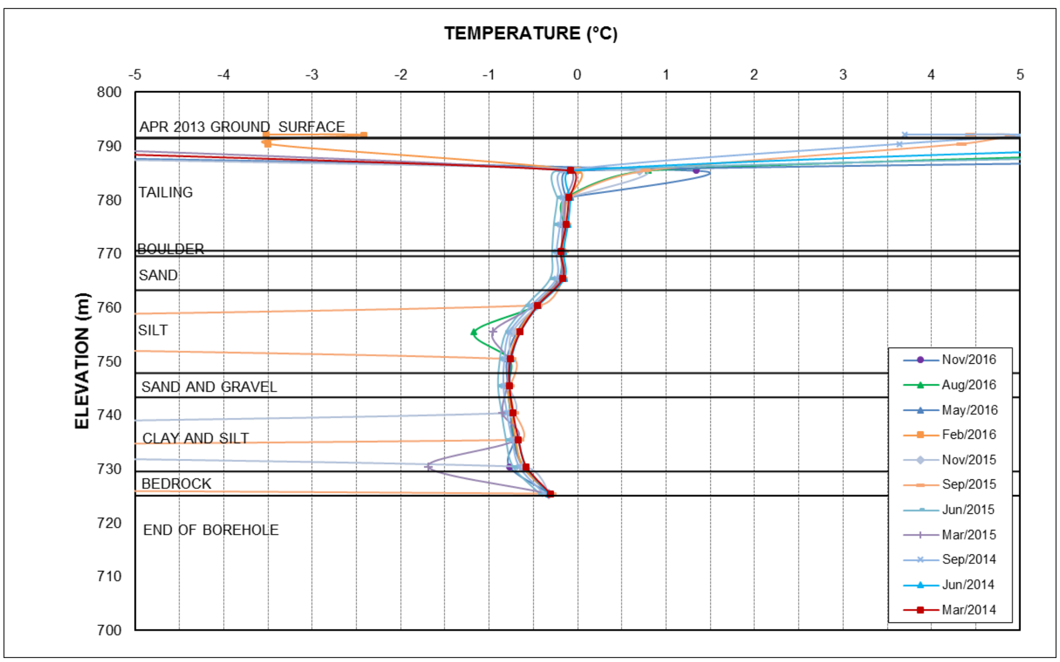


Figure 6-11: Thermistor DST-14 (2014-2016)

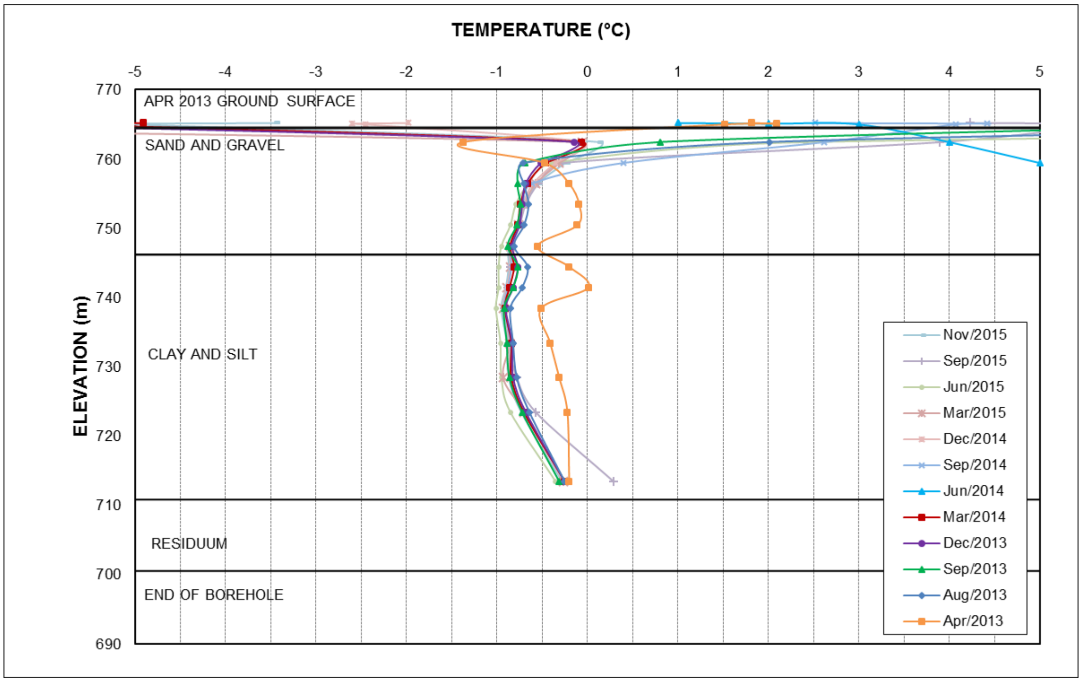


Figure 6-12: Thermistor DST-15 (2014-2016)

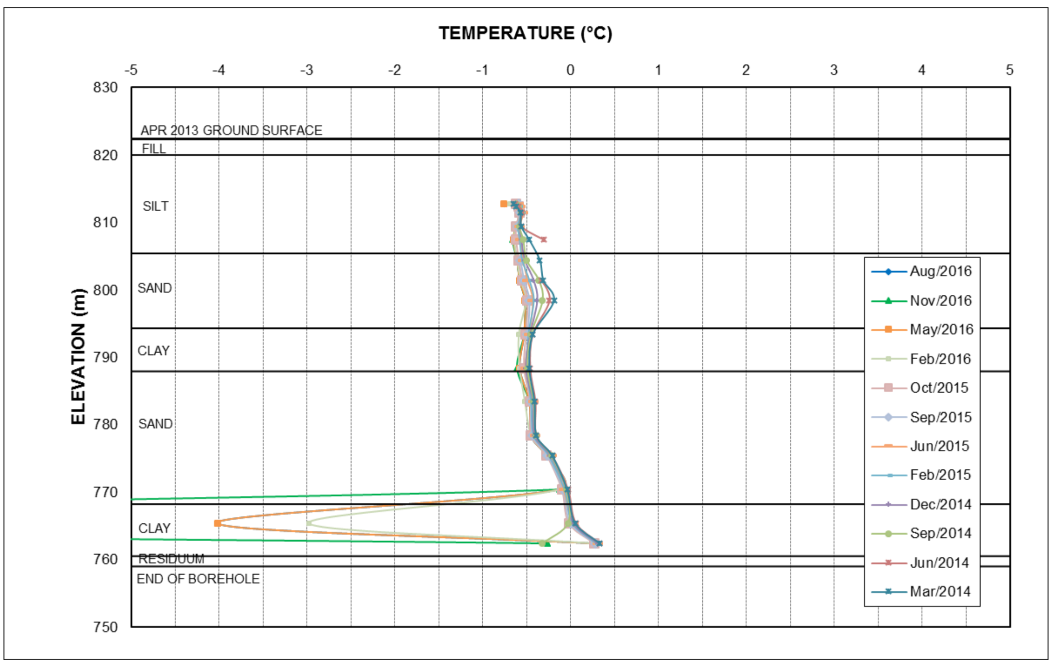


Figure 6-13: Thermistor AT2-1 (2014-2016)

6.5.2 Mill Water Pond Thermistors

Data collected from Mill Water Pond thermistors in 2016 are presented in Figure 6-14 and Figure 6-15. The Mill Water Pond was decommissioned in April 2016, and the thermistors were destroyed.

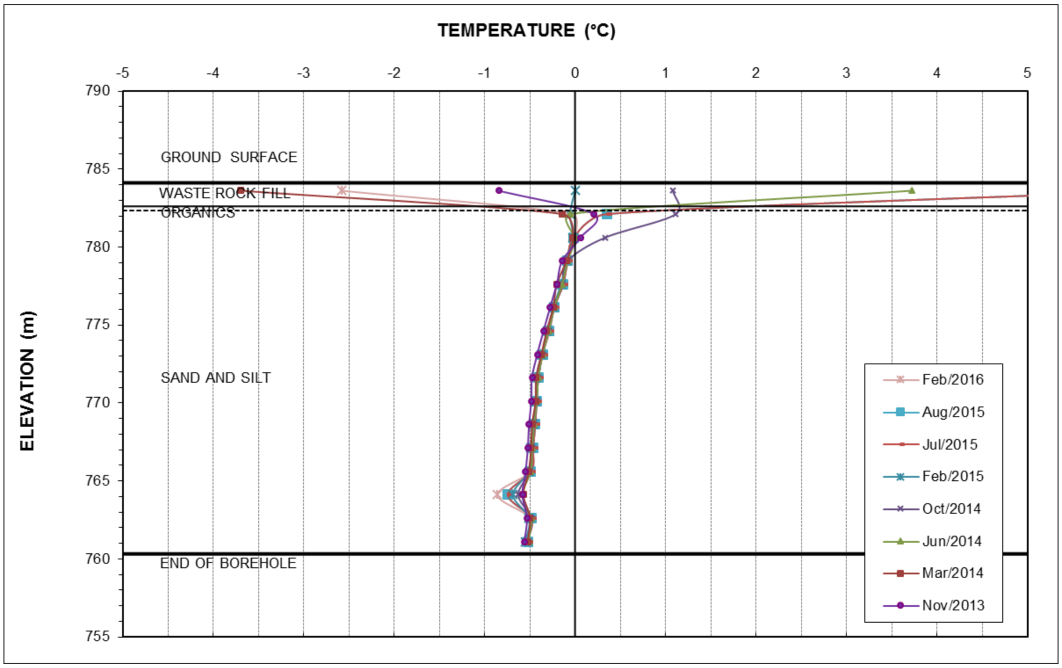


Figure 6-14: Thermistor MWPT-1 (2013-2016)

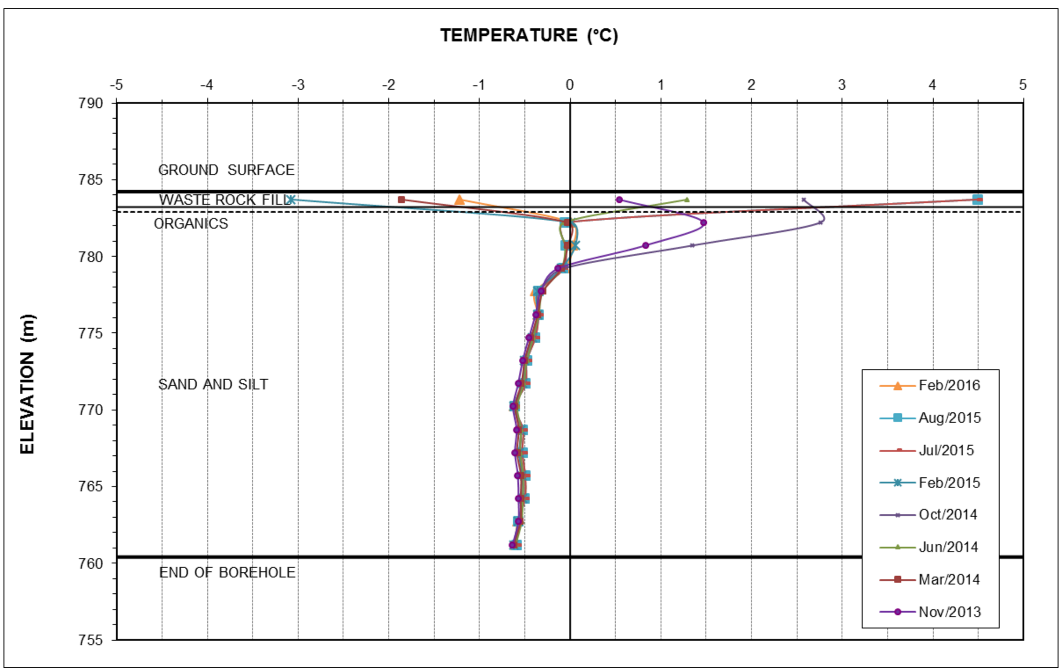


Figure 6-15: Thermistor MWPT-2 (2013-2016)

6.5.3 Main Pit Dam Thermistors

Data collected from the Main Pit Dam thermistors are presented in Figure 6-16 and Figure 6-17. Data was collected quarterly until February 2016 and has since been removed from the schedule. No major changes to ground temperatures at these locations were observed in 2016.

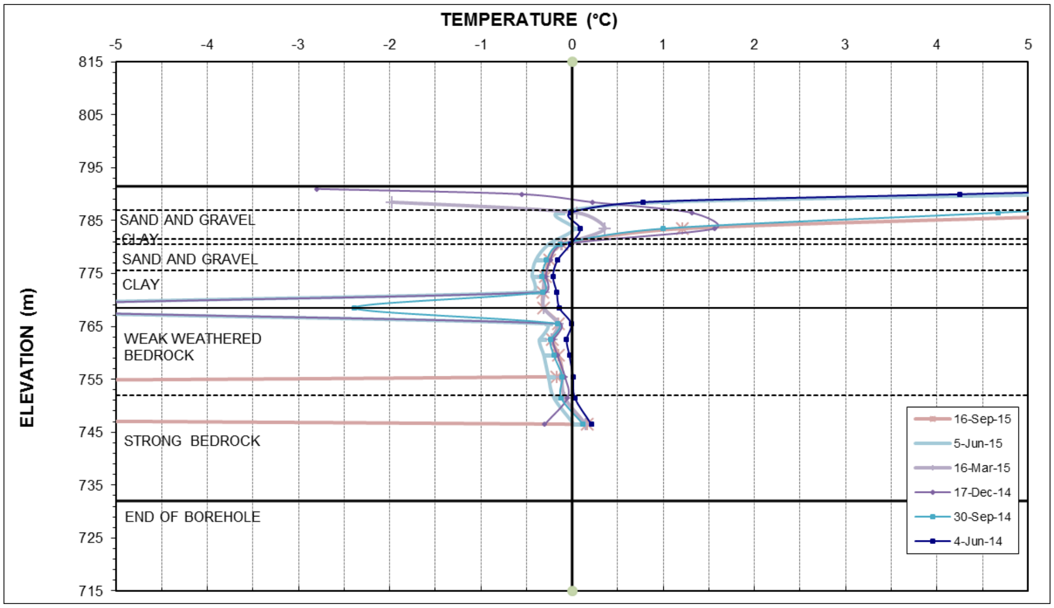


Figure 6-16: Thermistor MPD-1 (2014-2015)

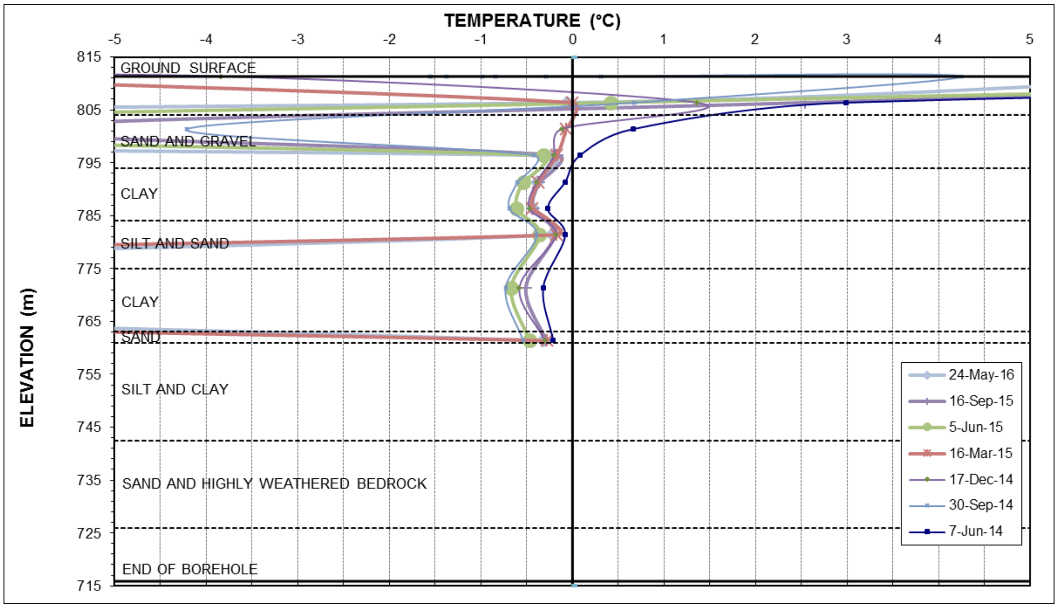


Figure 6-17: Thermistor MPD-2 (2014-2016)

6.5.4 Ridgetop Thermistors

Data are collected quarterly from both Ridgetop thermistors. No major changes to ground temperatures at the Ridgetop were observed in 2016.

6.5.5 Southwest Dump Thermistors

Data collected from SWD thermistors are presented Figure 6-18 to Figure 6-21. Data are collected quarterly. No major changes to ground temperatures at the SWD were observed in 2016.

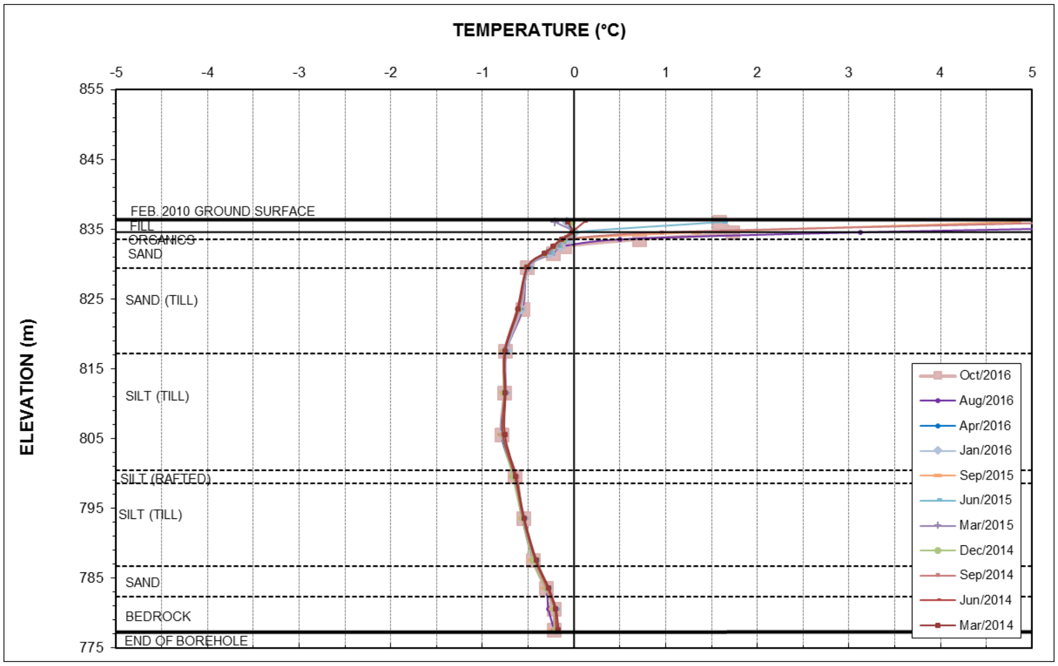


Figure 6-18: Thermistor SDT-1 (2014-2016)

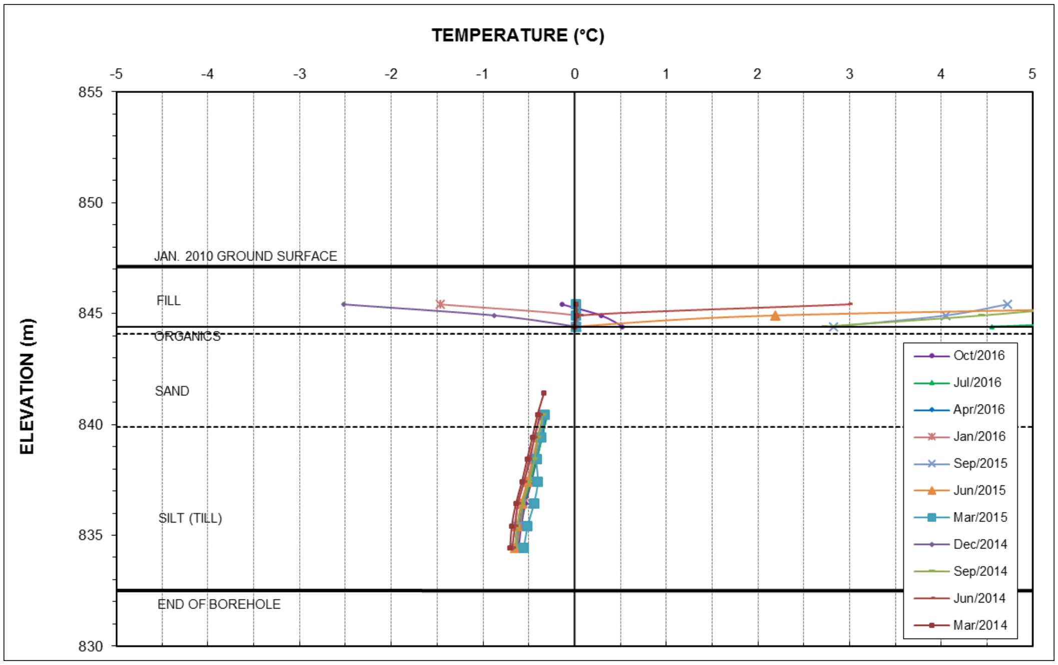


Figure 6-19: Thermistor SDT-2 (2014-2016)

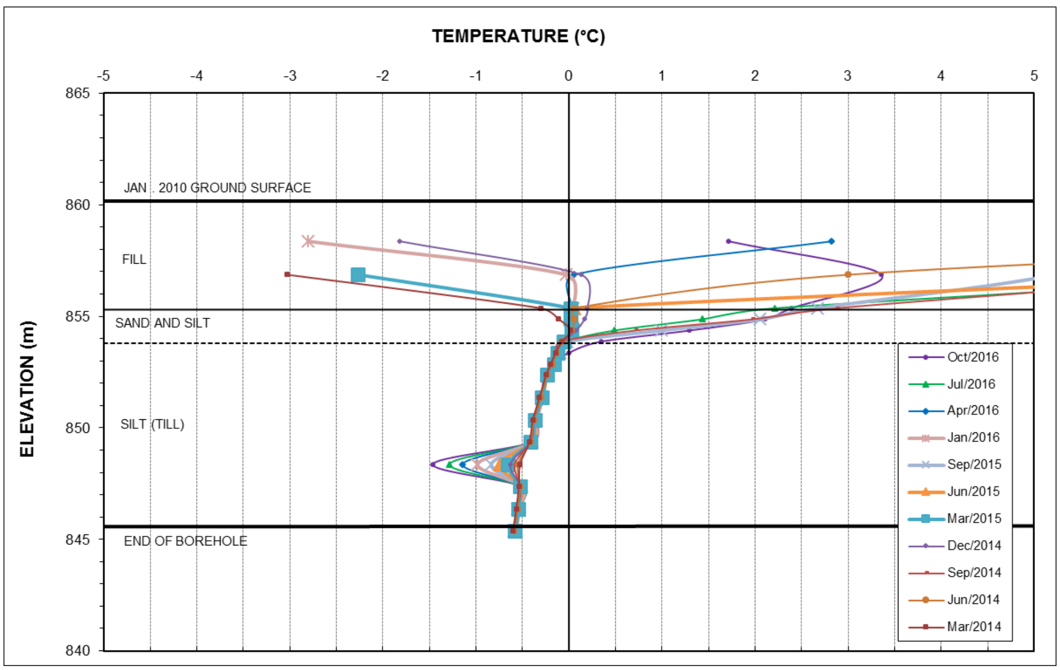


Figure 6-20: Thermistor SDT-3 (2014-2016)

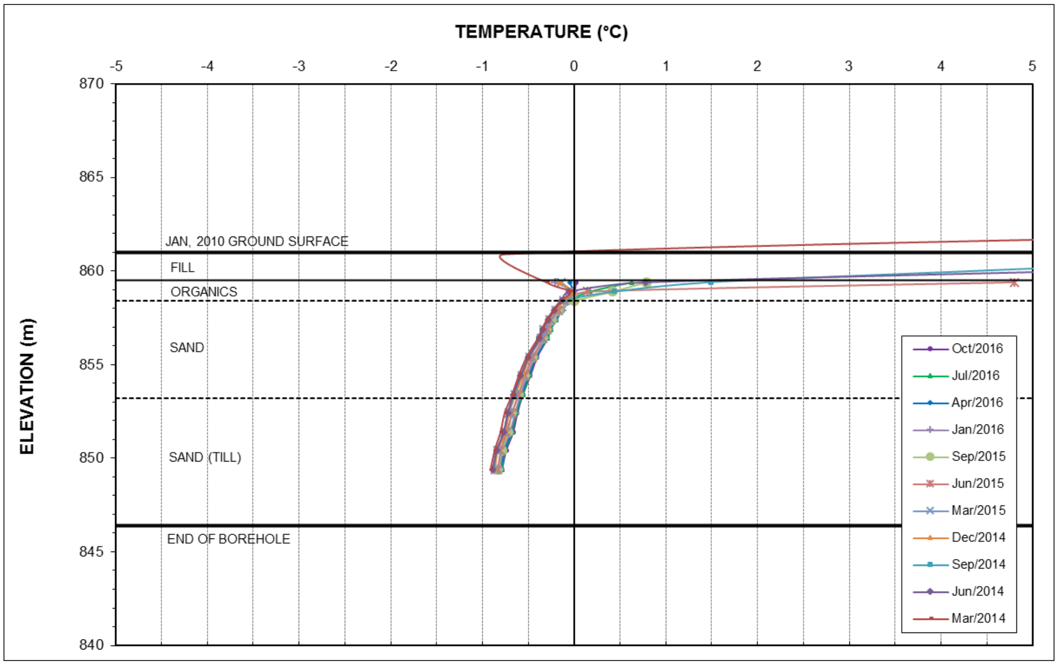


Figure 6-21: Thermistor SDT-4 (2014-2016)

6.5.6 Water Storage Pond Dam Thermistors

Data are collected monthly from all water retention dam thermistors. All thermistors continue to show temperatures well above zero since installation.

7 Seepage Water Quality Monitoring Program

Minto Mine implements a Seepage Monitoring Plan (SMP) to assess acid rock drainage and metal leaching conditions from several sources, including: pit wall seepage, ore stockpile areas, overburden dumps, waste rock dumps, DSTSF, Mill Valley Fill Extension 1 and 2, the mill area and other seepage locations.

Seepage monitoring conducted in 2016 was carried out in accordance with the EMSRP. The EMSRP states that seepage surveys will be conducted twice a year, during spring runoff and in early fall, by walking the toe of each waste dump, stockpile or other area of interest. The survey route for each seepage monitoring event are recorded using the tracking function of a GPS. A map showing the 2016 survey routes and monitoring locations can be found in Figure 7-1.

WUL QZ14-031 identifies a Surface Water Surveillance Program which requires regular monitoring of seepage at a number of permanent seepage water quality stations. These stations include: W8, W8A, W17, W36, W37, and W62. Prior to WUL QZ14-031, Minto operated under WUL QZ96-006 which included seepage monitoring sites W32, W38, W39 and W40 in the Surface Water Surveillance Program. The water quality results for these permanent seepage quality stations are additionally reported to the Yukon Water Board (YWB) on a monthly basis. Other seepage sites that have been located have been recorded by GPS to ensure continued monitoring. These additional sites are visited during the spring and fall and, if water is present, a sample is collected. Substantial variability in flow presence and/or volume has been observed at many seepage sites. All lab results for 2016 spring and fall seepage monitoring programs are provided in Appendix E.

Seepage site locations are marked by GPS and data is stored in the Minto Mine Water Quality Database, along with results from WUL sampling stations. Minto will continue to monitor these seepage areas and monitor the site workings for seeps on a semi-annual basis.

Observations from the 2016 Seepage Monitoring Program indicate that the majority of the seepage sites identified are seasonally variable. It has also been observed that weather patterns have an impact, where snow melt or rain contribute to observable flows that are absent during warm, dry weather. Analysis of seepage results and water quality analysis assists in improving understanding of water chemistry, load, and water balance issuing from waste dumps, overburden dumps, ore stockpiles, and tailings facilities.

Constituents of concern, namely dissolved copper, dissolved cadmium, dissolved iron, dissolved selenium, ammonia, nitrate, and nitrite have been graphed below for each site sampled. In cases where a graph's trend is skewed due to visual outliers (i.e. data points that are larger than the mean by an order of magnitude), a second graph with outliers removed is provided and labeled as "Reduced Concentration."

Figure 7-1: Seepage Monitoring Survey Routes and Monitoring Locations (2016)

7.1 Mill Valley Fill

The first phase of the Mill Valley Fill (MVF) was completed in 2012 and vertical culverts were installed at both W8 and W8A to enable water quality monitoring at these locations. Obtaining water samples at W8 has been sporadic since the installation of the vertical culvert. The last time this station produced water was in late 2013. The second phase of the Mill Valley Fill Extension was completed in early 2016. Additional extensions were added to the vertical culverts of W8 and W8A to preserve the sampling stations. Water quality results for W8 and W8A are outlined in Figure 7-2 through 7-10 and include 2016 results as well as historic data for dissolved copper, dissolved cadmium, dissolved iron, dissolved selenium, and nutrient levels for ammonia, nitrite, and nitrate.

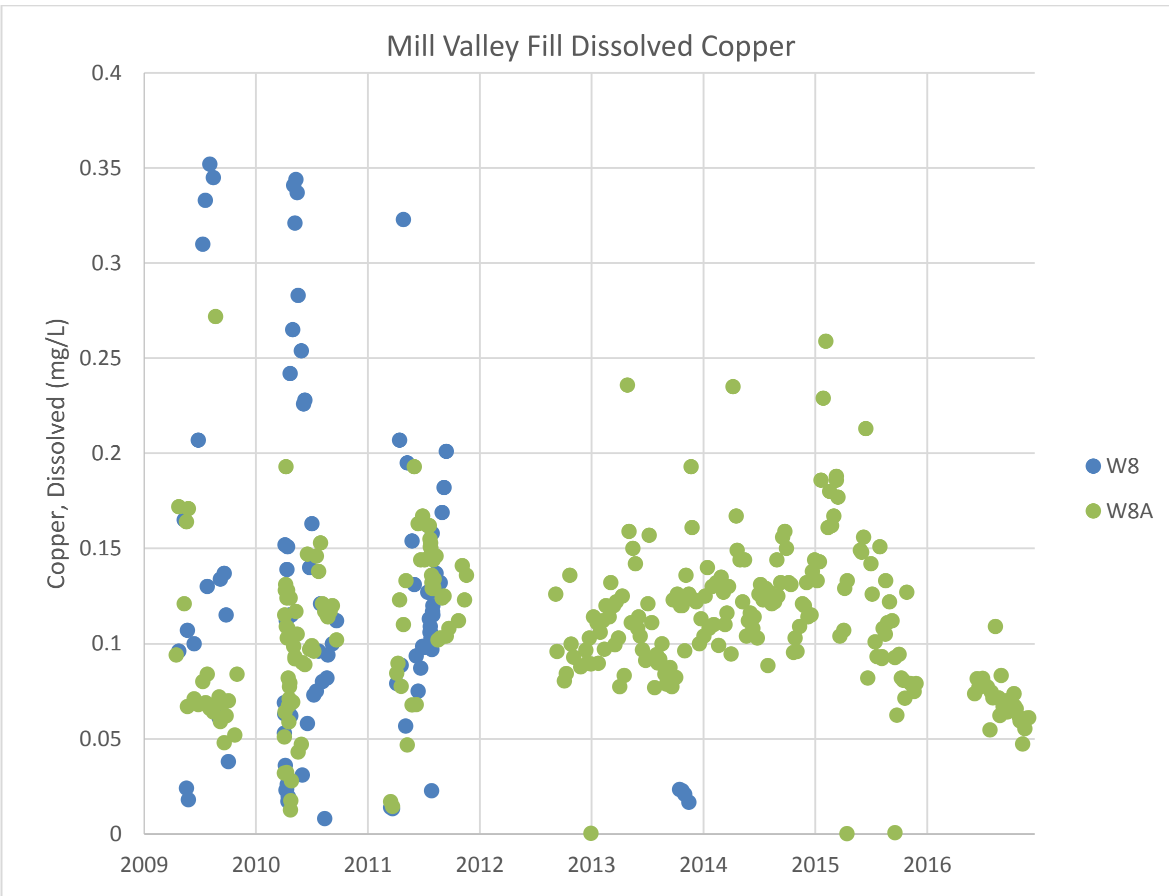


Figure 7-2: Mill Valley Fill Dissolved Copper

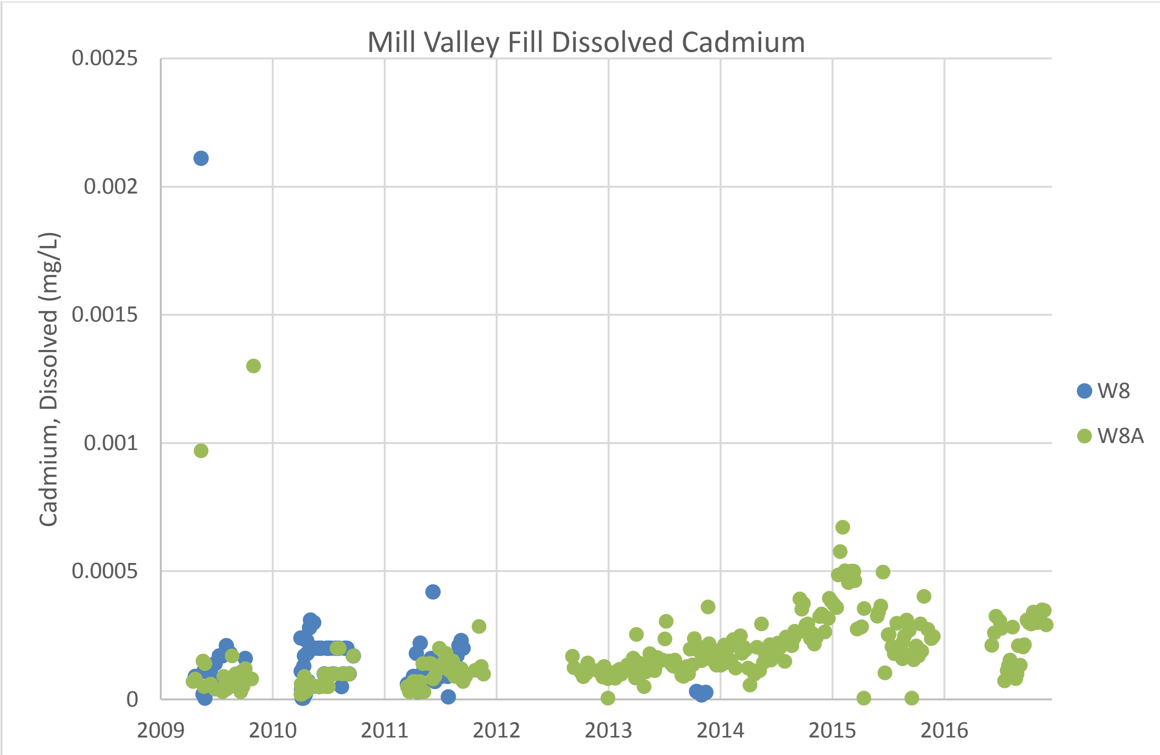


Figure 7-3: Mill Valley Fill Dissolved Cadmium

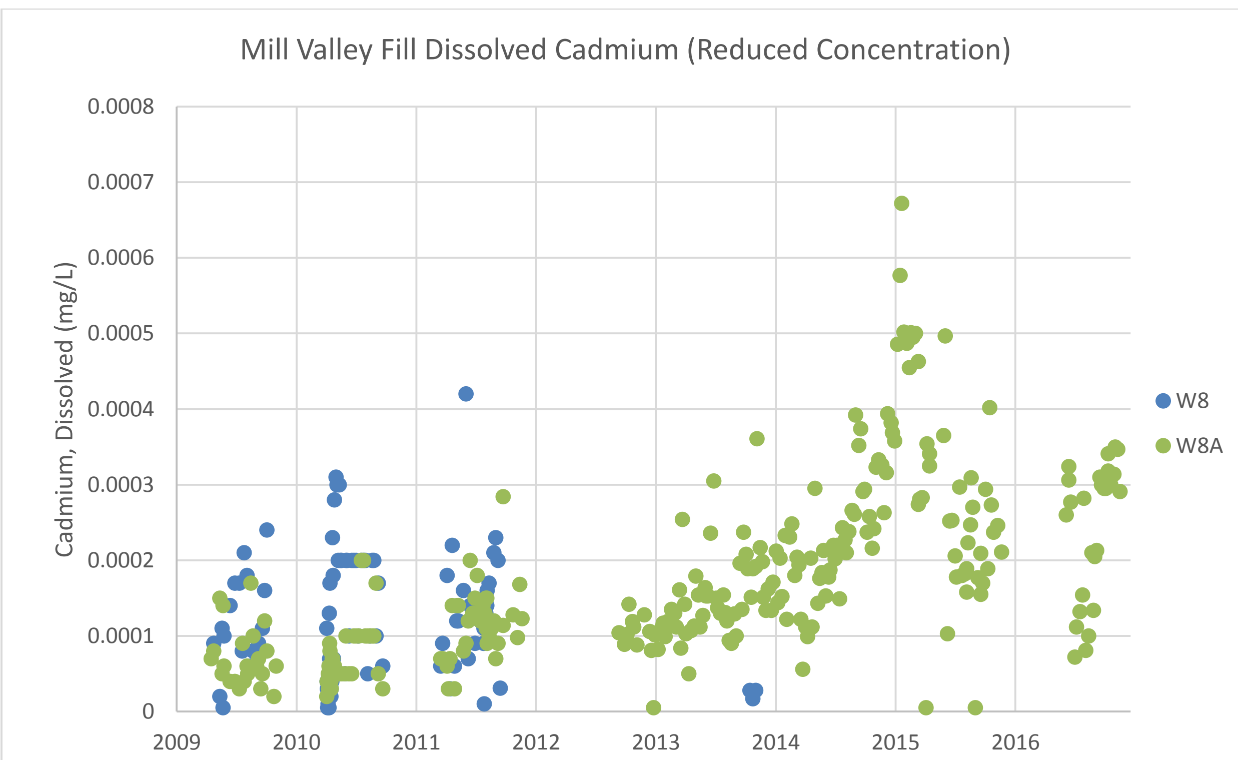


Figure 7-4: Mill Valley Fill Dissolved Cadmium (Reduced Concentration)

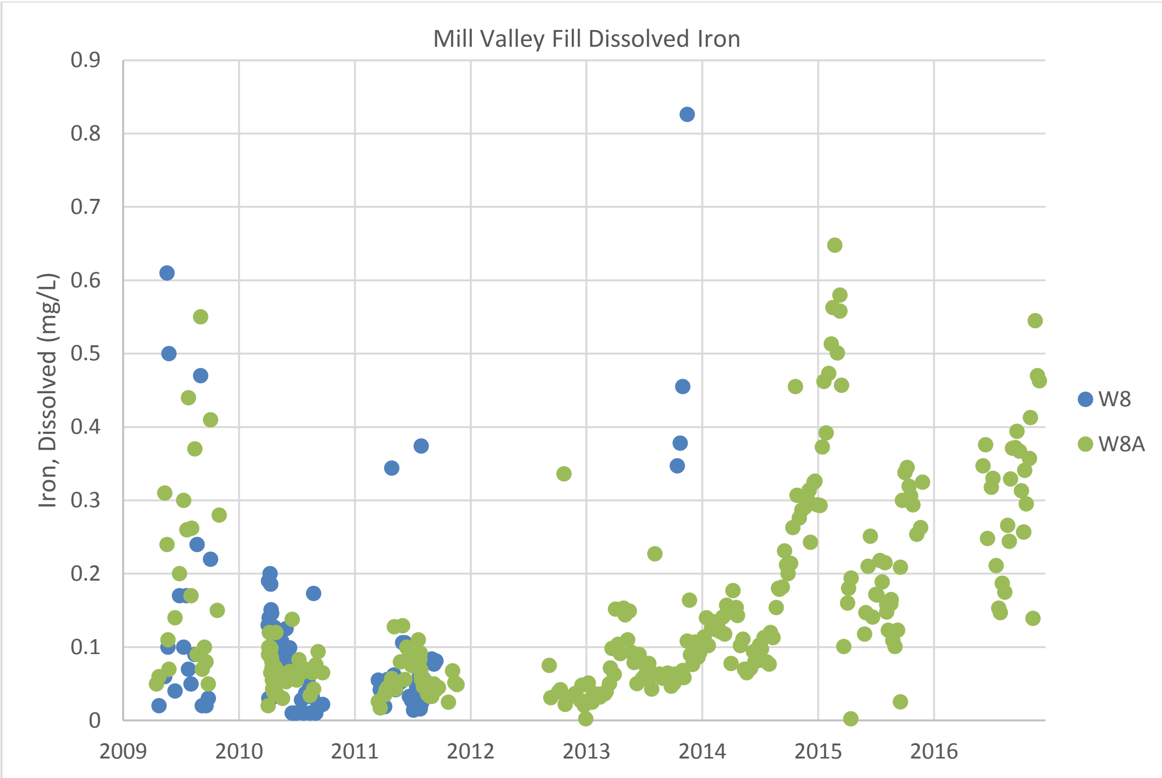


Figure 7-5: Mill Valley Fill Dissolved Iron

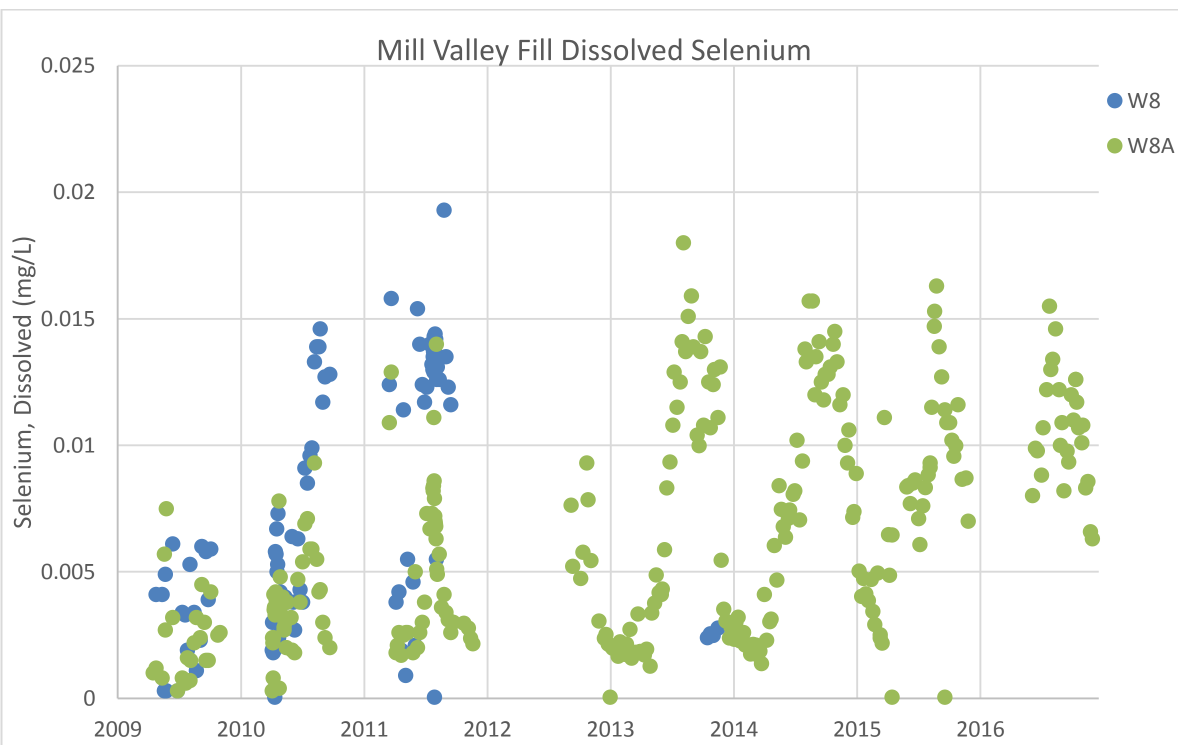


Figure 7-6: Mill Valley Fill Dissolved Selenium

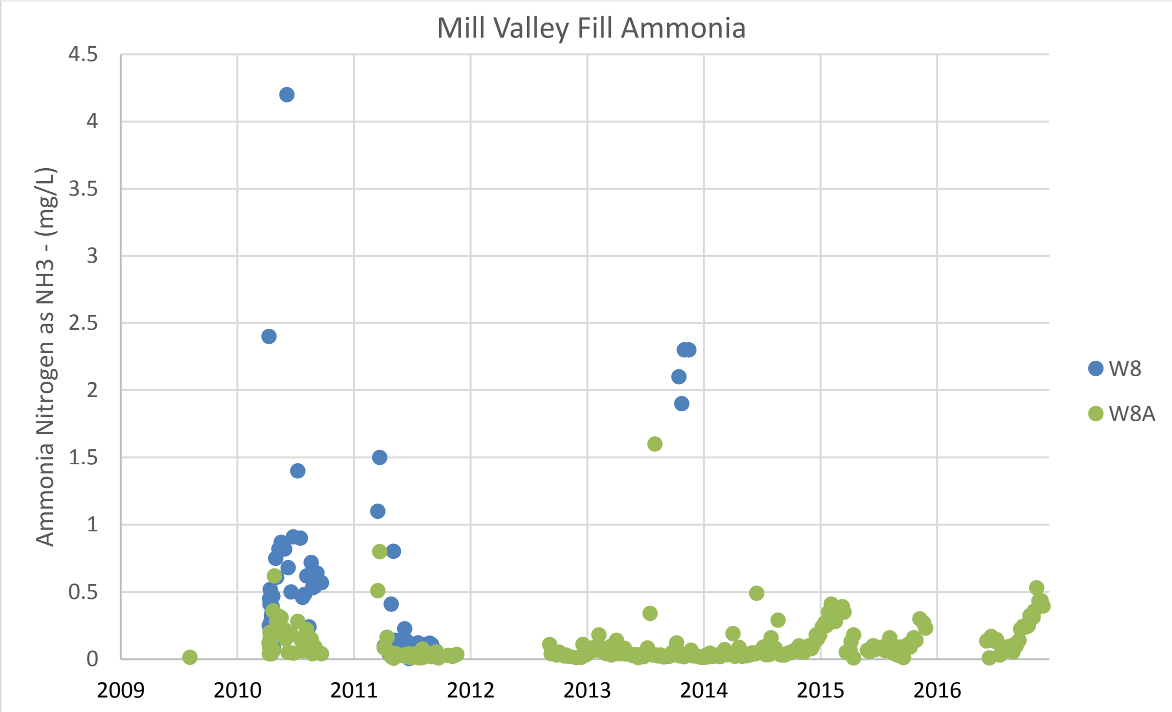


Figure 7-7: Mill Valley Fill Ammonia

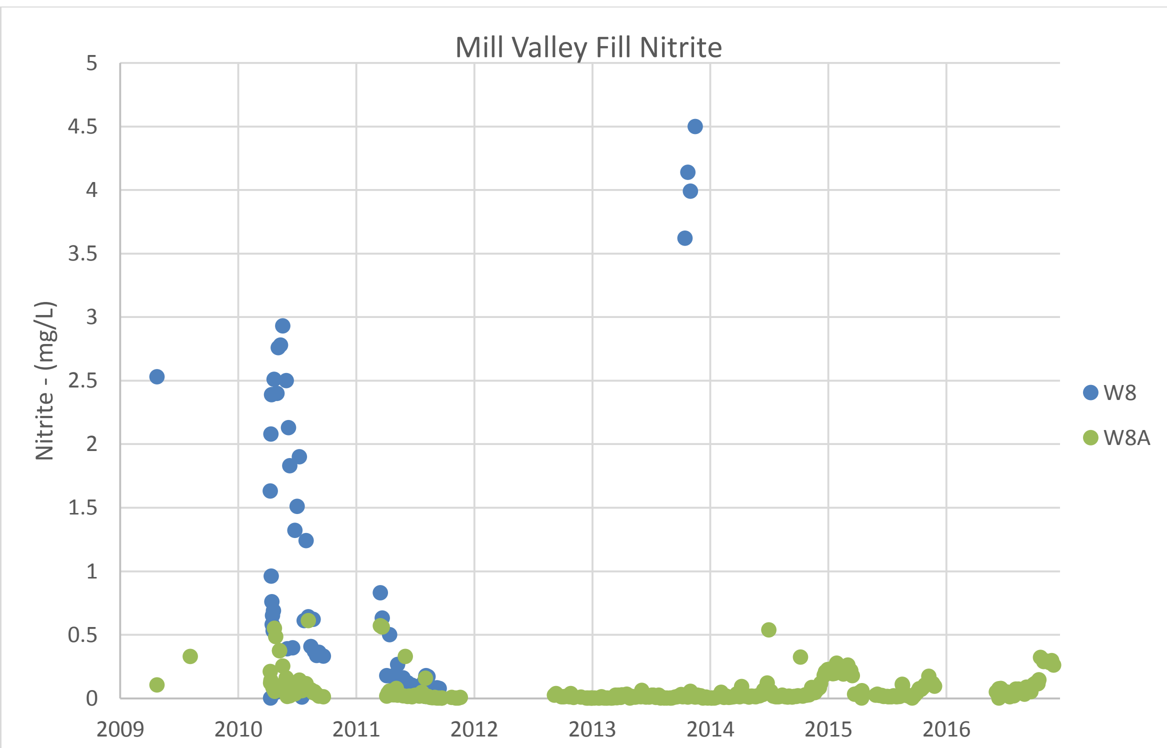


Figure 7-8: Mill Valley Fill Nitrite

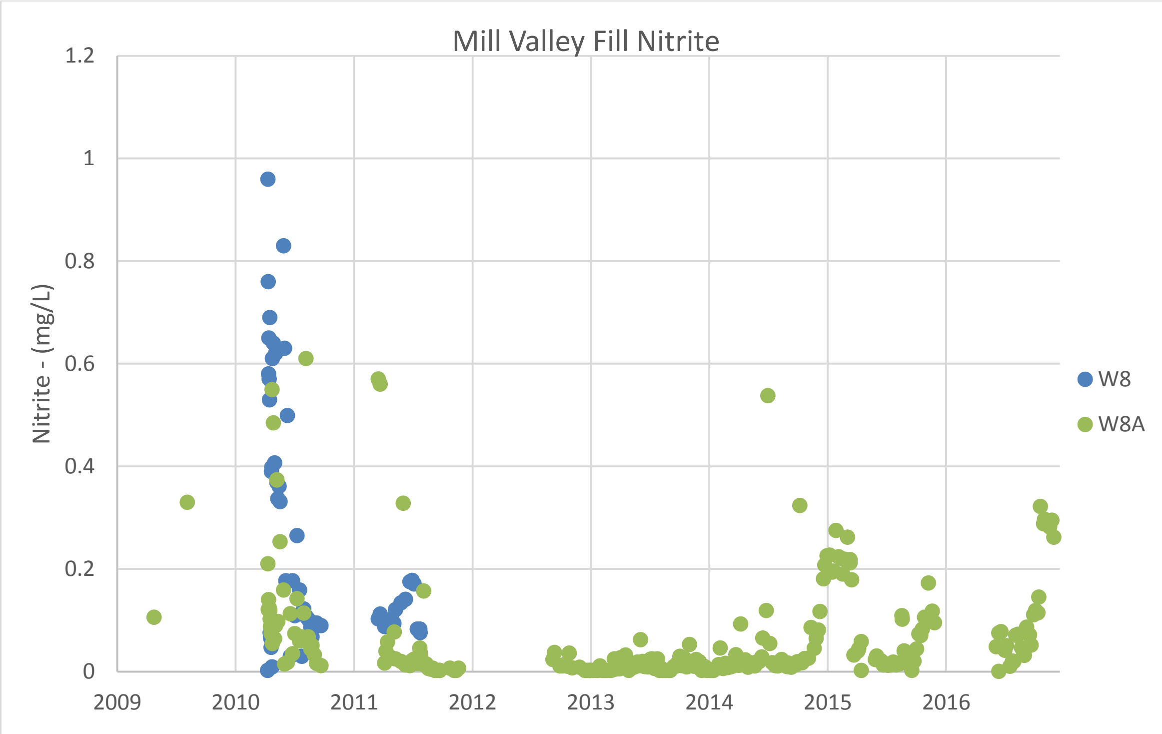


Figure 7-9: Mill Valley Fill Nitrite (Reduced Concentration)

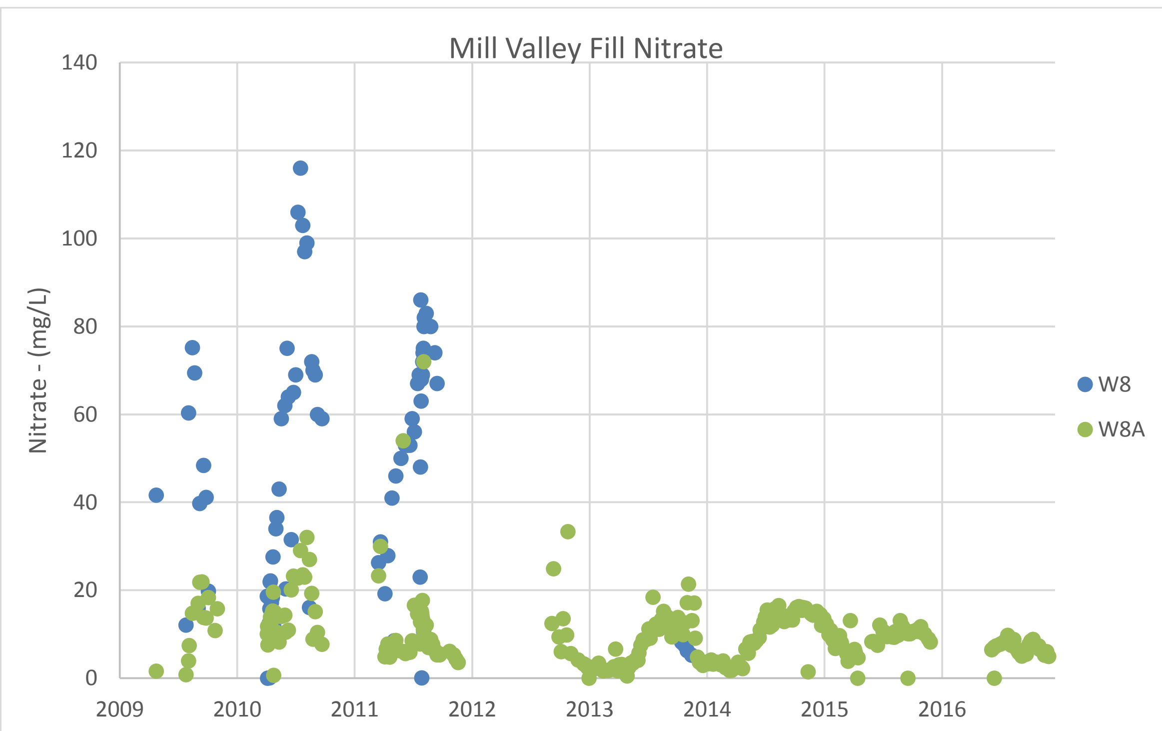


Figure 7-10: Mill Valley Fill Nitrate

7.2 Southwest Dump

Seepage was collected at stations SS1, SS29, SS30, SS31, SS39, SS44, SS49, SS50, SS51, and SS52. Additionally, W38 and W39 were monitored during the seepage sampling event. Samples are taken within ±5m of the original GPS point. If there is no seepage within the 5m buffer, the site is considered dry during that sampling session. Water quality results from the 2016 survey program for W38 and W39, as well as W32 and W40 historical data, are presented in Figure 7-11 to 7-18. Historical data and 2016 seepage water quality results for SS1, SS13, SS21, SS22, SS28, SS29, SS30, SS31, SS39, SS43, SS44, SS48, SS49, SS50, SS51, and SS52 are summarized in Figure 7-19 to Figure 7-39. The figures include water quality results for dissolved copper, dissolved cadmium, dissolved iron, dissolved selenium, and nutrient levels for ammonia, nitrite, and nitrate.

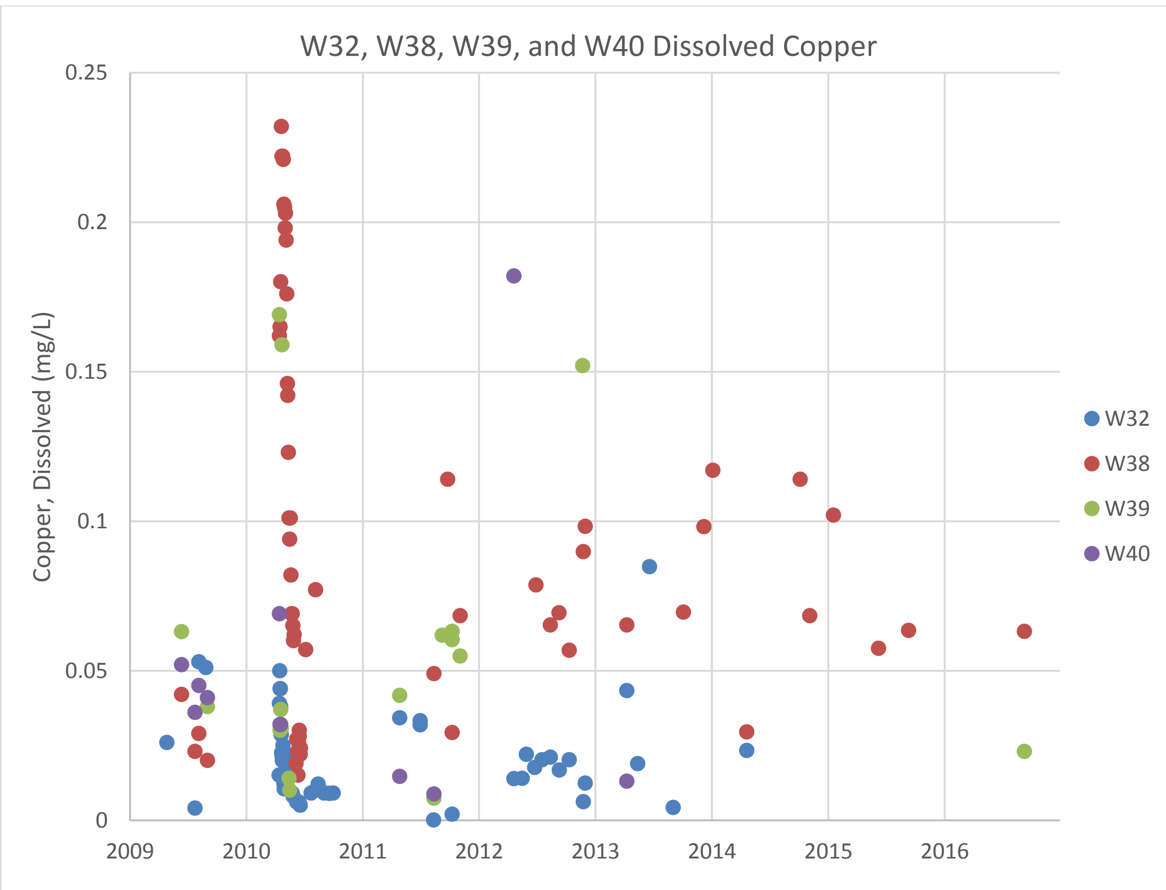


Figure 7-11: W32, W38, W39, and W40 Dissolved Copper

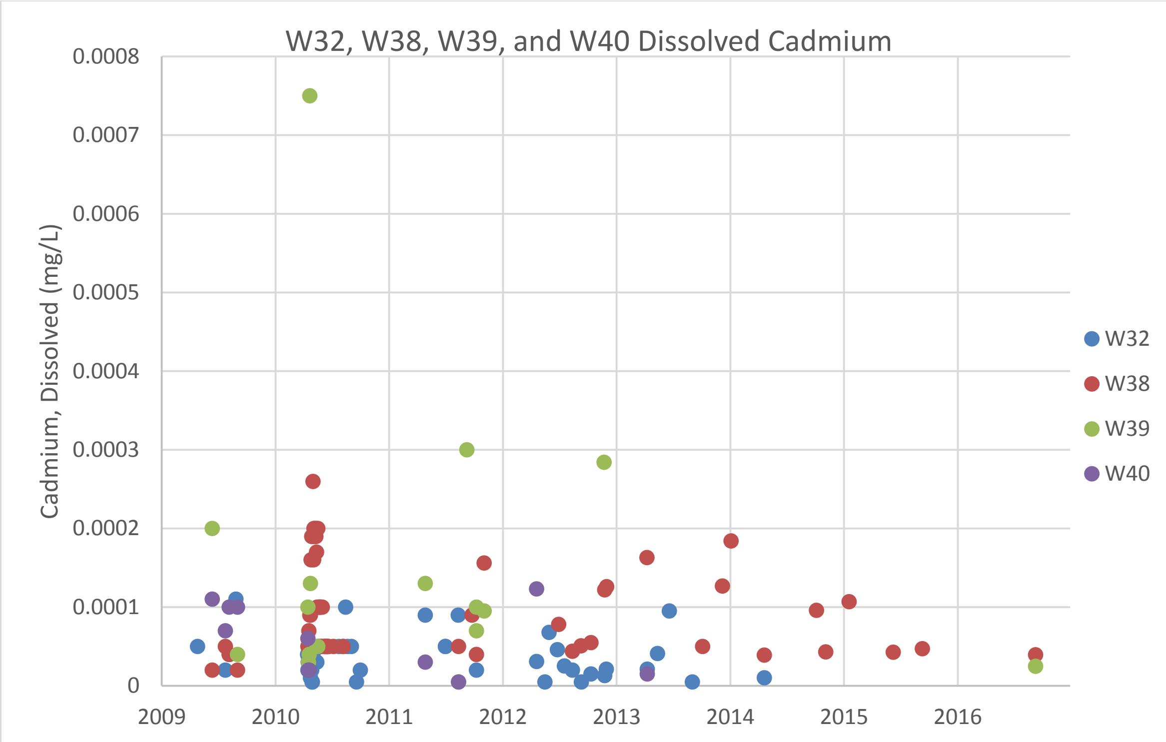


Figure 7-12: W32, W38, W39, and W40 Dissolved Cadmium

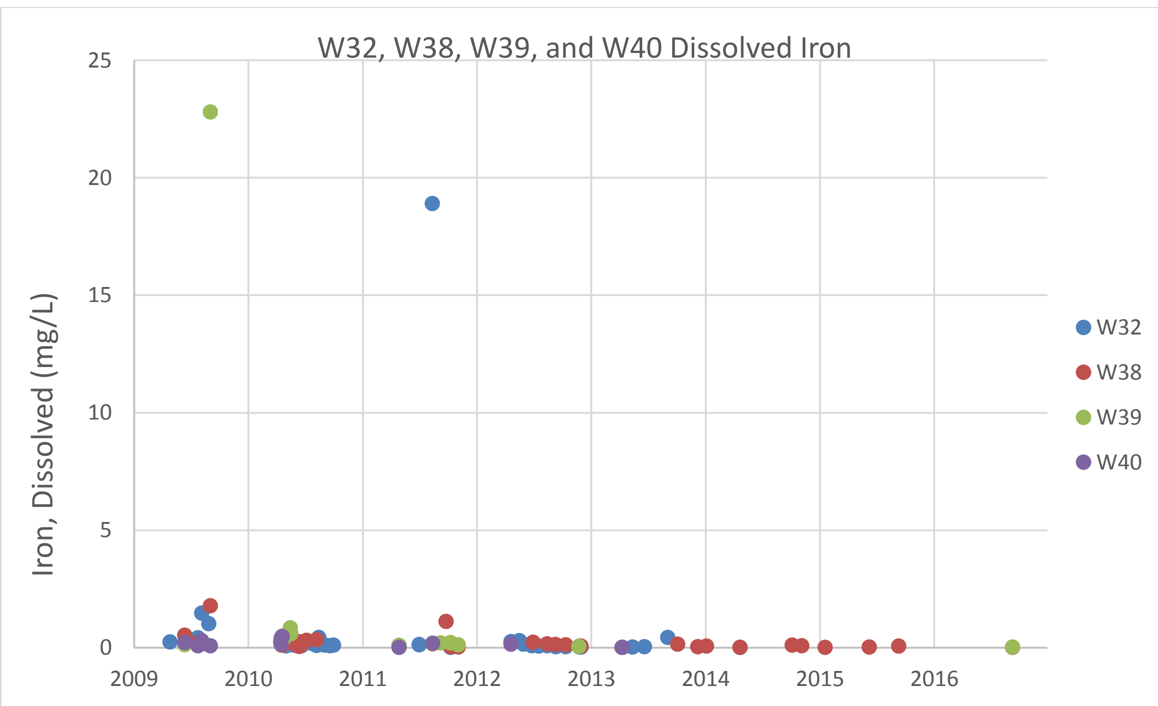


Figure 7-13: W32, W38, W39, and W40 Dissolved Iron

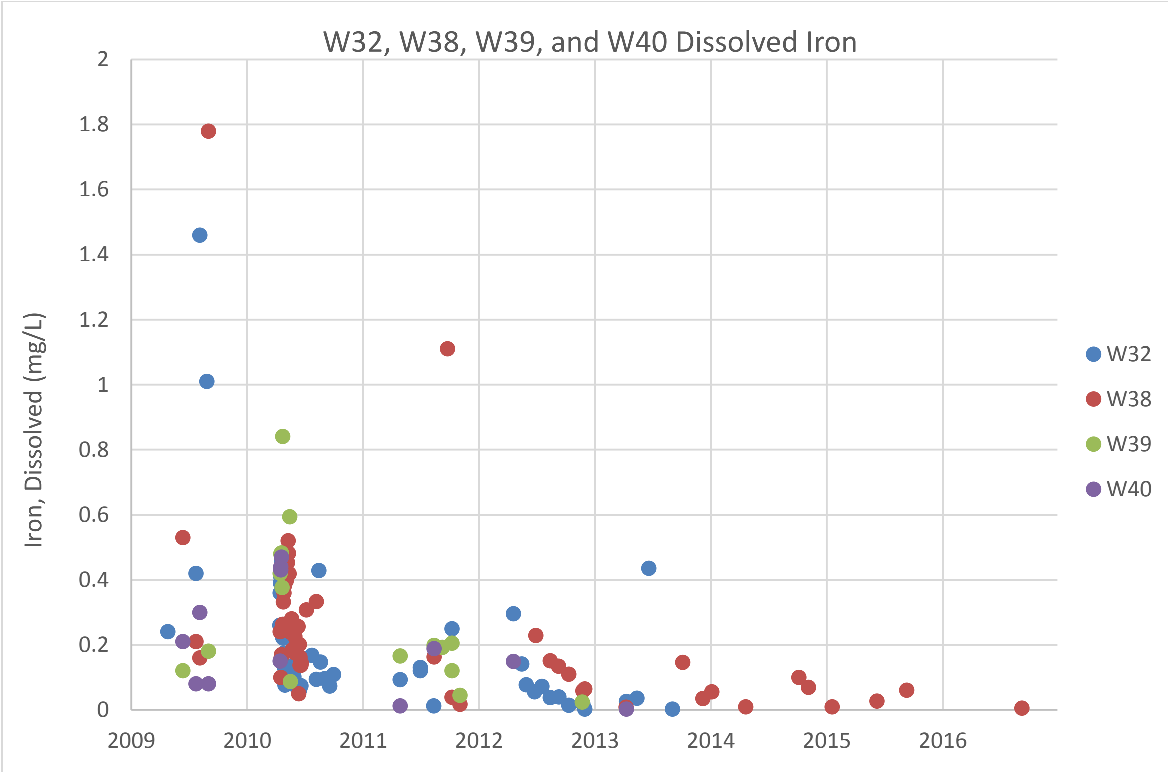


Figure 7-14: W32, W38, W39, and W40 Dissolved Iron (Reduced Concentration)

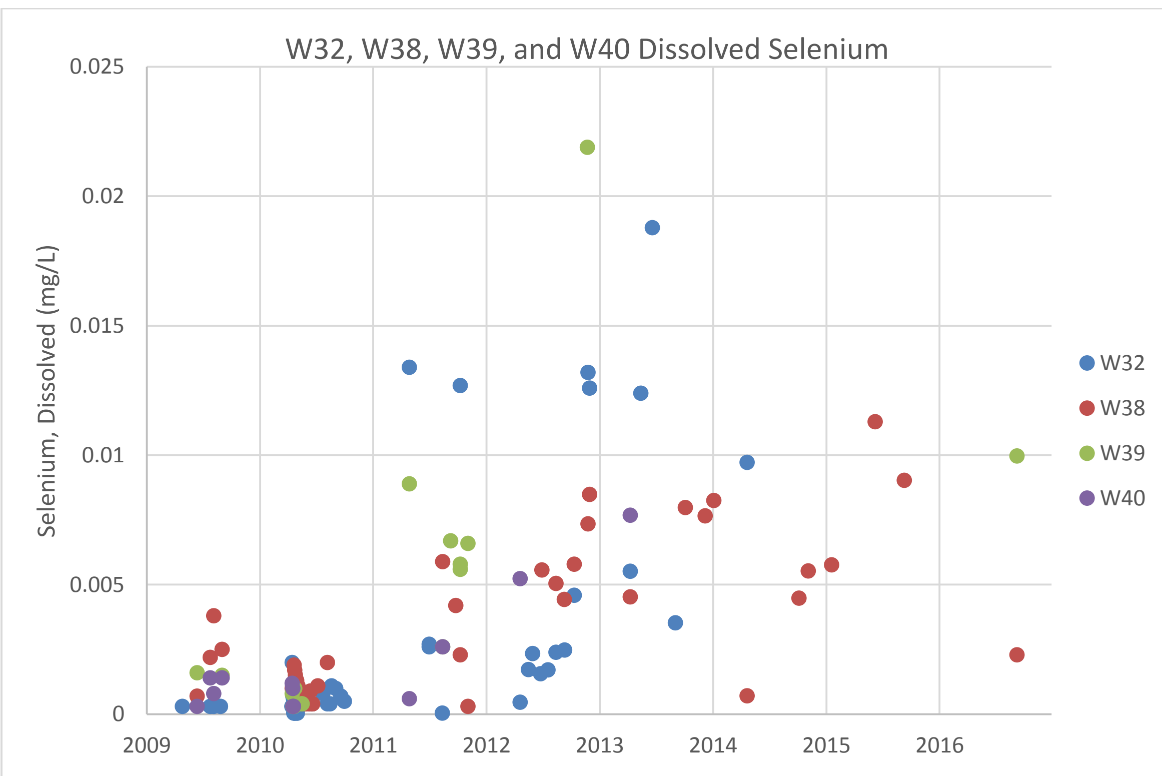


Figure 7-15: W32, W38, W39, and W40 Dissolved Selenium

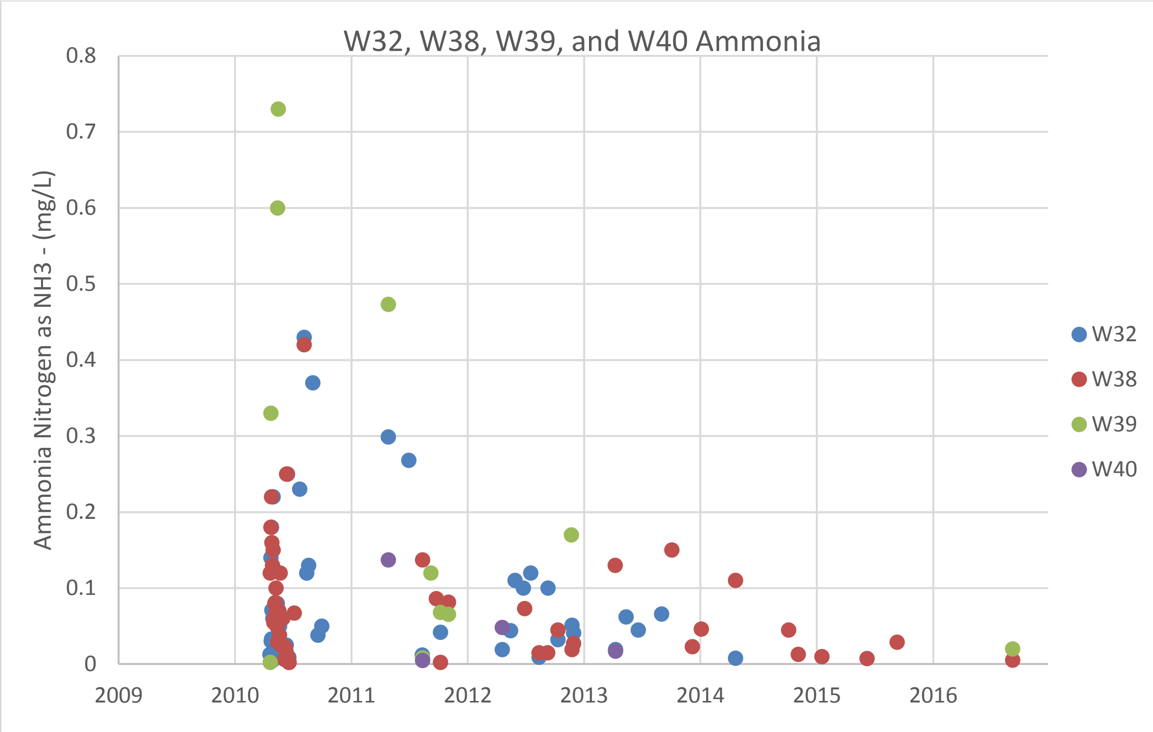


Figure 7-16: W32, W38, W39, and W40 Ammonia

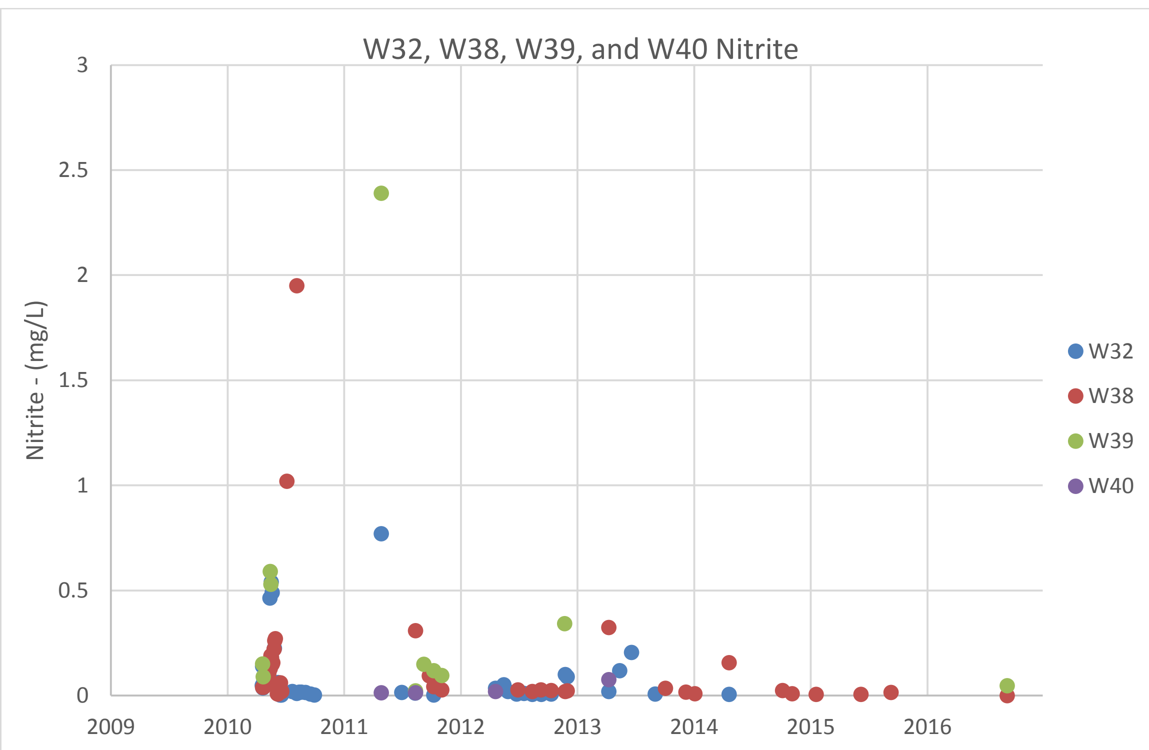


Figure 7-17: W32, W38, W39, and W40 Nitrite

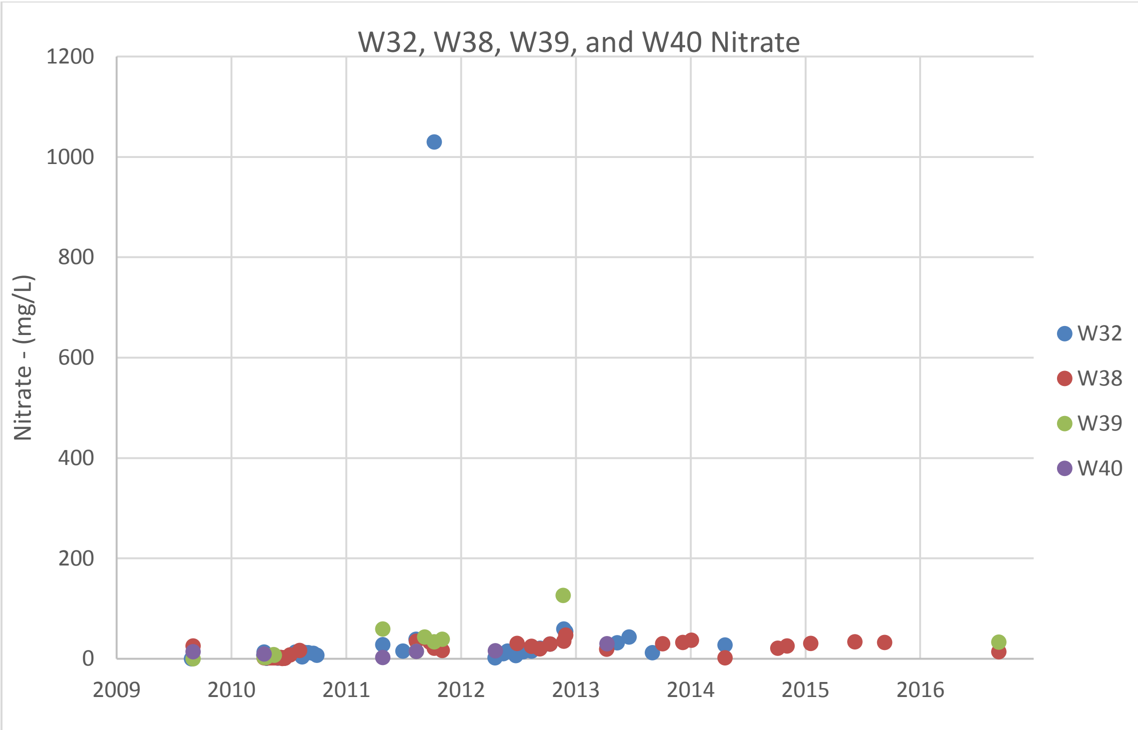


Figure 7-18: W32, W38, W39, and W40 Nitrate

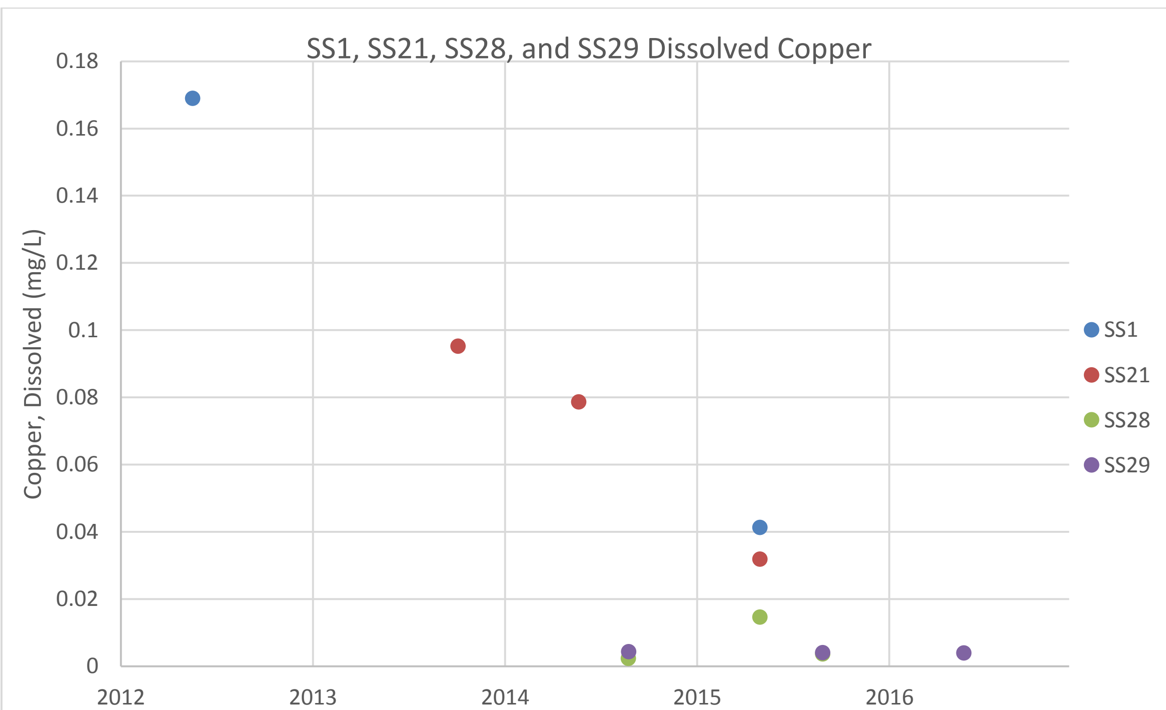


Figure 7-19: SS1, SS21, SS28, and SS29 Dissolved Copper

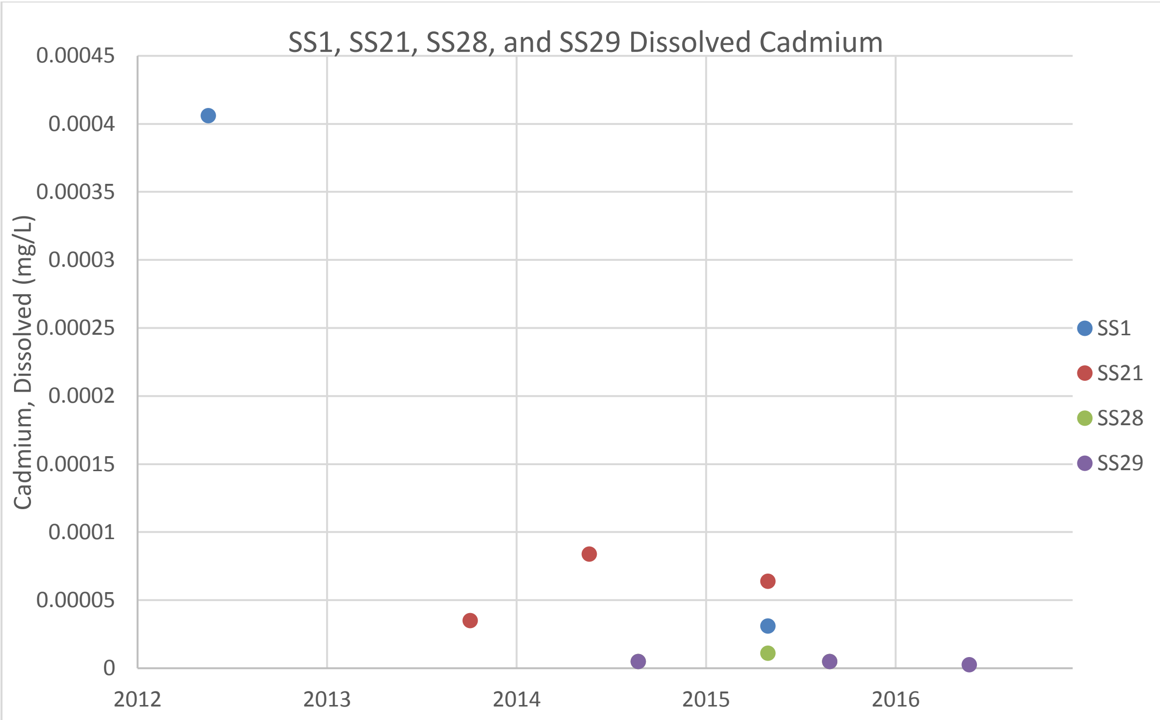


Figure 7-20: SS1, SS21, SS28, and SS29 Dissolved Cadmium

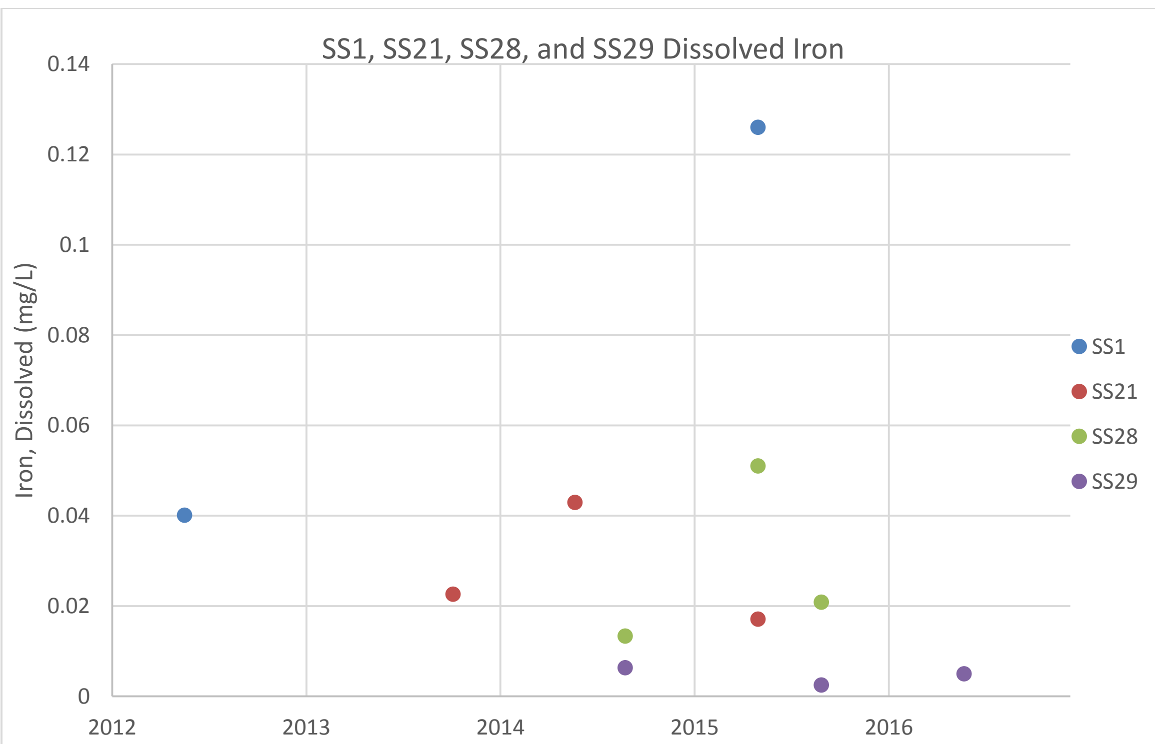


Figure 7-21: SS1, SS21, SS28, and SS29 Dissolved Iron

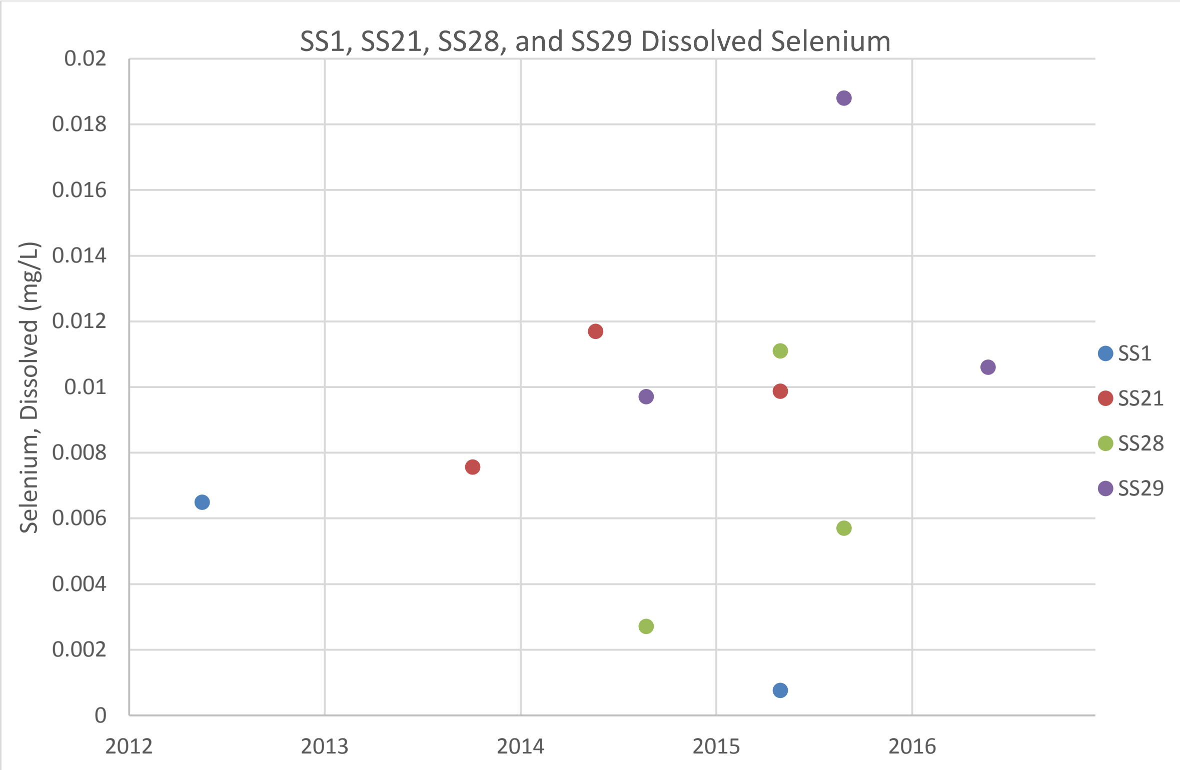


Figure 7-22: SS1, SS21, SS28, and SS29 Dissolved Selenium

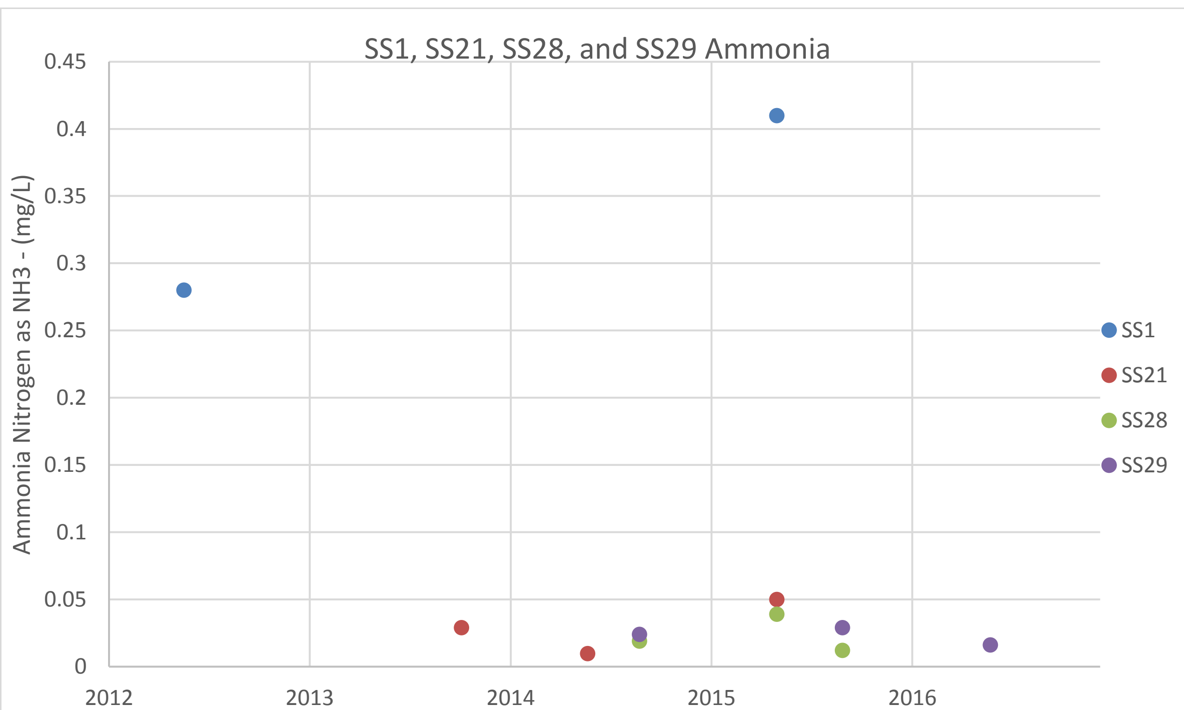


Figure 7-23: SS1, SS21, SS28, and SS29 Ammonia

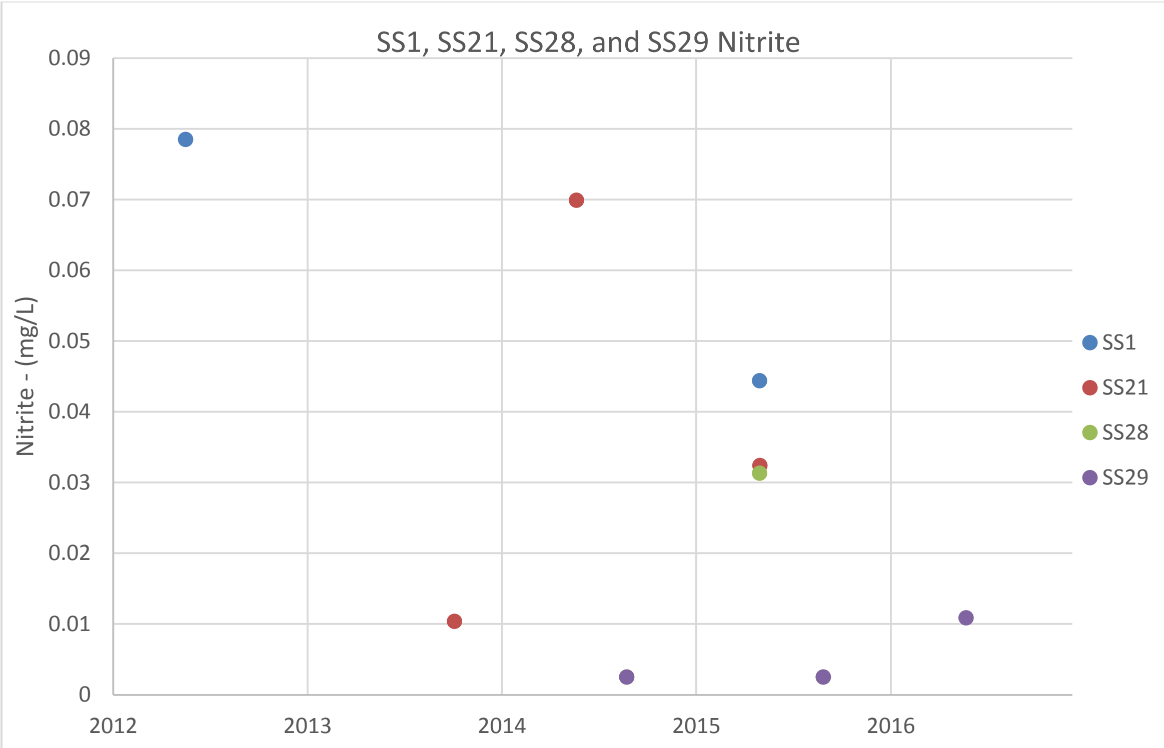


Figure 7-24: SS1, SS21, SS28, and SS29 Nitrite

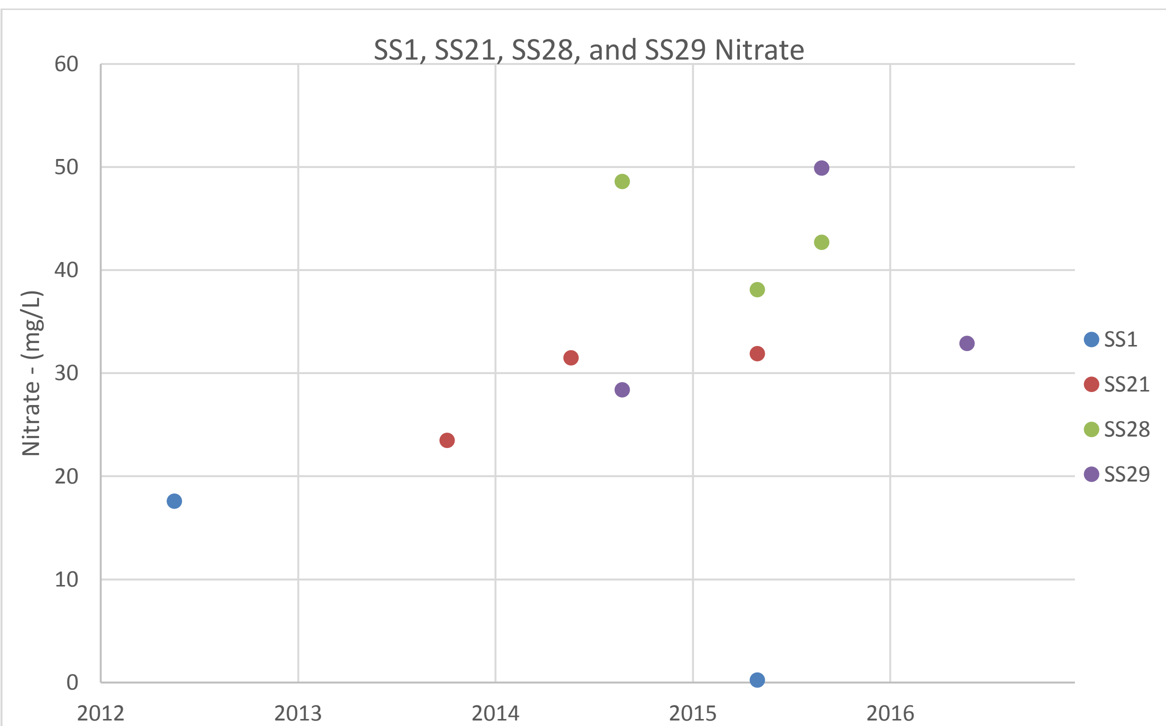


Figure 7-25: SS1, SS21, SS28, and SS29 Nitrate

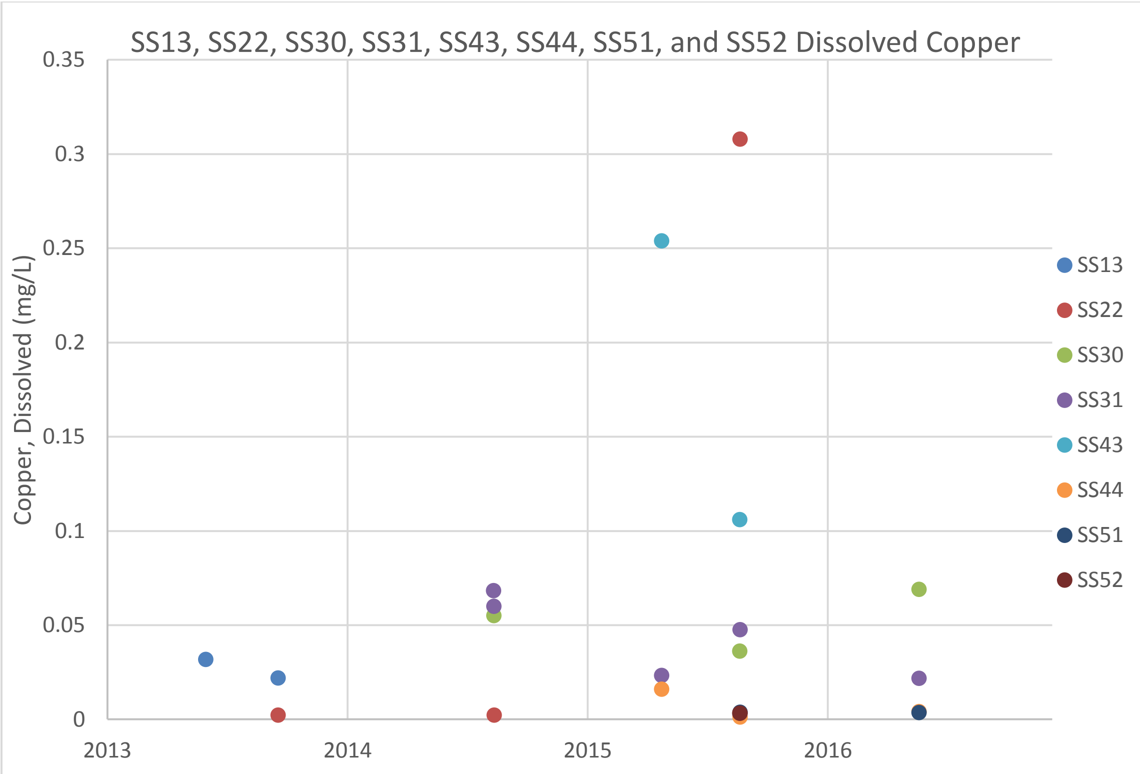


Figure 7-26: SS13, SS22, SS30, SS31, SS43, SS44, SS51, and SS52 Dissolved Copper

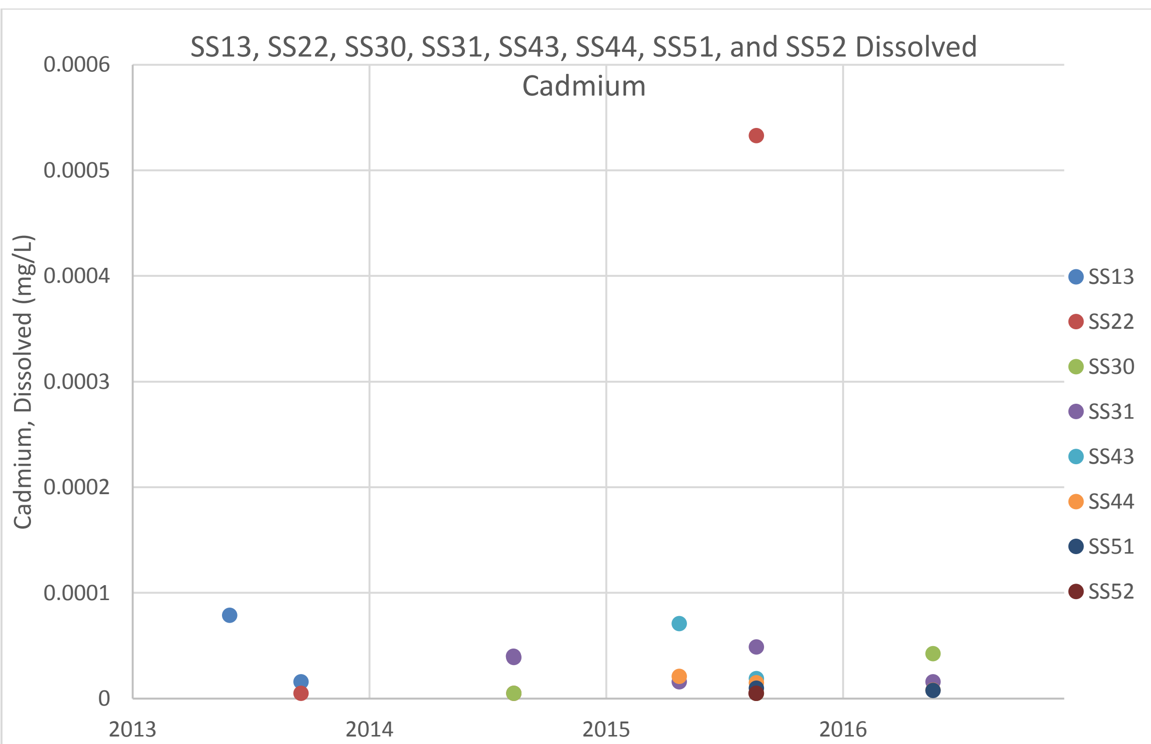


Figure 7-27: SS13, SS22, SS30, SS31, SS43, SS44, SS51, and SS52 Dissolved Cadmium

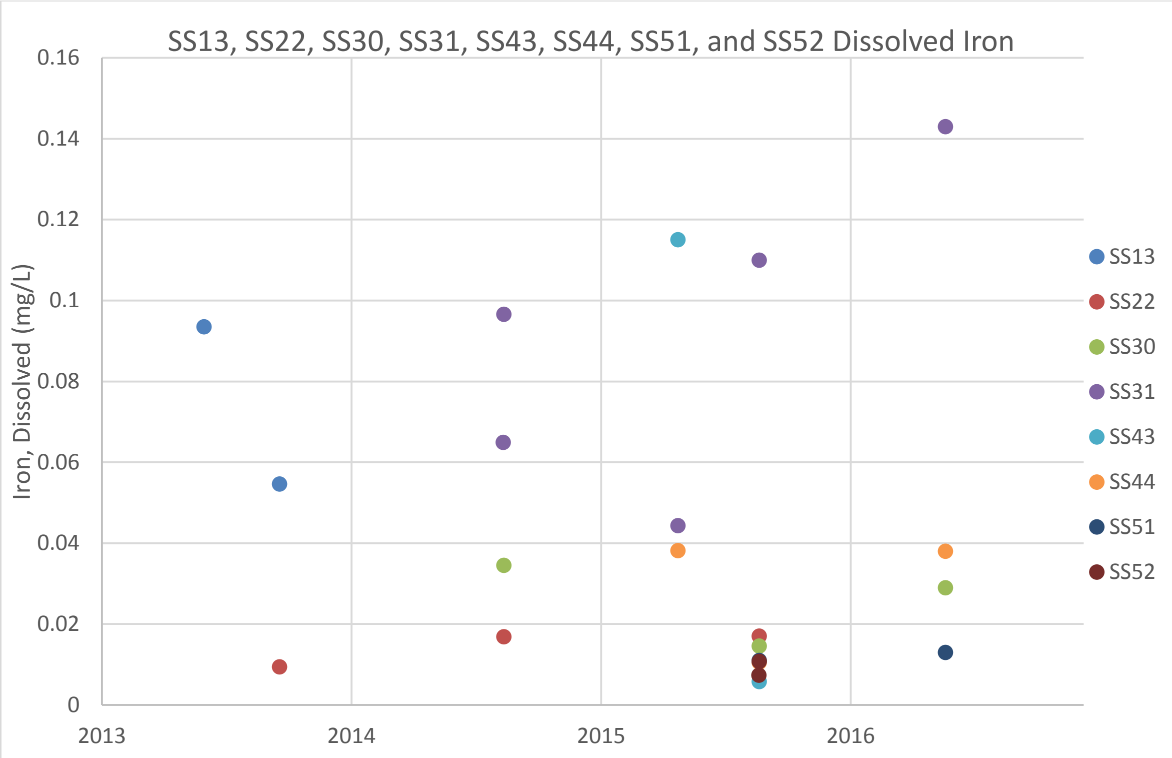


Figure 7-28: SS13, SS22, SS30, SS31, SS43, SS44, SS51, and SS52 Dissolved Iron

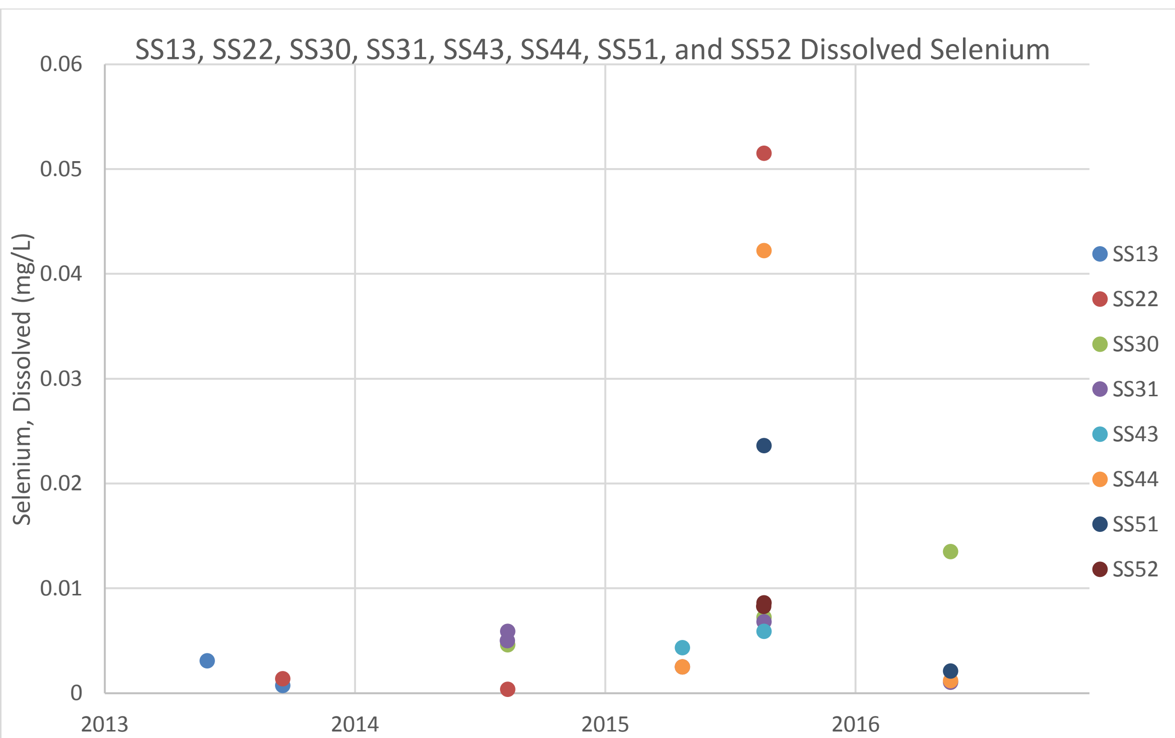


Figure 7-29: SS13, SS22, SS30, SS31, SS43, SS44, SS51, and SS52 Dissolved Selenium

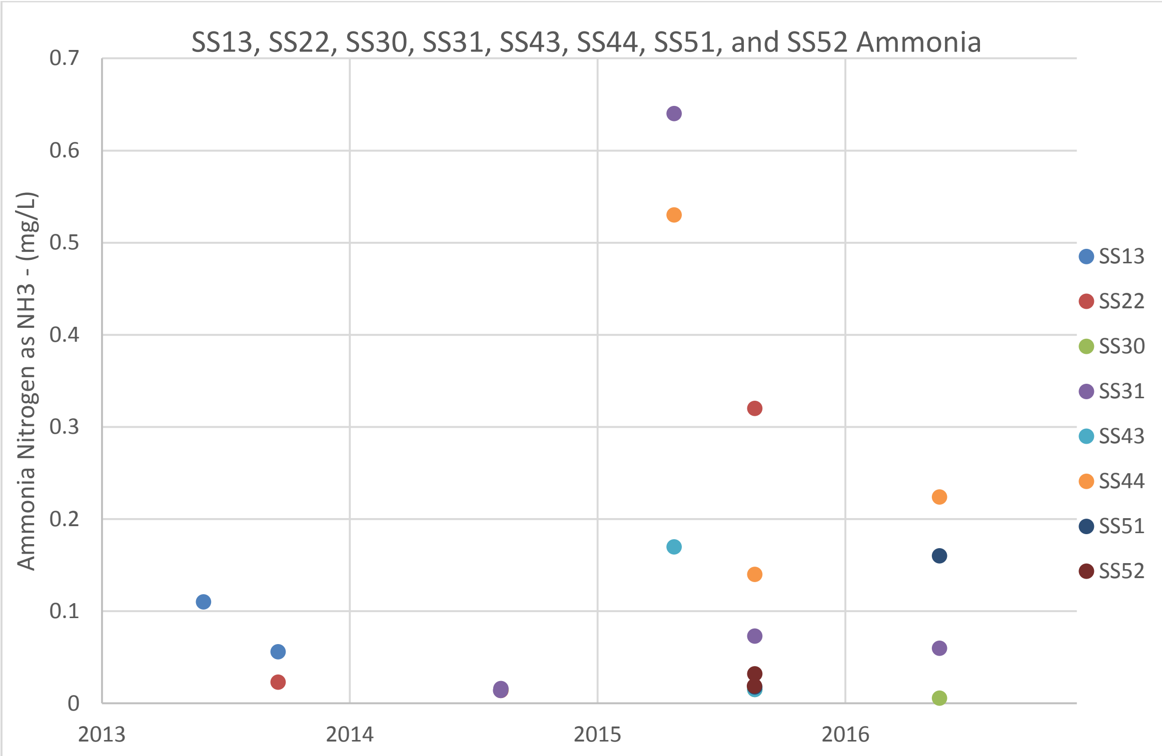


Figure 7-30: SS13, SS22, SS30, SS31, SS43, SS44, SS51, and SS52 Ammonia

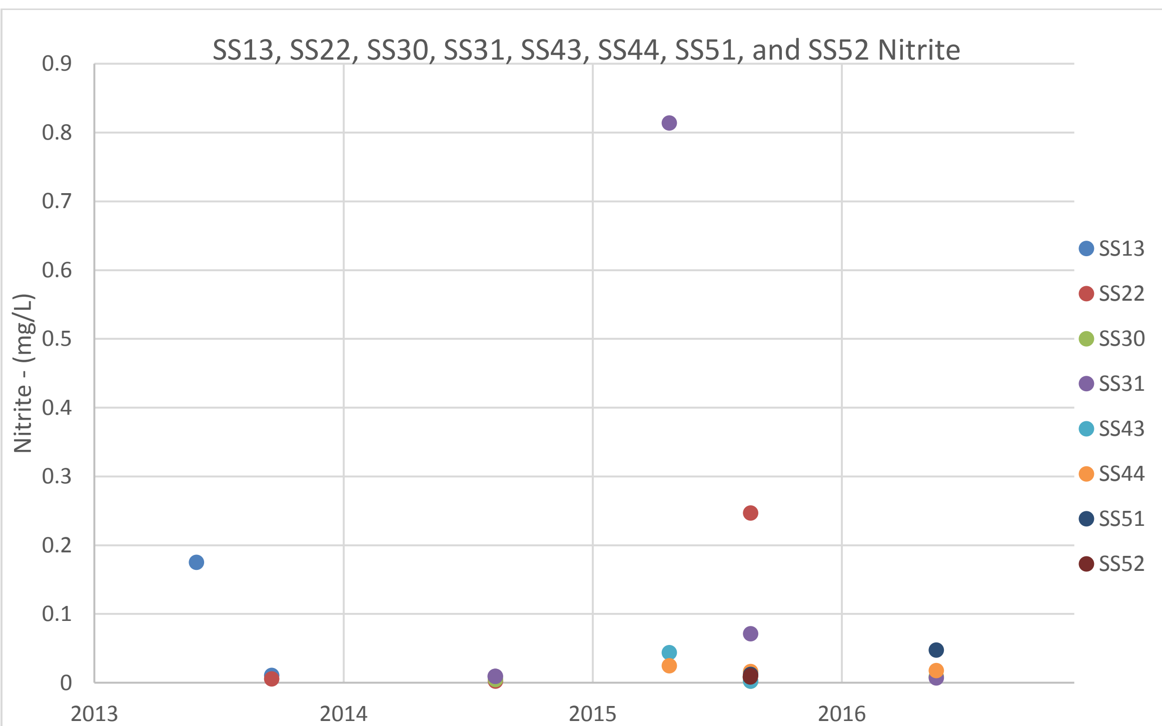


Figure 7-31: SS13, SS22, SS30, SS31, SS43, SS44, SS51, and SS52 Nitrite

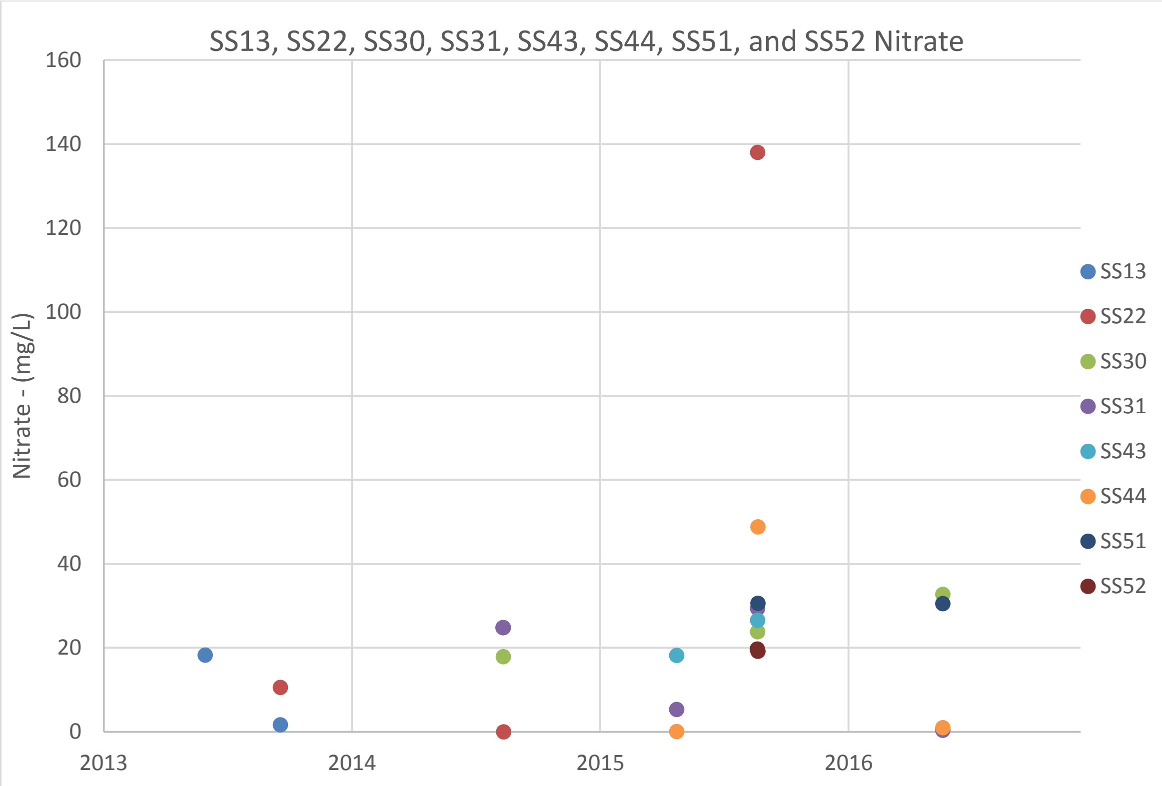


Figure 7-32: SS13, SS22, SS30, SS31, SS43, SS44, SS51, and SS52 Nitrate

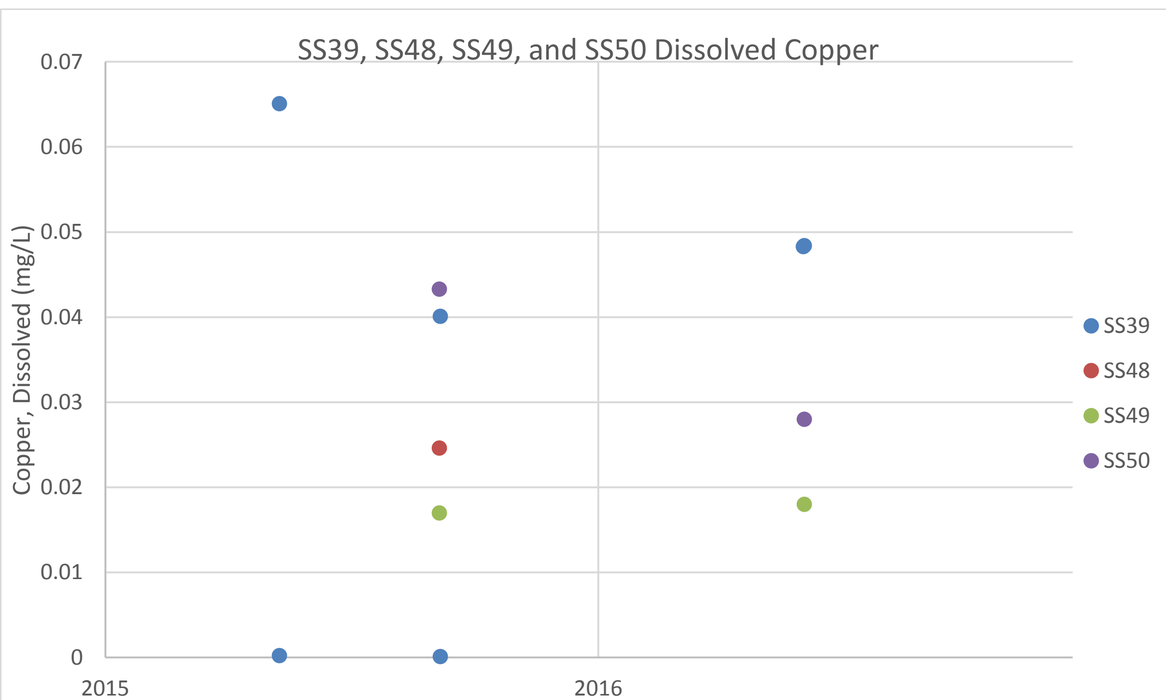


Figure 7-33: SS39, SS48, SS49, and SS50 Dissolved Copper

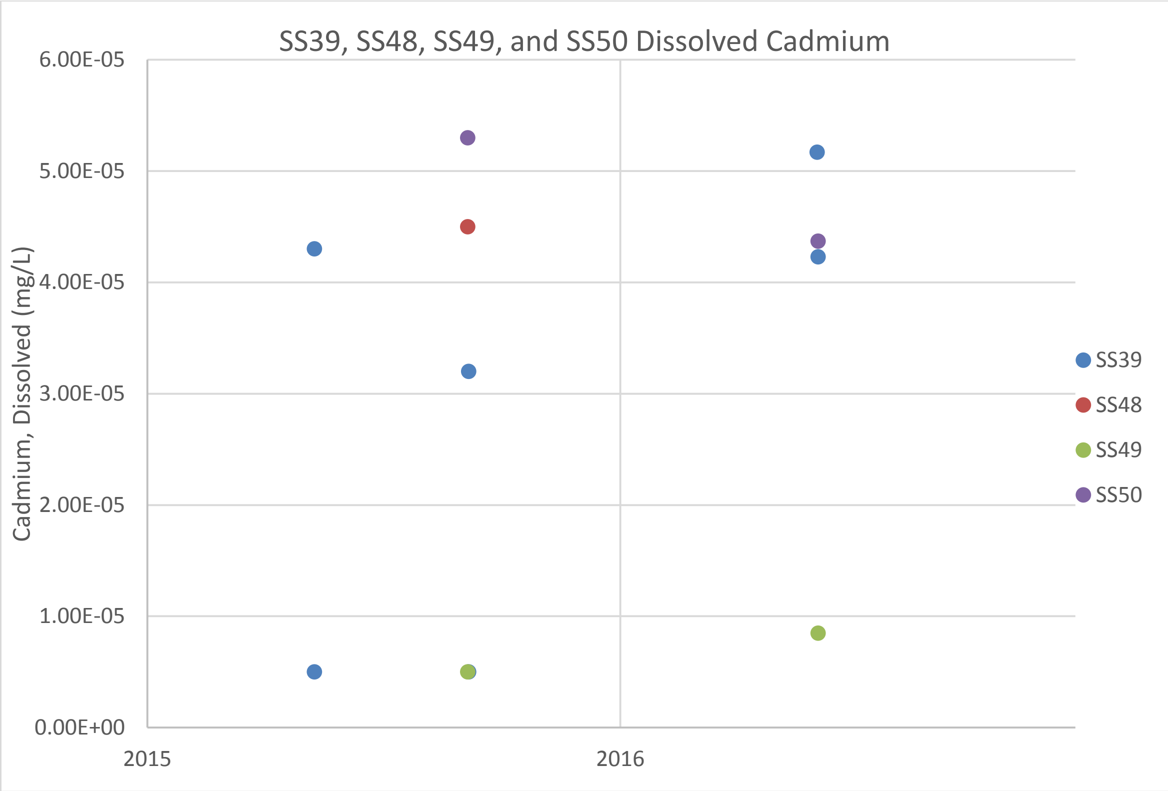


Figure 7-34: SS39, SS48, SS49, and SS50 Dissolved Cadmium

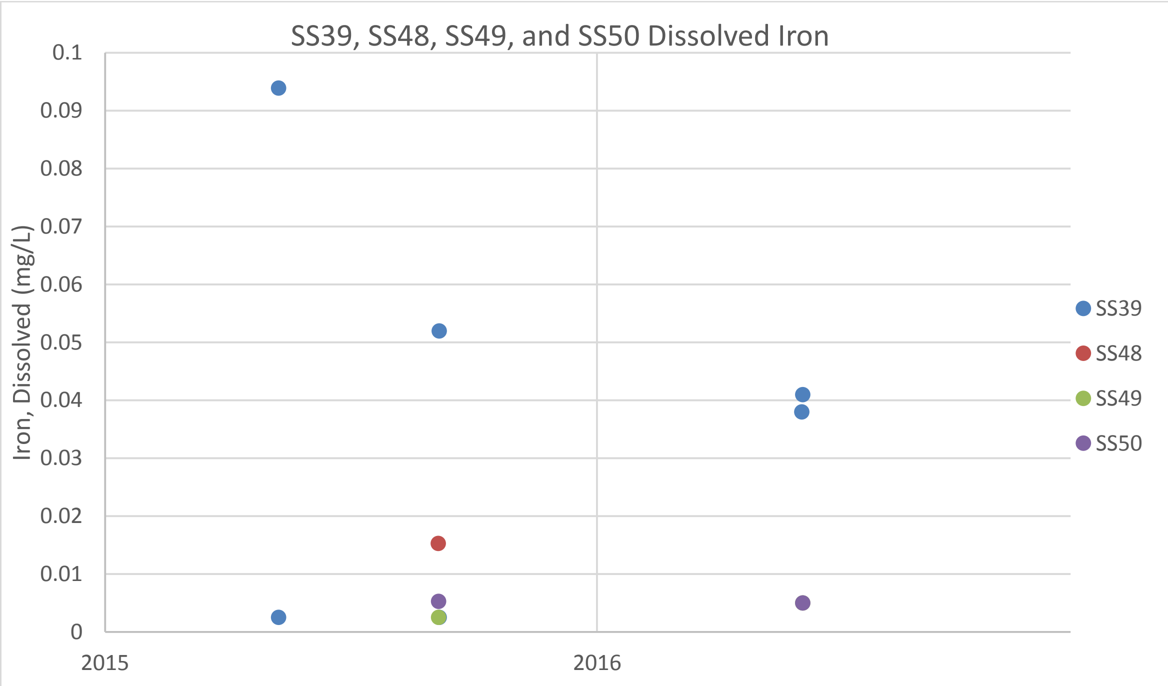


Figure 7-35: SS39, SS48, SS49, and SS50 Dissolved Iron

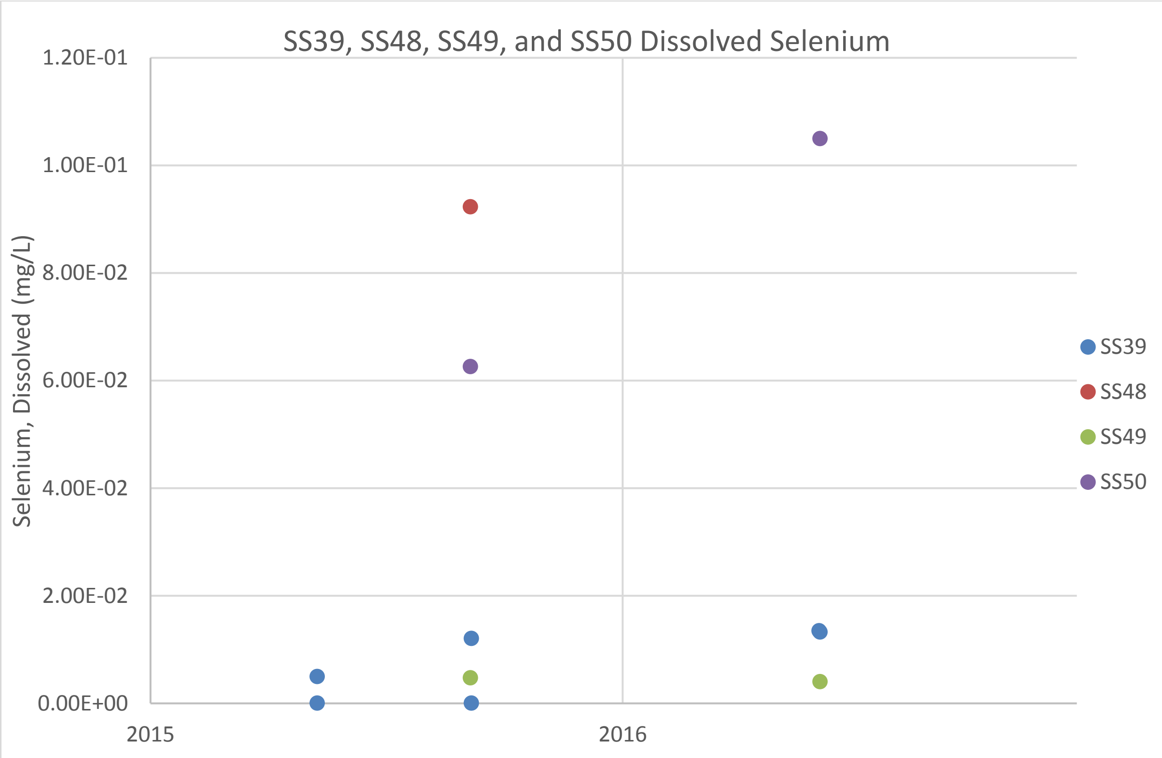


Figure 7-36: SS39, SS48, SS49, and SS50 Dissolved Selenium

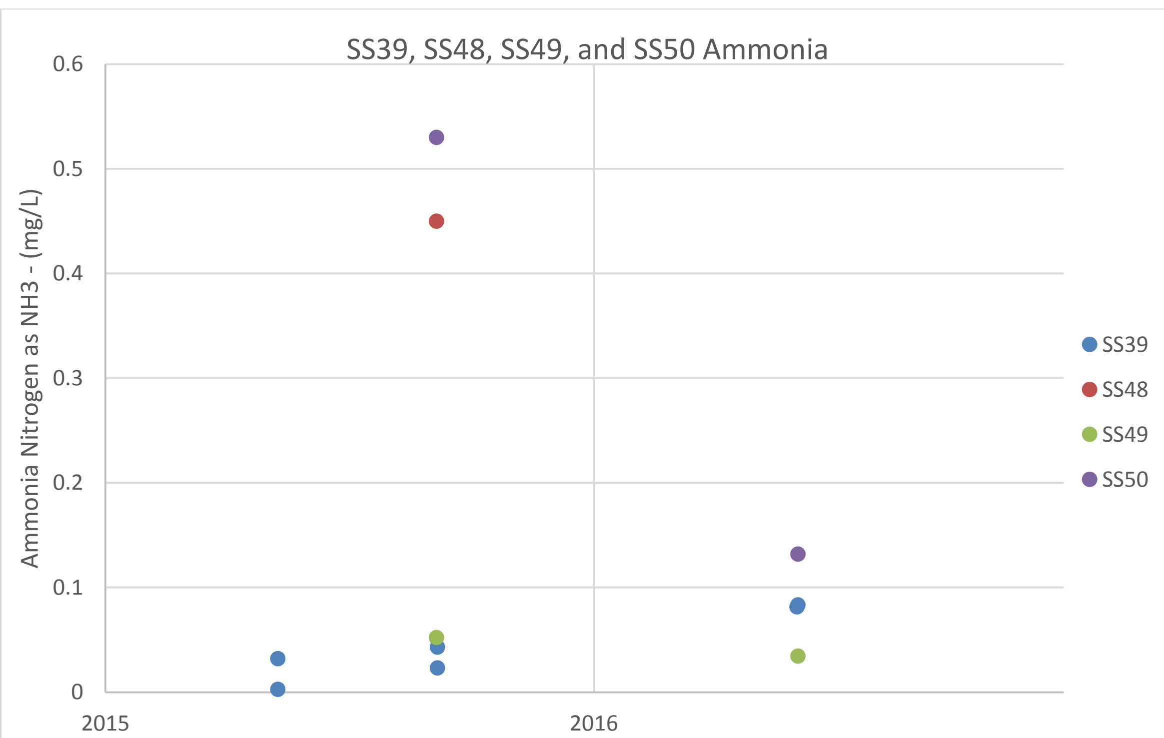


Figure 7-37: SS39, SS48, SS49, and SS50 Dissolved Ammonia

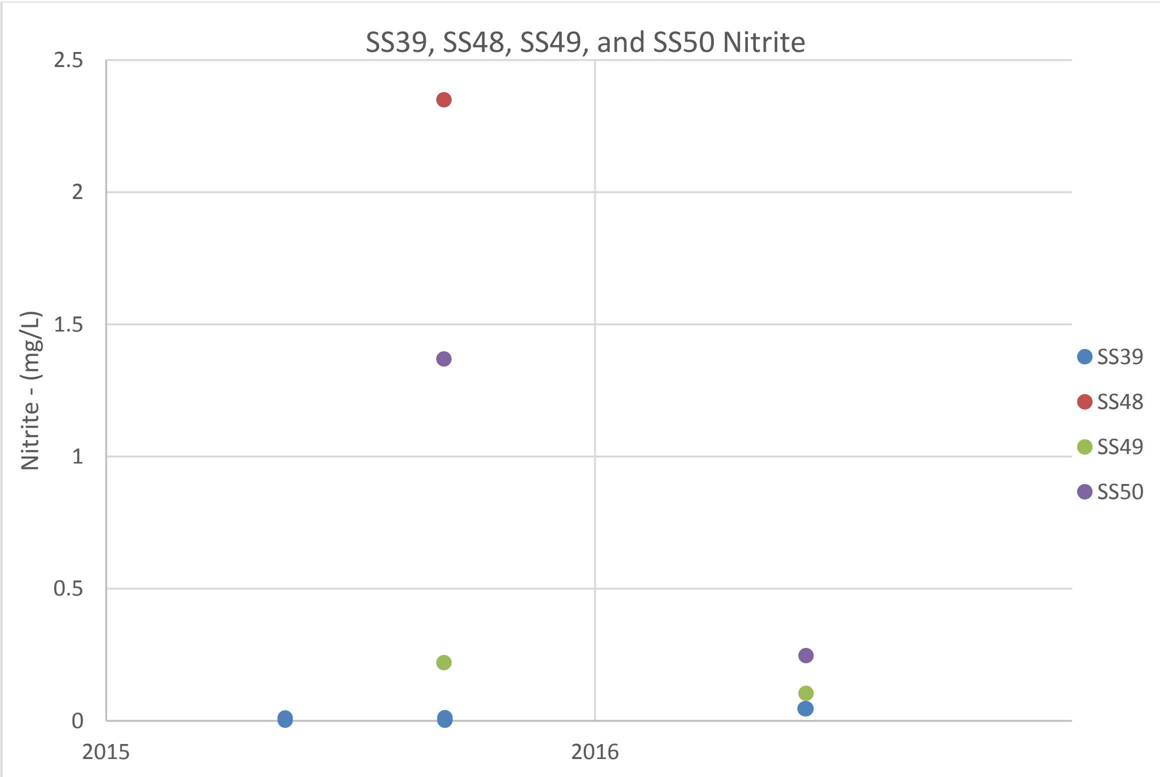


Figure 7-38: SS39, SS48, SS49, and SS50 Dissolved Nitrite

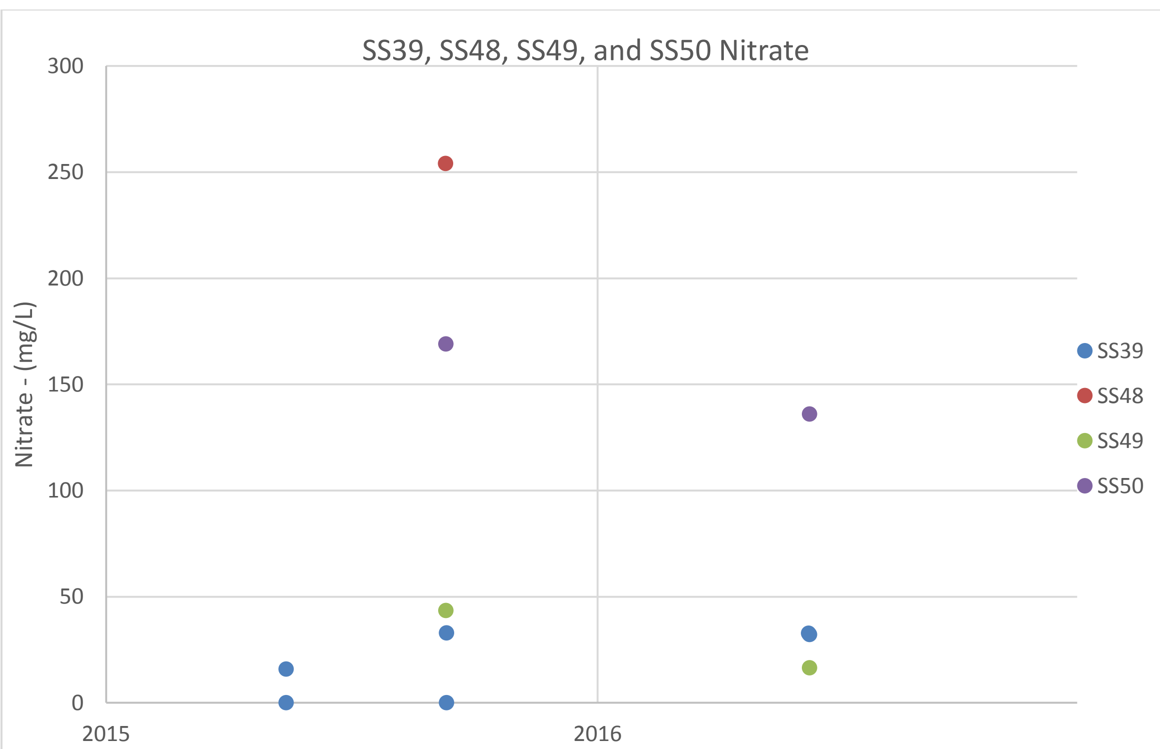


Figure 7-39: SS39, SS48, SS49, and SS50 Dissolved Nitrate

7.3 Minto Creek Detention Structure (MCDS) and Water Storage Pond

The Mill Valley Fill Extension Stage 2 (MVFE2) collection sump (W62) was constructed during the period of November 9, 2015 to February 7, 2016 as a replacement for the Minto Creek Detention Structure (W37) used prior to 2016. W37 was decommissioned and buried in February, 2016 as part of the MVFE2 construction. W62 is approximately 30m downslope from W37 and collects runoff and seepage from the Dry Stack Tailing Storage Facility and the Mill Valley Fill.

Water collected at W62 is pumped to the Main Pit. Water quality results for W37 (historical) and W62 are outlined in Figure 7-40 through Figure 7-46 and include results for dissolved copper, dissolved cadmium, dissolved iron, dissolved selenium, and nutrient levels for ammonia, nitrite, and nitrate.

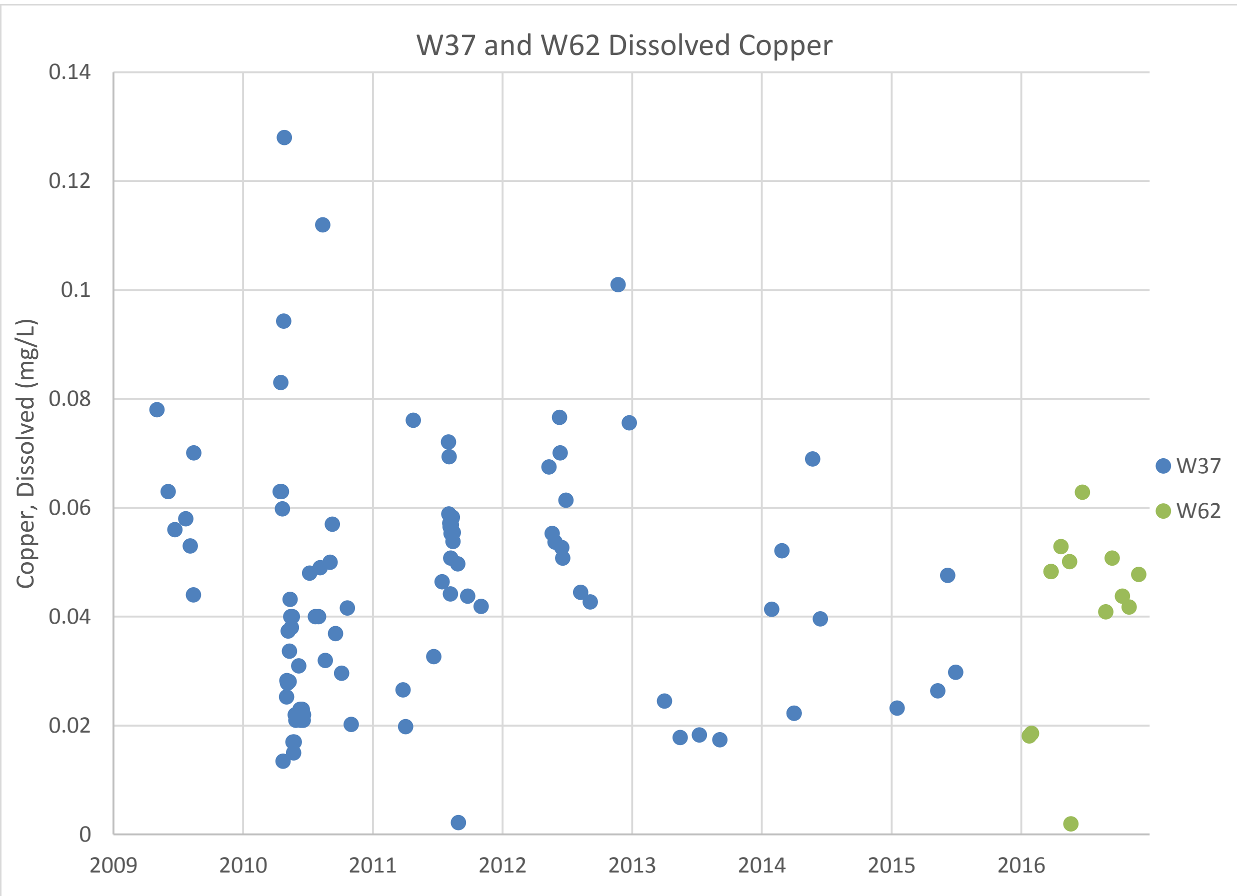


Figure 7-40: W37 and W62 Dissolved Copper

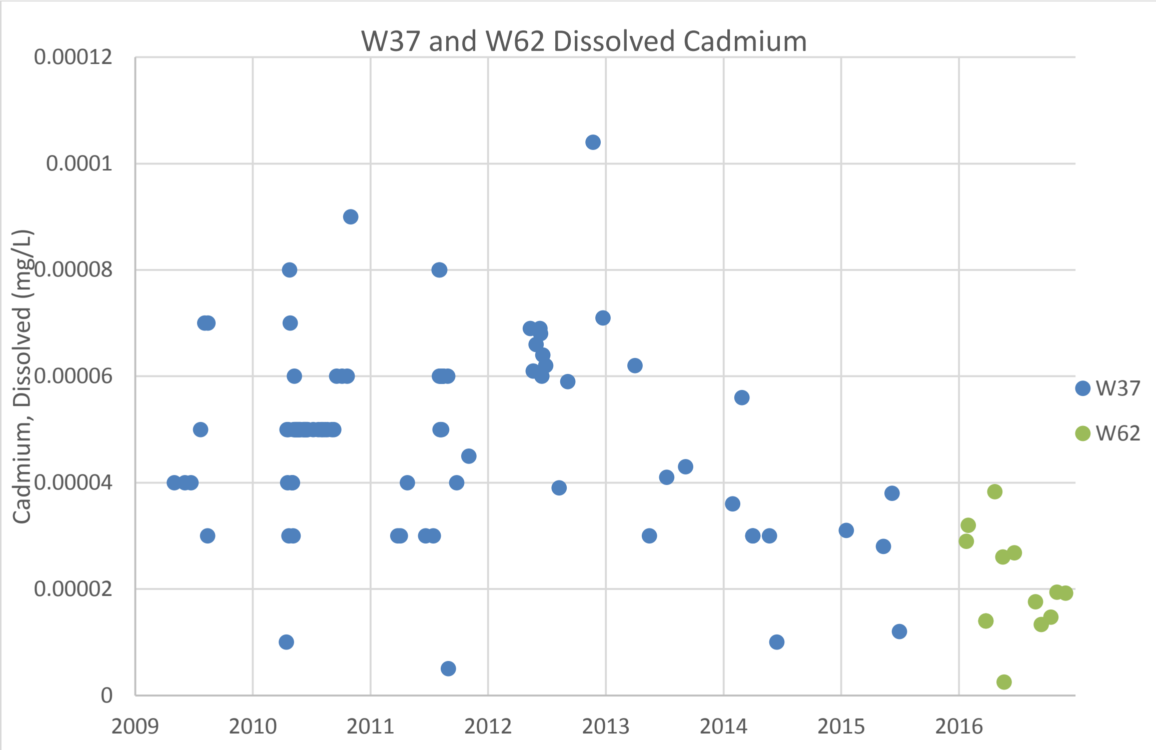


Figure 7-41: W37 and W62 Dissolved Cadmium

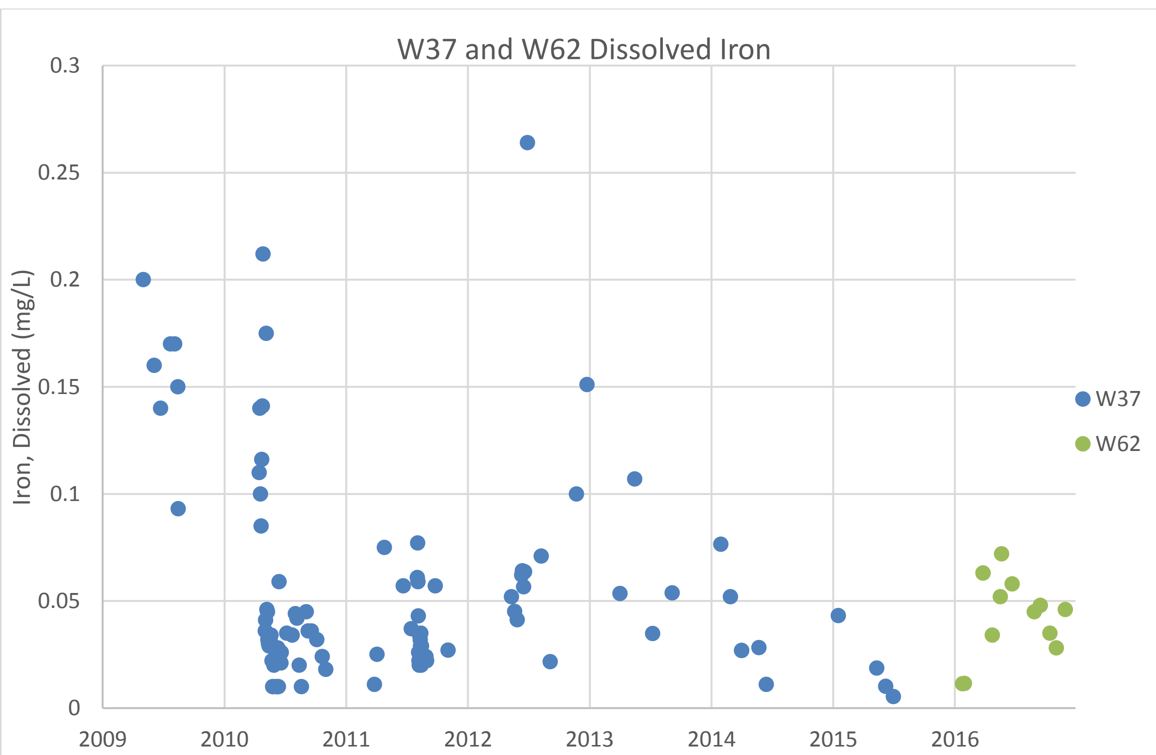


Figure 7-42: W37 and W62 Dissolved Iron

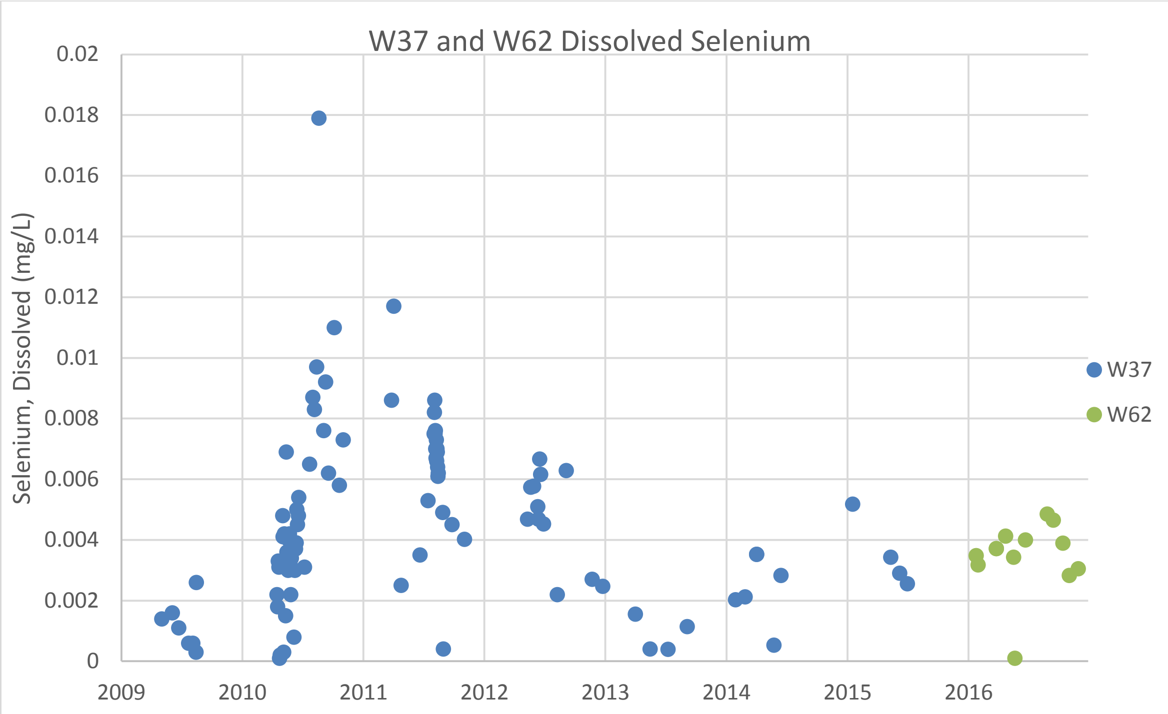


Figure 7-43: W37 and W62 Dissolved Selenium

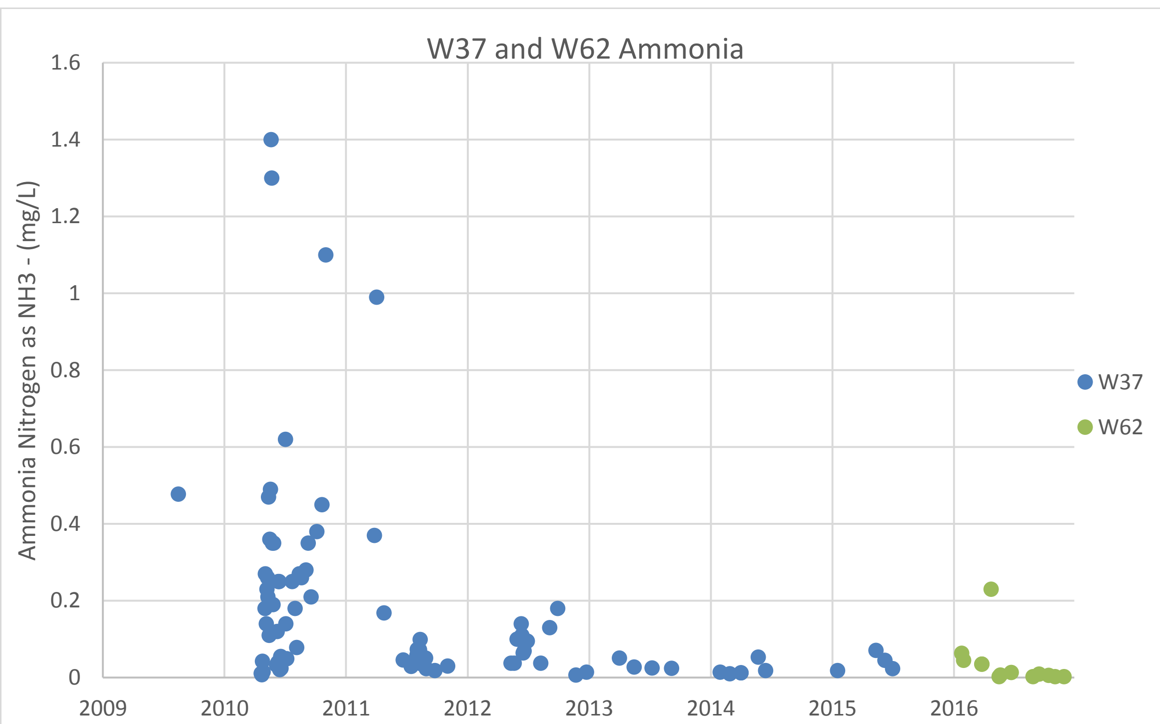


Figure 7-44: W37 and W62 Ammonia

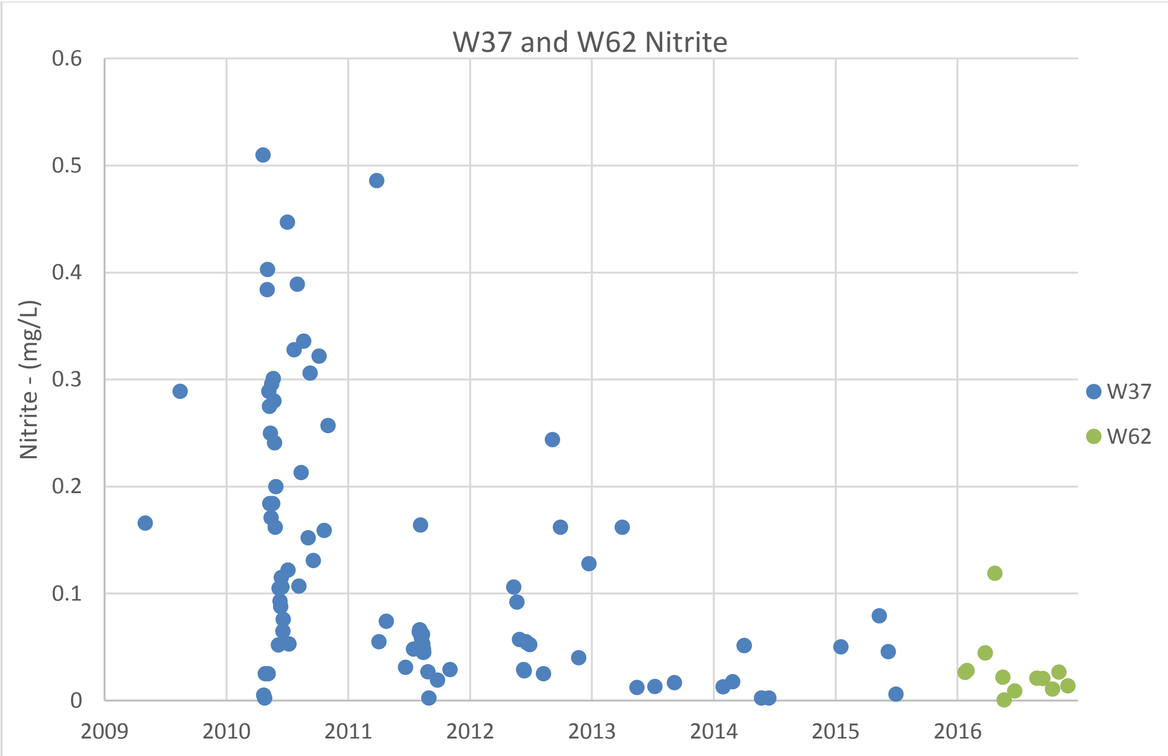


Figure 7-45: W37 and W62 Nitrite

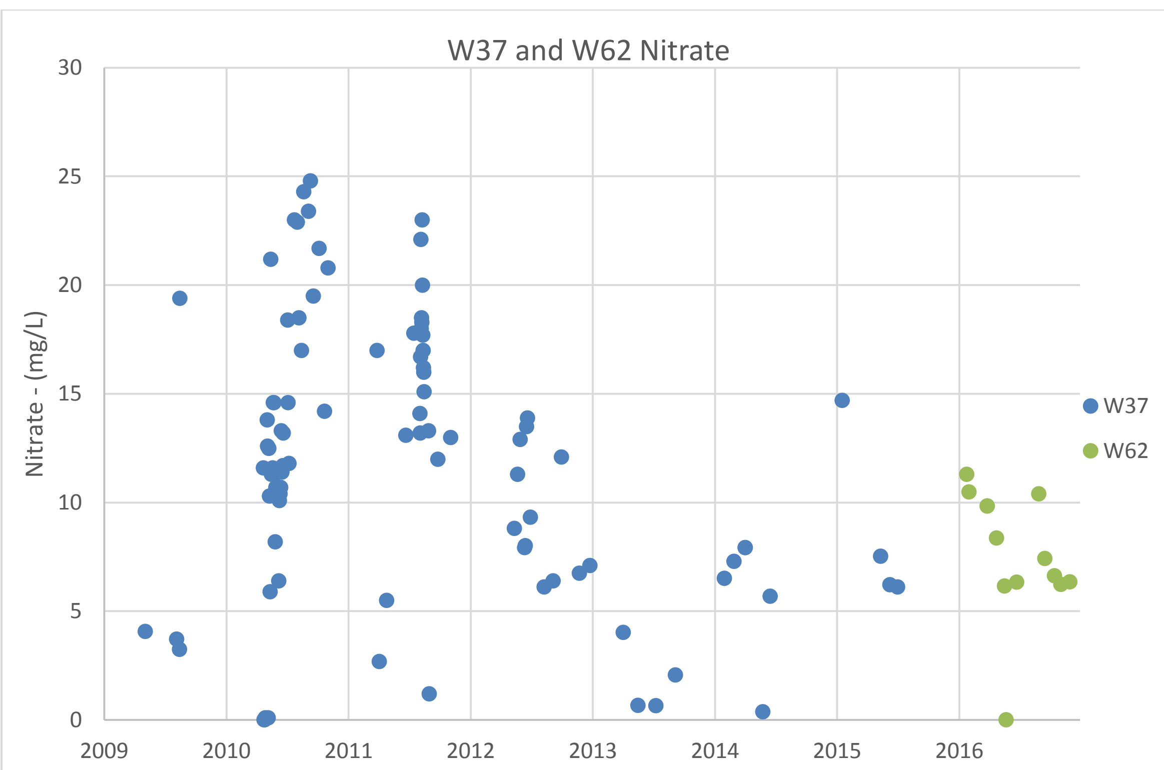


Figure 7-46: W37 and W62 Nitrate

7.4 Water Storage Pond Dam Seep

Seepage water quality at the Water Storage Pond Dam is represented by station W17. Water quality at station W17 is relatively consistent due to its being fed by a large stable body of water (Water Storage Pond). All dam seepage is collected in a vertical culvert and pumped back to the WSP via a 4" insulated heat traced pipe. Water quality statistics for station W17 from 2007 to 2016 are summarized below in Table 7-1. A total of 66 samples were collected in the 2016 monitoring period. Water quality results for W17 are further outlined in Figure 7-47 through Figure 7-55 and include historic water quality results for dissolved copper, dissolved cadmium, dissolved iron, dissolved selenium, and nutrient levels for ammonia, nitrite, and nitrate.

Table 7-1: W17 Water Quality Results Summary (2007-2016)

W17	Effluent Quality Standards (WUL Clause 9)	2007 - 2015 Summary Statistics			2016 Summary Statistics		
Parameters		Mean	Min	Max	Mean	Min	Max
pH	6.0-9.0	8.1	1.7	8.5	8.2	5.5	8.5
TSS (mg/L)	15	2.03	0.5	267	5.16	1.8	9.3
Nutrients (mg/L)							
Ammonia	0.75	0.03	-0.01	0.85	0.0151	0.0051	0.0470
Nitrite Nitrogen	0.18	0.05	0.003	7.85	0.0021	0.0013	0.0026
Nitrate Nitrogen	27.3	4.32	0.01	12.40	1.327	0.051	2.750
Dissolved Metals (mg/L)							
Aluminum	0.3	0.00611	0.00150	0.25500	0.00478	0.00050	0.05370
Arsenic	0.015	0.0004	0.0001	0.0037	0.00034	0.00005	0.00052
Cadmium	0.004104*	0.000032	0.0000025	0.00278	3.25E-06	2.50E-06	7.10E-06
Chromium	0.003	0.000662	0.00005	0.008	0.000185	0.00005	0.0005
Copper	0.039	0.006	0.0003	0.031	0.0055	0.00010	0.0072
Iron	3.3	0.011	0.003	0.358	0.0132	0.0025	0.450
Lead	0.012	0.000118	0.000009	0.000800	0.000046	0.000025	0.000100
Molybdenum	0.219	0.00662	0.00050	0.02240	0.00512	0.00003	0.00605
Nickel	0.33	0.00099	0.00050	0.01100	0.00043	0.00025	0.00071
Selenium	0.006	0.00117	0.00005	0.0050	0.00051	0.000025	0.00085
Zinc	0.09	0.00385	0.00050	0.04300	0.00136	0.00050	0.00570

Bold values indicate exceedances of the WUL standards

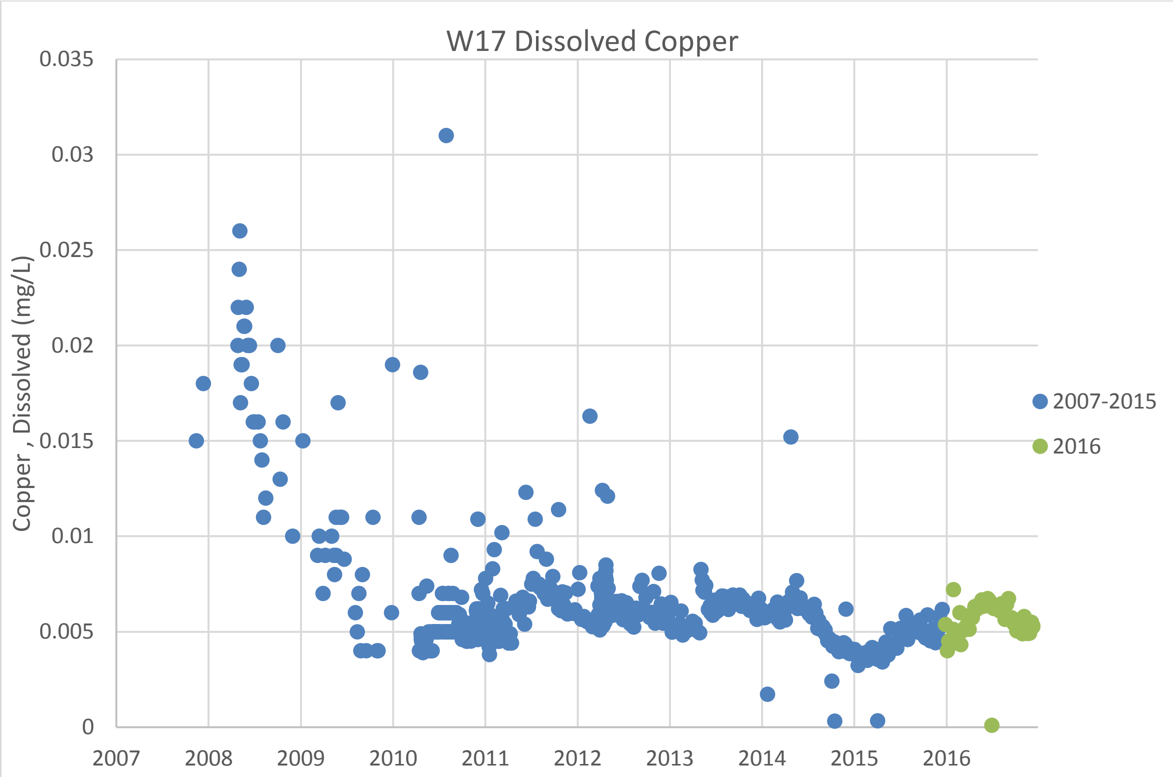


Figure 7-47: W17 Dissolved Copper

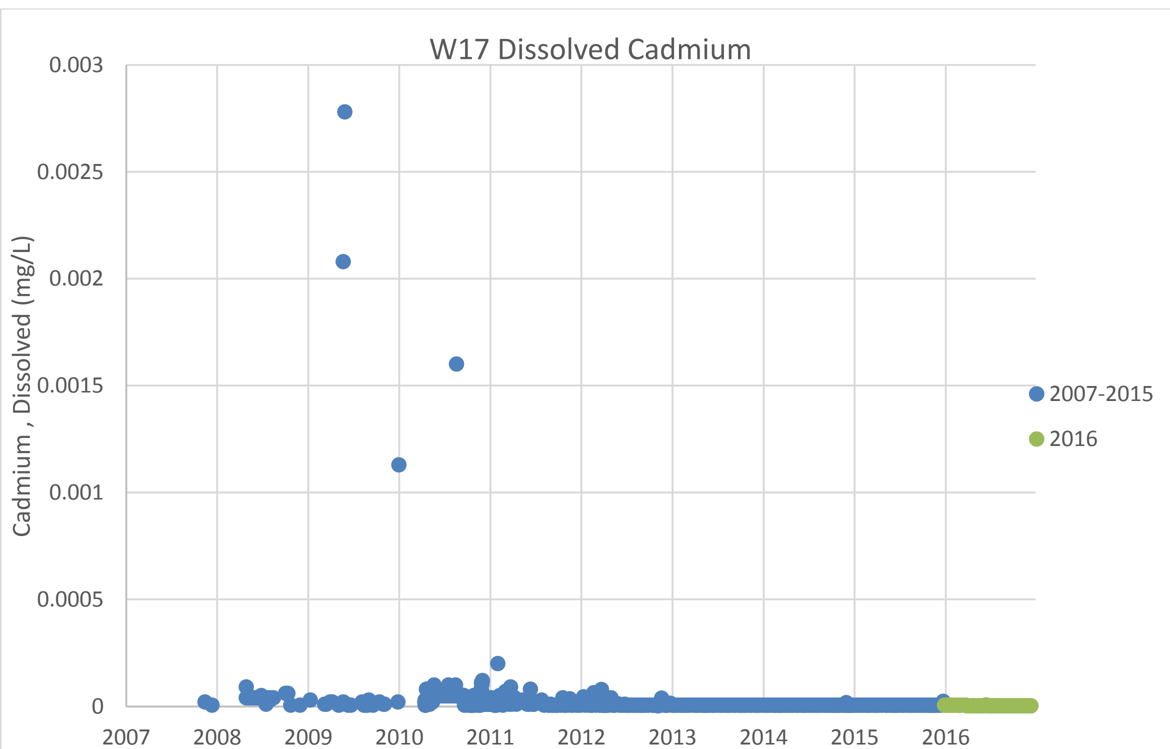


Figure 7-48: W17 Dissolved Cadmium

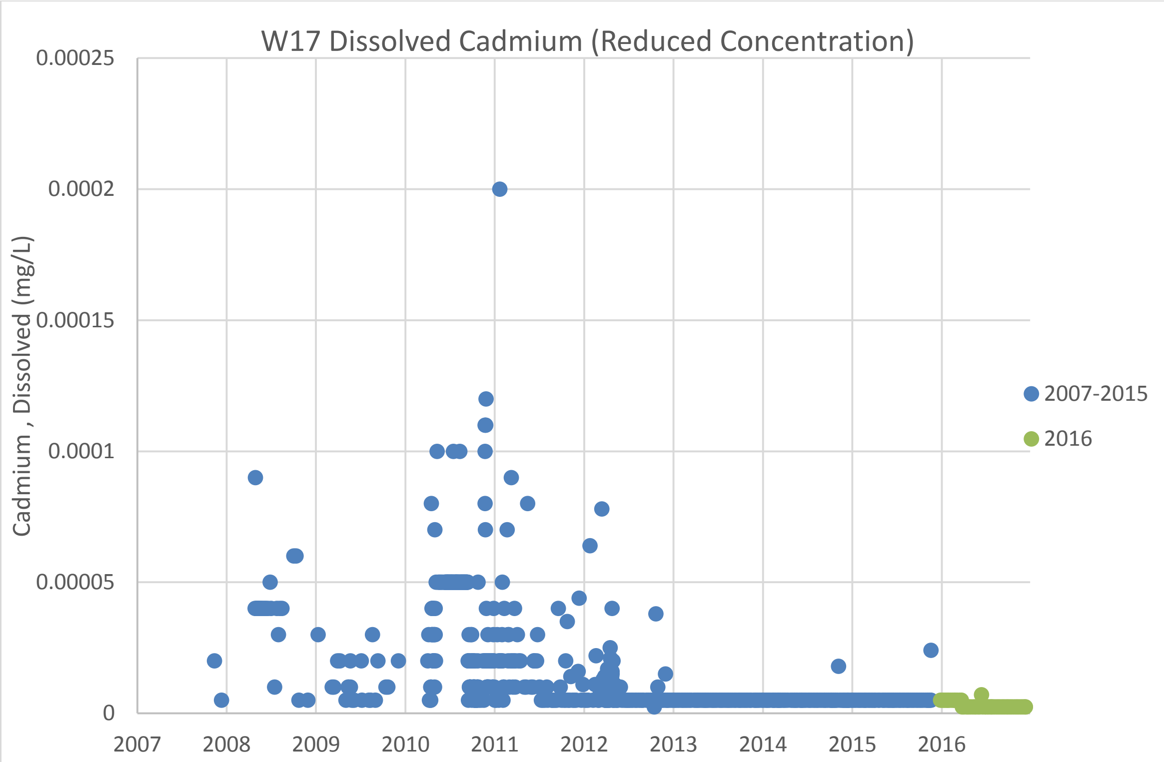


Figure 7-49: W17 Dissolved Cadmium (Reduced Concentration)

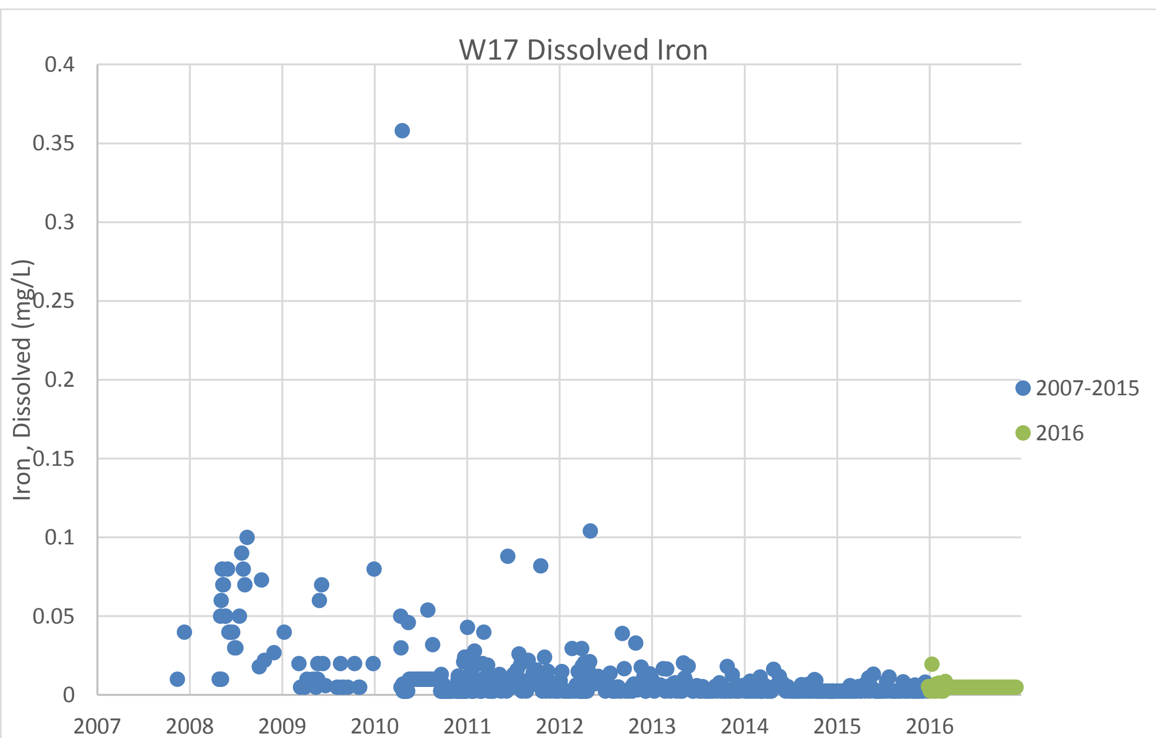


Figure 7-50: W17 Dissolved Iron

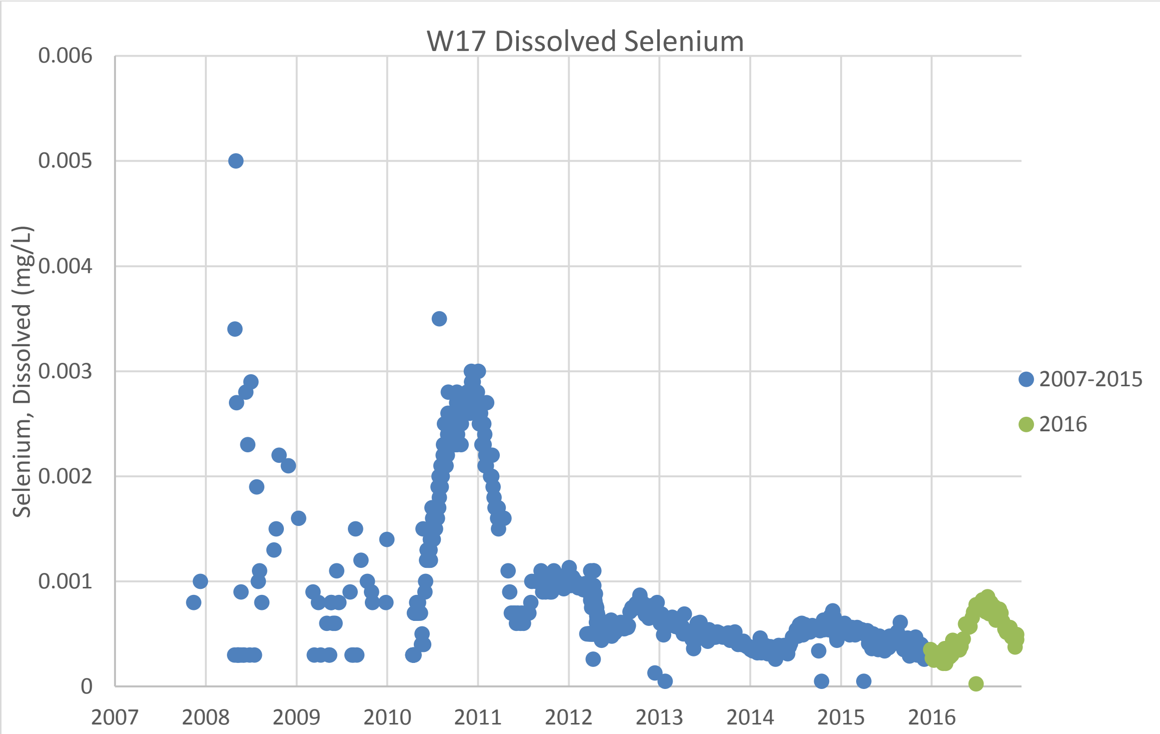


Figure 7-51: W17 Dissolved Selenium

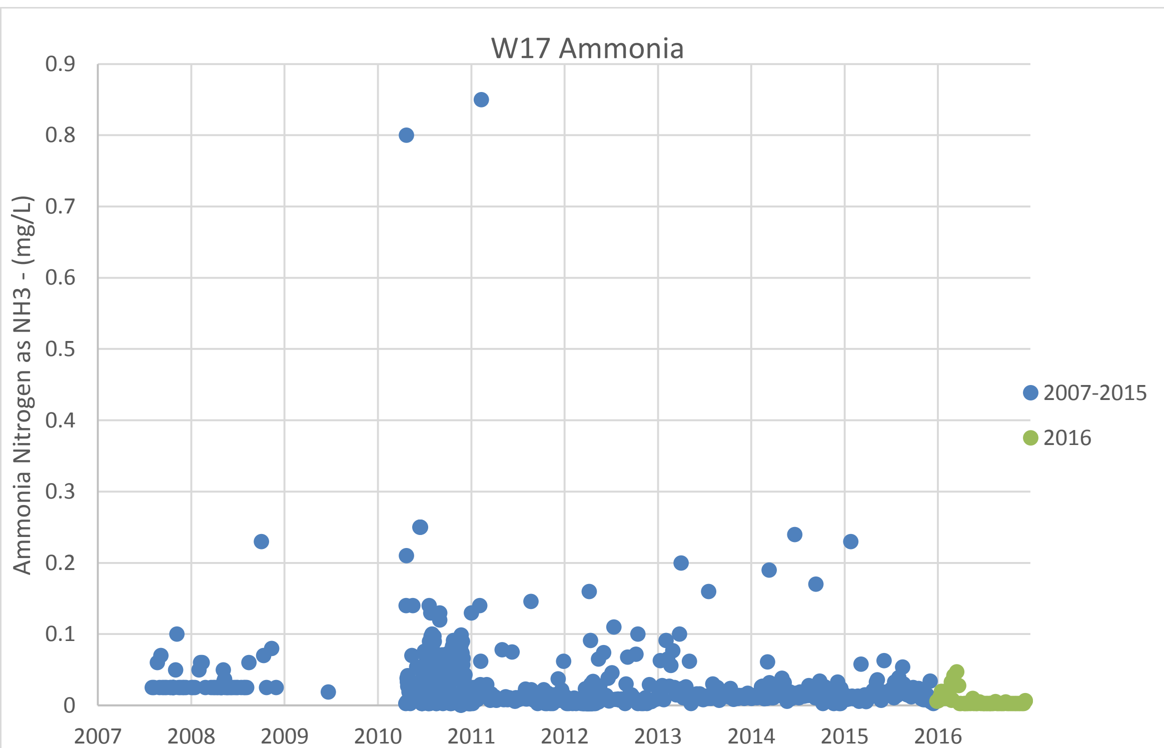


Figure 7-52: W17 Ammonia

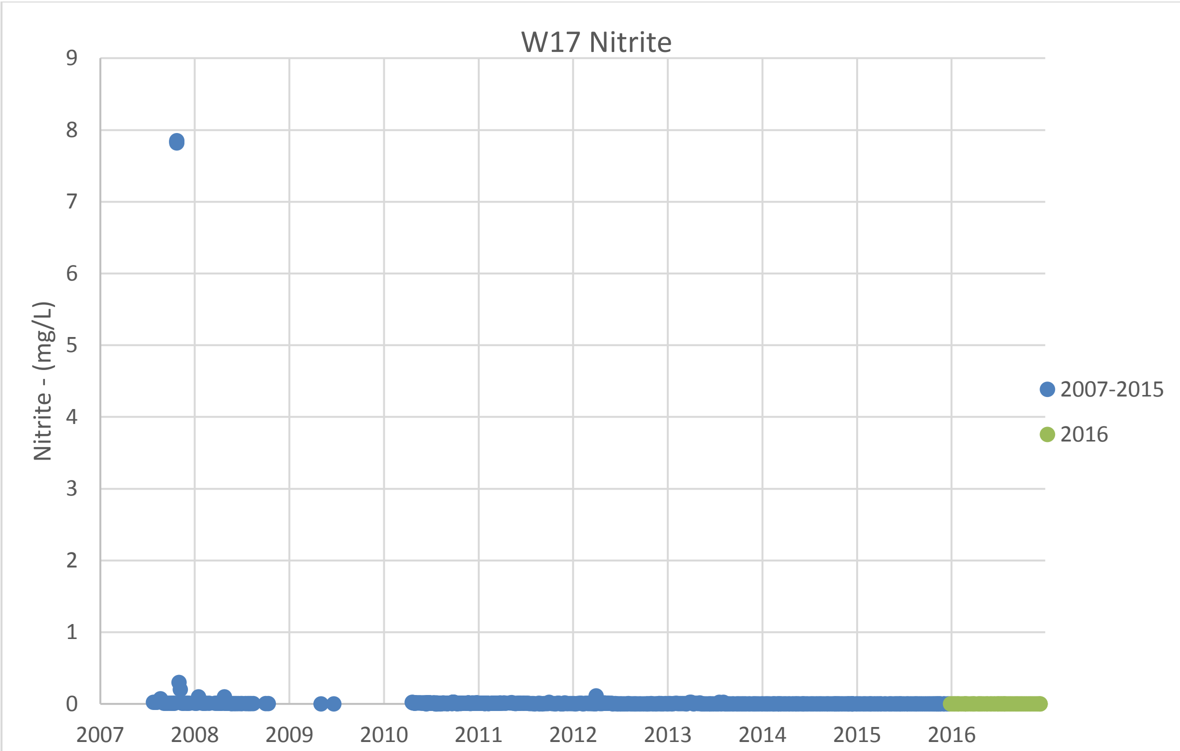


Figure 7-53: W17 Nitrite

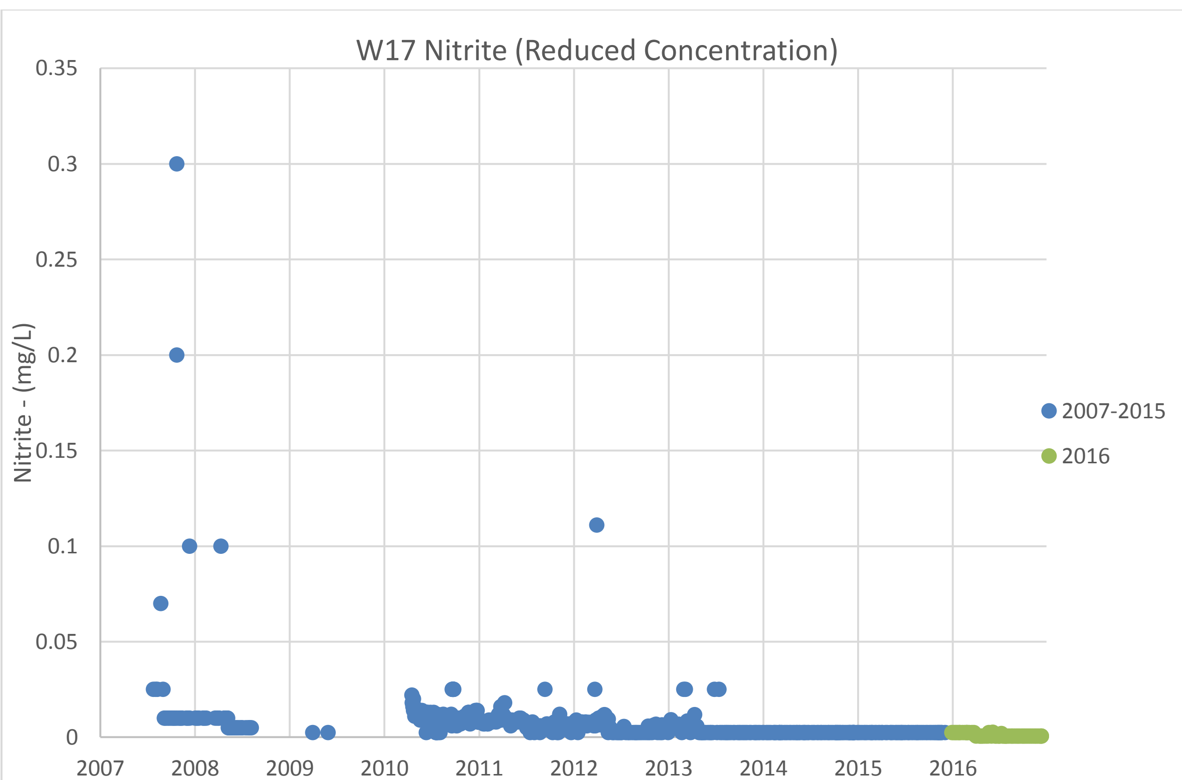


Figure 7-54: W17 Nitrite (Reduced Concentration)

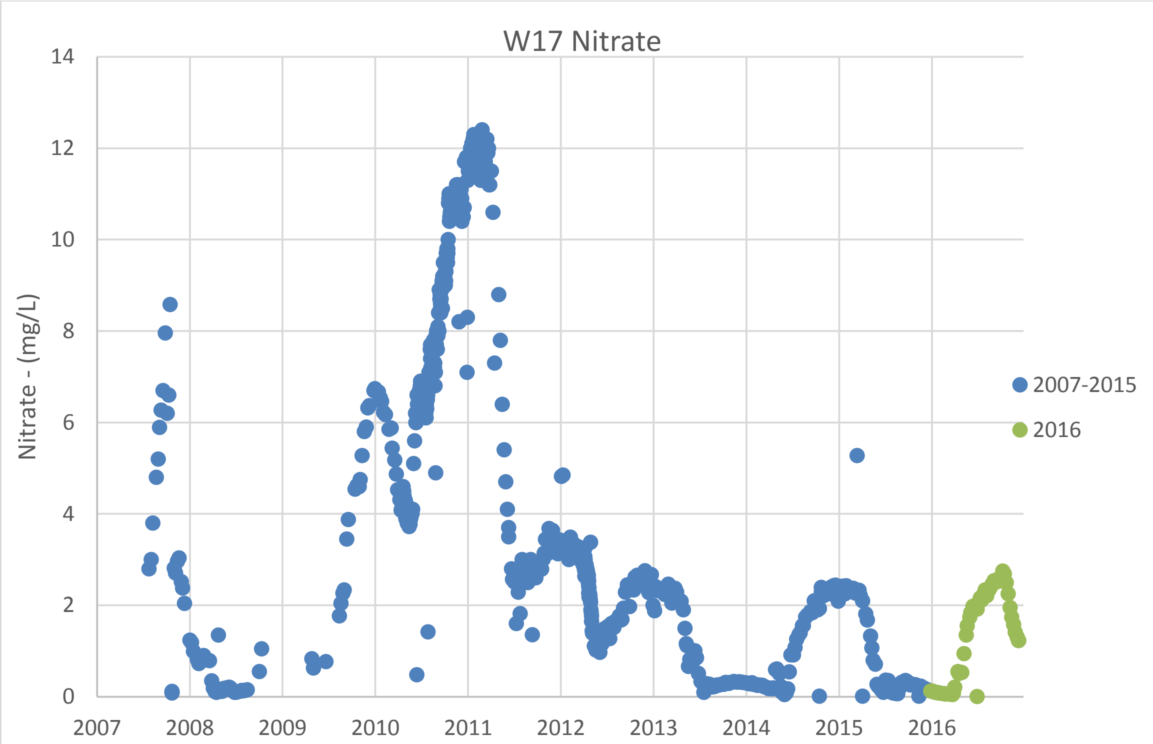


Figure 7-55: W17 Dissolved Nitrate

7.5 Dry Stack Tailings Storage Facility (DSTSF)

No seepage flow was observed along the DSTSF during either of the 2016 seepage surveys. In years past, water has flowed along the tailings diversion ditch road and down the toe of the south side of the DSTSF. Historical water quality results for the DSTSF-associated seepage sites (SS9, SS10, SS17, SS18, SS19, SS34, SS35, SS36, and SS45) are outlined in Figure 7-56 through Figure 7-62 and include results for dissolved copper, dissolved cadmium, dissolved iron, dissolved selenium, and nutrient levels for ammonia, nitrite, and nitrate.

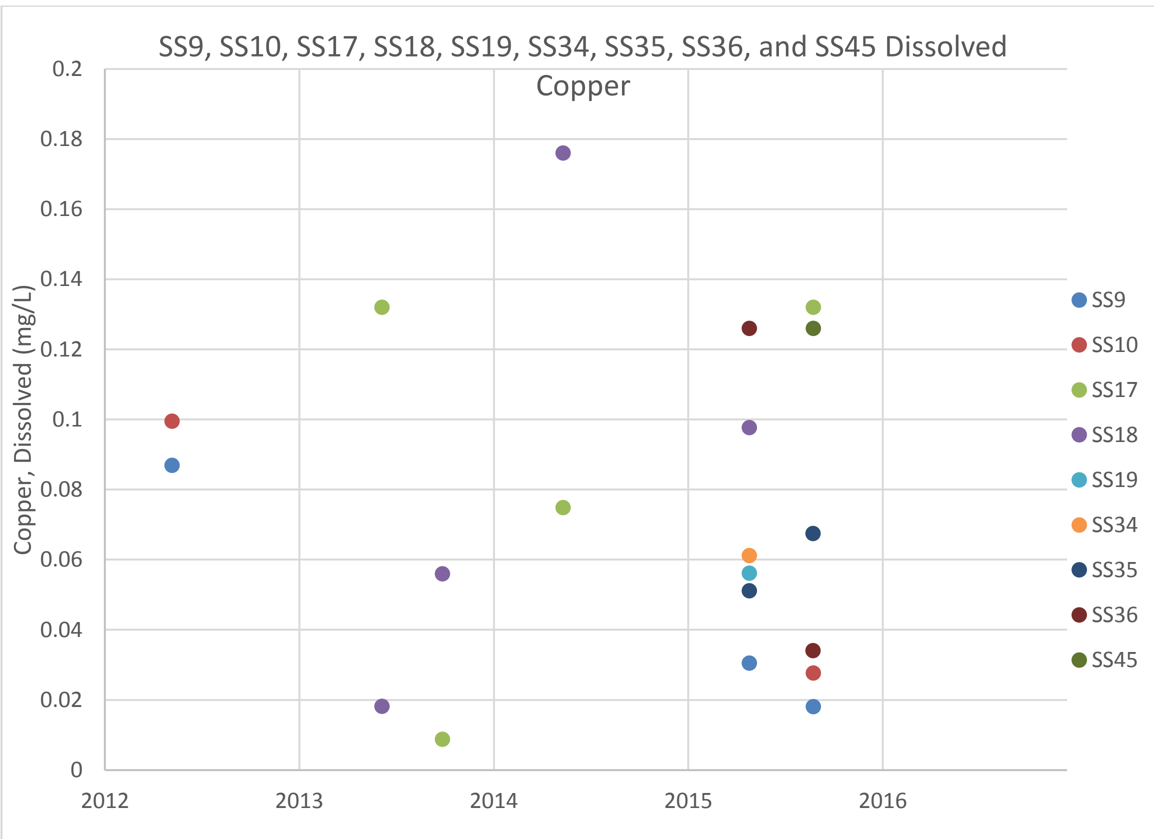


Figure 7-56: SS9, SS10, SS17, SS18, SS19, SS34, SS35, SS36, and SS45 Dissolved Copper

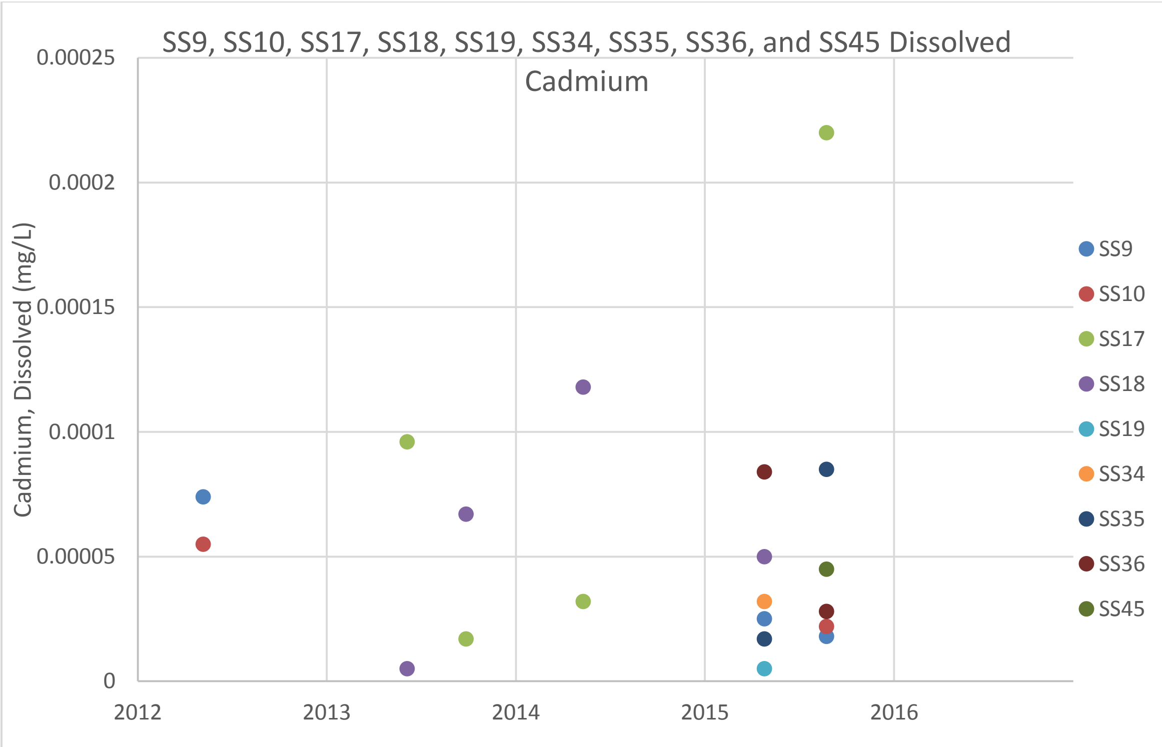


Figure 7-57: SS9, SS10, SS17, SS18, SS19, SS34, SS35, SS36, and SS45 Dissolved Cadmium

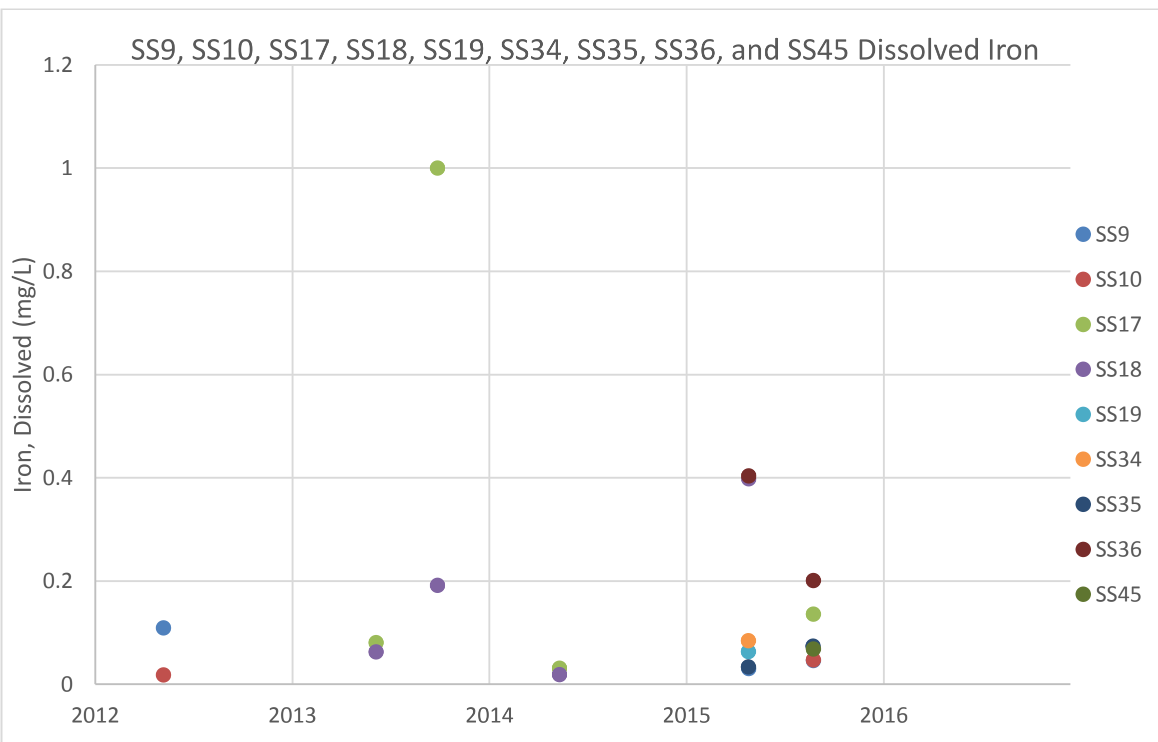


Figure 7-58: SS9, SS10, SS17, SS18, SS19, SS34, SS35, SS36, and SS45 Dissolved Iron

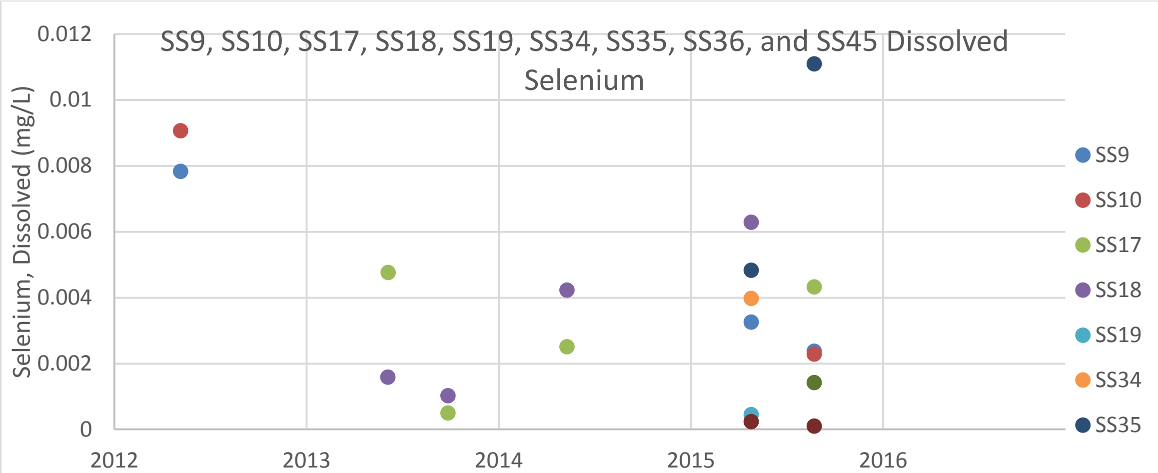


Figure 7-59: SS9, SS10, SS17, SS18, SS19, SS34, SS35, SS36, and SS45 Dissolved Selenium

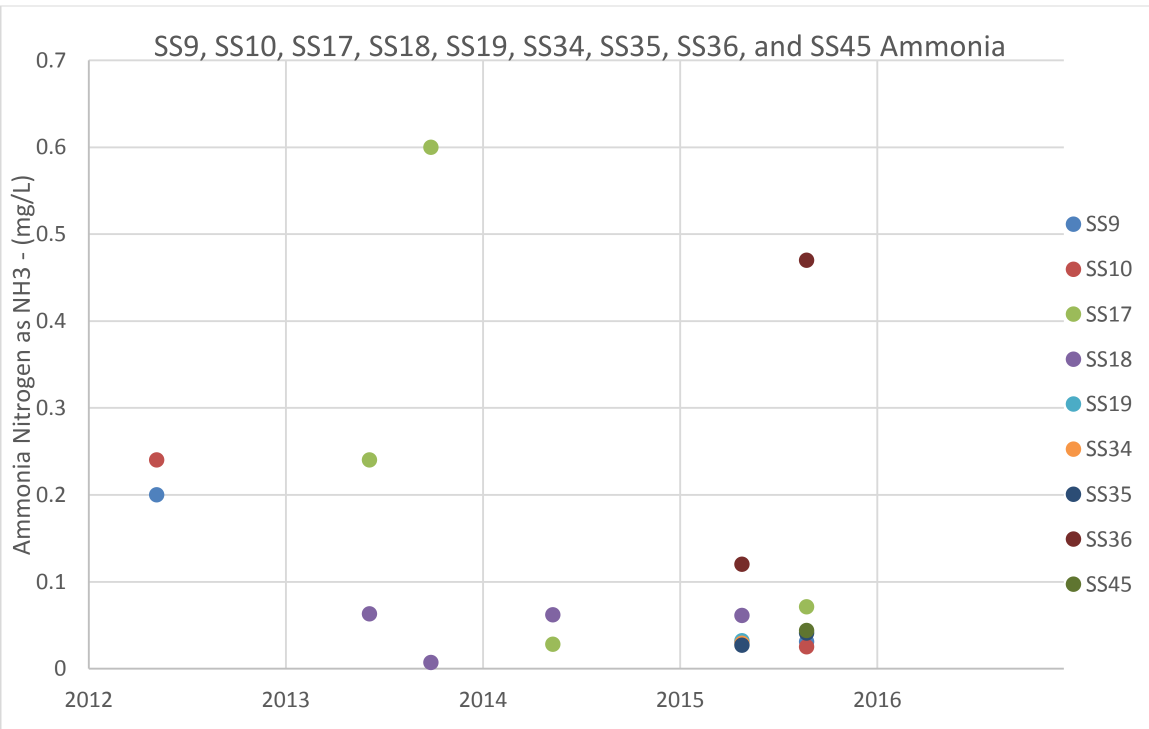


Figure 7-60: SS9, SS10, SS17, SS18, SS19, SS34, SS35, SS36, and SS45 Ammonia

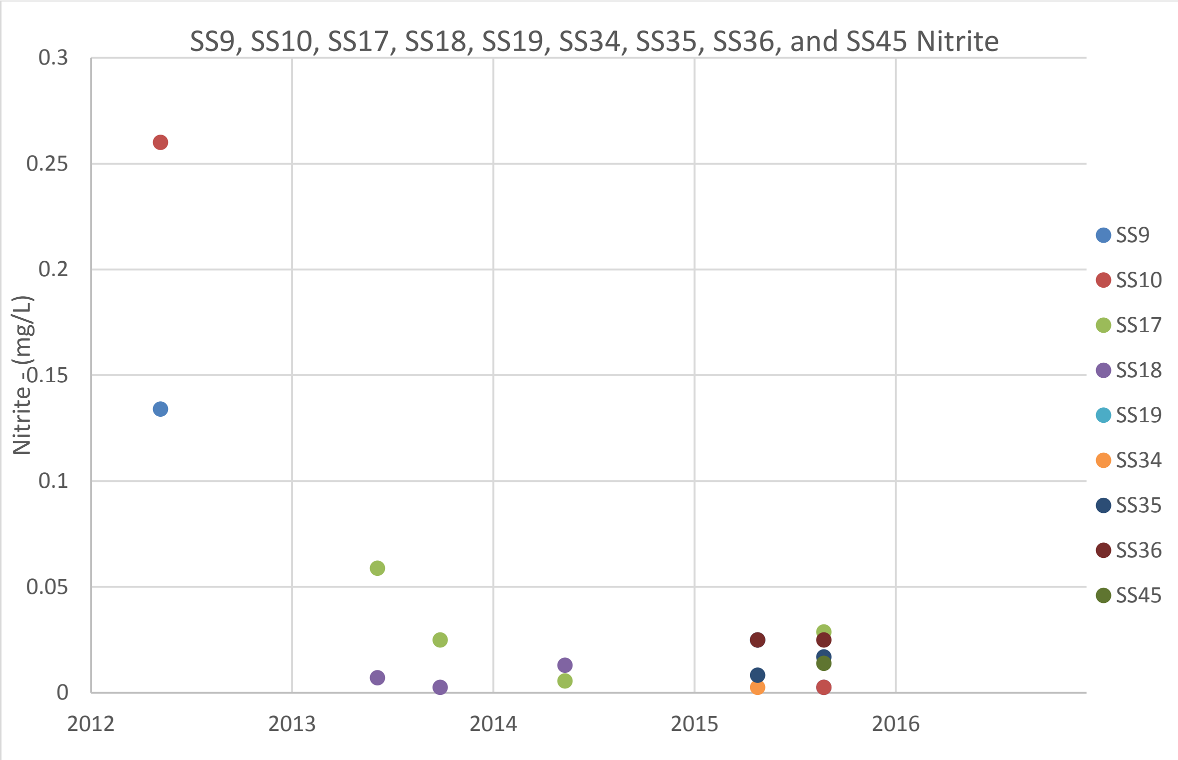


Figure 7-61: SS9, SS10, SS17, SS18, SS19, SS34, SS35, SS36, and SS45 Nitrite

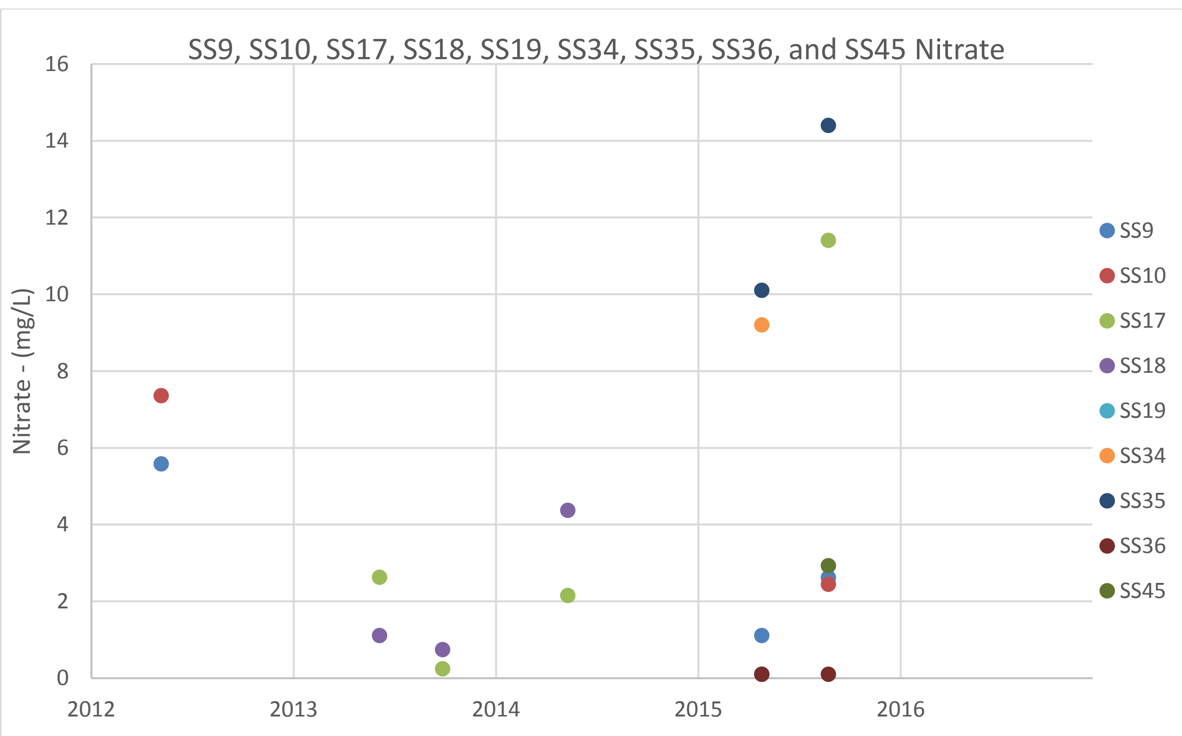


Figure 7-62: SS9, SS10, SS17, SS18, SS19, SS34, SS35, SS36, and SS45 Nitrate

7.6 Ore Stockpiles

Surface seepage runs along the toe of the west ore stockpile and into the ditch parallel to the heavy vehicle road. All seeps in this area drain into the west ore stockpile sump and are pumped to the Main pit. Seepage monitoring stations SS5, SS6, SS7, SS8 and SS33 capture seepage from the stockpile during spring and fall sampling program. Seepage sites SS46 and SS47 at the toe of the underground ore stockpiles were discovered and added to the network in the fall of 2015 (SS46 and SS47). Water quality results are outlined in Figure 7-63 through Figure 7-70 and include historic water quality results for dissolved copper, dissolved cadmium, dissolved iron, dissolved selenium, and nutrient levels for ammonia, nitrite, and nitrate.

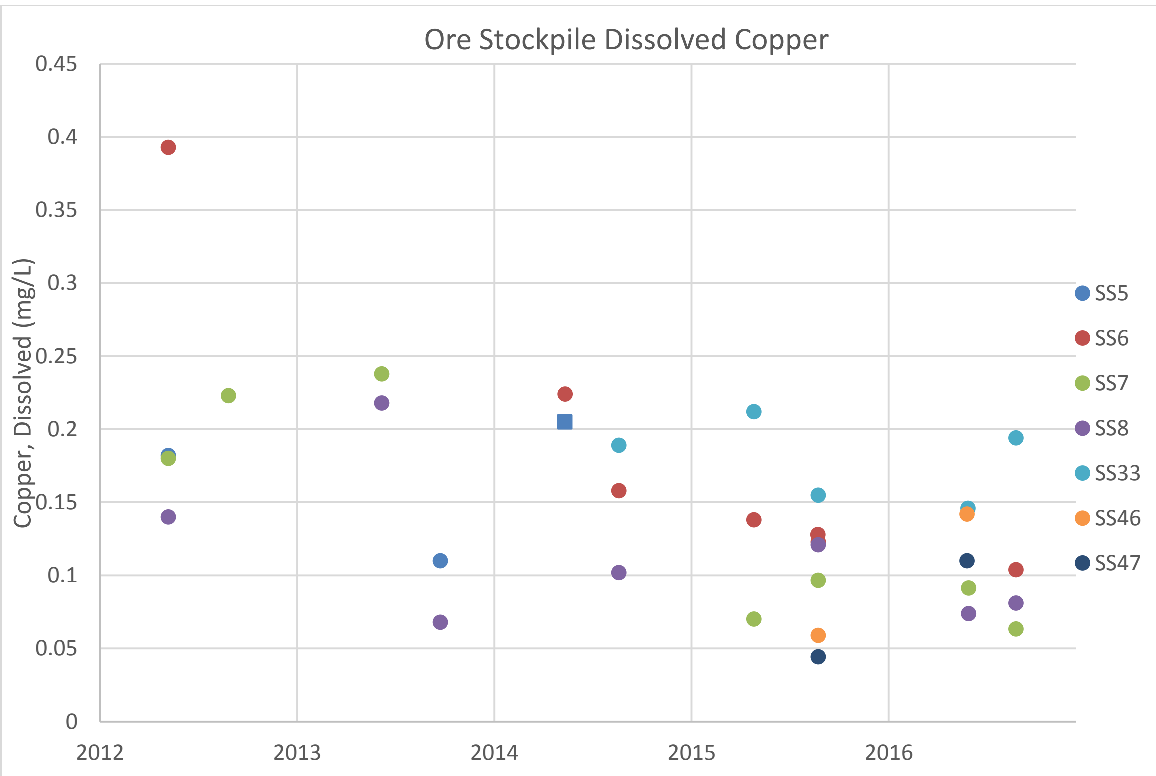


Figure 7-63: Ore Stockpile Dissolved Copper

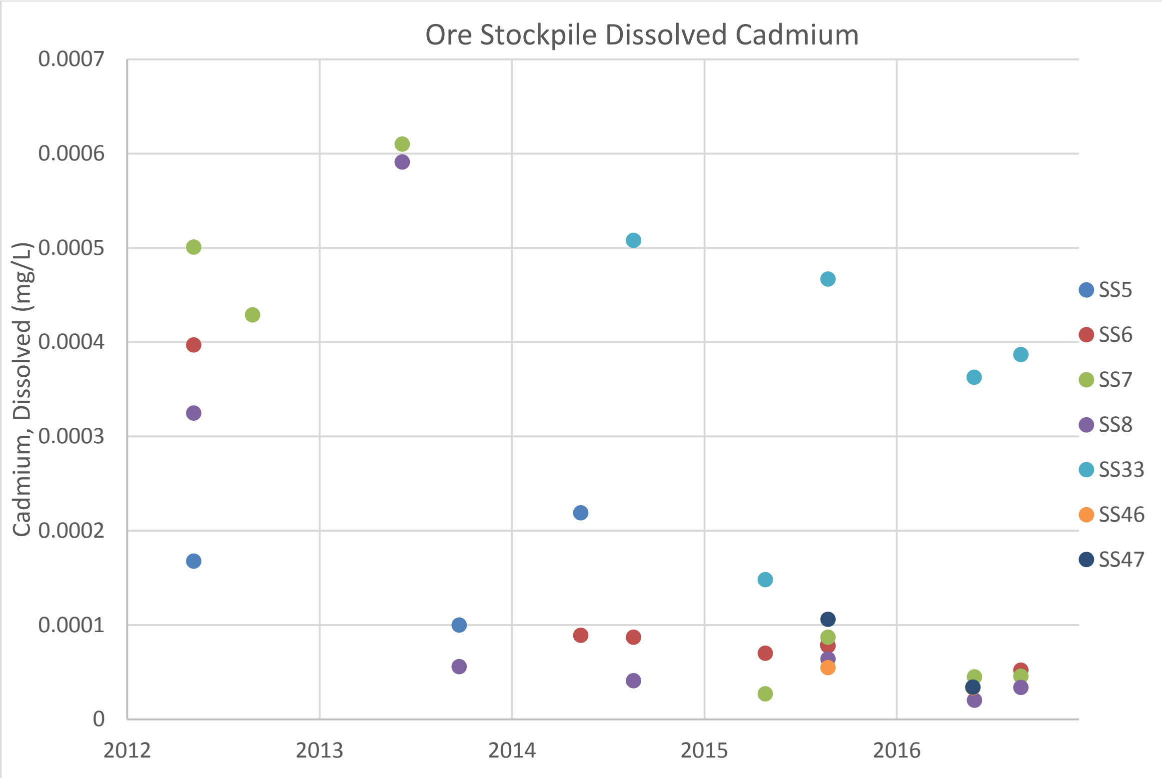


Figure 7-64: Ore Stockpile Dissolved Cadmium

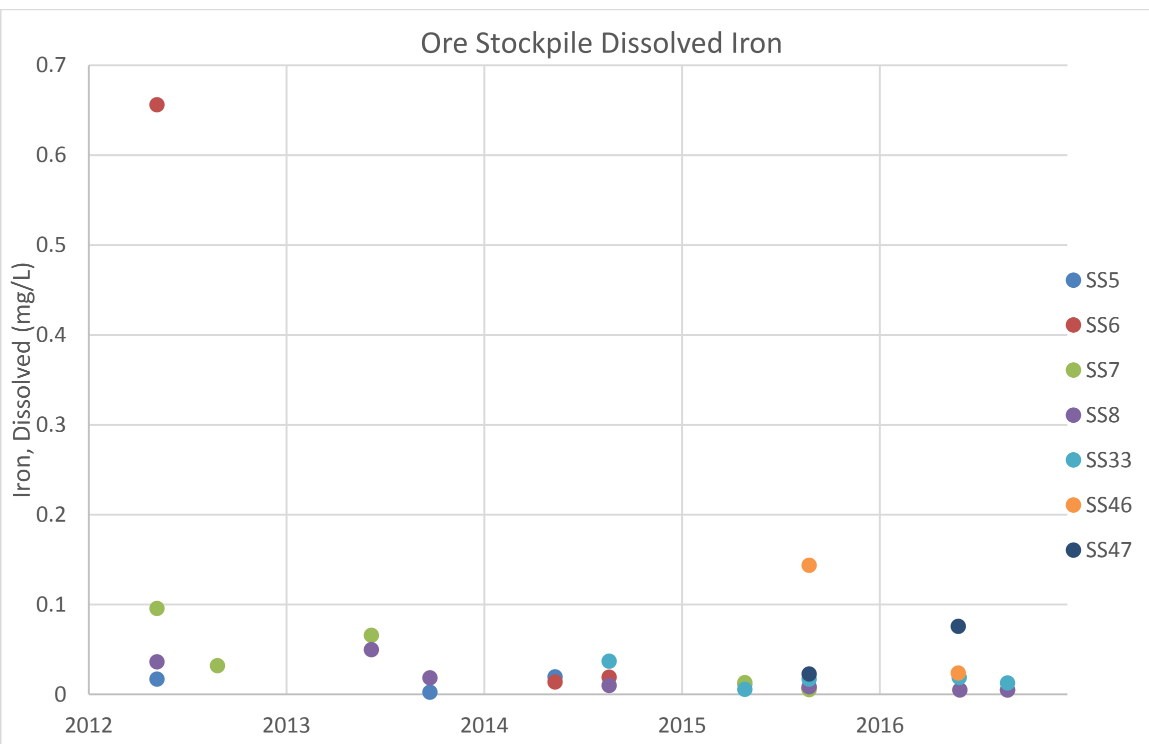


Figure 7-65: Ore Stockpile Dissolved Iron

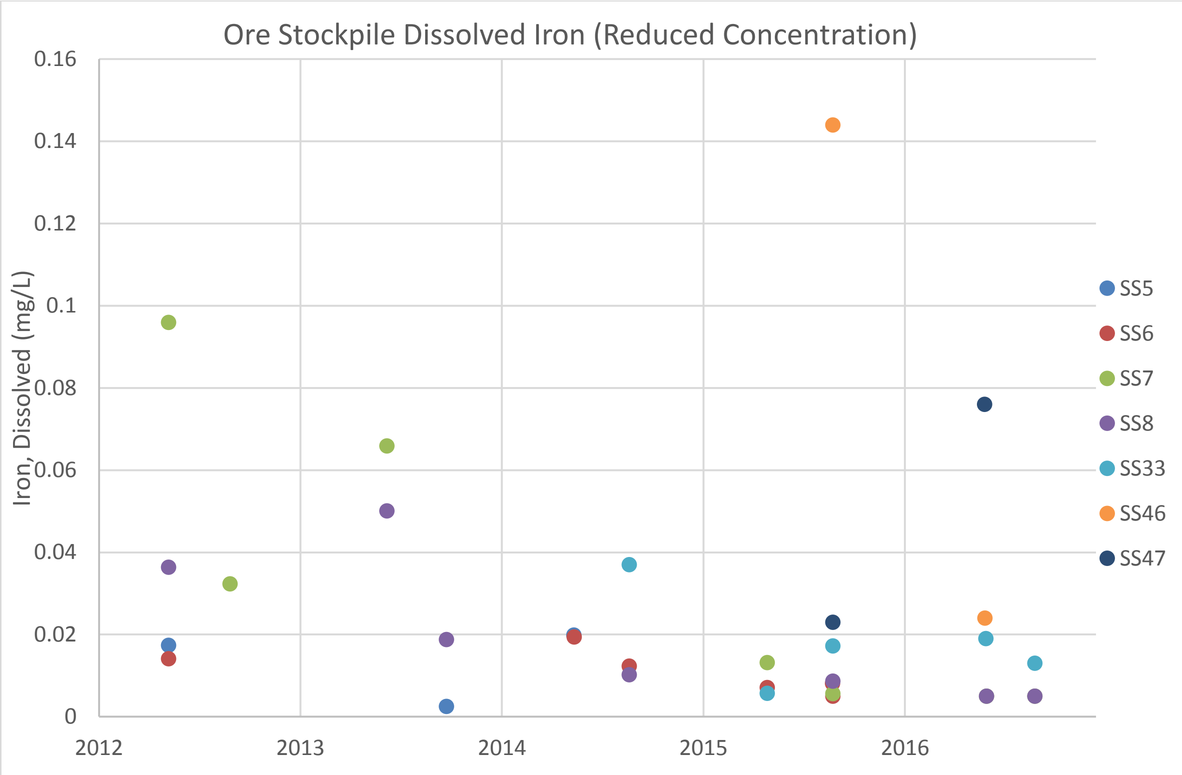


Figure 7-66: Ore Stockpile Dissolved Iron (Reduced Concentration)

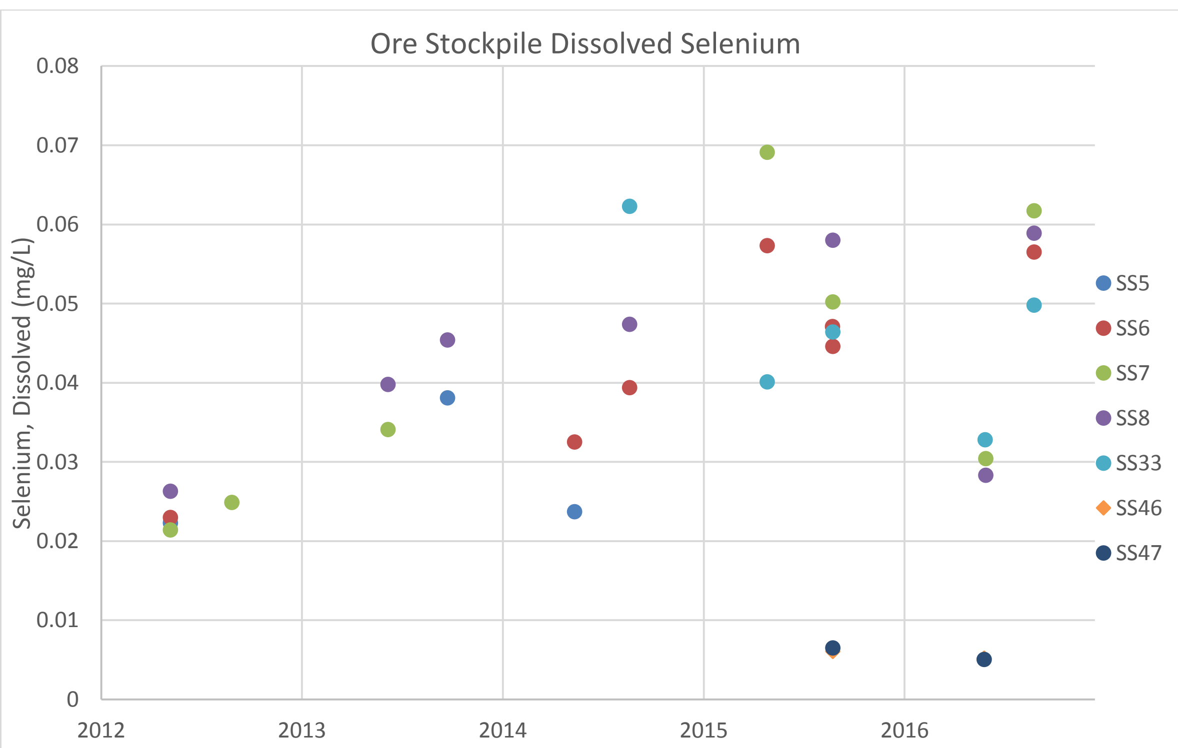


Figure 7-67: Ore Stockpile Dissolved Selenium

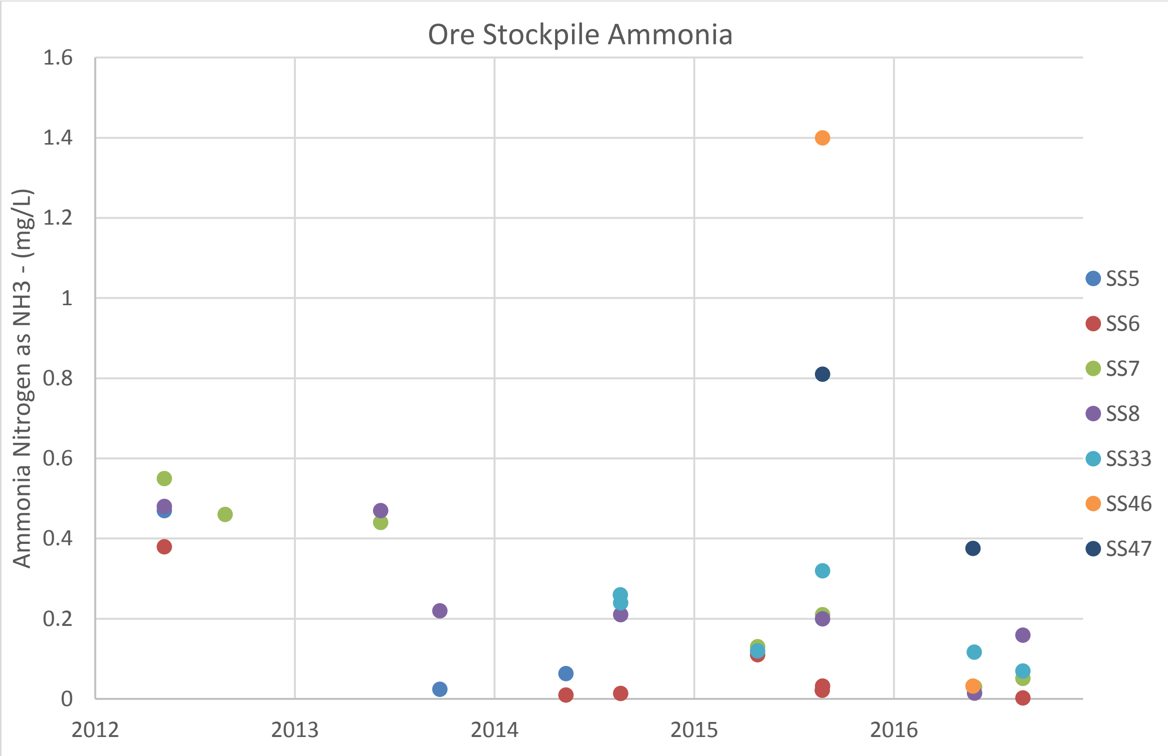


Figure 7-68: Ore Stockpile Dissolved Ammonia

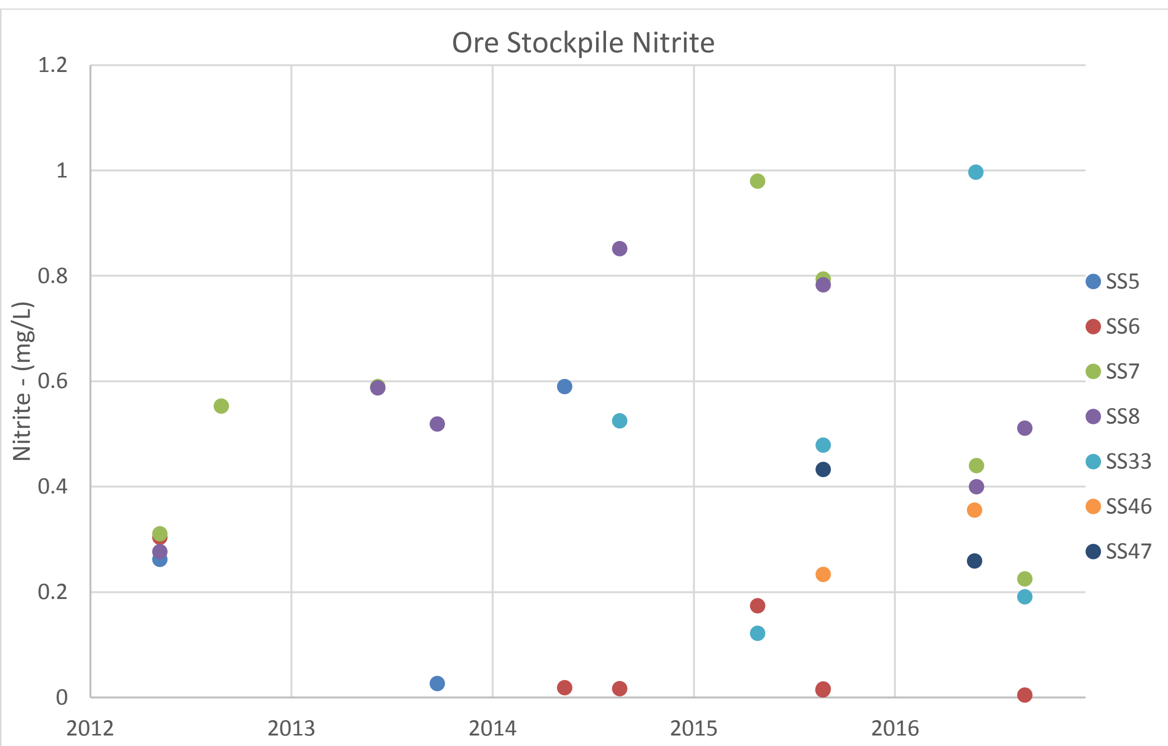


Figure 7-69: Ore Stockpile Dissolved Nitrite

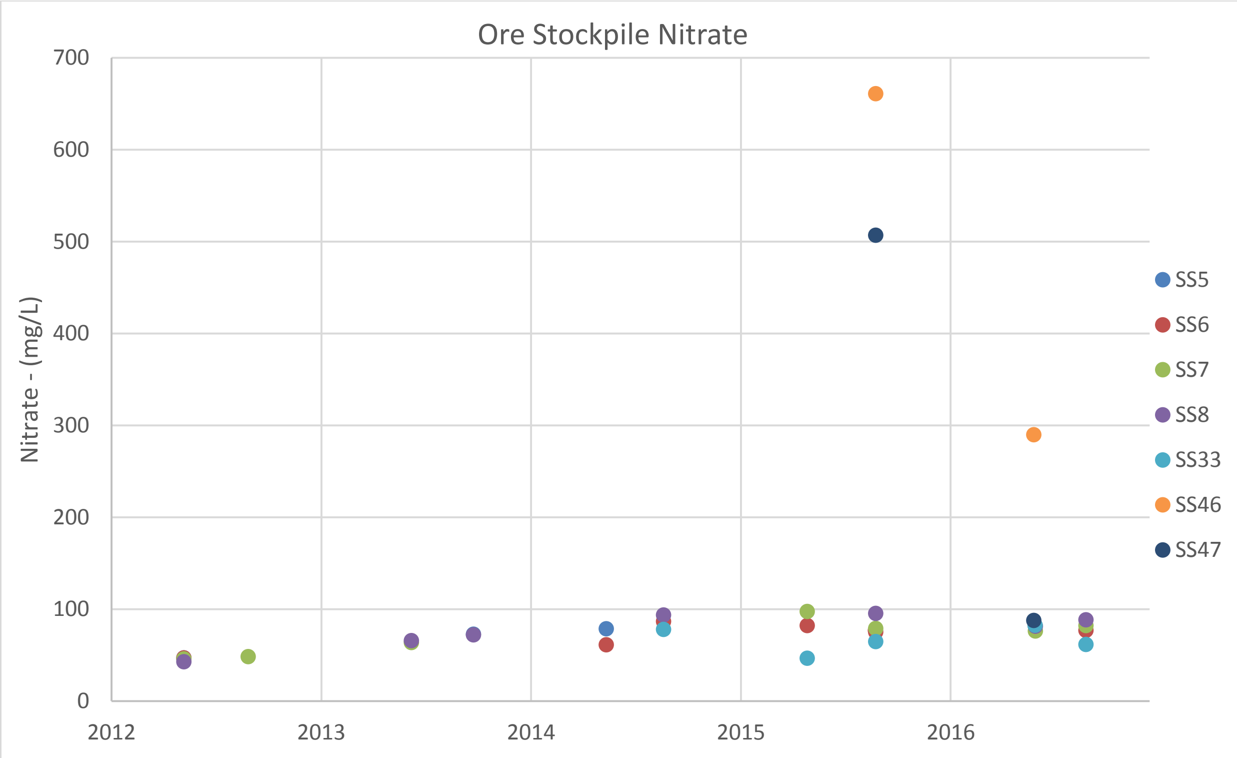


Figure 7-70: Ore Stockpile Dissolved Nitrate

7.7 Reclamation Overburden Dump (ROD)

In the 2016 Seepage Monitoring Survey, no water samples were collected from sites SS2, SS3, SS11, SS14, and SS15. All sites along the ROD were observed to be dry during the 2014, 2015, and 2016 surveys. Therefore the Seepage Monitoring Program will no longer include surveys of the ROD.

7.8 Main Waste Dump

No new seeps were discovered along the toe of the Main Waste Dump (MWD), and existing seeps were observed to be dry during both sampling events in 2016. Historical data is presented in Figure 7-71 through Figure 7-77 and include water quality results for dissolved copper, dissolved cadmium, dissolved iron, dissolved selenium, and nutrient levels for ammonia, nitrite, and nitrate.

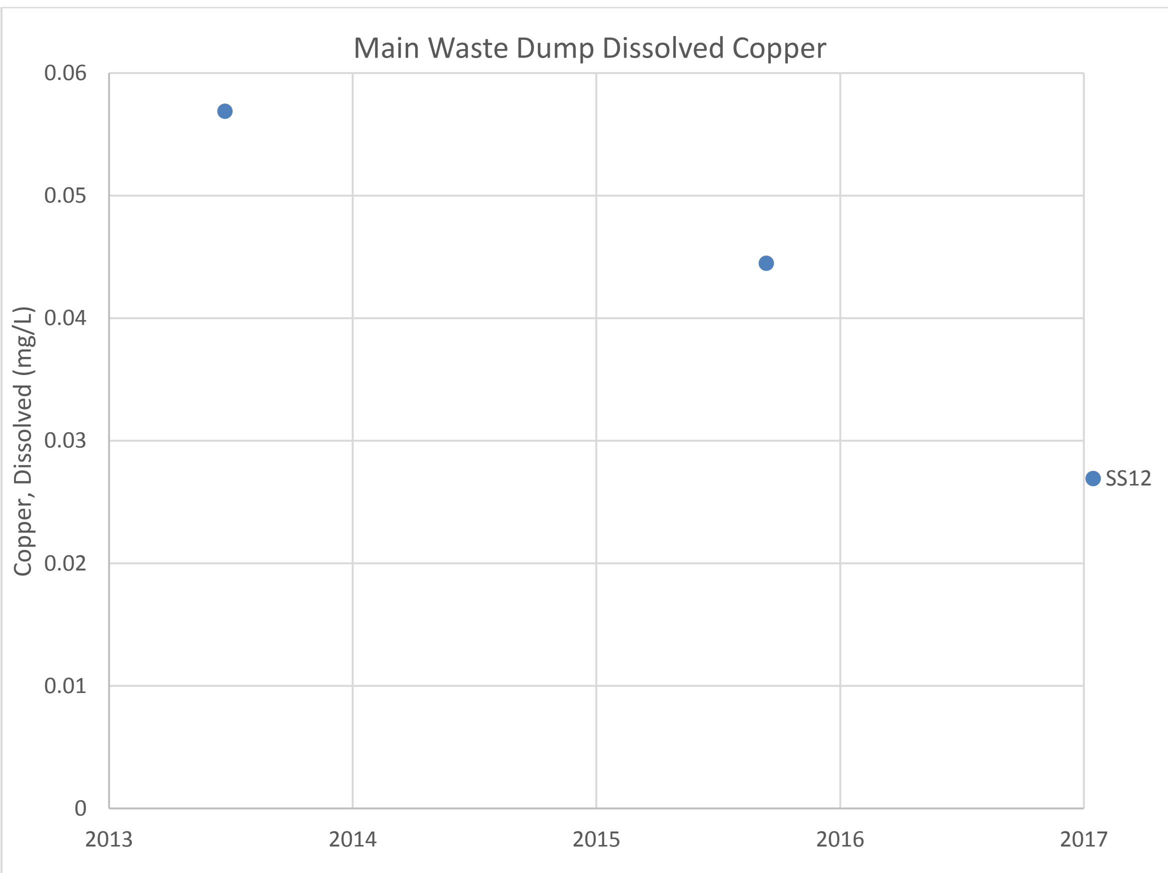


Figure 7-71: Main Waste Dump Dissolved Copper

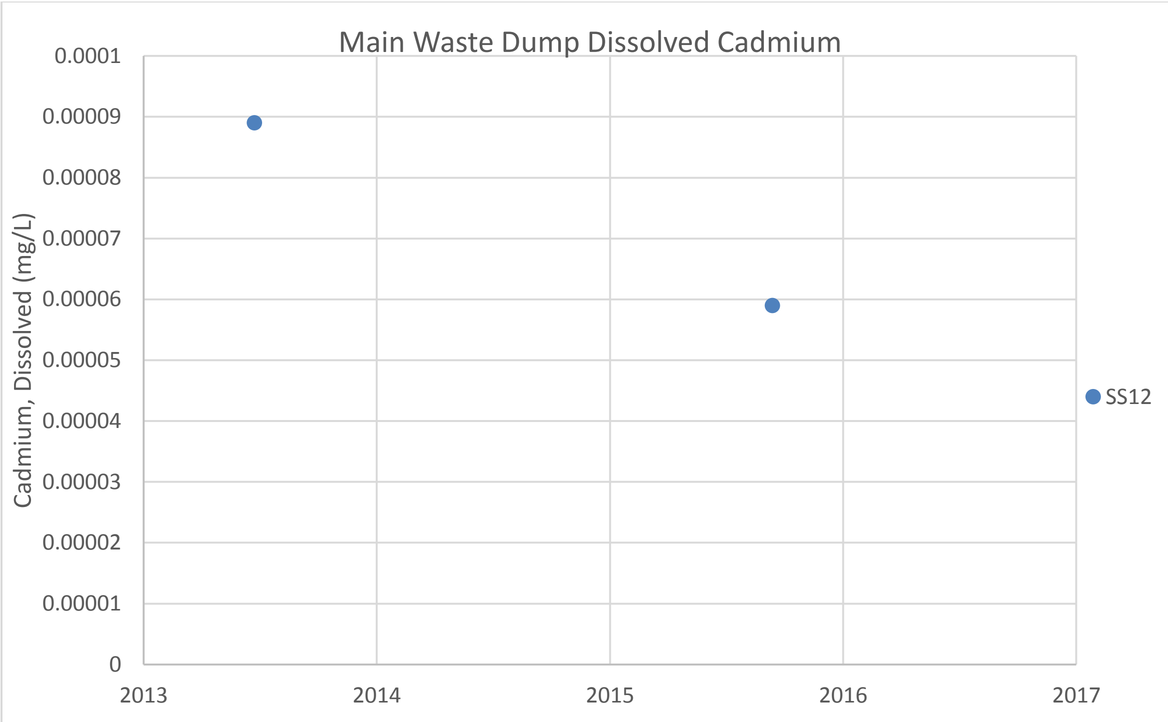


Figure 7-72: Main Waste Dump Dissolved Cadmium

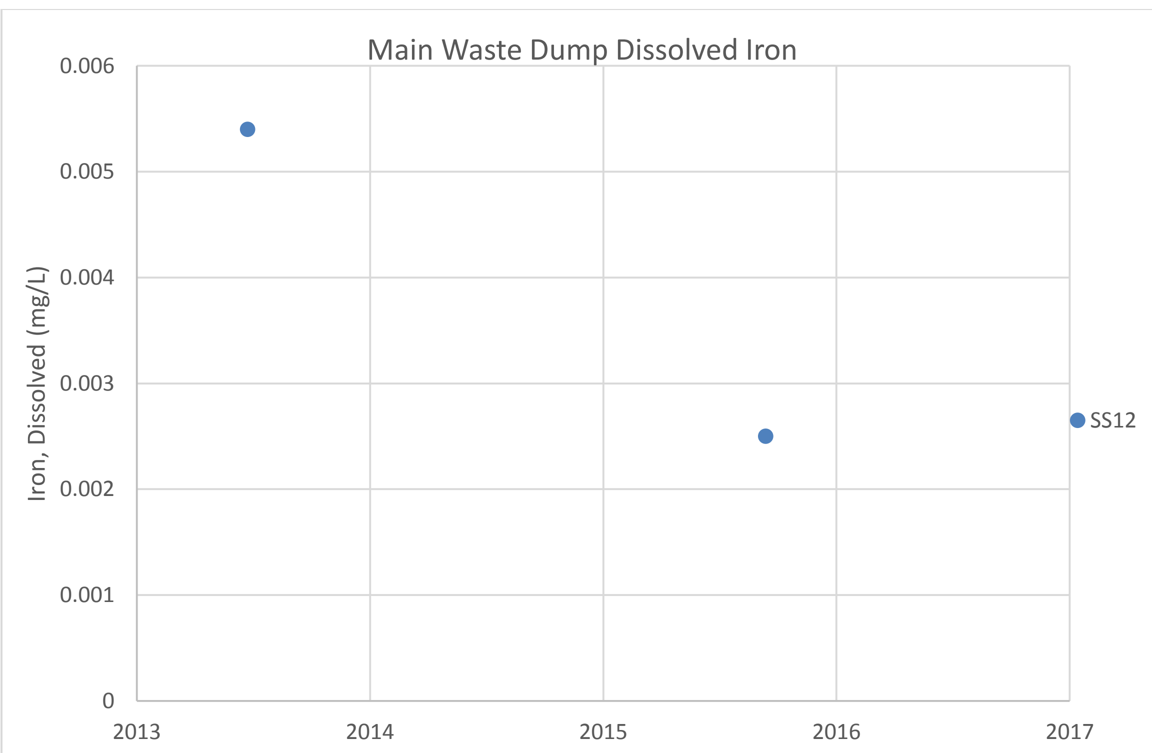


Figure 7-73: Main Waste Dump Dissolved Iron

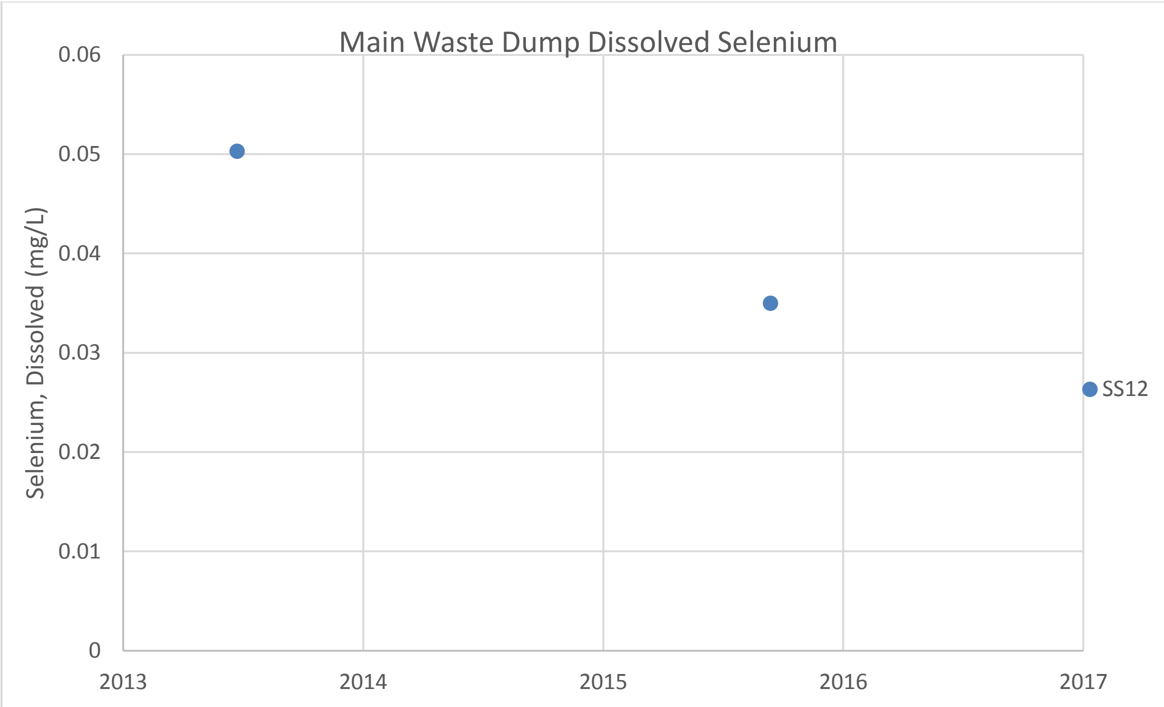


Figure 7-74: Main Waste Dump Dissolved Selenium

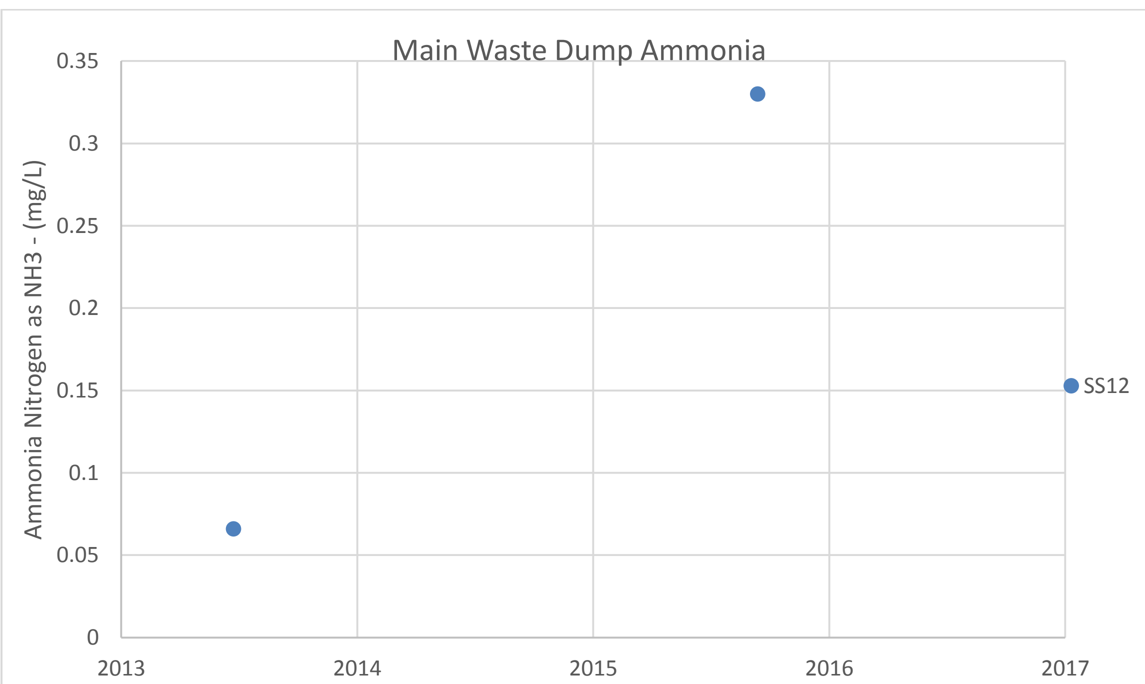


Figure 7-75: Main Waste Dump Ammonia

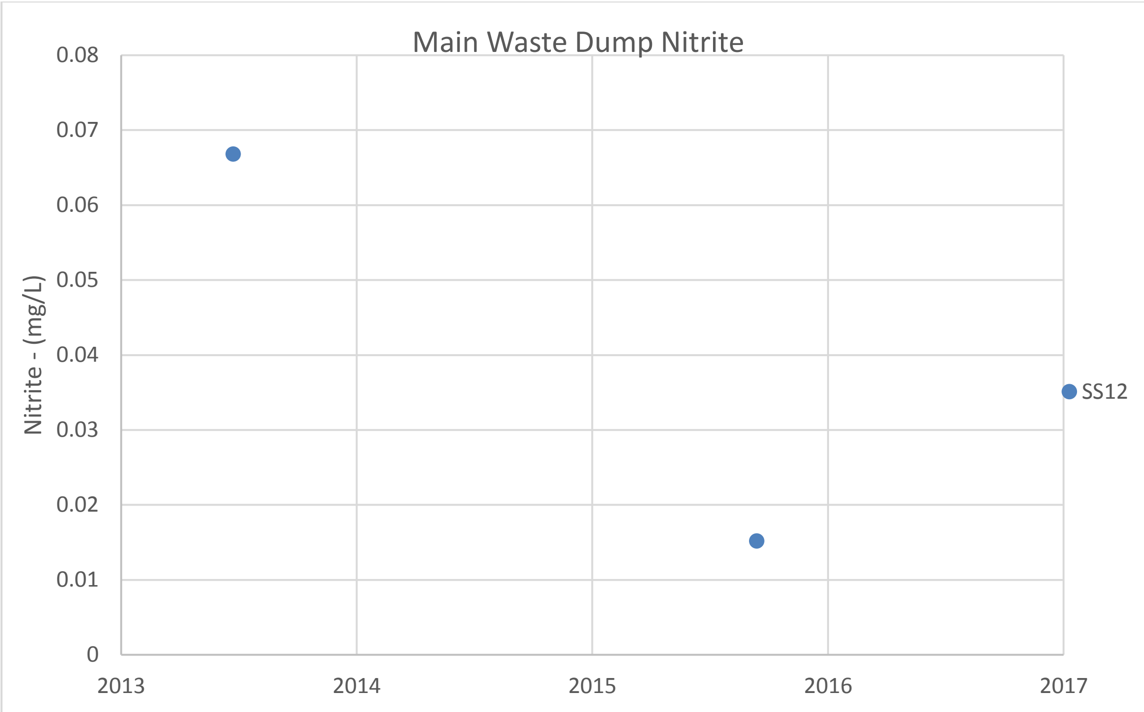


Figure 7-76: Main Waste Dump Nitrite

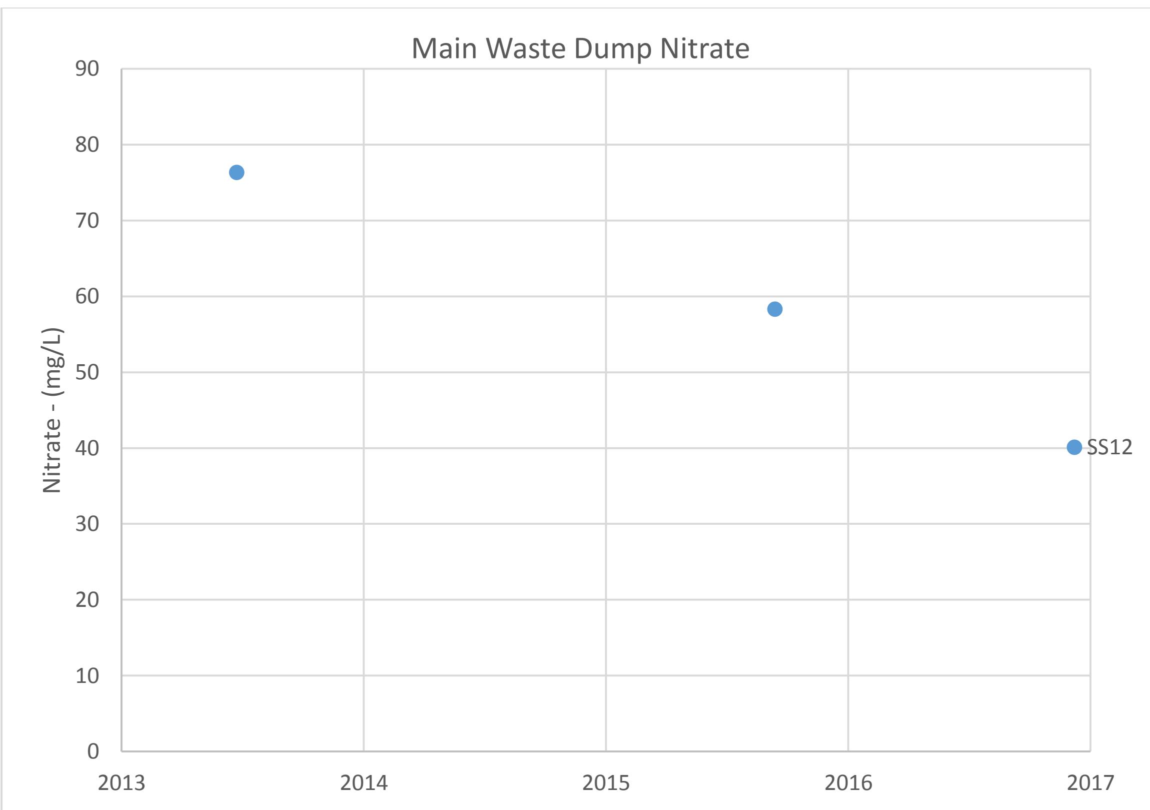


Figure 7-77: Main Waste Dump Nitrate

7.9 Mill Area

SS32 was discovered in 2014 behind the camp along the mill area survey route. SS32 was sampled in both the spring and fall of 2016 and the results are displayed in Figure 7-78 through Figure 7-84.

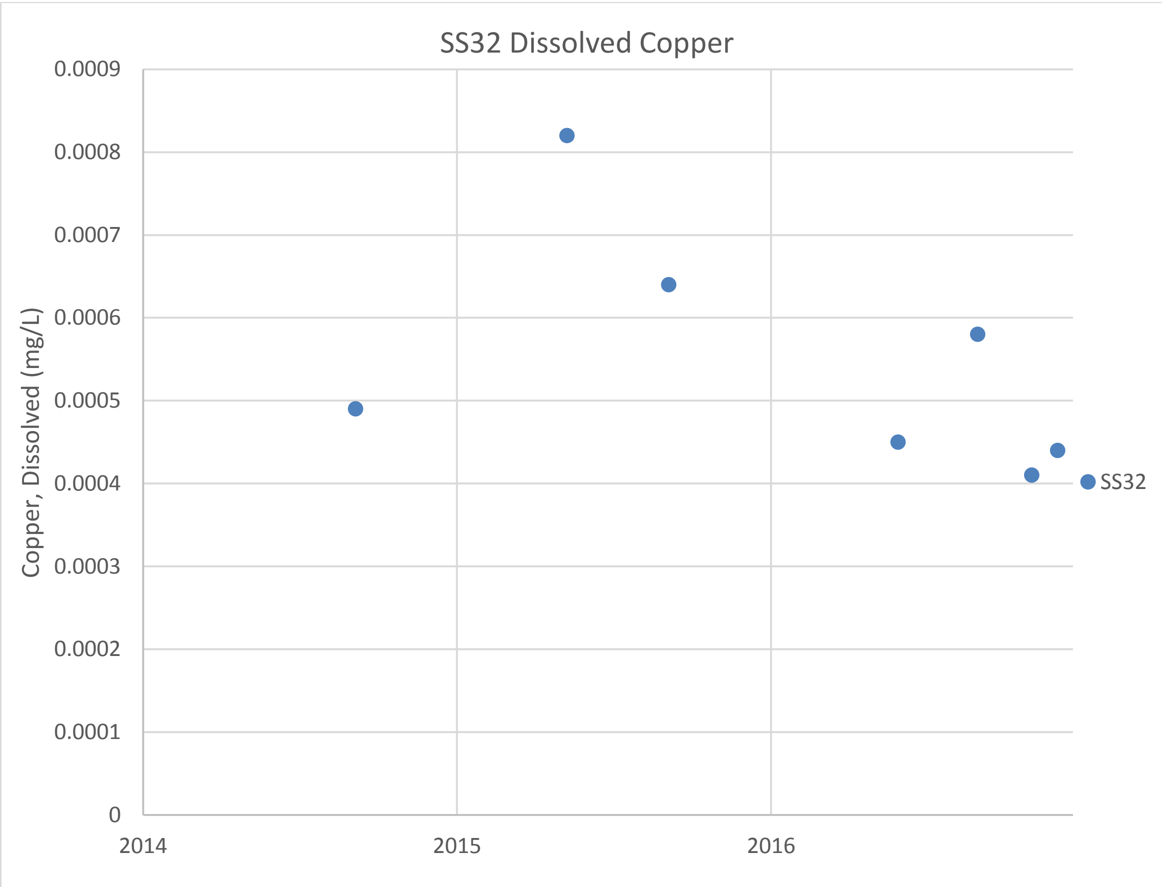


Figure 7-78: SS32 Dissolved Copper

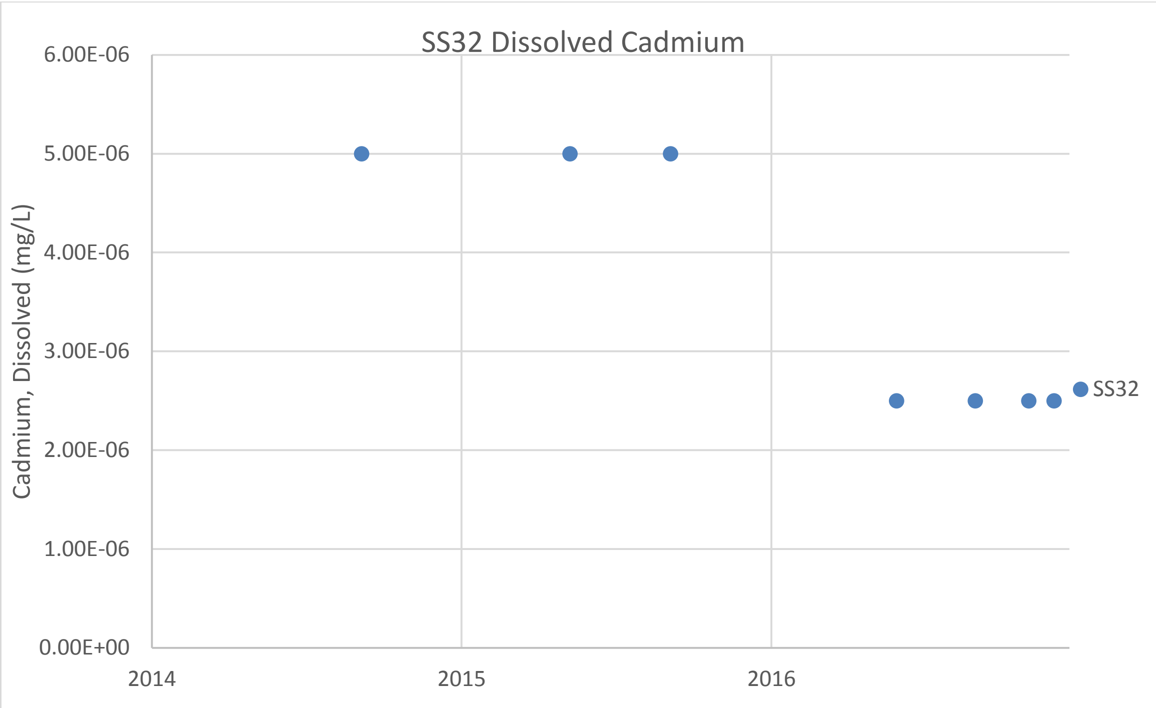


Figure 7-79: SS32 Dissolved Cadmium

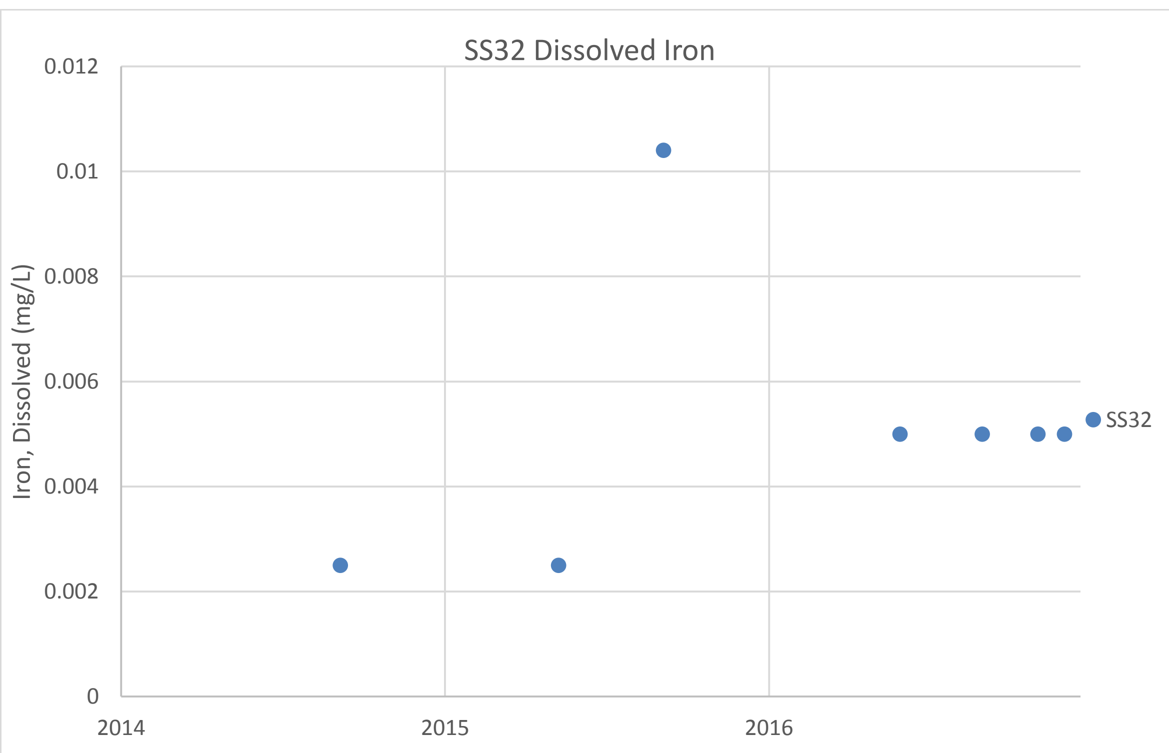


Figure 7-80: SS32 Dissolved Iron

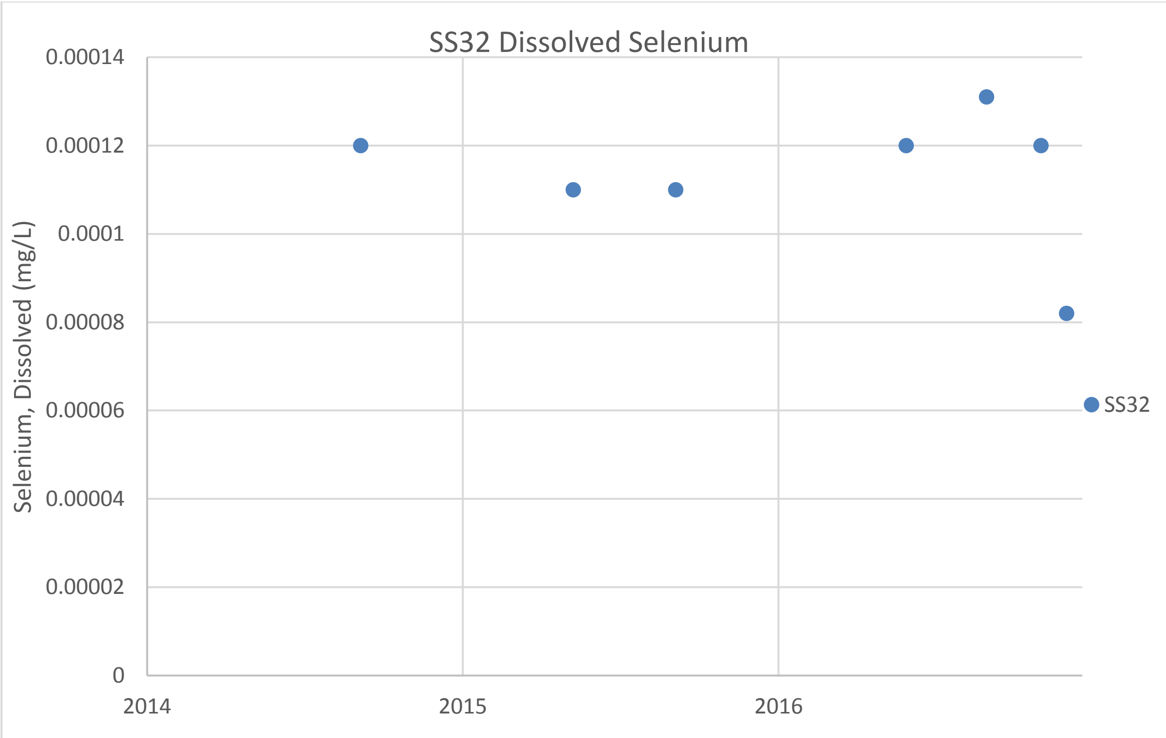


Figure 7-81: SS32 Dissolved Selenium

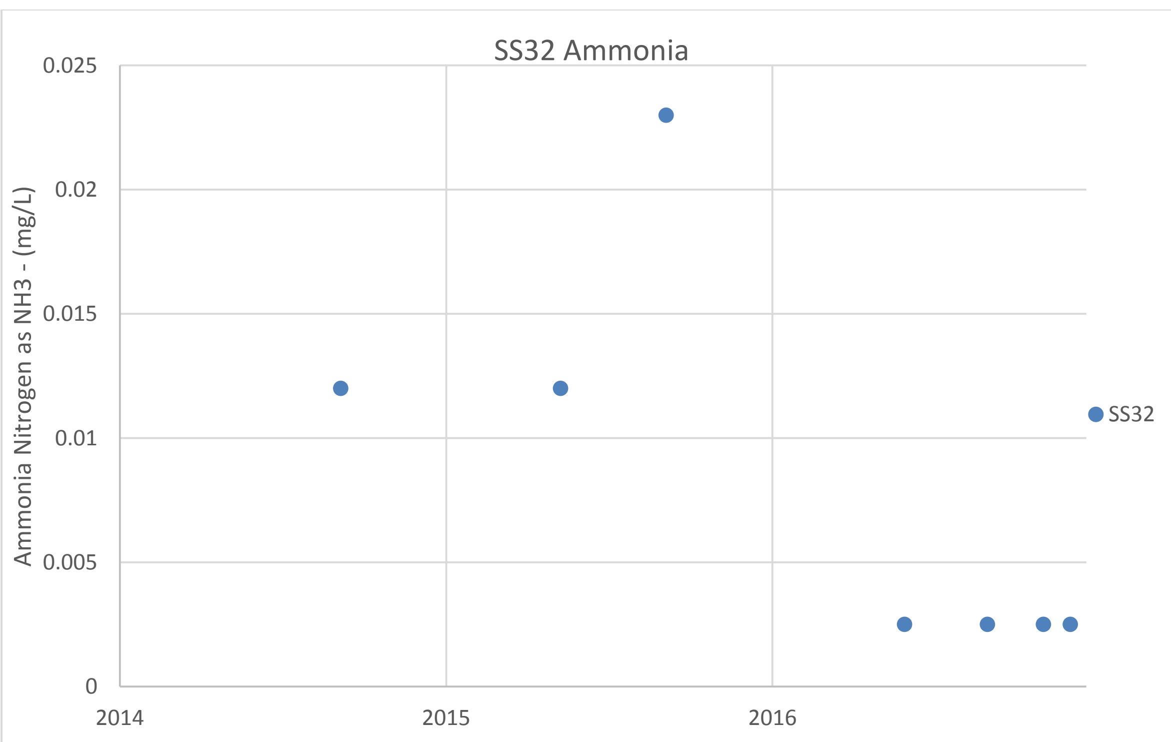


Figure 7-82: SS32 Ammonia

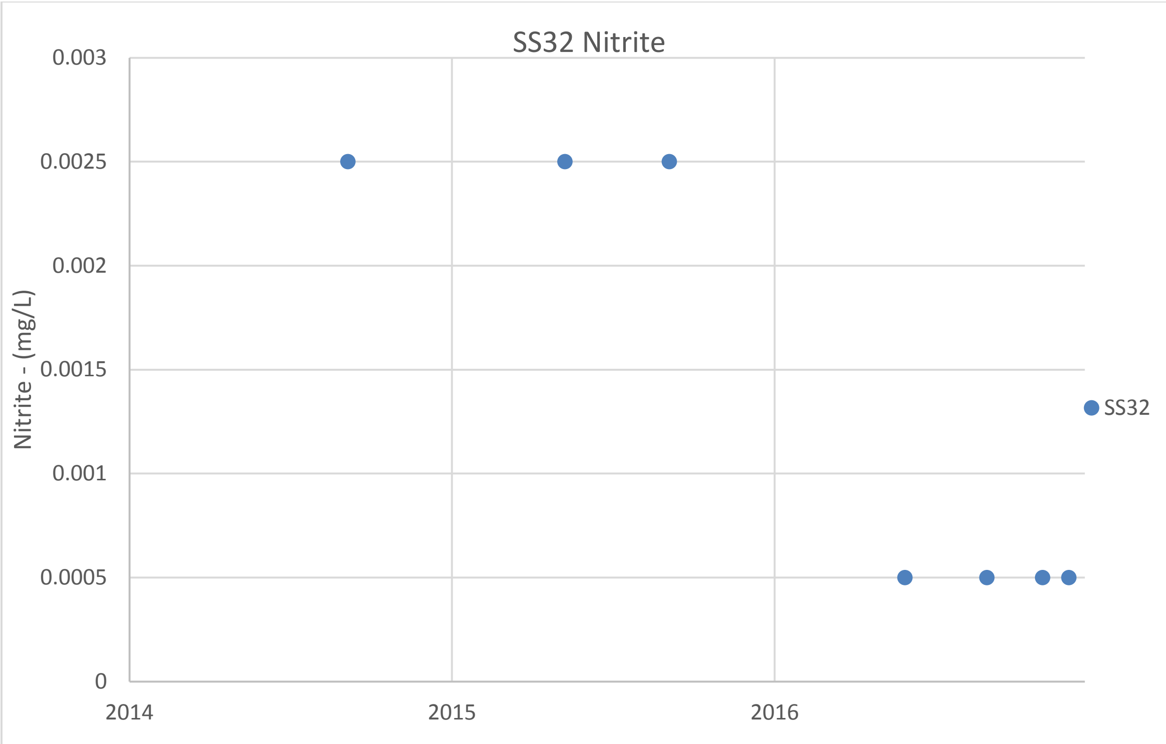


Figure 7-83: SS32 Nitrite

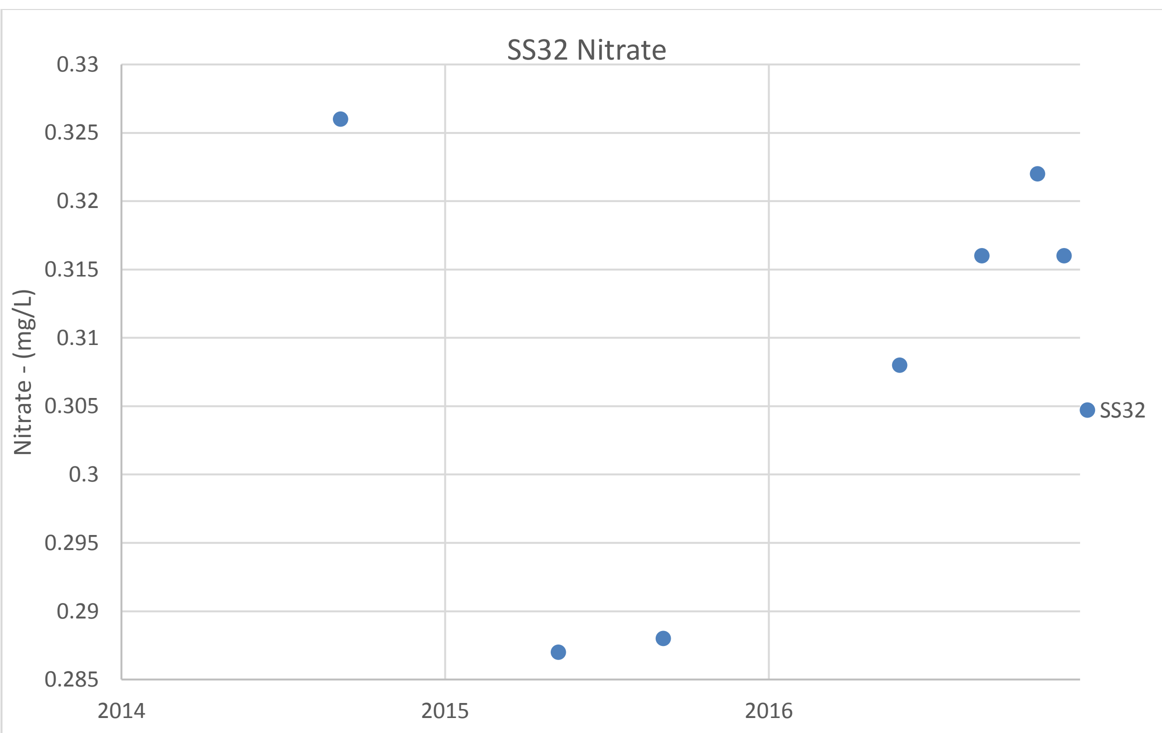


Figure 7-84: SS32 Nitrate

8 Water Management

The water balance for the Minto Mine forms the basis of the water management strategy at the site. The water management strategy at the site is for conveyance structures to either divert or release clean surface water or direct impacted water to the Main Pit and eventually treatment.

The Minto Mine generally has a positive water balance, meaning that the site-wide annual runoff is greater than the volume of water required to operate the mine. Therefore, it is necessary to release water to Minto Creek. In the event surface runoff does not meet the discharge limits stipulated in the WUL, Minto Mine has the ability to treat and release water using a combination of active treatment, conveyance structures and water storage features. The following sections will summarize water treatment, conveyance and storage during the reporting period.

8.1 Water Storage and Conveyance Network

There were no major changes to the management of water storage or conveyance structures in 2016. The strategy for managing the mine water inventory was unchanged in 2016, and the water conveyance network is illustrated in Figure 8-1. Compliant (clean) surface water was collected and diverted to the WSP, and subsequently discharged to Minto Creek. Runoff from developed mine areas (mine water) was collected and stored in the Main Pit and was used for ore processing, deposition of tailings and feed water for the Water Treatment Plant.

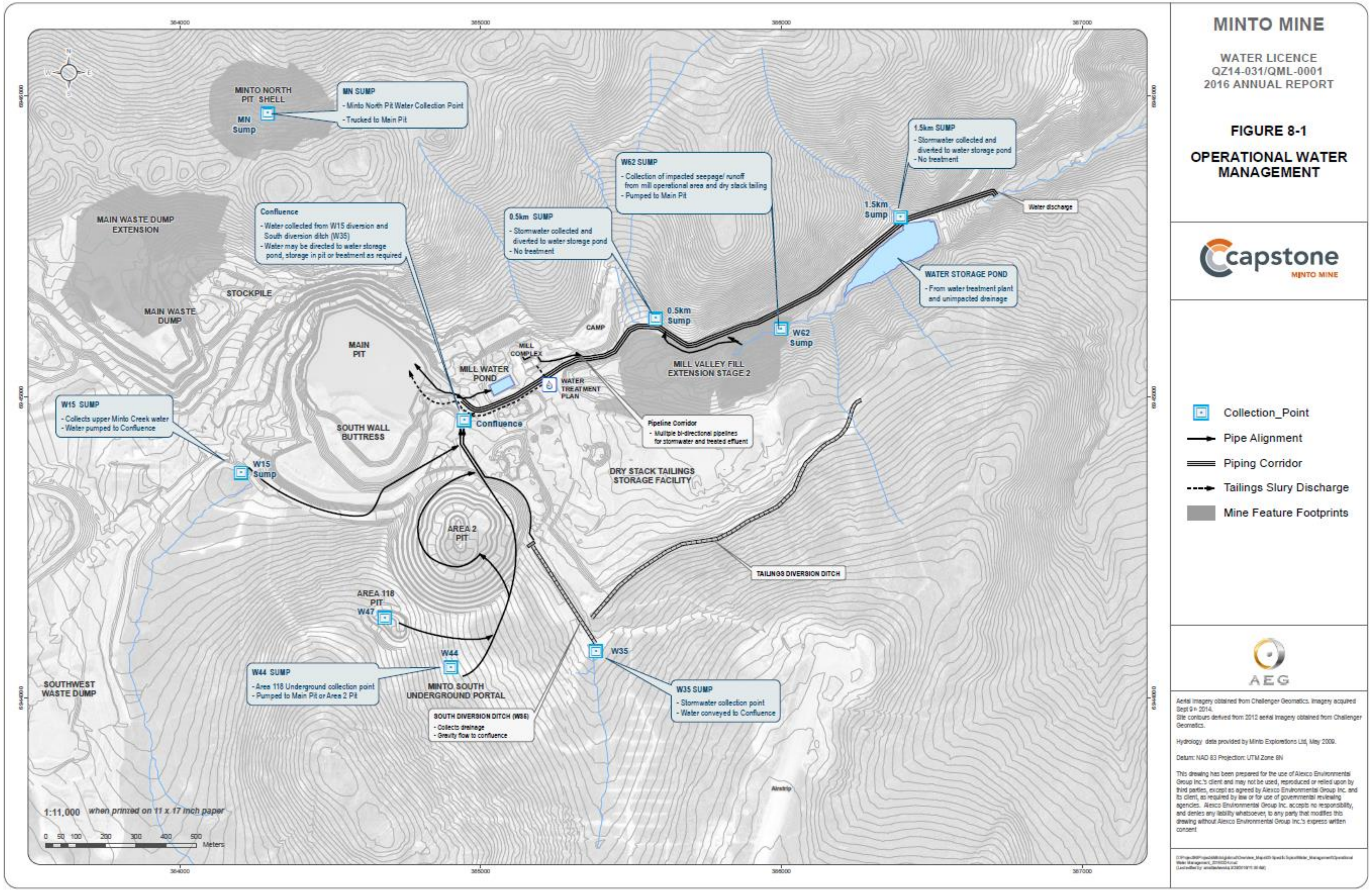


Figure 8-1: Minto Mine Water Conveyance Network (2016)

8.2 Water Storage Volumes Movement and Tracking

The main water balance components are summarized in Table 8-1 and include the volumes of water stored at the Minto Mine, and the volume discharge to Minto Creek in 2016. Table 8-2 provides a summary of water volumes moved by conveyance structure but is not reconciled against the water balance.

Table 8-1: Minto Mine Water Balance Summary (2016)

	Units	Main Pit Tailings Management Facility	Area 2 Pit Tailings Management Facility	WSP
Volume Change 2016 (water + tailings)	m^3	-183,000	1,053,000	-15,000
Tailings Deposited, total	BCM	0	524,000	-
Water Volume Change 2016	m^3	-183,000	529,000	-15,000
Estimated Groundwater Inflow	m^3	0	30,000	0
Total Water Inventory Increase in 2016	m^3	364,000		
Total Water Discharged to Minto Creek in 2016	m^3	254,000		
Total Site-Wide Yield in 2016	m^3	**617,000**		

Table 8-2: Volume of Water Moved by Conveyance Structure (2016)

Description	W15 to Main Pit	W17 to WSP	W35 to Main Pit	W35 to WSP	W36 to Main Pit	W15 to WSP	WSP to Environment	MN to Main Pit	RO to Environment
Annual Conveyance Volume (m^3)	36,024	70,318	25,763	39,726	3,313	98,426	196,727	1,011	57,048
Description	**W62 to Main Pit**	**Main Pit to Mill**	**Mill to Area 2 Pit**	**UG1 to Area 2 Pit**	**UG1 to Main Pit**	**Area 2 Pit to Main Pit**	**WTP to WSP**	**Camp Well**	**ERT Well**
Annual Conveyance Volume (m^3)	147,972	1,293,325	1,334,348	684	24,319	510,448	167,317	9,499	1,170

The reported volumes are approximates only.

8.2.1 Water Conveyance Tracking

Diversion of W35 water (SDD): Water was diverted from the south catchment (collected at station W35) to the WSP. An estimated total of 65,489 m^3 moved through the SDD in 2016 as measured by a Mace FloSeries® 3 open pipe flow measuring device. The Mace Flo Series device was calibrated to ensure the unit was measuring accurately.

Diversion of W15 water: The W15 sump collects surface runoff from adjacent undisturbed catchments, the SWD and part of the MWD. A total of 134,450 m^3 was conveyed through the W15 conveyance structure in 2016. The W15 flows were measured and recorded using a Seametrics® mag flow meter with digital head relay module.

Pump Back of W36 water (MCDS): Water collected downstream of the mill area, ore stockpiles and DSTSF is collected at the MCDS and pumped back to the Main Pit for treatment. A total of 3,313 m^3 was conveyed through this structure in 2016. The flow volumes were measured and recorded using a Seametrics® mag flow meter with digital head relay module. The 2016 flow volume from the MCDS was lower due to being decommissioned in February 2016decommissioning. The pump back system of W62 (MVFES2 Collection Sump) Pump Back of W62 replaced the W36 station and a total of 147,942 m^3 was conveyed through this structure in 2016. The flow volumes at W62 were measured and recorded using a Seametrics® mag flow meter with digital head relay module.

8.2.2 Water Storage Tracking

Main Pit: The Main Pit was used as a reservoir to support the following: water use for the Mill process; collection of impacted runoff; supply feed water to the water treatment plant; and receive water/tailings from the mill. Water quality dictates that all water reporting to this location must undergo treatment prior to discharge. A total of 724,531 m^3 of water was conveyed to the Main Pit in 2016 (note that this volume includes water conveyed from the mill to the Main Pit).

Area 2 Pit: The Area 2 Pit was used to support the following: supply water to the Mill via the Main Pit; collection of impacted site water; receiving water/tailings from the Mill. A total of 1,335,032 m^3 was conveyed to the Area 2 Pit in 2016.

WSP: The WSP worked effectively as a storage location for un-impacted water and maintained the water quality below effluent quality standards. A total of 375,787 m^3 of water was conveyed to the WSP in 2016.

8.2.3 Water Conveyance Construction

Maintenance activities consisted of routine maintenance on water conveyance structures. In the fall of 2016 Minto added piping to allow for the pump back of water from WSP to the WTP for additional treatment if required.

8.2.4 Water Balance and Water Quality Predictions Modeling

As per the WUL Clause 108, Minto is required to update the Water Balance and Water Quality Model. Minto retained SRK Consulting to complete a 2016 site water balance and water quality prediction model update, provided in Appendix F.

8.3 Water treatment

Surface runoff that did not meet the WUL effluent standards was directed to the Main Pit through the W15 Pipeline, W35 SDD, or via the W62 pump back.

Minto has the option of treating for:

- Total suspended solids (TSS) only: clarification;
- TSS, copper and cadmium: clarification and chemical precipitation; or
- All water quality parameters present in the Main Pit: clarification and reverse osmosis (RO).

Water treatment by-products including TSS sludge and RO reject is pumped back to the Main Pit.

8.3.1 Operations Overview

The water treatment system operated for 178 days in 2016 from March 21 to August 7. The plant was restarted September 3 to re-treat water from WSP to be discharged to the creek. The RO units operated for 3,569 hours producing 224,365 m^3 of permeate. A total of 167,317 m^3 of permeate was discharged to the WSP. In late fall from September 9 to October 9th the RO discharge was of sufficient quality to be discharged directly to Minto Creek. A total of 57,048 m^3 was discharged from WTP directly to Minto Creek.

RO removal efficiency decreased throughout the operating season as a result of low water temperatures and increased contaminant build up in the RO membranes. Several days of downtime were needed to wash the membranes. Table 8-3 and Table 8-4 summarize the 2016 water treatment operations statistics, reagent consumption and contaminant removal efficiency.

Table 8-3: WTP Operating Statistics (2016)

WTP Statistics 2016	
Plant Feed (m^3)	363,978
RO Treated (m^3)	224,365
Discharged to WSP (including blending) (m^3)	167,317
Runtime (hour) (Discharge hours)	3569.3
Recovery (%)	61
Reagent Consumption	
Polyclear 2528 (floc) (m^3)	20
Average Flow Rate floc (average ml/min)	1,850
Hydrex (m^3)	32
Average Flow Rate Hydrex (average ml/min)	150
Actisand (85 micron sand) kg	1000
Sodium Bicarbonate (m^3)	76
Antiscalant liters	2496
1 micron filters each	1,350
RO membranes each	71
CUNO 10 micron filters each	262

Table 8-4: WTP Constituent Removal Summary (2016)

Parameter	Units	Average WTP Intake	Average WTP Product (RO)
pH-L	pH units	8.1	6.9
Cond-L	µS/cm	1027	164
TDS	mg/L	684	108
TSS	mg/L	6.2	3.1
Ammonia	mg/L	2.111	0.36
N-NO2	mg/L	0.78	0.17
N-NO3	mg/L	19.79	4.57
Al-D	mg/L	0.0111	0.0094
Cd-D	mg/L	0.000022	0.000007
Cr-D	mg/L	0.00017	0.00015
Cu-D	mg/L	0.0258	0.00071
Fe-D	mg/L	0.015	0.0102
Pb-D	mg/L	0.000063	0.000066
Mo-D	mg/L	0.0556	0.0076
Ni-D	mg/L	0.0015	0.0006
Se-D	mg/L	0.0107	0.0016
Zn-D	mg/L	0.0032	0.0023

8.4 Water Discharge

8.4.1 Discharge Volumes

Minto Mine discharged approximately 196,776 m^3 of water to Minto Creek from the WSP thru W16A in 2016. An additional 57,048 m3 was discharged directly from the RO to Minto Creek.

8.4.2 Compliance

As per WUL Clause 6 the rate of water discharge to Minto Creek is calculated based on daily creek flow measurements. The daily discharge volumes are presented in Appendix G.

The calculated maximum allowable discharge was exceeded on three occasions. Two of these were due to an error in the flow calculation that was not discovered until the following week. August 31 discharged 1230 m^3 while the calculated allowable volume was 1220m^3. September 13th discharge was 1426 m^3 while the calculated allowable volume was 1210 m^3. September 17th discharge volume was 1697 m^3 while the calculated allowable volume was 1690 m^3. This event was due to wear and decreased fine control of the valve. Minto increased the conservativeness in setting the valve for the remainder of the season.

Water Quality monitoring stations are discussed in Section 5.2.

8.5 Hydrology

In 2016 and as part of the EMSRP, Minto monitored hydrological conditions at water quality stations including the following: stations within the operational mine area; stations downstream from the mine operational area that are influenced by mine effluent discharge; and reference stations downstream from the mine operational area that are not exposed to effluent. Hydrological monitoring is performed using a variety of methods including: manual discrete discharge measurements through the use of a flow meter, continuous stage measurement through the deployment of Solinst Level Loggers and Barometric Loggers and monitoring of an engineered flume.

8.5.1 Minto Creek Hydrology

Hydrological monitoring on Minto Creek is conducted in accordance with the requirements outlined in the WUL. During the 2016 monitoring period, Minto Mine maintained and collected data from the following four hydrometric stations along Minto Creek.

- W3 - flume downstream of the Water Storage Pond (WSP);
- MC-1 - located in Minto Canyon – mid-catchment;

- W1 - located approximately 1 km upstream of Yukon River – lower catchment; and
- W7 - tributary on the south side of Minto Creek.

At the hydrometric stations, Solinst Level Loggers and Barometric Loggers were used in conjunction with staff gauge readings and manual flow measurements to produce volumetric flow rates.

For details on the 2016 results of Minto Creek hydrology see the *Minto and McGinty Creek 2016 Surface Hydrology Memo* in Appendix H.

8.5.2 McGinty Creek Hydrology

In 2016, hydrological monitoring on McGinty Creek was conducted as per the schedule outlined in the EMSRP. During the 2016 monitoring period, Minto Mine maintained and collected data from the following three hydrometric stations along McGinty Creek.

- MN-0.5 – West Tributary of McGinty Creek
- MN-2.5 – East Tributary of McGinty Creek
- MN-4.5 – McGinty Creek near the Mouth

At the hydrometric stations, Solinst Level Loggers and Barometric Loggers were used in conjunction with staff gauge readings and manual flow measurements to produce volumetric flow rates.

For details on the 2016 results of McGinty Creek hydrology see the *Minto and McGinty Creek 2016 Surface Hydrology Memo* in Appendix H.

8.5.3 Hydrology QA/QC

Detailed procedures for hydrology monitoring at the Minto Mine are detailed in the *Minto Mine Surface Water Hydrology* SOP. No changes were made to the hydrology SOP in 2016.

9 Physical Monitoring Program

Minto's physical monitoring program consists of a combination of instrumentation and visual inspections. Site wide inspections are carried out semi-annually - May/June post thaw and September pre freeze-up. Q2 inspection must be completed by an external geotechnical engineering consultant in accordance with Clause 13.2 of the QML. As specified in the WUL and *Minto Physical Monitoring Plan*, the following additional inspections are also performed:

- Active waste rock and overburden dumps – daily during construction;
- Active open pits – weekly;
- Diversion ditch – daily during water conveyance;
- Dry Stack Tailings Storage Facility, Mill Valley Fill Extension and Mill Valley Fill Extension 2 – monthly;
- Main Pit and Area 2 Pit tailings storage facilities – quarterly; and
- WSP dam – weekly (seepage), monthly (stability).

Deformation monitoring instrumentation includes survey hubs and borehole inclinometers, described in the following sections. A layout of physical monitoring instrumentation is in Figure 9-1 below. The updated *Physical Monitoring Plan* can be found in Appendix I.

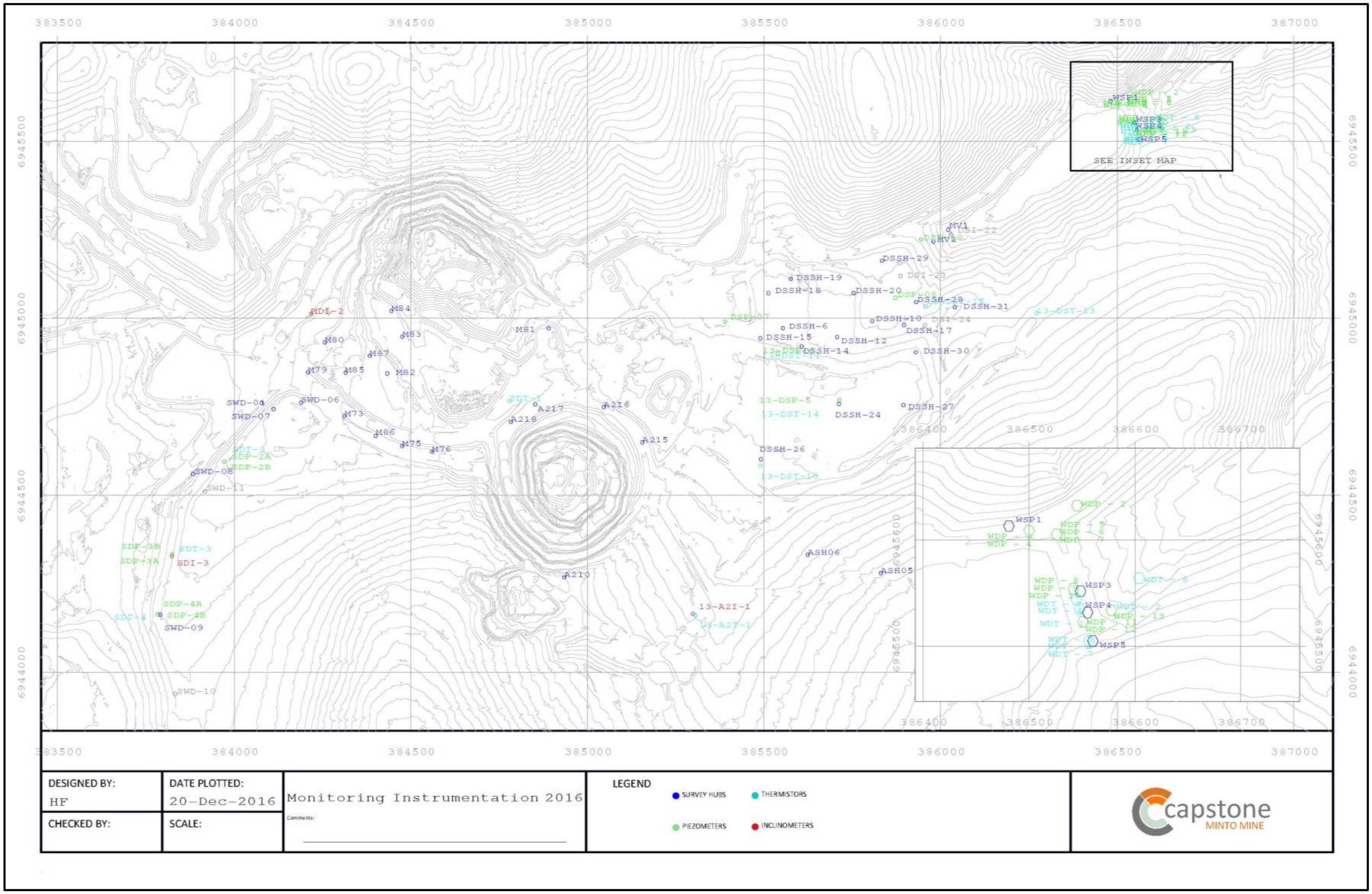


Figure 9-1: Physical Monitoring Program Installation (2016)

9.1 Physical Deformation Monitoring Instrumentation

9.1.1 Survey Hubs

Physical deformation monitoring consists of survey hubs at the Main Pit, Area 2 Pit, DSTSF, SWD and WSP dam. The monitoring results are summarized below.

9.1.1.1 Main Pit/South Wall Buttress Survey Hubs

There are currently twelve operating survey hubs on the Main Pit south wall buttress. Data collected are presented in Figure 9-2. Data was collected bi-weekly for hubs M73, M75, M76, M79, M80 and M81 and weekly for hubs M82, M83, M84 and M87.

In general the movement rates continued a gradual decrease in 2016, with rates now nearing zero movement in some of the hubs. The in-pit survey hubs indicated relatively consistent movement rates in 2016 as presented in Figure 9-3. M82 and M84 saw an increase in movement in July, but have since stabilized. This movement is associated with tension cracking of a lift of an in-pit dump, not part of the south wall buttress. The area is no longer accessed and is not considered a hazard.

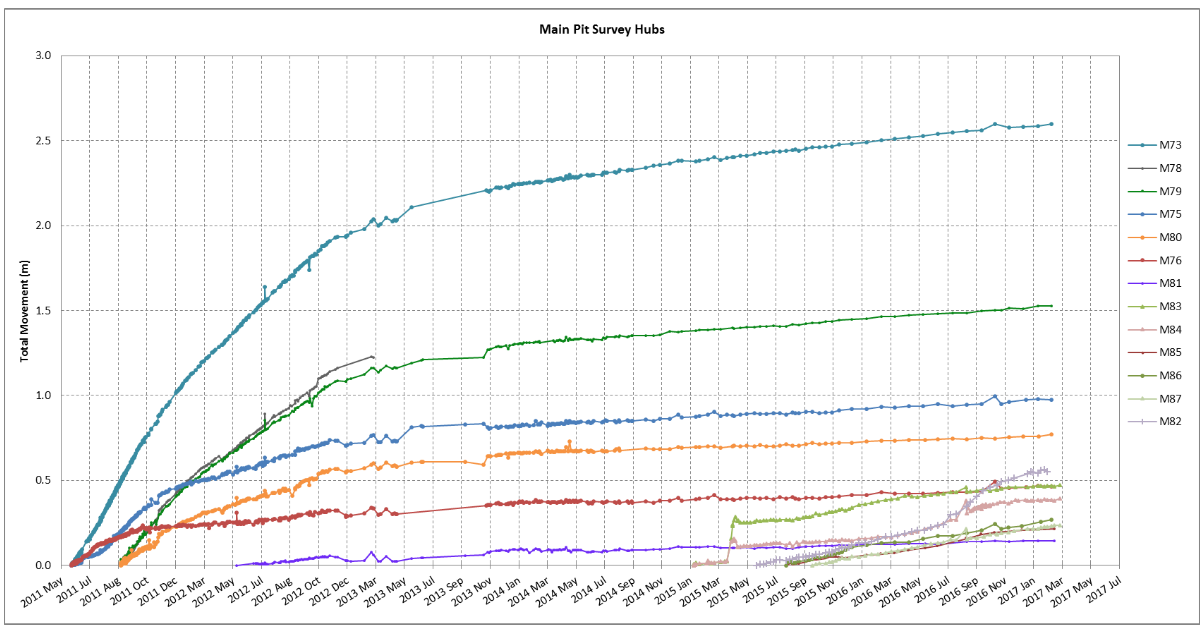


Figure 9-2: Main Pit/South Wall Buttress Survey Hub Data (2011-2016)

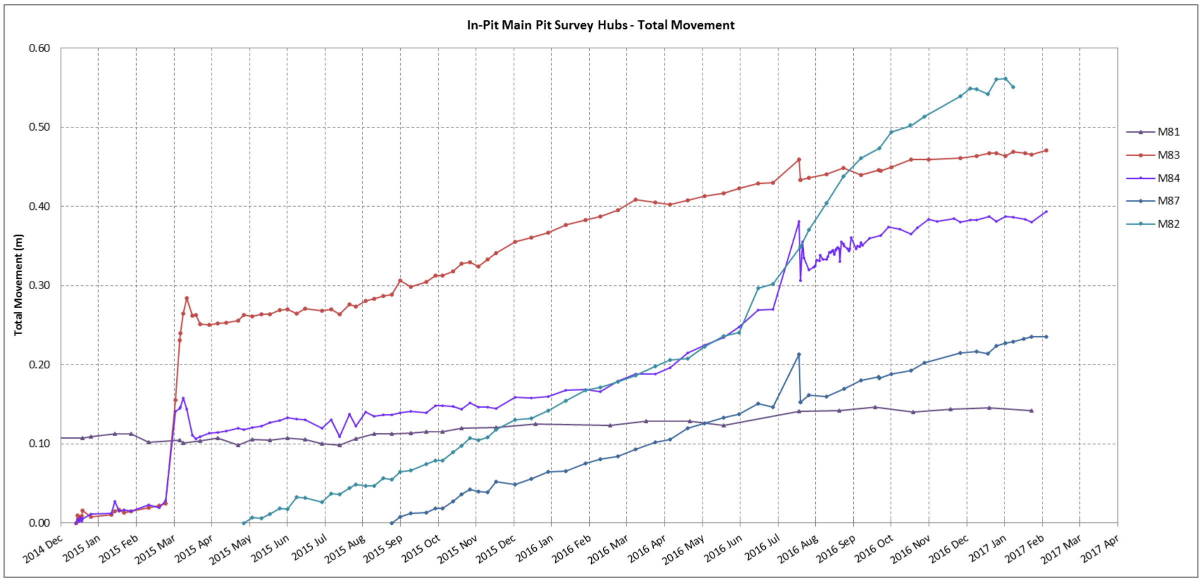


Figure 9-3: Main Pit/South Wall Buttress Survey Hub Data (2014-2016)

9.1.1.2 Dry Stack Tailings Storage Facility/Mill Valley Fill Survey Hubs

There are currently eighteen operating survey hubs on the DSTSF and MVFE2. After the construction of the Mill Valley Fill Extension (MVFE) Stage 2 was complete, ten survey hubs were reinstalled. Data collected are presented in Figure 9-4 and Figure 9-5. Data are collected weekly. All hubs indicated a continued gradual decrease in movement rates in 2016. Most hubs have shown a significant decrease in movement rate since the completion of the MVFE2 construction in summer, 2016.

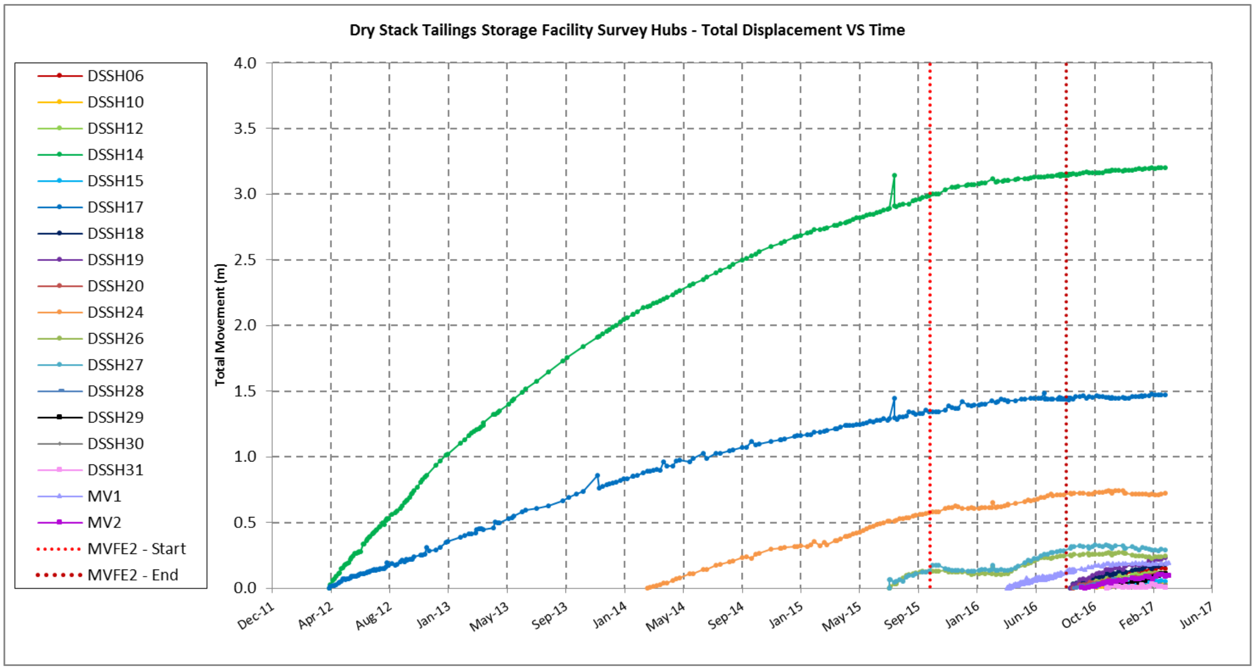


Figure 9-4: DSTSF Survey Hub Data (2010-2016)

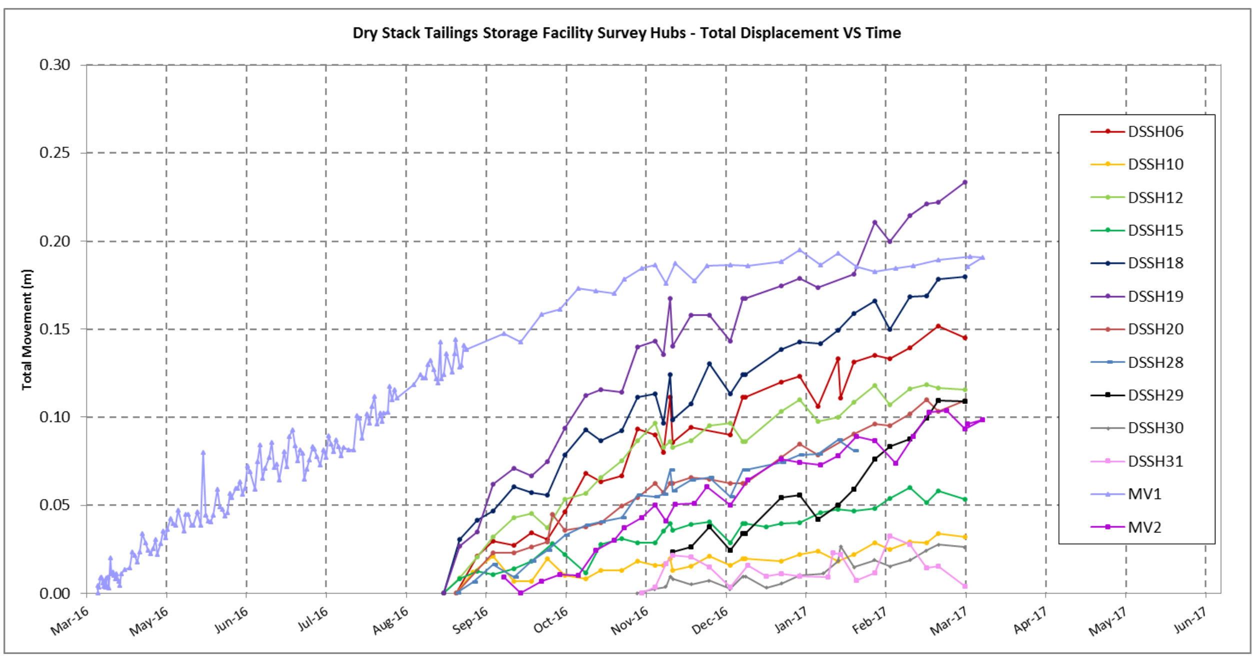


Figure 9-5: DSTSF Survey Hub Data (2015-2016)

9.1.1.3 Southwest Dump Survey Hubs

There are currently five operating survey hubs on the SWD. SWD-03A and SWD-05A are loose in the ground and not considered reliable and have not been included. SWD-02, SWD-02A and SWD-04A have been replaced in December 2016 with SWD-08, SWD-07 and SWD-09 respectively. Data collected are presented in Figure 9-6. Data are collected monthly. Hubs indicated relatively consistent movement rates in 2016, with the exception of SWD-04A nearing zero movement.

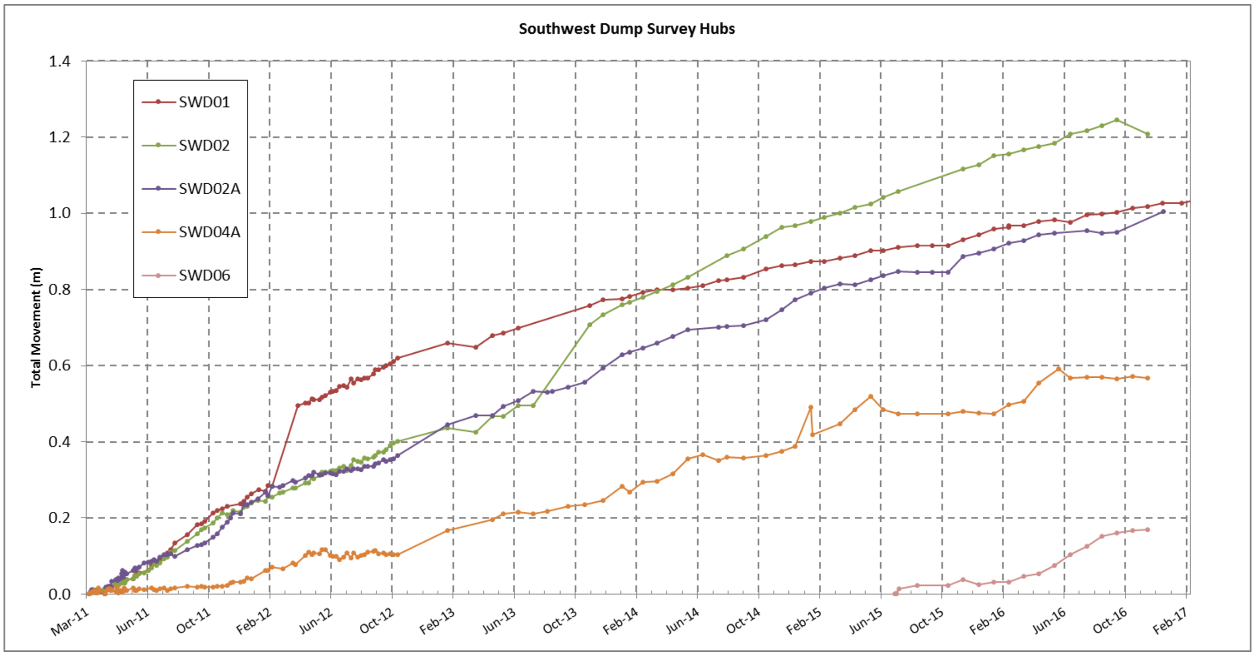


Figure 9-6: SWD Survey Hub Data (2011-2016)

9.1.1.4 Water Storage Pond Dam Survey Hubs

There are currently four operating survey hubs on the WSP dam. There was no change to the operational status of any the hubs in 2016. Data collected are presented in Figure 9-7. Data are collected monthly. Data continue to indicate no movement.

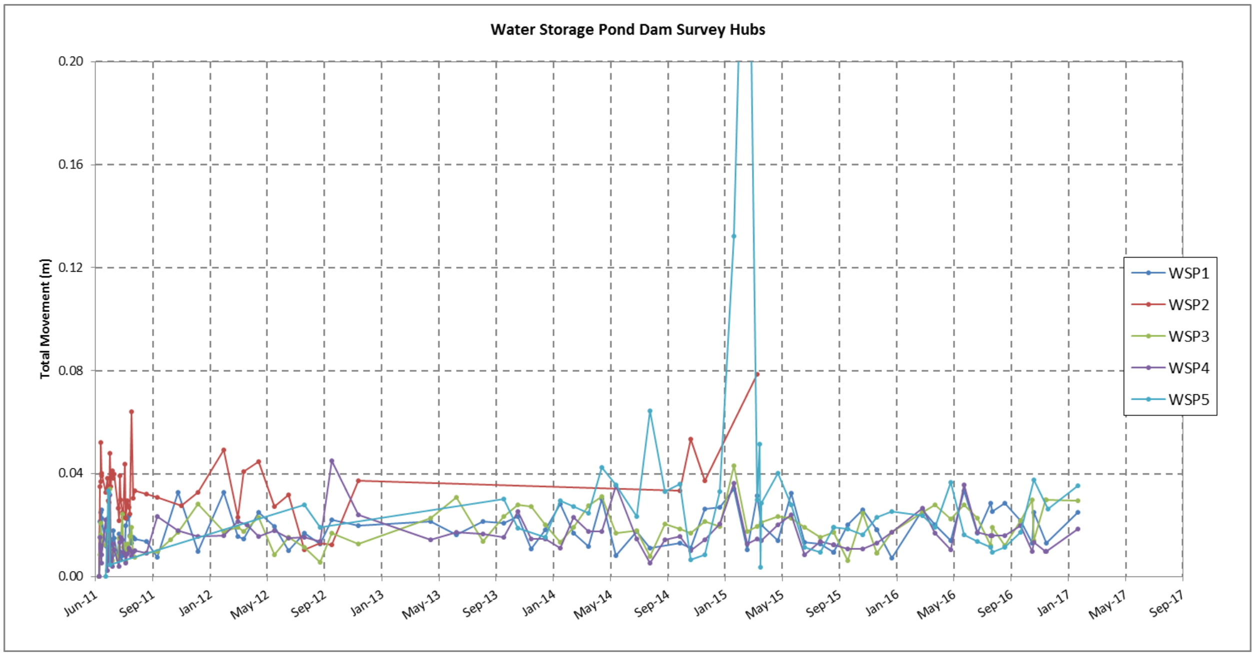


Figure 9-7: Water Retention Dam Survey Hub Data (2011-2016)

9.1.2 Inclinometers

Physical deformation monitoring consists of monitoring of inclinometers at the DSTSF and Main Pit. The monitoring results are summarized below.

9.1.2.1 DSTSF Inclinometers

There are currently four operating inclinometers in the DSTSF area. DSI-10 sheared off in February. DSI-22, DSI-23 were installed in December 2016 and DSI-24 was installed in January 2017. Data collected for the most recent surveys in 2016 relative to the original surveys are presented in Figure 9-8 through Figure 9-10. DSI-22 and DSI-24 froze after installation. Readings will resume in spring 2017. A2I-1 is monitored quarterly. DSI-22, DSI-23 and DSI-24 are monitored weekly.

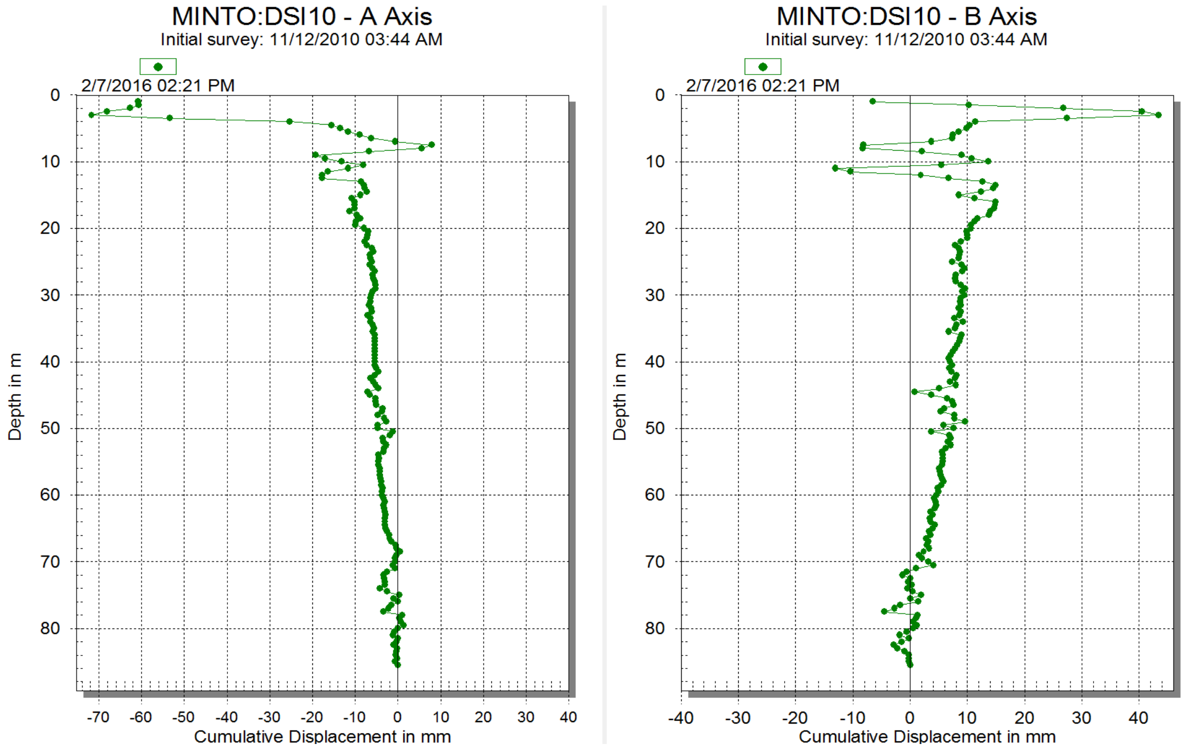


Figure 9-8: DSTSF Inclinometer DSI-10 (2016)

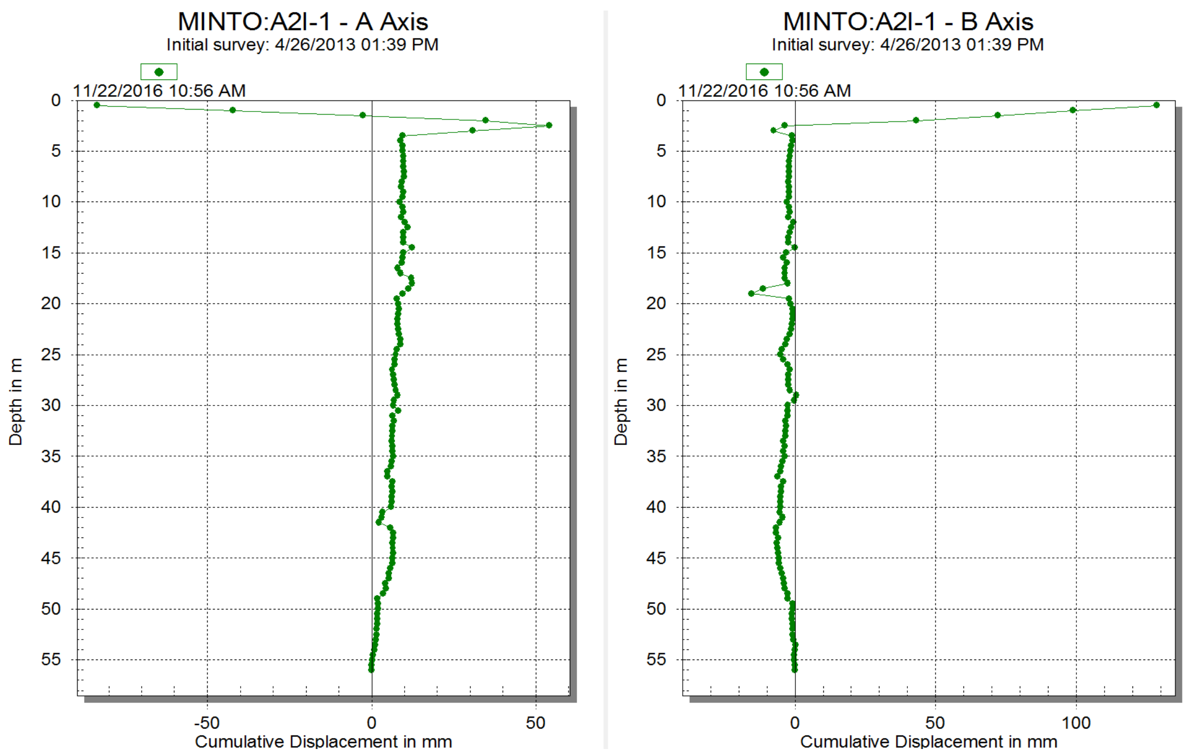


Figure 9-9: DSTSF Inclinometer A2I-1 (2016)

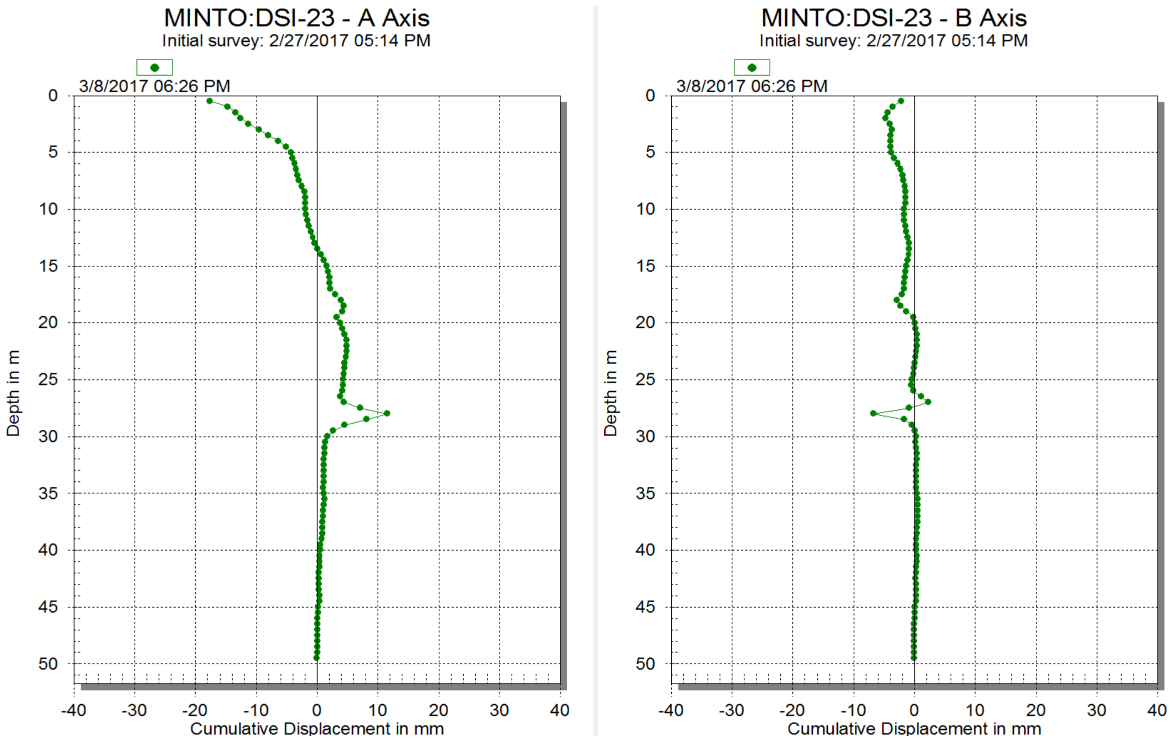


Figure 9-10: DSTSF Inclinometer DSI-23 (2016)

9.1.2.2 Main Pit Inclinometers

There is currently one operating inclinometer in the Main Pit west/south wall area. Readings re-commenced in October 2013 after not having been recorded since November 2012. Data are collected quarterly. Data collected for the most recent survey are presented in Figure 9-11.

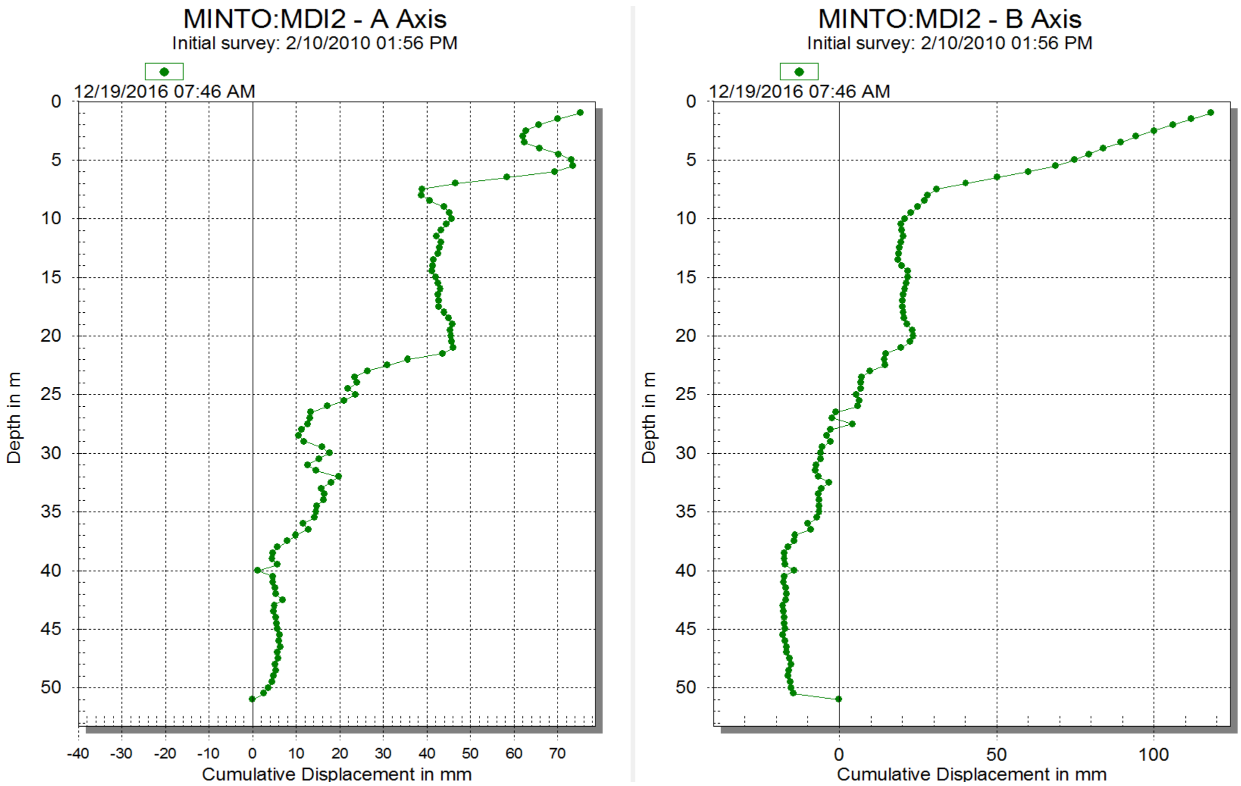


Figure 9-11: Main Pit Inclinometer MDI-2 (2016)

9.1.2.3 Southwest Dump Inclinometers

There is currently one operating inclinometer in the Southwest Dump area. Readings re-commenced in April 2014 after not having been recorded since November 2012. Data are collected quarterly. Data collected for the most recent survey are presented in Figure 9-12.

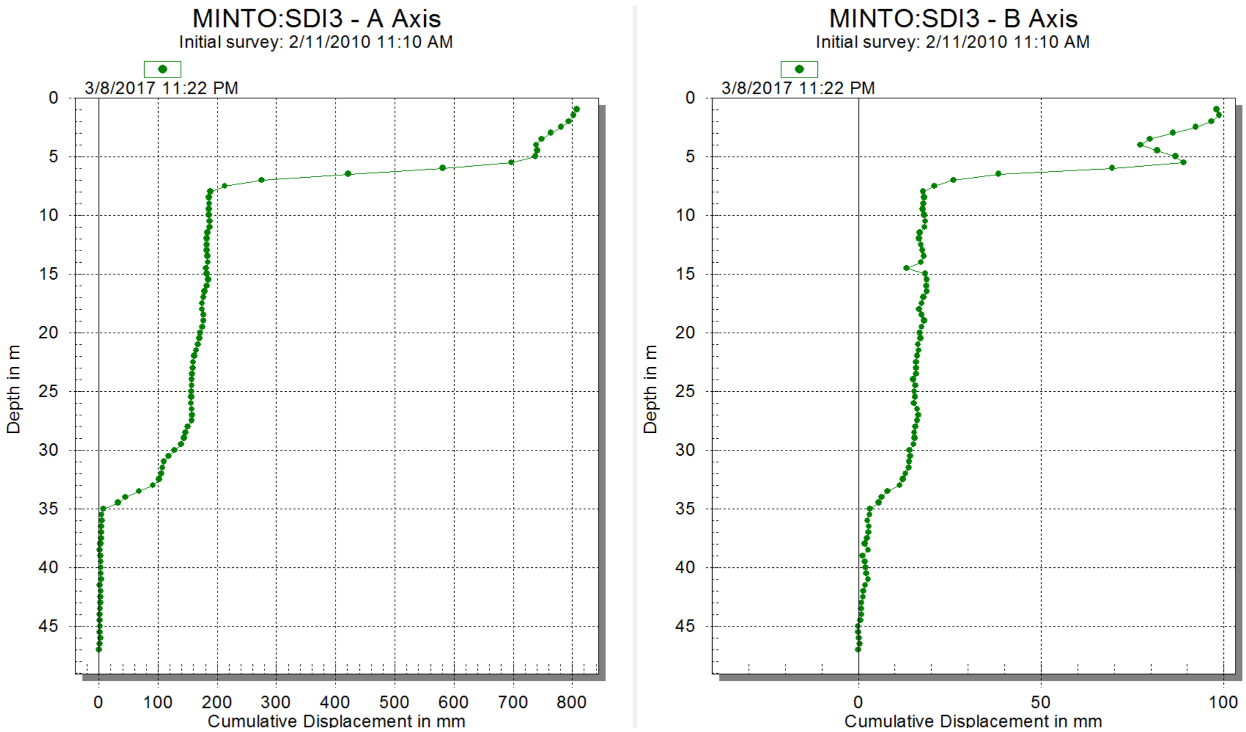


Figure 9-12: Main Pit Inclinometer SDI-3 (2016)

9.2 Engineer's Annual Physical Inspection Reports

As required by the WUL and QML, the following structures are inspected semi-annually by Minto's geotechnical engineer and annually by an external geotechnical engineering consultant:

- Big Creek Bridge;
- Mill and camp site;
- Dry Stack Tailings Storage Facility and Mill Valley Fill Extension (Stage 1 and 2);
- Fuel containment facility;
- Main Waste Dump;
- Ore stockpiles;
- Reclamation Overburden Dump;
- Ice Rich Overburden Dump;
- South Diversion Ditch;
- Tailings Diversion Ditch
- Southwest Waste Dump;
- Main Pit including South Wall Buttress and In-Pit Dumps;
- Water Storage Dam;
- Area 118 and Area 2 Pit; and,
- Minto North Pit.

Table 9-1 summarizes the recommendations from the most recent external inspection in August 2016 and the associated planned actions. All actions from previous inspections have been closed.

Table 9-1: Annual Physical Inspection Report Summary (2016)

Area	Recommendation	Action
DSTSF/MVFE2	Additional survey hubs and inclinometers within the DSTSF and MVFE are planned. Some of this instrumentation, including at least one inclinometer near toe of the MVFE Stage 2 (near MV1), should investigate the cause of the observed movement.	All survey hubs replaced upon construction completion in August 2016. Three inclinometers installed in December 2016 and January 2017.
SWD	The remainder of the survey hubs that have heaved should be replaced.	Survey hub replacement to be completed prior to freshet.
	Surveys of the crack and depression locations should be compared to past dump surfaces to complement the assessment of the source/cause of the cracking (e.g. edge of historical waste rock bench?)	Survey of cracks completed in September 2017. Assessment of source/cause to be completed by August 2017.
Mill Site	The 'falling rocks' warning sign adjacent to the Seacans is small and easy to miss. A larger sign should be placed with an additional warning sign	Additional and larger signage installed in June 2016. Monitoring, including photographs, is carried out semi-annually as part of the site

Area	Recommendation	Action
	recommended at the opposite end near the Electrician Shop.	geotechnical inspections. No major changes have been observed.
	Continue to monitor the retaining wall near the mill's apron feeder tunnel and maintain a photographic record of its condition.	Monitoring of retaining wall already apart of the Mill Site inspection carried out bi-annually.
Camp Site	Continue to monitor the erosion channels to ensure the remedial measures have been effective.	Monitoring of erosion channels already apart of the Camp Site inspection carried out bi-annually.
SDD	Clean the overflow spillway on both sides of the access road.	Completed summer 2016.
WSP Dam	Continue regular monitoring of the dam as per the OMS Manual.	Monitored during monthly inspections as per OMS Manual.
South Wall Buttress / In Pit Dump	M84 should be monitored on a minimum weekly basis during periods of active construction of the SAT Dump located to the north of the In-Pit dump.	M84 has been monitored on a weekly basis since August 12, 2016
	Visual inspections of the In-Pit Dump above the SAT dump should be incorporated into the daily visual inspections that occur when SAT material is being placed in the SAT Dump.	Inspection of In-Dump has been incorporated into the SAT Dump inspections since July 2016.
	An extensometer should be installed across the main crack to monitor displacement.	Extensometer installed across cracking on August 23, 2016.
	The crack endpoints should continue to be spray painted in order to monitor potential crack propagation.	Monitoring of cracks propagation by marking with spray paint is already a standard procedure for Geotechnical staff.
	Continue to limit access to the In-Pit Dump area near M84.	Access to the In-Pit Dump has been restricted since August 2016.
Minto North Pit	Continue monitoring as per the Minto Ground Control Plan.	Monitored as per the Minto Ground Control Plan. Pit completed October 2016.

10 Adaptive Management Plan - Operations

The Operations Adaptive Management Plan has been in use since WUL QZ14-031 became active. The Adaptive Management Plan – December 2015 (AMP Dec.2015) was the EMR approved plan for the 2016 year. There was no approved plan under the WUL. Multiple revisions to the AMP were proposed in 2016, and have been submitted and approved in early 2017.

The comparative tables for the adaptive management stations and associated levels are included in the monthly WUL reports. For 2016 the monthly reports provided the exceedances of AMP Dec.2015 and also provided a comparison to the proposed AMP 2016-01 for informational purposes.

A summary of the approved AMP Dec.2015 exceedances is included in the sections below.

10.1 Surface Water Quality – Minto Creek

There were no triggers of the AMP in January, February, March, November or December.

10.1.1 Minto Creek – W2

A summary of the W2 exceedances of the AMP are discussed below.

Aluminum and chromium - April 12th there was an exceedance of the expected case water quality by dissolved aluminum and chromium which triggered the AMP. The comparative examination of the results from W3 indicated mine loadings were not responsible for the exceedance. No further action was required.

Molybdenum - There was an exceedance of the worst case water quality prediction for dissolved Molybdenum on May 25, 2016. This was an on-going exceedance, although not always consecutive, throughout the sampling season. Levels returned to below the worst case water quality prediction value in October. Dissolved Molybdenum concentrations remained well below the WQOs for W2 in 2016, and was about times lower than the CCME recommended guideline for the protection of freshwater aquatic life. Another important item to note is there are no upward trends for this parameter. In August the Mo-D investigation was conducted, AMP1 - Molybdenum Investigation, the report was submitted to the inspector and to SFN. Mo-D will continue to be monitored but no further investigation will occur unless there is an increased level equivalent to half the CCME guideline for the protection of aquatic life (0.0365 mg/L).

Zinc - The worst case predicted value for dissolved zinc on September 6th was exceeded (sample result - 0.0075 mg Zn/L) in one sample, but was below the detectable limit in the duplicate sample. The investigation protocol was initiated. The lab was contacted and the sample was retested for dissolved zinc. The retests showed a variance from the original result (Retest#1: 0.0051 mg/L and Retest#2: 0.0064 mg/L); however, this range of variance is within the lab's qa/qc limits and therefore no data modification will be made to the final certificate of analysis. The mine has determined that this is not a true exceedance of the predicted worst case WQ, due to the retest values and the below detectable duplicate sample. This was an isolated event that did not trigger the AMP specific threshold.

Nitrates - The expected case predicted value for nitrate was exceeded for the sample collected on October 18, 23, & 24th. This triggered the AMP Specific Threshold 1 and subsequently Specific Threshold 2 and the AMP response plan was initiated. Samples collected before this exceedance and following did not exceed the expected case concentration for nitrates. This 3-week period of slightly elevated nitrate concentrations is reflective of the increased discharge from the WSP during the winter condition release. Samples collected Nov.1st and 11th indicated that the concentration of nitrates has returned to below the expected case levels. The short timeframe and levels that did not exceed the predicted worst case concentrations is not expected to negatively impact the creek. Recommendations for future discharge events during frozen conditions include: daily in-house monitoring of nitrates, and running trend analysis to ensure the elevated levels are stable and not trending upwards.

10.1.2 Minto Creek – W50

Minto monitored the specific performance thresholds for surface water quality in Minto Creek at WQO station W50 after October 10, 2016. All samples collected after October 10th, 2016 at W50 met the WQO. No adaptive management was required.

10.2 Surface Water Quality – McGinty creek

Minto monitored the specific performance thresholds for surface water quality in McGinty Creek. No adaptive management was required during 2016.

10.3 Groundwater Quality – Minto Creek

Various exceedances of AMP levels triggered a review of the groundwater data by the qualified professional. All groundwater data was forwarded to SRK Consulting for review and recommendations. See Appendix J, *2016 AMP Groundwater SRK Memo,* for details.

10.4 Groundwater Quality - McGinty Creek

Minto monitored the specific performance thresholds for McGinty Creek groundwater. No adaptive management was required during 2016.

10.5 Water Management AMP

Water storage capacity in the Main Pit Tailings Management Facility and the Area 2 Pit Tailings Management Facility exceeded 1,000,000 m^3 during the operational period and as such, no responses from the adaptive management plan were applied.

10.6 Physical Monitoring Program AMP

The results of the Physical Monitoring Program are compared to the thresholds set out in the 2016 Adaptive Management Plan (AMP) on a weekly basis by the Geotechnical EIT. Table 10-1 and Table 10-2 below, summarize the threshold statuses for the Category 1 and Category 2 facilities.

Category 1 facilities are those found in areas of ice-rich periglacial foundations that have previously experienced deep seated foundation movement and include the Dry Stack Tailings Storage Facility, Mill Valley Fill Extension (Stages 1 and 2), Southwest Waste Dump, and South Wall Buttress/Main Pit Dump. Category 2 facilities are all other waste rock dumps, including the Main Waste Dump and Main Waste Dump Expansion, Reclamation Overburden Dump, and Ice-rich Overburden Dump.

Table 10-1: Category 1 Facilities – Threshold Status, December 2016

Specific Performance Thresholds	Thresholds Exceeded	Response
Specific Threshold 1 • Observation of unusual occurrence including: • tension cracks, settlement, or sloughing; • a seismic event that exceeds the 1:475 return period event; • abnormal seepage from any area of the slopes; • increased turbidity from seepage; • Physical damage.	In-Pit Dump	Tension cracking and settling has propagated for several years across the in-pit dump. The engineer of record (SRK) has reviewed and determined that the cracking is not a stability concern for the buttress. Current conditions: tension cracking is obscured by snow.
Specific Threshold 2 One survey hub or inclinometer reading indicating an increase in the movement rate greater than the long-term trend and outside the range of instrumentation error.	M82, M84	April 2016: Main Pit survey hubs M82 and M84 showing increase in long-term trend. SRK notified. M84 reading frequencies initially increased to daily, and have since been reduced to weekly. Inspections of the area daily during SAT dump construction. Current conditions: movement rates for both hubs have decreased back to the long-term trend.

Specific Performance Thresholds	Thresholds Exceeded	Response
Specific Threshold 3 For DSTSF and MVFE piezometers 13-DSP-05a, 13-DSP-06, 15-DSP-07, and 15-DSP-08, an increase in piezometric pressures under unfrozen or thawing conditions such that Ru exceeds 0.4. For MVFE2 piezometer 15-DSP-10, an increase in piezometric pressures under unfrozen or thawing conditions such that the equivalent water elevation is 3 m above the original ground surface. Or Temperature greater than zero at a depth of 2 m below original ground (all SWD ground temperature cables, and DSTSF ground temperature cables DST-10, DST-11, and DST-14 only)	DSP-07 (2, 3, 4 and 5)	December, 2015: DSP-07 has displayed Ru values higher than 0.4 for sensors 2, 3, 4 and 5 since installation. This piezometer is outside the MVFE2 footprint and is not considered a stability concern. Reading frequency was increased to every two weeks (from monthly). High initial values may have been due to grout curing. Current conditions: no change, readings have been slowly increasing.
	DSP-08 (1)	April, 2016: DSP-08 displayed Ru values higher than 0.4 for sensor 1 (@5m depth). The design engineer was notified. No instability was noted during inspections. Reading frequency was increased to bi-weekly (from monthly), and increased to daily while dumping in the immediate vicinity. Current conditions: Ru value is still >0.4, however, has been decreasing since June 30, 2016.
	DSP-08 (2, 3, 5 and 6)	May 31, 2016: An additional spike was noted on sensors 2, 3, 5 and 6. Again, the design engineer was notified and no instability was noted on inspection. Sensor 5 has since dropped to below the 0.4 threshold. Current conditions: no change, readings have been slowly increasing.
	DSP-10	DSP-10 has displayed a water elevation >1m above ground surface depth since March 8th, 2016. The design engineer was contacted, and reading frequencies were immediately increased to weekly. Reading frequency was further increased to daily on March 14. On Sept 1, 2016 reading frequency was reduced to weekly, see response to Specific Threshold 4 for more details. Current conditions: equivalent water level is >3m.

Specific Performance Thresholds	Thresholds Exceeded	Response
Specific Threshold 4 For DSTSF and MVFE piezometers 13-DSP-05, 13-DSP-06, 15-DSP-07, and 15-DSP-08, an increase in piezometric pressures under unfrozen or thawing conditions such that Ru exceeds 0.6. For MVFE2 piezometer 15-DSP-10, an increase in piezometric pressures under unfrozen or thawing conditions such that the equivalent water elevation is 10 m above the original ground surface.	DSP-07 (2 and 3)	February 3, 2016: DSP-07 sensors 2 and 3 are above the 0.6 threshold. This piezometer is outside the MVFE2 footprint and is not considered a stability concern. Current conditions: no change, readings have been slowly increasing.
	DSP-08 (1)	April 29. 2016: DSP-08 sensor 1 is above 0.6 threshold. Review of conditions by the Geotechnical EIT and engineer of record, SRK Consulting. Conditions have stabilized. Construction complete, inspections reduced to monthly. Reading frequency maintained at bi-weekly. No stability concerns identified. Current conditions: Ru value is still >0.6, however, has been decreasing since June 30, 2016.
	DSP-08 (2)	July 1, 2016: DSP-08 sensor 2 is above 0.6 threshold. Review of conditions by the Geotechnical EIT and engineer of record, SRK Consulting. Conditions have stabilized. Construction complete, inspections reduced to monthly. Reading frequency maintained at bi-weekly. No stability concerns identified. Current conditions: no change, readings have been slowly increasing.

Specific Performance Thresholds	Thresholds Exceeded	Response
	DSP-10	DSP-10 has displayed an equivalent water level >3m above ground surface depth since April 1st, 2016. Summary of actions below: April 1: Design engineer notified. Inspection frequency increased to daily. Dumping on the lower tier was suspended. April 4: Two survey hubs were installed on the eastern slope to monitor for movement with a daily reading frequency. April 5: The lower tier was re-opened for dumping after stabilization of piezometer values. Going forward, piezometer data was reviewed prior to dumping each subsequent lift. May 3: Inspections were reduced to weekly, with a daily review of monitoring data. When working along the eastern edge of the final lift, a daily inspection was conducted. August 25: Survey hub reading frequency reduced to weekly as construction was complete. Sept 1: Piezometer reading frequency was reduced to weekly as the data had stabilized and construction was complete. Once the facility construction was complete, the inspections were reduced back to monthly. Piezometer readings remain on a weekly schedule. Current conditions: equivalent water level is >10m.
Specific Threshold 5 Three consecutive survey hub or inclinometer readings indicating an increase in the movement rate movement greater than the long-term trend. Or Three consecutive survey hub readings indicating a change in horizontal direction of movement greater than 15 degrees from the long term trend.	M82, M84	April 2016: Main Pit Dump survey hubs M82 and M84 showing increase in long-term trend. SRK notified. M84 reading frequencies initially increased to daily, and have since been reduced to weekly. Inspections of the area daily during SAT dump construction. Current conditions: movement rates for both hubs have decreased back to the long-term trend.

Specific Performance Thresholds	Thresholds Exceeded	Response
	M81, M82, M83, M84	M81, M82, M83 and M84 have all displayed a change in horizontal movement greater than 15 degrees from the long term trend. These directional changes occurred in January 2013 (M81), April 2016 (M82 and M83) and May 2016 (M84). Inspection of all hubs conducted with no change in conditions noted. Reading frequency increased to weekly. Current conditions: no further change in the direction of movement observed.
	SWD-06	SWD-06 has displayed a change in horizontal movement greater than 15 degrees from the long term trend. This directional changed occurred in September, 2016. An inspection was conducted, and the change is likely due to differential settlement of the hub during spring thaw. Current conditions: no further change in the direction of movement observed.

Table 10-2: Category 2 Facilities – Threshold Status, December 2016

Specific Performance Thresholds	Thresholds Exceeded	Response
Specific Threshold 1 • Observation of unusual occurrence including: • tension cracks, settlement, or sloughing; • a seismic event that exceeds the 1:475 return period event; • abnormal seepage from any area of the slopes; • increased turbidity from seepage; • physical damage.	MWD	1m-deep depression formed in May 2016 in on the 905m-elevation pad of the MWD, currently being used as a POX stockpile. No bulging noted at toe and no other stability concerns noted. Monthly inspections continued during active MWDE construction. MDI-2 showing no change in trend. Current conditions: no further changes observed. MWDE construction is now complete and progressive reclamation activities are underway.
Specific Threshold 2 **WSP Dam:** One survey hub reading indicating an increase of movement outside range of instrumentation error. **All other Category 2 Facilities:** Survey hub cumulative displacements between 150 mm and 500 mm.	None	N/A
Specific Threshold 3 **WSP Dam:** One piezometer reading outside of its long-term trend (in comparison to the reservoir pond elevation). **All other Category 2 Facilities:** Survey hub cumulative displacements greater than 500 mm.	None	N/A
Specific Threshold 4 **WSP Dam:** Three consecutive survey hub readings indicating increase in movement outside range of instrumentation error.	None	N/A

11 Aquatic Environmental Monitoring Program

The Aquatic Environmental Monitoring Program (AEMP) is composed of Minto's requirements under the MMER and biological monitoring of sediment, benthic invertebrates, fish and fish habitat. Monitoring under the MMER is presented in Section 11.1 and the AEMP sediment, benthic invertebrates, fish and fish habitat is presented in Section 11.2.

11.1 Metal Mine Effluent Regulations Monitoring Programs

The Metal Mine Effluent Regulations (MMER) outline requirements for monitoring and reporting of discharged effluent volume and quality under the MMER to Environment Canada. Details of the Metal Mine Effluent Program, including sampling station locations and monitoring frequency, are outlined in the EMSRP and the results are submitted on a quarterly and annual basis to Environment Canada.

11.1.1 Effluent Monitoring Program

The MMER Program requires effluent monitoring and sampling at the final discharge point (FDP) station W3, downstream of the end of pipe discharge. The W3 sampling station is collected when there is a deposit of water at W3; testing occurs weekly for deleterious substances.

Weekly effluent monitoring samples are tested for the deleterious substances as described in the MMER including the total metals arsenic, copper, lead, nickel and zinc; total suspended solids (TSS) and pH. Weekly samples are collected at least 24 hours apart and not more than 7 days apart. Minto is striving for consistency and has internally set Tuesdays as the sampling day for MMER.

Radium 226 and acute lethality tests are conducted quarterly due to the reduced frequency guidelines outlined in the MMER.

The Effluent Monitoring Program results are submitted to Environment Canada quarterly and are presented in Appendix K.

11.1.2 Environmental Effects Monitoring Water Quality Monitoring

The EEM Water Quality Monitoring Program is designed to characterize water quality in the exposure area (W3) surrounding the point of entry of effluent and compares the results to those in reference (un-impacted) areas. Water quality samples must be collected four times a year, not less than one month apart, while the mine is discharging effluent at the Final Discharge Point (FDP) of W3. Samples are collected at the exposure area (W3), receiving environment station (W2) and reference station (W7). Effluent toxicity testing is required annually using a total of four tests; one each of a fish, invertebrate, algae and plant species.

The EEM Water Quality Monitoring Program results submitted to Environment Canada annually, are presented in Appendix K.

11.1.3 Environmental Effects Monitoring Biological Monitoring

The EEM Biological Monitoring Program outlines fish population, fish tissue and benthic invertebrate tests conducted under Schedule 5, Part 2 of the MMER. Minto Mine has submitted the results of three study designs with the last study design taking place in 2014. In 2015, Minto prepared the Phase 4 EEM Study Design Report. In 2016 Minto prepared and conducted the fourth study, the analysis and reporting of this study data is currently underway.

11.2 Biological Monitoring Program

Clause 71 and 72 of the WUL requires an Annual Biological Monitoring Program that includes monitoring of sediment, periphyton, benthic invertebrates, fish and fish habitat. The following sections summarize the monitoring programs and more detailed reports can be found in Appendix L and Appendix M. Appendix L contains information with respect to the sediment, periphyton, and benthic invertebrate monitoring programs and Appendix M contains information relative to the fish monitoring programs.

11.2.1 Sediment Monitoring Program

The objectives of the sediment monitoring program were to characterize particle size, total organic carbon content and concentrations of metals, metalloids and nutrients in sediments. A 10 day *Chironomus dilutus* and a 14 day *Hyalella azteca* sediment toxicity test were conducted in 2016 to evaluate survival and growth. Sediments collected in 2016 were largely composed of fine particles in the silt and sand size categories (Table 11-1). Mean total organic carbon (TOC) content of sediment collected from upper Minto Creek (3.4%) and lower Minto Creek (6.2%) were lower than the comparable reference areas - upper McGinty Creek (5.3%) and lower Wolverine Creek (6.6%), respectively (Table 11-1). Arsenic and copper were the only analytes with mean concentrations greater than Interim Sediment Quality Guidelines for the protection of aquatic life (ISQG; CCME 1999) in an effluent-exposed area (upper and/or lower Minto Creek; Table 11-1). However, mean arsenic concentrations in upper Minto Creek was below ISQG and lower than the reference area, upper McGinty Creek (which was greater than ISQG). This suggests that arsenic concentrations were not mine-related. Mean copper concentrations in lower Minto Creek were greater than the ISQG and mean copper concentrations at upper Minto Creek were above the Probable Effect Level (PEL). Both areas had higher concentrations than the corresponding reference areas, which were lower than the ISQG (Figure 11-1). With progression from upper to lower Minto Creek, sediment copper concentrations decreased from a mean of 216 to 72 mg/kg, respectively, indicating improvement with distance downstream. Due to the predominantly erosional habitat in upper Minto Creek, there are few areas where sediment is deposited and even this occurs only in small quantities that likely wash away each year during freshet. Therefore, elevated sediment copper in fine sediment in the upper reaches of Minto Creek may be of limited importance in terms of exposure and potential effects to biota. In lower Minto Creek, fine sediment deposits are somewhat more common and therefore more relevant to aquatic life. Both sediment toxicity tests indicated no adverse effects to survival or growth in lower Minto Creek sediment when compared to the laboratory control and the field reference (lower Wolverine Creek).

These results continue to indicate no adverse effects associated with lower Minto Creek sediment and were similar to previous toxicity testing in 2011 and 2015 (Minnow 2012, Minnow 2016).

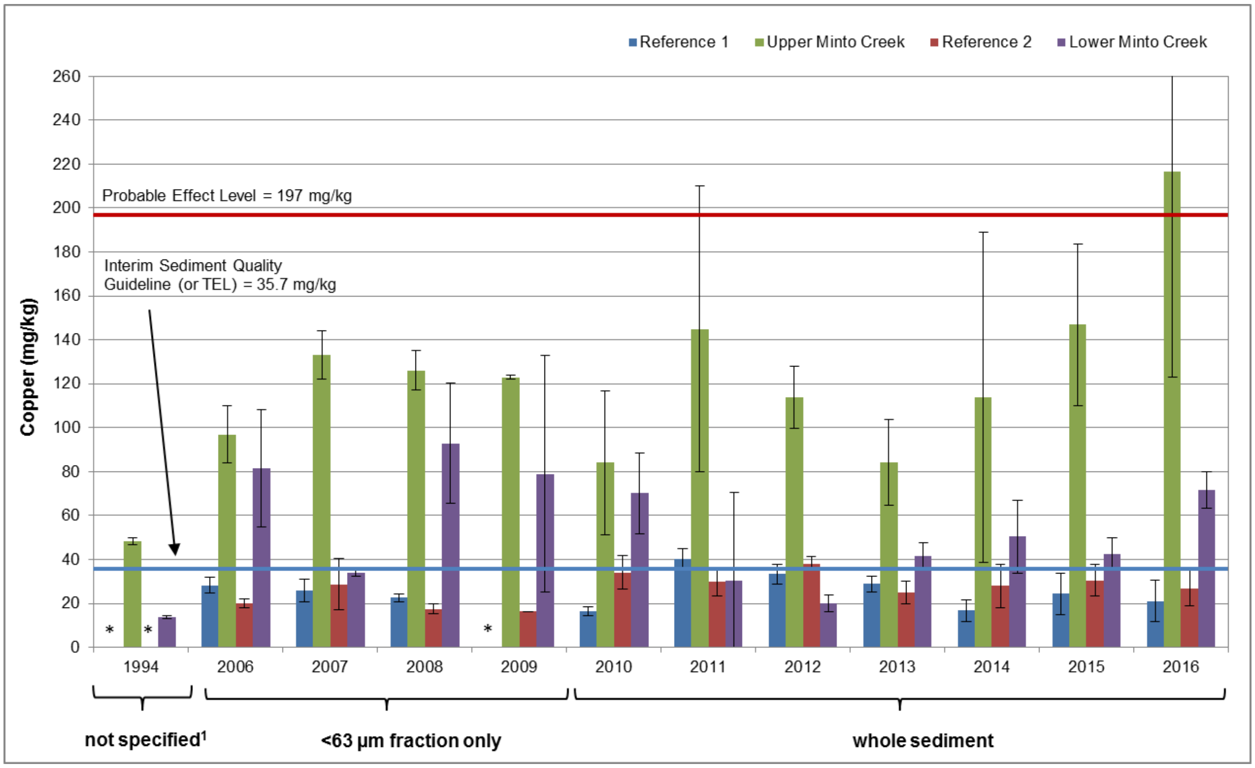
Table 11-1: Sediment Chemistry Data Collected at Exposed and Reference Areas, Minto Mine (2016)

	Analytes	Units	CSQG [1]		Upper McGinty Creek (Reference)				Upper Minto Creek (Exposure)				Lower Wolverine Creek (Reference)				Lower Minto Creek (Exposure)			
			ISQG	PEL	Mean	Standard Deviation	Minimum	Maximum	Mean	Standard Deviation	Minimum	Maximum	Mean	Standard Deviation	Minimum	Maximum	Mean	Standard Deviation	Minimum	Maximum
Particle size, TKN, carbon analytes and pH	Loss on Ignition	%	-	-	14	7.8	3.0	20	8.8	3.8	5.0	15	15	6.5	4.0	21	13	3.3	8.0	17
	pH (1:2 soil:water)	pH units	-	-	6.97	0.44	6.54	7.58	7.58	0.07	7.51	7.66	6.99	0.24	6.76	7.37	8.03	0.04	7.97	8.07
	% Gravel (>2mm)	%	-	-	-	-	-	-	-	-	-	-	2.0	2.2	< 1.0	6.0	< 1.0	-	< 1.0	< 1.0
	% Sand (2.0mm - 0.063mm)	%	-	-	-	-	-	-	-	-	-	-	31	22	8.6	58	31	6.7	22	38
	% Silt (0.063mm - 4um)	%	-	-	-	-	-	-	-	-	-	-	61	21	32	80	61	4.7	55	67
	% Clay (<4um)	%	-	-	-	-	-	-	-	-	-	-	6.7	3.1	3.7	12	8.7	2.5	4.8	11
	Total Kjeldahl Nitrogen	%	-	-	0.30	0.17	0.073	0.50	0.23	0.072	0.13	0.28	0.35	0.15	0.10	0.49	0.38	0.11	0.22	0.51
	Inorganic Carbon	%	-	-	0.16	0.080	0.072	0.29	0.17	0.029	0.15	0.22	0.16	0.051	0.077	0.20	0.26	0.068	0.17	**0.35**
	Inorganic Carbon (as CaCO3 Equivalent)	%	-	-	1.4	0.67	0.60	2.4	1.4	0.24	1.2	1.8	1.3	0.43	0.6	1.7	2.2	0.57	1.4	**2.9**
	Total Carbon by Combustion	%	-	-	5.5	3.1	1.4	10	3.5	1.3	2.2	4.9	6.8	3.0	1.8	9.2	6.5	1.8	3.7	8.8
	Total Organic Carbon	%	-	-	5.3	3.0	1.3	9.3	3.4	1.3	2.0	4.8	6.6	2.9	1.7	9.0	6.2	1.8	3.5	8.5
Total Metals	Aluminum (Al)	mg/kg	-	-	10,530	3,996	4,800	15,500	12,240	1,203	10,600	13,400	12,824	2,743	8,020	14,800	14,720	1,219	12,600	15,700
	Antimony (Sb)	mg/kg	-	-	0.39	0.14	0.19	0.56	0.51	0.058	0.45	0.59	0.43	0.084	0.28	0.49	0.59	0.065	0.48	0.65
	Arsenic (As)	mg/kg	5.9	17	7.2	1.9	4.6	10	5.9	0.33	5.5	6.3	6.3	1.4	4.8	8.2	8.8	1.0	7.1	9.7
	Barium (Ba)	mg/kg	-	-	207	77	100	309	225	38	181	266	194	55	97	235	289	40	221	321
	Beryllium (Be)	mg/kg	-	-	0.34	0.12	0.17	0.48	0.48	0.042	0.41	0.52	0.73	0.16	0.45	0.83	0.53	0.053	0.44	0.57
	Bismuth (Bi)	mg/kg	-	-	< 0.20	-	< 0.20	< 0.20	< 0.20	-	< 0.20	< 0.20	< 0.20	-	< 0.20	< 0.20	< 0.20	-	< 0.20	< 0.20
	Boron (B)	mg/kg			< 5.0	-	< 5.0	< 5.0	< 5.0	-	< 5.0	< 5.0	< 5.0	-	< 5.0	< 5.0	< 5.0	-	< 5.0	< 5.0
	Cadmium (Cd)	mg/kg	0.60	3.5	0.16	0.072	< 0.050	0.24	0.27	0.078	0.18	0.37	0.23	0.082	0.086	0.29	0.26	0.054	0.17	0.32
	Calcium (Ca)	mg/kg	-	-	7,906	2,407	3,840	10,200	8,944	1,145	7,460	10,400	10,078	2,645	5,490	12,300	13,120	1,445	10,600	14,200
	Chromium (Cr)	mg/kg	37	90	22	9.6	7.7	34	28	1.7	26	30	43	9.3	26	49	36	2.2	32	38
	Cobalt (Co)	mg/kg	-	-	9.1	2.8	4.5	12	11	0.87	9.8	12	12	2.0	9.1	14	12	1.1	10	13
	Copper (Cu)	mg/kg	36	197	21	9.5	7.2	33	**216**	93	**97**	**334**	27	7.9	13	32	**72**	8.4	**57**	**78**
	Iron (Fe)	mg/kg	-	-	23,840	7,534	12,700	31,300	25,380	1,386	23,800	26,800	27,080	4,070	20,500	30,600	29,700	1,899	26,400	30,900
	Lead (Pb)	mg/kg	35	91	4.6	1.6	2.2	6.5	6.3	0.58	5.8	7.0	6.0	1.2	3.8	6.9	6.8	0.42	6.1	7.1
	Lithium (Li)	mg/kg	-	-	6.9	2.2	3.6	9.5	8.7	0.92	7.5	9.5	9.6	1.9	6.4	11	12	0.86	10	12
	Magnesium (Mg)	mg/kg	-	-	3,846	1,197	1,920	5,130	6,636	518	5,980	7,140	8,220	1,345	5,860	9,090	7,246	544	6,300	7,640
	Manganese (Mn)	mg/kg	-	-	558	195	422	897	**2,336**	778	**1,370**	**3,280**	485	184	300	776	**1,485**	335	977	**1,830**
	Mercury (Hg)	mg/kg	0.17	0.49	0.055	0.027	0.015	0.087	0.043	0.010	0.029	0.050	0.086	0.046	0.024	0.15	0.077	0.023	0.054	0.11
	Molybdenum (Mo)	mg/kg	-	-	0.52	0.072	0.44	0.61	**2.1**	0.68	**1.2**	**2.7**	0.54	0.068	0.46	0.63	0.83	0.11	0.66	0.94
	Nickel (Ni)	mg/kg	-	-	16	5.7	7.3	23	28	2.3	25	31	35	6.2	24	38	31	3.0	25	32
	Phosphorus (P)	mg/kg	-	-	785	218	425	954	931	46	851	965	1,030	138	859	1,150	918	48	864	973
	Potassium (K)	mg/kg	-	-	690	223	370	930	1,648	243	1,300	1,920	984	161	720	1,130	1,450	114	1,250	1,520
	Selenium (Se)	mg/kg	-	-	0.48	0.17	0.22	0.66	0.67	0.27	0.39	**1.0**	0.39	0.11	< 0.20	0.47	0.82	0.20	0.53	**1.1**
	Silver (Ag)	mg/kg	-	-	0.10	0.0045	< 0.10	0.11	0.14	0.035	< 0.010	0.18	0.11	0.0084	< 0.10	0.12	0.13	0.018	< 0.10	0.14
	Sodium (Na)	mg/kg	-	-	203	63	111	265	353	13	335	370	421	30	386	447	340	20	306	358
	Strontium (Sr)	mg/kg	-	-	66	21	34	90	98	16	78	117	99	28	51	122	122	16	95	138
	Thallium (Tl)	mg/kg	-	-	0.069	0.020	< 0.050	0.096	0.096	0.012	0.081	0.11	0.086	0.0070	< 0.050	0.094	0.11	0.011	0.095	0.12
	Tin (Sn)	mg/kg	-	-	< 2.0	-	< 2.0	< 2.0	< 2.0	-	< 2.0	< 2.0	< 2.0	-	< 2.0	< 2.0	< 2.0	-	< 2.0	< 2.0
	Titanium (Ti)	mg/kg	-	-	582	181	315	780	735	29	699	769	800	84	680	916	715	24	689	749
	Uranium (U)	mg/kg	-	-	1.2	0.40	0.48	1.5	1.2	0.29	0.90	1.6	2.8	1.0	1.1	3.4	1.3	0.17	1.1	1.5
	Vanadium (V)	mg/kg	-	-	47	13	27	63	57	1.6	55	59	65	7.4	53	71	61	2.2	57	62
	Zinc (Zn)	mg/kg	123	315	41	14	20	56	68	10	54	78	53	8.5	39	59	63	5.4	54	67

Indicates sediment concentration exceeding CSQG ISQG. (blue)
Indicates sediment concentration exceeding CSQG PEL. (green)
Bold Indicates sediment concentration exceeding the higher reference mean by more than two times.

[a] If value was < method detection limit (MDL), summary statistics were calculated using 1x MDL (i.e. if result was < 0.048, summary statistics were calculated using the value 0.048).

[1] Canadian Sediment Quality Guidelines - ISQG = interim sediment quality guideline; PEL = probable effect level (CCME 1999).

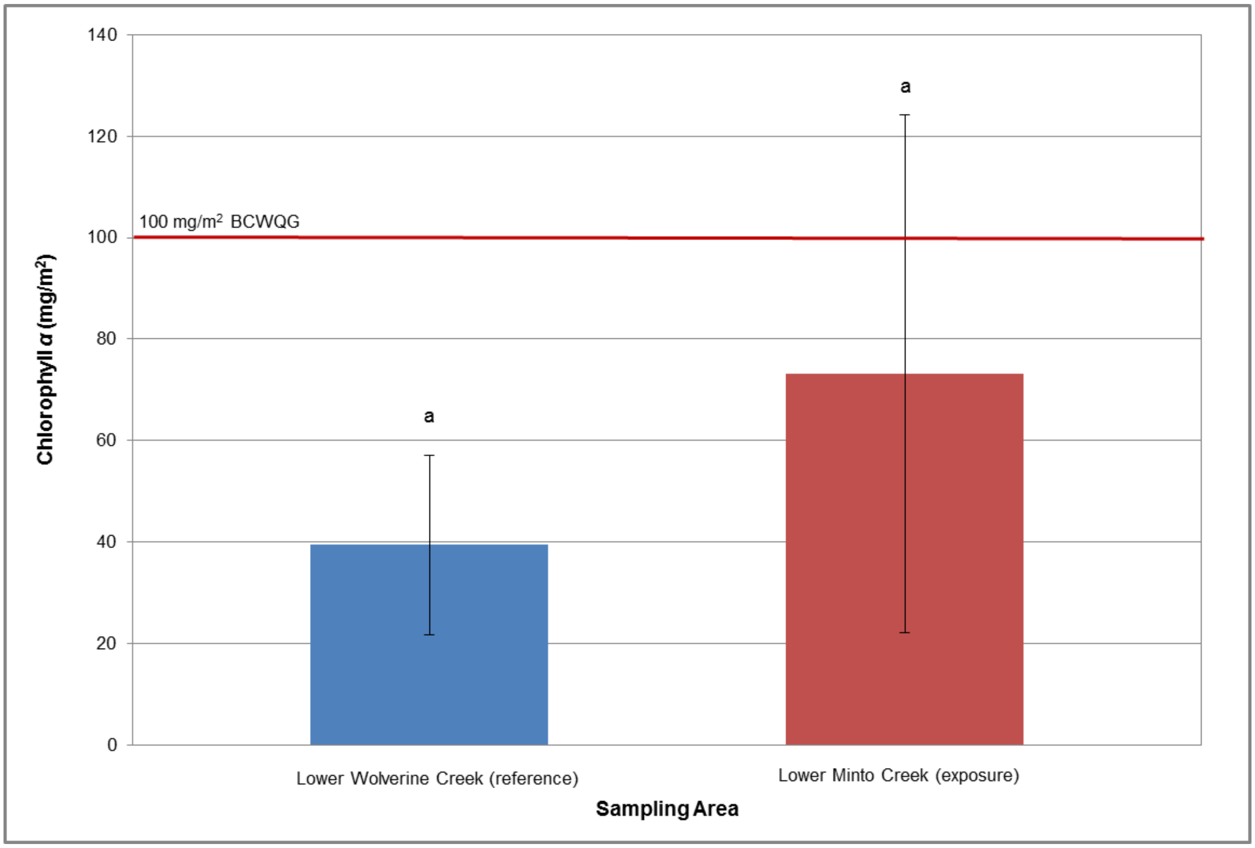


Reference 1 = Station W6 (south-flowing tributary) in 2006 to 2008 and McGinty Creek in 2010 to 2015; Reference 2 = Station W7 (north-flowing tributary) in 2006 to 2009 and Wolverine Creek in 2010 to 2015; * = no data. TEL = Threshold Effect Levels. [1] Methods were not specified, fine sediment was collected in triplicate in the mainstem of Minto Creek (HKP 1994)

Figure 11-1: Mean Copper Concentrations in Sediment Collected in Minto Creek and Reference Locations (mean ± standard deviation) (1994-2015)

11.2.2 Periphyton and Chlorophyll a Monitoring

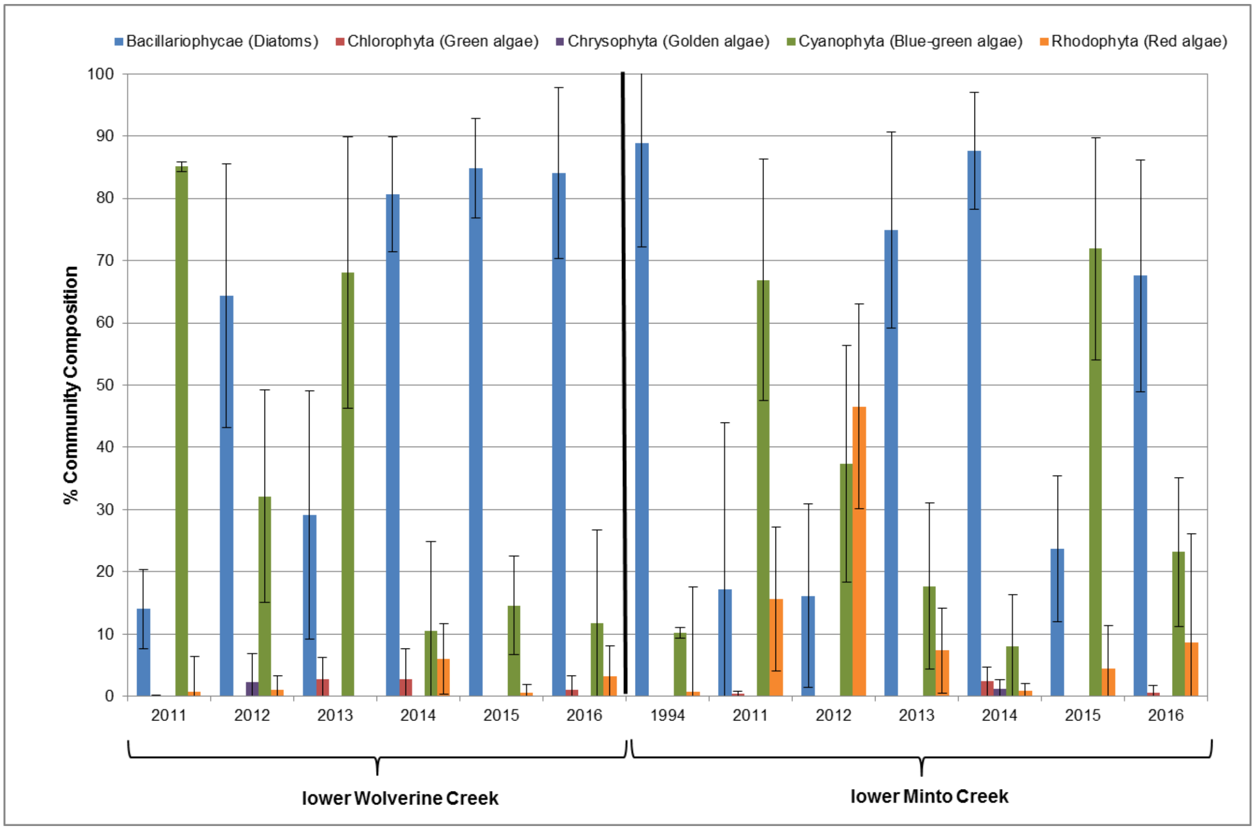
Periphyton production and community data were collected at lower Minto Creek and lower Wolverine Creek. Productivity was assessed through measurements of chlorophyll α in periphyton (used as a surrogate for the productivity of photosynthetic organisms). Concentration of chlorophyll α in periphyton was higher at lower Minto Creek than at lower Wolverine Creek but not significantly (Figure 11-2). Mean chlorophyll α concentrations at both areas were below the British Columbia Water Quality Guideline (BCWQG) of 100 mg/m^2 for the protection of aquatic life (BCMOE 1985). In previous years, production of both creeks were classified as low (oligotrophic) based on the classification system of Dodds et al. (1998), which sets the oligotrophic-mesotrophic boundary for benthic chlorophyll α at 20 mg/m^2. Production in September 2016 was classified as eutrophic at lower Minto Creek (73 mg/m^2) and mesotrophic at lower Wolverine Creek (39 mg/m^2). Based on only total phosphorus, both creeks would be defined as oligotrophic as was observed in previous years (Dodds et al. 1998). While sampling it was noted that periphyton was more plentiful than in previous years. Since total phosphorus in water did not exceed guidelines and chlorophyll α was high at both areas, higher levels chlorophyll α could be related to natural variability (e.g., low flow) of periphyton production.



*Different letters represent significant differences between sites.

Figure 11-2: Mean chlorophyll α in periphyton from lower Wolverine Creek and lower Minto Creek (mean ± standard deviation), Minto Mine WUL, 2016.

The periphyton community of lower Minto Creek was evaluated and compared to that of lower Wolverine Creek in order to evaluate any potential mine-related effects. Dominant phyla in lower Minto and Wolverine creeks were Bacillariophycae (diatoms) and Cyanophyta (blue-green algae). Bacillariophycae were dominant at lower Minto Creek (68% of community) and lower Wolverine Creek (84% of the community). Temporal variability in community composition has been high in both exposure and reference areas (Figure 11-3). For example, at lower Minto Creek, Bacillariophycae were dominant in 1994, 2013, 2014, 2016; Rhodophyta (red algae) in 2012 and Cyanophyta in 2011, 2015 (Figure 11-3). This lack of temporal consistency was also observed at lower Wolverine Creek, with Cyanophyta dominant in 2011 and 2013 and Bacillariophycae in 2012, 2014-2016 (Figure 11-3; Minnow 2013; 2014, 2015, 2016).



Data presented as mean ± standard deviation

Figure 11-3: Periphyton community composition in Lower Minto Creek (1994, 2011-2016) and lower Wolverine Creek (2011-2016).

Data presented as mean ± standard deviation, Minto Mine WUL, 2016.

11.2.3 Benthic Invertebrate Monitoring

Benthic invertebrate communities at erosional areas of lower Minto Creek were summarized and compared to erosional areas of lower Wolverine Creek and lower Big Creek in order to evaluate any potential mine-related effects. The erosional benthic invertebrate community of lower Minto Creek differed from that of both reference areas on the basis of Bray-Curtis index (higher), percent chironomids (higher), percent oligochaetes (lower) and CA Axis-1 (higher; Table 11-2). Consistent with Bray-Curtis index results, communities differed among areas. Percent EPT did not differ significantly among areas but differences were seen with abundances of chironomids and oligochaetes (Table 11-2). The higher proportion of chironomids suggest a mine influence, but in combination with the lower presence of oligochaetes together with EPT taxa not being significantly different between areas suggest limited influence of the mine on the benthic invertebrate community (Chapman et al. 1982a,b; Rosenberg and Resh 1993; Taylor and Bailey 1997). A potential decrease in number of taxa from 2012-2014 identified was not supported by the 2015 and 2016 data and appears to represent natural variability (Minnow 2015, 2016).

Table 11-2: Benthic invertebrate community metrics and statistical comparisons, Minto Mine WUL, 2016.

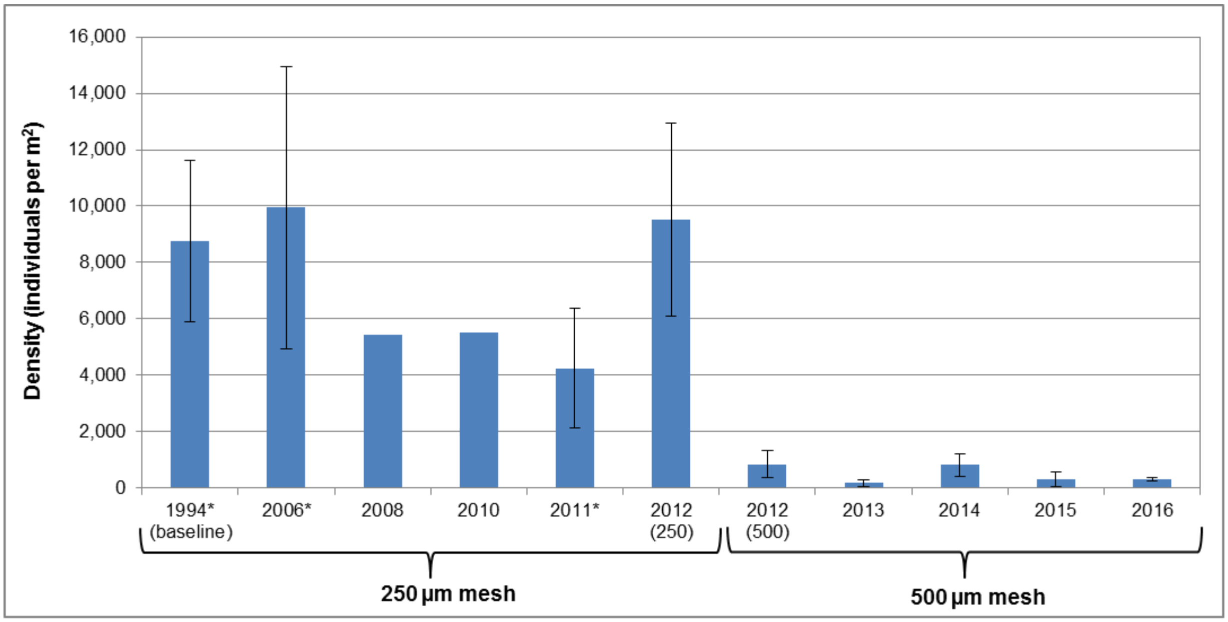
Metric	Comparison		Area Means		Statistical Contrasts		
	Exposure Site	Reference Site			Significant Difference between areas?	Direction	p-value
Density (organisms/m^2)	lower Minto Creek	lower Wolverine Creek	307	226	NO	-	1.000
		lower Big Creek		735	YES	Minto < Big	0.025
Number of Taxa	lower Minto Creek	lower Wolverine Creek	19	24	NO	-	0.217
		lower Big Creek		33	YES	Minto < Big	0.001
Simpson's Diversity[1]	lower Minto Creek	lower Wolverine Creek	0.79	0.73	YES	Minto > Wolverine	0.056
		lower Big Creek		0.87	YES	Minto < Big	0.016
Simpson's Evenness[1]	lower Minto Creek	lower Wolverine Creek	0.26	0.21	NO	-	1.000
		lower Big Creek		0.26	NO	-	1.000
BC Index to Combined Reference Median	lower Minto Creek	lower Wolverine Creek	0.86	0.38	YES	Minto > Wolverine	0.009
		lower Big Creek		0.65	YES	Minto > Big	0.016
EPT (%)[2]	lower Minto Creek	lower Wolverine Creek	27	33	NO	-	1.000
		lower Big Creek		25	NO	-	1.000
Chironomids (%)	lower Minto Creek	lower Wolverine Creek	61	12	YES	Minto > Wolverine	< 0.001
		lower Big Creek		38	YES	Minto > Big	0.042
Oligochaetes (%)	lower Minto Creek	lower Wolverine Creek	3.9	44	YES	Minto < Wolverine	0.001
		lower Big Creek		24	YES	Minto < Big	0.020
CA Axis-1 (33.6%)	lower Minto Creek	lower Wolverine Creek	235	-105	YES	Minto > Wolverine	< 0.001
		lower Big Creek		-68	YES	Minto > Big	< 0.001
CA Axis-2 (24.2%)	lower Minto Creek	lower Wolverine Creek	18	170	YES	Minto < Wolverine	< 0.001
		lower Big Creek		-40	NO	-	0.323

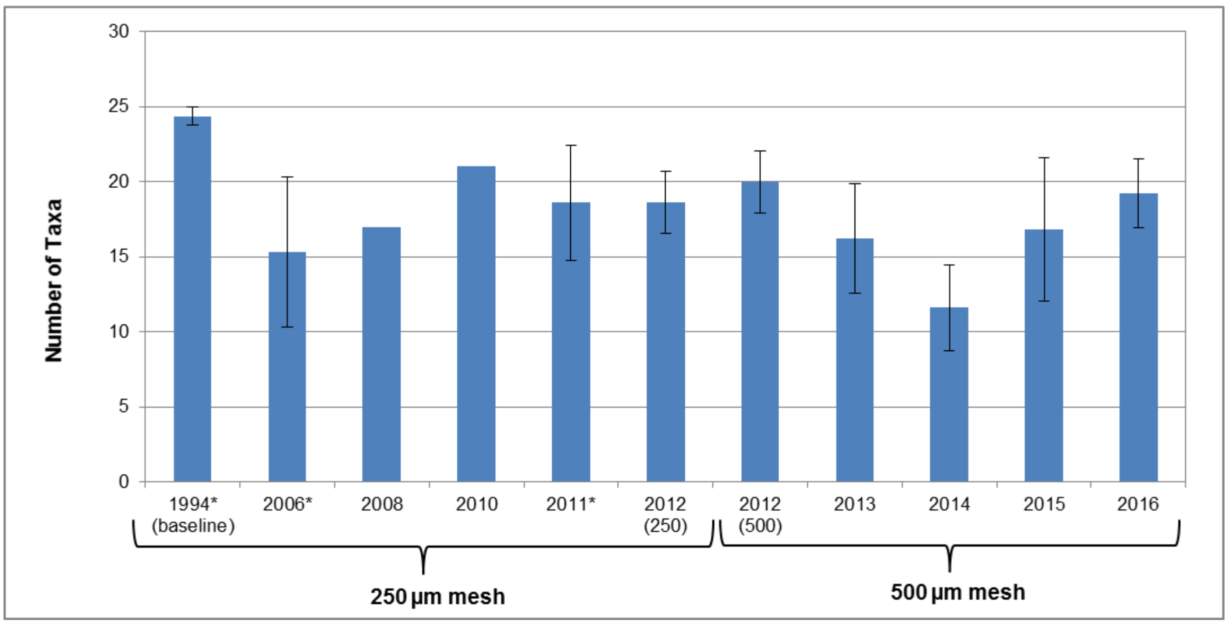
(grey box) Indicates a statistically significant difference between exposed and reference areas, p = 0.10.

[1] Calculated as recommended by Environment Canada 2012.

[2] Percent Ephemeroptera (mayfly), Plecoptera (stonefly), Trichoptera (caddisfly).

Comparisons of benthic invertebrate community metrics in 2016 to those documented in previous years indicated substantial temporal variability (as also observed with periphyton communities) at both the receiving environment and reference areas. Benthic invertebrate density in 2016 was lower than in 2014 and 2015 but higher than in 2013 (Figure 11-4). Number of taxa at lower Minto Creek in 2016 was within the historical range from 2006 onwards, but moderately lower than in 1994 (Figure 11-4).





Data presented as mean ± standard deviation where replicated. Asterisk (*) indicates a year the mine was not discharging.

Figure 11-4: Benthic invertebrate community density and taxon richness at Lower Minto, Minto Creek, 1994-2016.

Data presented as mean ± standard deviation where replicated. Asterisk (*) indicates a year the mine was not discharging.

11.2.4 Fisheries Monitoring Program

The objectives of the 2016 Fisheries Monitoring Program were to monitor, assess and characterize fish usage in Minto Creek during open water season, and to provide data allowing interpretation of the potential role and influence of the Minto Mine on the fish community. The 2016 fisheries program was a continuation of the previous year's components, and targeted all species that have previously been encountered as well as any new species. As part of the 2016 monitoring program, assessments at Big Creek were made concurrently with sampling in Minto Creek, to compare fish use in a neighbouring system relative to Minto Creek. Fish monitoring studies were conducted as per the EMSRP.

Fish monitoring of Minto Creek and Big Creek was conducted monthly during open water season, from June to September 2016, at trapping sites consistent with the 2010 mark-recapture study and the 2011 to 2015 fish monitoring programs. Capture effort included the use of Gee-type Minnow traps with 0.635 cm wire mesh size baited with Yukon River origin Chinook salmon roe. A total of eighteen to twenty-five minnow traps were set each time in Minto Creek, depending on water levels and availability of pools and backwater areas. Four traps were set each time in Big Creek, in the vicinity of the Minto road bridge.

All fish captured were identified, enumerated and measured for fork length or total length (± 1 mm), inspected for abnormalities, and released in the vicinity of their trapping location. Juvenile Chinook Salmon were also weighed (± 0.1g) prior to being released.

Additional supporting information collected included photo documentation of the creek, water level readings at W1 staff gauge, in situ water parameters in Minto Creek, Big Creek and the Yukon River (temperature, dissolved oxygen, conductivity, pH, Oxidation-Reduction Potential), discharge at W1, as well as weather conditions at time of sampling. Supporting variables also included monitoring of the previously identified fish barrier (1.2 km upstream of the Yukon River confluence) and/or any new barriers that may have developed.

For details on the 2016 results of Fisheries Monitoring Program see Appendix M.

11.3 Copper Toxicity Study

The copper toxicity study was initiated in 2015, due to a mild freshet and no major rainfalls, a turbid flow sampling could not be completed in 2016, but will be in 2017 (if possible). See Appendix N for a letter regarding the current status of the program and the report on the copper toxicity for a clear flow stream.

11.4 Aquatic Environmental Monitoring Program (AEMP) Review

As required by clause 102 of the WUL, a review and evaluation of the AEMP program was conducted. The findings of the program review for the sediment, benthics and periphyton are found in the recommendation section of Appendix L. The findings of the fisheries program review are found in Appendix O. A summary of the conclusions and recommendations provided below:

1. It is recommended that both lower Wolverine Creek and lower Big Creek continue to be sampled as reference areas for the benthic invertebrate community assessment to provide better perspective on whether any of the observed differences are actually due to mine influence or simply due to natural differences among creeks.
2. It is recommended that sediment toxicity testing is not completed in 2017, but that it is completed at a three-year frequency (next monitoring in 2019) or in response to any increase in concentrations of copper (or other mine-related analyte).
3. It is recommended that periphyton community monitoring is removed from the WUL monitoring program as results are highly variable and are not effective in determining potential mine effects.
4. It is also recommended that fisheries monitoring program be reduced from annually frequency to a three year frequency (next monitoring in 2019) to align with the next EEM cycle study. If, however, a substantial change to discharge strategy (quantity or quality) occurs due to unforeseen circumstances than fish monitoring should be re-instated until conditions returned to normal.

12 Meteorological Monitoring Program

Meteorological monitoring at the Minto Mine consists of data collection for the following parameters: rainfall, snowfall, temperature, evaporation, wind speed and direction, barometric pressure, relative humidity, and solar radiation (incoming and reflected). The Meteorological Monitoring Program includes the Climate Monitoring Program (EMSRP Section 4.1) and the Snow Survey Program (EMSRP Section 4.2). Data collected under the Meteorological Monitoring Program, along with baseline climatic data, provides input for the following mine projects:

- Site water management;
- Prediction for yearly water events (e.g. freshet);
- Design of water storage, conveyance and discharge systems; and
- Design of flood control structures on the road network.

12.1 Climate Monitoring Program

The 2016 Climate Monitoring Program data are presented below in Figure 12-1 through Figure 12-8. During 2016, Minto Mine had one meteorological station located approximately 70 m northeast of the north end of the airstrip, in an area that allows ample meteorological exposure from all directions. Trees are clear for a radius of 30 m from the meteorology station and beyond that radius is a sparse growth of 2 m tall conifers.

The meteorology station is a research grade Campbell Scientific station that records the following parameters: maximum wind speed, minimum wind speed, average wind speed, wind direction, precipitation (rain and snow), temperature, relative humidity, pan evaporation, barometric pressure, solar radiation and calculated evapotranspiration. Data are averaged over the one-hour archiving period and then saved to the datalogger.

The outgoing short wave radiation sensor and evaporation pan were added in July 2016.

Due to a downloading error during the installation of new monitoring equipment, all data from July 17th to July 19th was lost, and partial data was lost from July 19th and July 20th 2016.

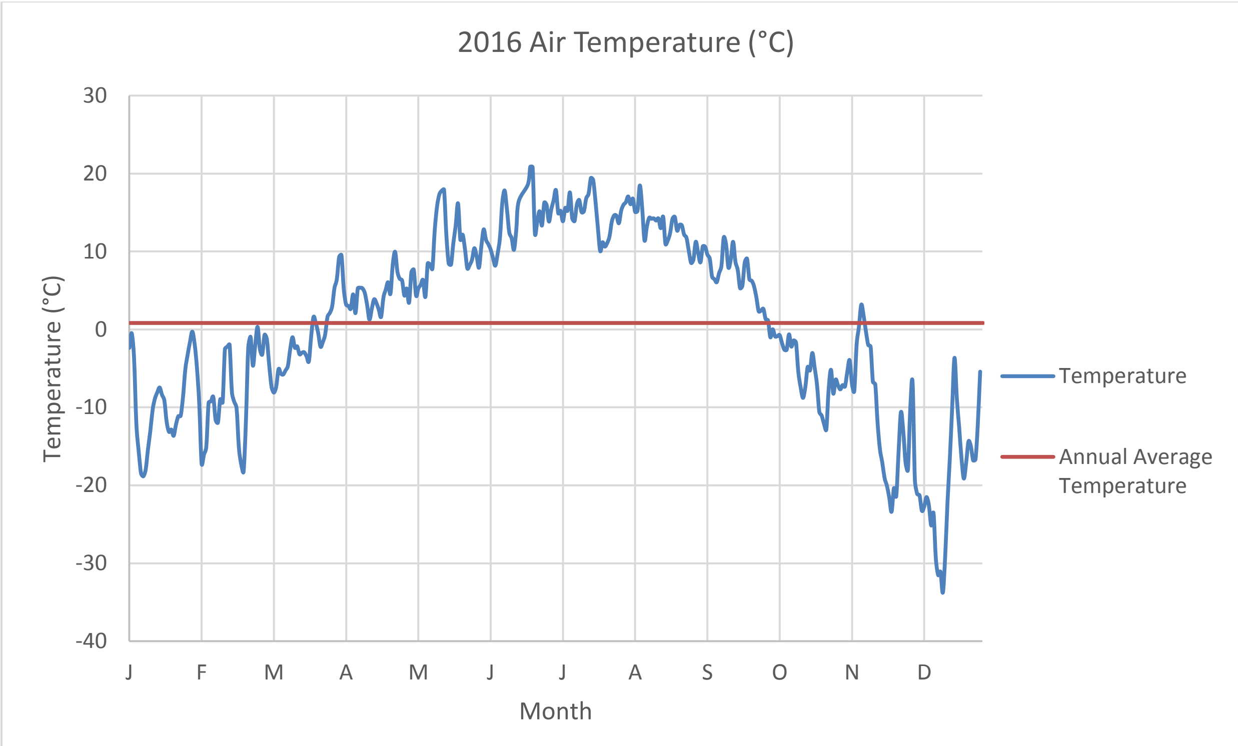


Figure 12-1: Air Temperature (2016)

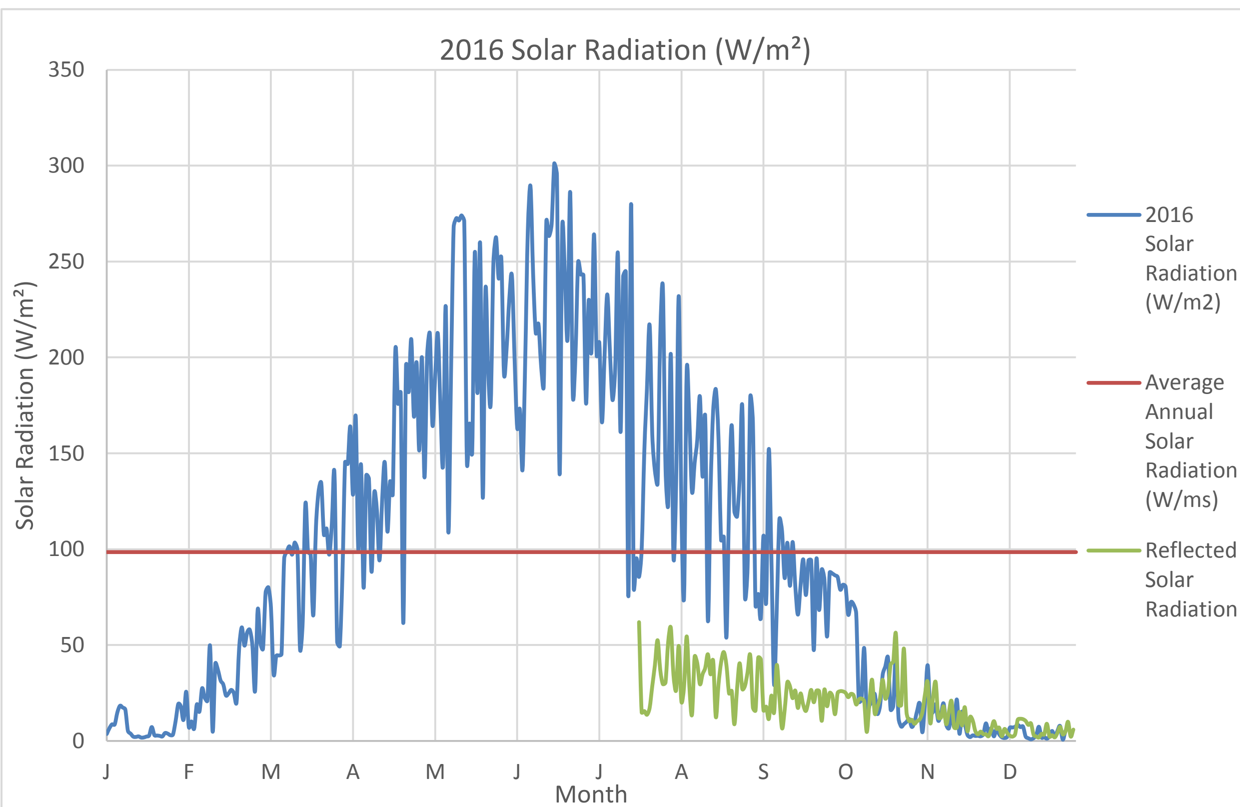


Figure 12-2: Solar Radiation (2016)

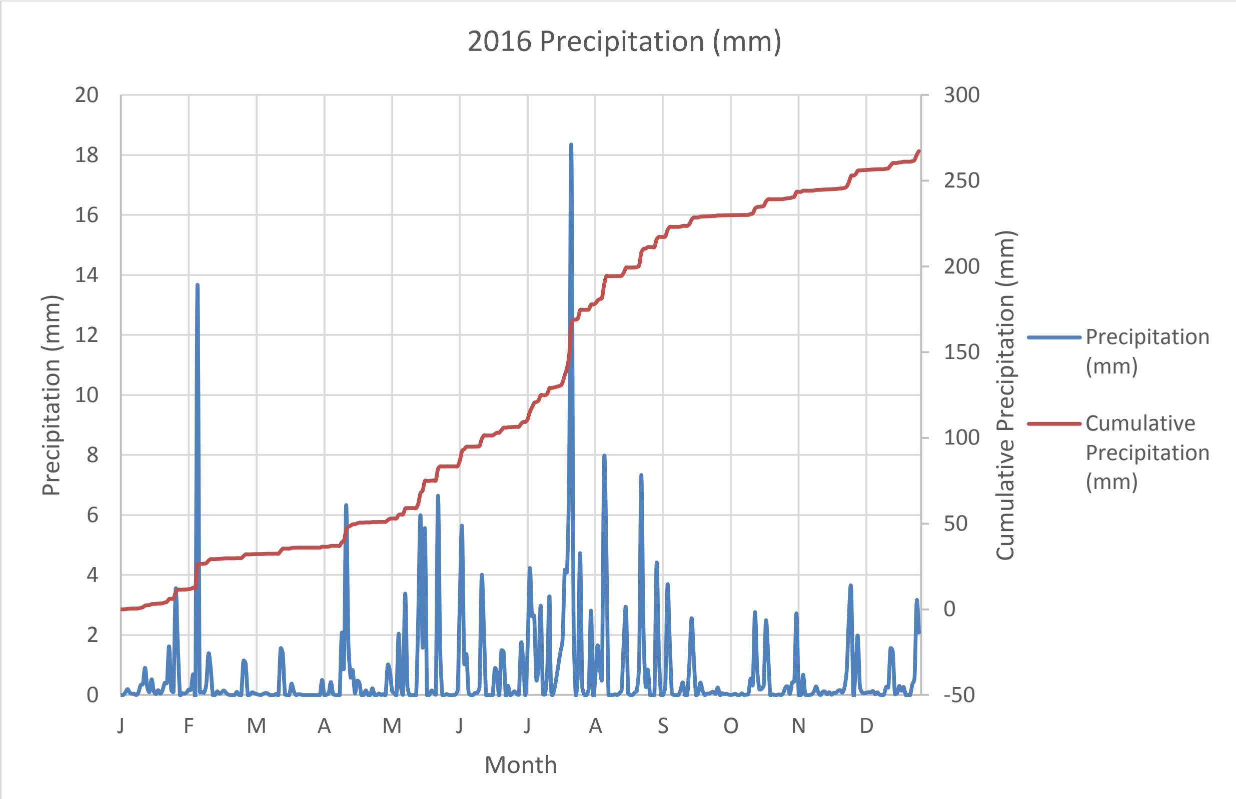


Figure 12-3: Precipitation (2016)

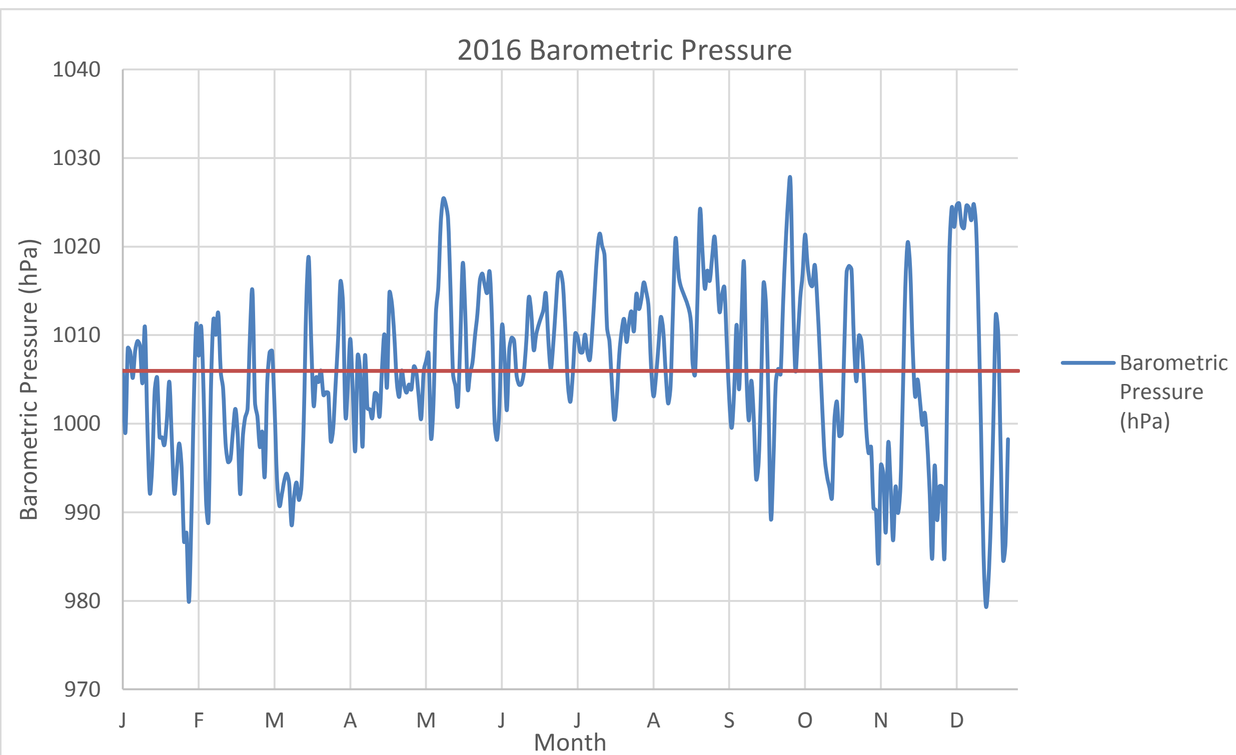


Figure 12-4: Barometric Pressure (2016)

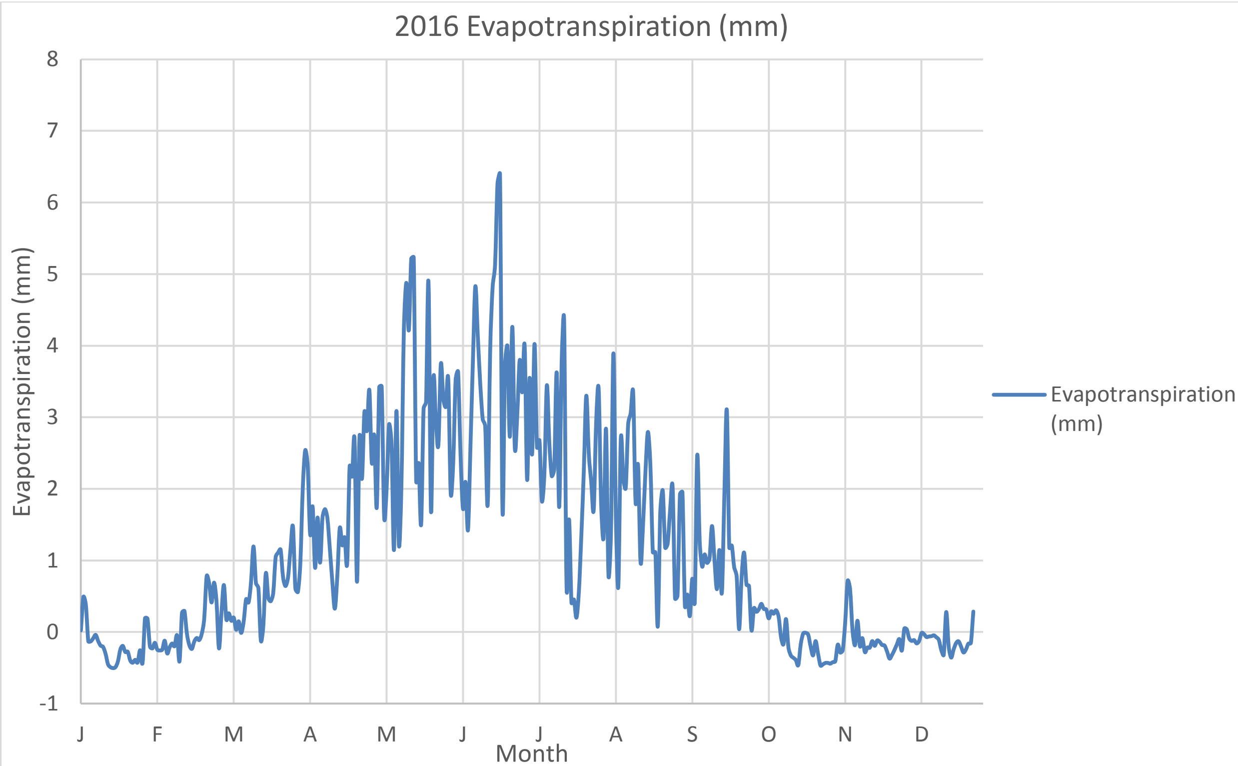


Figure 12-5: Evapotranspiration (2016)

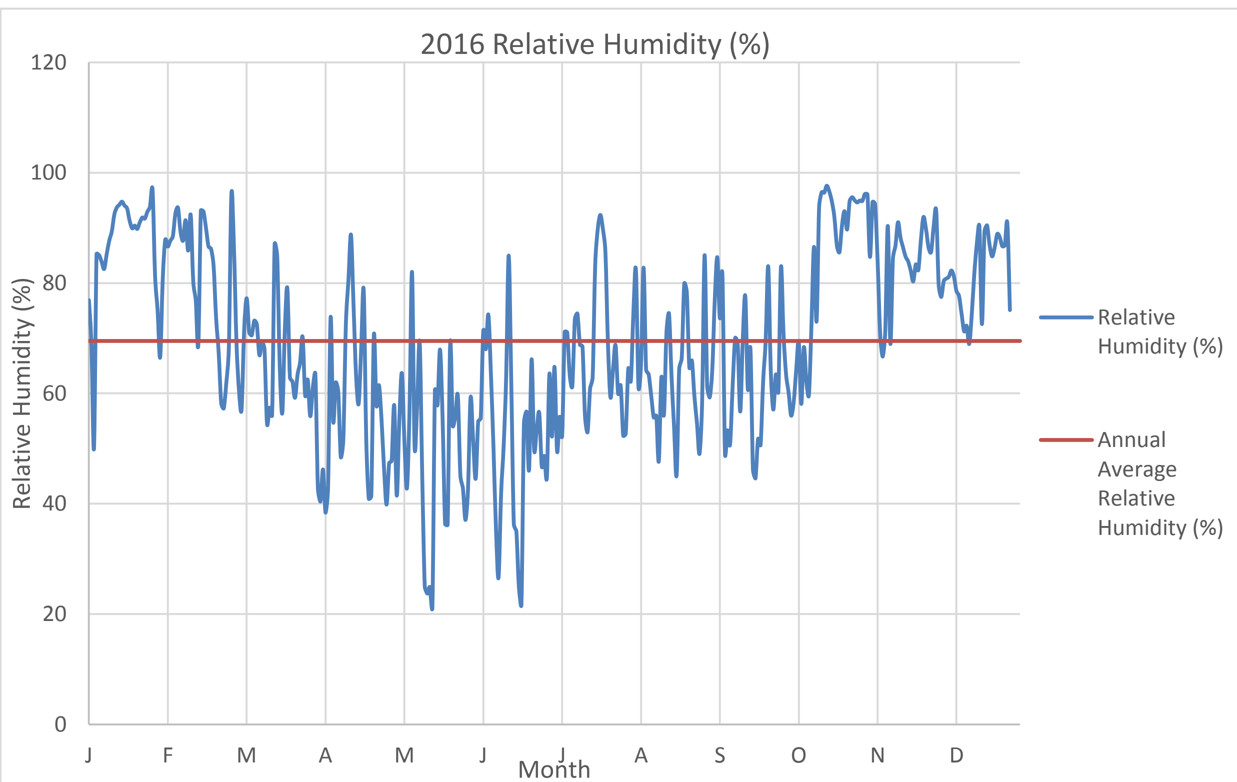


Figure 12-6: Relative Humidity (2016)

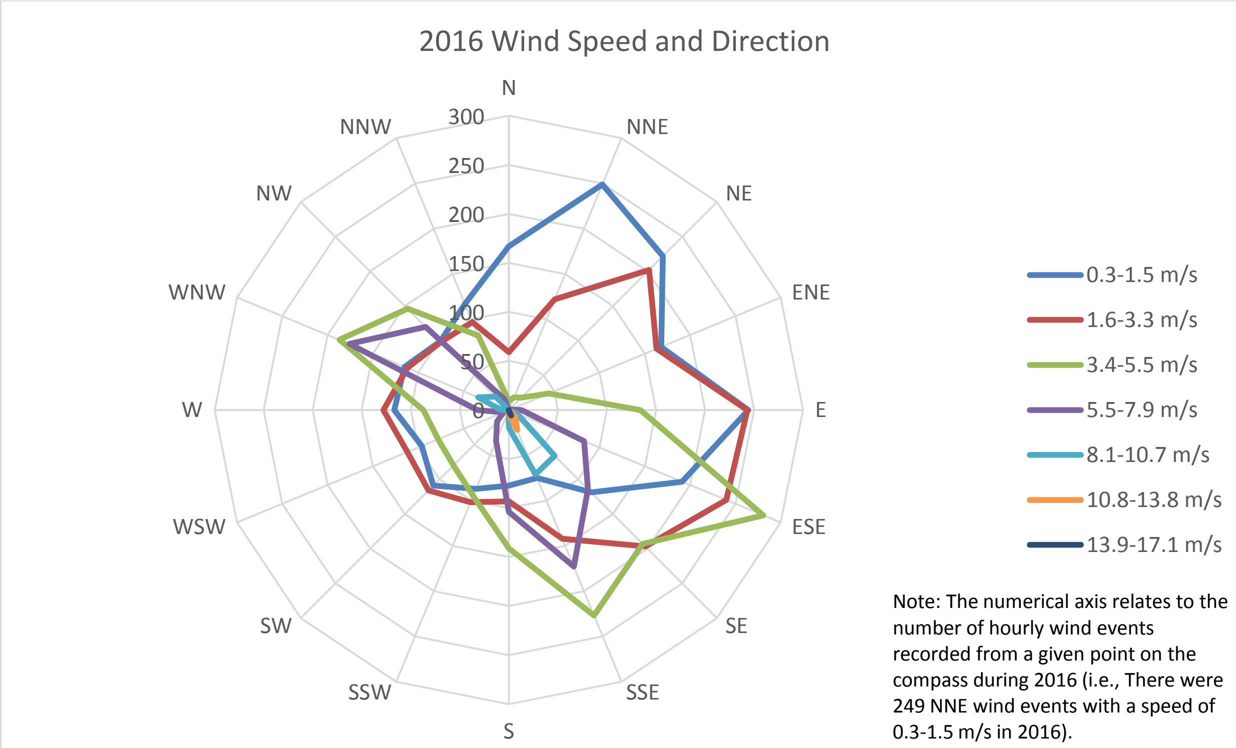


Figure 12-7: Wind Speed and Direction Events (2016)

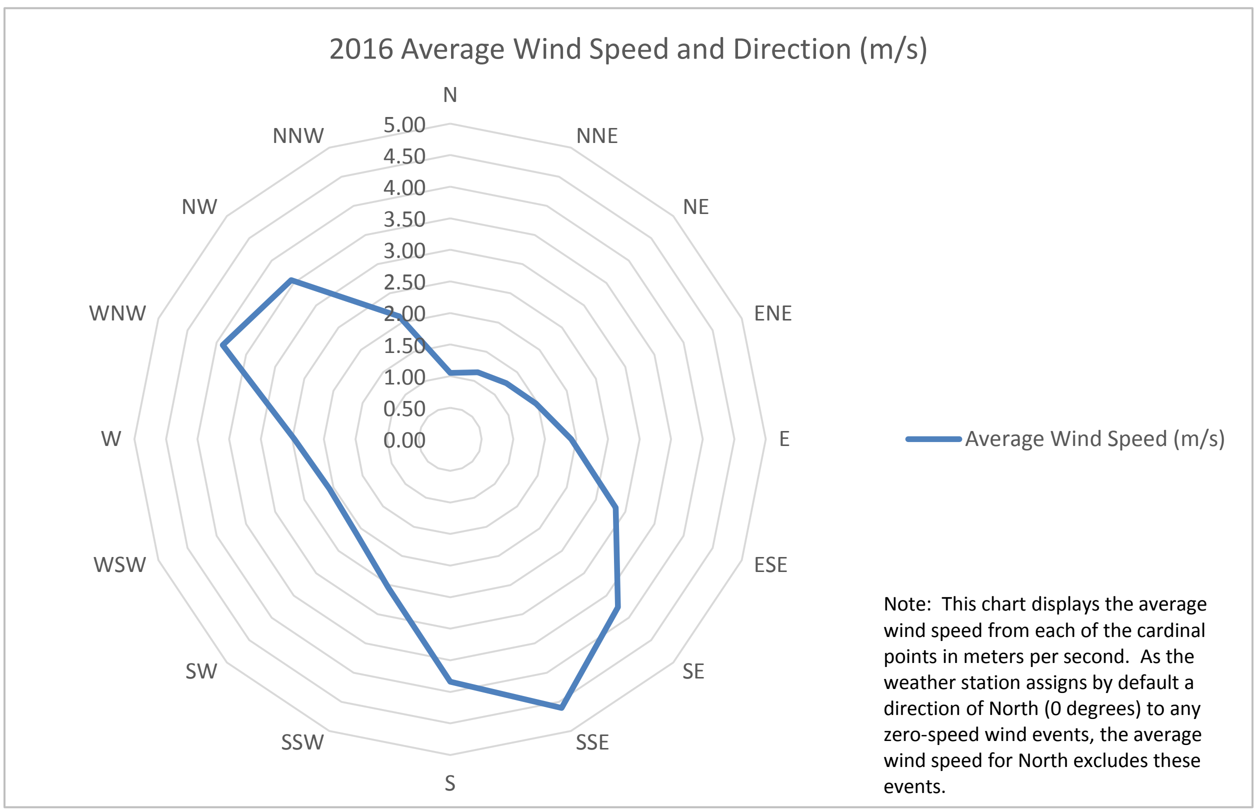


Figure 12-8: Average Wind Speed and Direction (2016)

12.2 Snow Survey Program

As required by the WUL Clause 96 and as part of the EMSRP, Minto collects snow data at the mine. The objective of the Snow Survey Program is to collect data used for calculating the snow water equivalent at the Minto. Snow water equivalents are inputs for the Minto Mine Site Water Balance models. Three courses are surveyed during the first week of February, March & April each year. If conditions permit, Minto will additionally survey the snow courses in May. These courses are East-facing (near the Dyno compound), North-facing (near the airstrip) and South-facing (above the Tank Farm), as detailed in Table 12-1. Along each course, ten stations are sampled using a machined core tube with cutting end and scale with assembly. The parameters collected during the surveys include snow depth, core length, core weight, snow density, weather, site conditions, snowpack conditions, crust layers, and snow temperature. Multi-year results to 2016 (averaged across the three snow courses) are presented in Appendix F – 2016 Water Balance and Water Quality Model Summary for the Minto Mine.

Table 12-1: Snow Survey Course Locations

Course Location	Description	Aspect	UTM	
			Easting	Northing
Dyno	East of the Dyno compound on an east facing slope along a cut line surrounded by moderately densely tree area.	East Facing	8V 383 594	694 3377
Fuel Farm	North of the Minto Mine fuel farm on a south facing slope in a sparse to moderately densely treed area.	South Facing	8V 385 061	694 5318
Airstrip	Northeast of the Minto Mine airstrip on a north facing slope in a sparsely treed area.	North Facing	8V 386 255	694 4284

12.3 Meteorology QA/QC

Procedures for meteorology monitoring at the Minto Mine are detailed in the Meteorology Station Standard Operating Procedures. Minto has installed a satellite connection to the Met Station 2 to enable real time viewing of the weather station data. The meteorology data is downloaded and reviewed twice monthly by Environmental Department staff and routine visual inspections of the monitoring stations occur on a weekly basis.

13 Geochemistry

13.1 Waste Rock Verification Program

The Waste Rock Verification Program was initiated in 2014 to support and monitor waste rock handling procedures at the Minto Mine. The program was developed to address Clause 95 of the WUL, with the results of the program to be included in the Annual Report. The program consists of detailed record keeping on the type and quantity of waste rock placed at each location, and monitoring and verification of the characteristics of the waste rock stored at each location as per the Waste Rock and Overburden Management Plan.

Minto's Technical Services Department tracks all waste dispatched between the source and the destination using the mine's computer database system. The dispatch data are based on load count sheets compiled by the mining contractor.

Samples are taken by Minto geology personnel on dump crests that had been active in the previous month as determined by the production tracking database. The grab sample consists of one shovel full of material taken at twenty-five individual one meter intervals over the distance of the recently placed waste. Particles greater than a pebble (64-80 mm) in size are manually rejected, the sample is then labelled and delivered to Minto's onsite assay lab.

Each sample is analysed for total copper (Cu (T)), total sulfur (S (T)), and total carbon (C (T)) content using an Eltra CS-800 induction furnace. S (T) and C (T) values are converted into equivalent Acid Potential (AP-S (T)) and Neutralization Potential (NP-C (T)) values, and NP-C (T): AP-S (T) ratios (NP/AP) are calculated for each sample. The resulting (NP-C (T)): (AP-C (T)) ratios are compared to the segregation criteria and assigned "pass" or "fail" designations, which is a 3:1 ratio at Minto.

Between January and August of 2016, ninety eight grab samples of waste (WST) were collected from the Main Waste Dump Extension (MWDE) and eighty five samples were collected from the Mill Valley Fill Extension 2 (MVFE 2). All of the rock placed in these dumps during this period consisted of exclusively of waste material from the Minto North Pit.

Of the one hundred and eighty three sample taken from the two destinations, one hundred and seventy nine met the pass criteria based on the NP/AP segregation criteria. The four failures, two each in the MWDE and the MVFE 2, were determined to be isolated events and therefore no additional sampling was required. Of note, three samples taken in the MWDE in January returned ratios that did not meet the pass criteria; as the samples contained below detection limit carbon, sulfur and copper values, the rock was confirmed to be inert and no further action was taken. The average monthly values of the Acid-Base Accounting (ABA) parameters for each dump location are summarized in Table 13-1, below. For a complete summary of the sample results, please refer to Appendix P.

Table 13-1: Waste Rock Management Verification Program Summary (2016)

Average ABA Parameter Values: Month By Location								
Location	Month	Waste Type	Cu%	C% (Tot)	S% (Tot)	NP	AP	NP/AP
MWDE	Jan	WST	0.007	0.061	0.001	5.07	0.03	162
	Feb	WST	0.018	0.182	0.014	15.14	0.43	35
	Mar	WST	0.023	0.125	0.009	10.38	0.28	38
	Apr	WST	0.021	0.116	0.013	9.70	0.42	23
	May	WST	0.029	0.161	0.010	13.40	0.31	44
	Jun	WST	0.075	0.380	0.057	31.63	1.77	18
	Jul	WST	0.279	0.401	0.146	33.40	4.56	7
	Aug	WST	0.156	0.394	0.066	32.83	2.06	16
MVFE 2	Jan	WST	0.019	0.214	0.009	17.83	0.29	61
	Feb	WST	0.009	0.109	0.016	9.11	0.49	19
	Mar	WST	0.011	0.077	0.004	6.38	0.11	56
	Apr	WST	0.007	0.151	0.001	12.56	0.04	357
	May	WST	0.046	0.152	0.039	12.69	1.21	11
	Jun	WST	0.020	0.390	0.070	32.45	2.18	15
	Jul	WST	0.011	0.278	0.024	23.12	0.74	31

13.2 Acid-Base Accounting Program

The EMSRP commits to the submission of results of the ABA Program that was conducted during the reporting year. The ABA program determines the Neutralizing Potential Ratio ((defined as Neutralizing Potential divided by Acid Potential [NP/AP]) (NPR)) for overburden and waste rock to confirm that the NPR is greater than three. An NPR value of three or greater is generally considered indication of non-acid generating material. A separate, parallel program was initiated to determine the NPR of the tailings solids.

The following is a summary of results from the ABA program for the monitoring period January to December 2016.

A total of 213 samples were collected from the Minto North Pit, Area 2 Underground and the Area 118 Underground deposits and sent to an accredited laboratory (SGS CEMI Ltd., ALS Minerals) during the 2016 monitoring period. The samples were analyzed according to the MEND Modified NP Method as noted in the EMSRP.

The mean NP/mean AP results for waste rock samples was 14.49 for the duration of the monitoring period. 13 samples during the 2016 monitoring period were below the NPR threshold of 3 for construction grade waste rock. The mean paste pH values for all samples tested in 2016 were 8.75. The mean sulphide sulphur ($S(S^{-2})$) content for waste rock samples during the 2016 monitoring period was 0.05%. In 2016, 6 samples were above the $S(S^{-2})$ content for construction grade waste (waste grading Cu <0.1%, NPR>3, $S(S^{-2})$<0.3%).

9 tailings samples were analyzed in this period and had a mean NP/mean AP of 16.79. All tailings samples were well above a NPR of 4. All nine samples of tailings were also below 0.30% $S(S^{-2})$ content and had a paste pH between 8.3 and 8.8.

A full report including lab results and analysis can be found in Appendix Q.

14 Terrestrial Monitoring Programs

14.1 Wildlife Monitoring Program

The *Minto Mine Wildlife Protection Plan* (a component of the EMSRP) establishes guidelines for minimizing wildlife disturbance at the Minto Mine site and along the development corridor and includes a monitoring program to yield information about wildlife use in the area. The 2016 activities under the Wildlife Monitoring Program including the area and frequency of monitoring, are summarized in Table 14-1, below.

Table 14-1: Wildlife Monitoring Activities (2016)

Area Monitored	Monitoring Activities	Frequency
Wildlife Monitoring	Wildlife monitoring consisted of maintaining a wildlife observation log onsite and reporting wildlife encounters. Environmental personnel on site monitored project activities in order to address wildlife concerns.	Ongoing
Migratory Birds	Monitoring to determine if waterfowl and shorebirds settle on impacted water bodies, such as the Main or Area 2 Pits. Environmental personnel on site monitor project activities and modify operations to address wildlife concerns.	Seasonal, Daily during migratory periods
Species at risk/ of concern	Any caribou observations are reported to the Conservation Officer in Carmacks. Bank swallows have been observed to nest in residuum piles in the summer months, in which case these piles are cordoned off and left undisturbed until after the late summer migration.	As necessary

In addition to the Wildlife Monitoring Activities listed in Table 14-1, the Minto Environmental Department gathered observations from mine site staff with Wildlife Observation forms. These forms were posted at many accessible locations around site and employees were encouraged to record all wildlife observations. The forms were collected periodically and the sightings entered in a wildlife tracking sheet, which is included in Appendix R.

In 2016, 104 wildlife sightings were recorded. The majority of these sightings were comprised of mammals: 40 individual bear sightings, 20 foxes, 19 deer, 5 moose, and 13 wolves, 7 lynx. Other animals observed on site included but were not limited to, hares, grouse, ptarmigan, sheep, dunlin, and geese.

The most active animal observation month was May and the most common sighting was bears. Majority of animal hazing occurred between March and July, which appears successful as few reoccurring animals were sighted.

Additional activities that took place on site included wildlife education (including bear awareness training) and safety flashes concerning the prevention of wildlife habituation on site.

14.2 Erosion and Sedimentation Monitoring Program

As part of the EMSRP, Minto has developed and implemented a *Sediment and Erosion Control Plan* (SECP). The objective of the SECP is to minimize local site impacts from erosion and prevent sedimentation to the receiving environment of Minto Creek. The 2016 activities associated with the Erosion and Sedimentation Monitoring Program are identified in Table 14-2, below. There were no significant issues in 2016.

Table 14-2: Erosion and Sedimentation Monitoring Activities (2016)

Activity	Location	Frequency
Visual inspections	Bottoms of slopes and depressions of large structures.	As needed following heavy rain events, and during freshet.
	Road routes: ditches and outlets of culverts and pipes.	As needed following heavy rain events, and during freshet.
Water quality monitoring for total suspended solids (TSS)	Water quality monitoring stations W2, W3, W50 and W17	Weekly and during heavy runoff periods.
Physical inspection of surface facilities by a Yukon registered Engineer.	Water Storage Pond Dam, Mill Water Pond, all waste rock and overburden dumps, all water diversion and conveyance structures and the dry stack tailings storage facility.	After the spring thaw period in May/June of each year and again prior to the on-set of winter in September of each year

14.3 Invasive Plant Species Monitoring Program

As part of the EMSRP, Minto developed an *Invasive Species Monitoring Standard Operating Procedure* in 2015. The Invasive Species Monitoring Plan, created in 2014, was the basis for the SOP. The SOP details how the monitoring program will be conducted.

The 2016 invasive species program focused primarily on the site access road. The Minto Environmental Department completed an invasive plant survey of the twenty-seven kilometer access road, focusing primarily on the high-risk species as listed by the Yukon Invasive Species Council (YISC) (Table 14-3). During the course of the access road survey, no high-risk species were observed. For a summary of the access road invasive species survey results, please refer to Table 14-4, below.

Vegetation surveys have been completed annually since September 2012 on the MWD and both seed mix and natural regeneration species have been noted during the survey. In accordance with the EMSRP, invasive plant surveys will be continue through 2017, particularly along invasive species pathways such as roads with high visitor traffic, recently exposed areas, and areas that have been recently reclaimed.

Table 14-3: High Priority Invasive Species as determined by the Yukon Invasive Species Council, 2016

Common Name	Latin Name
Bird vetch	*Vicia cracca*
Common tansy	*Tanacetum vulgare*
Creeping thistle	*Cirsium arvense*
Hawkweeds	*Hieracium sp.*
Leafy spurge	*Euphorbia esula*
Oxeye daisy	*Leucanthemum vulgare*
Perennial sow-thistle	*Sonchus arvensis*
Scentless chamomile	*Tripleurospermum perforata*
Spotted knapweed	*Centaurea stoebe*

Table 14-4: Minto Mine Invasive Species Monitoring Program Results, 2016

Invasive Plant Survey Date	Site Location	Site Description	Species Observed
8/20/2016	Access Road Left Side	km 0	Hawksbeard
8/20/2016	Access Road Left Side	km 0.5	Brome
8/20/2016	Access Road Left Side	km 0.5	Hawksbeard
8/20/2016	Access Road Left Side	km 0.7	Hawksbeard
8/20/2016	Access Road Left Side	km 1	Hawksbeard
8/20/2016	Access Road Left Side	km 1.1	Hawksbeard
8/20/2016	Access Road Right Side	km 1.3	Foxtail
8/20/2016	Access Road Left Side	km 1.5	Hawksbeard

Invasive Plant Survey Date	Site Location	Site Description	Species Observed
8/20/2016	Access Road Left Side	km 1.5	w.sw.clover
8/20/2016	Access Road Right Side	km 1.5	Hawksbeard
8/20/2016	Access Road Right Side	km 0-1.5	Hawksbeard
8/20/2016	Access Road Left Side	km 2.1	Hawksbeard
8/20/2016	Access Road Left Side	km 2.3	Hawksbeard
8/20/2016	Access Road Right Side	km 2.4-2.7	Hawksbeard
8/20/2016	Access Road Right Side	km 2.7-3.1	Hawksbeard
8/20/2016	Access Road Left Side	km 3	Hawksbeard
8/20/2016	Access Road Left Side	km 3.1	Hawksbeard
8/20/2016	Access Road Left Side	km 3.2	Hawksbeard
8/20/2016	Access Road Right Side	km 3.1-3.4	Hawksbeard
8/20/2016	Access Road Right Side	km 3.4-3.7	Hawksbeard
8/20/2016	Access Road Right Side	km 3.7	Hawksbeard
8/20/2016	Access Road Left Side	km 4.1	Hawksbeard
8/20/2016	Access Road Left Side	km 4.3	Hawksbeard
8/20/2016	Access Road Left Side	km 4.5	Hawksbeard
8/20/2016	Access Road Right Side	km 4.1-4.3	Hawksbeard
8/20/2016	Access Road Right Side	km 4.3-4.9	Hawksbeard
8/20/2016	Access Road Right Side	km 4.9-5.0	Hawksbeard
8/20/2016	Access Road Left Side	km 5	Hawksbeard
8/20/2016	Access Road Left Side	km 5.1	Hawksbeard
8/20/2016	Access Road Left Side	km 5.5	Hawksbeard
8/20/2016	Access Road Right Side	km 5.0-5.1	Hawksbeard
8/20/2016	Access Road Right Side	km 5.1-6.5	Hawksbeard
8/20/2016	Access Road Left Side	km 6	Hawksbeard
8/20/2016	Access Road Left Side	km 6.2	Hawksbeard
8/20/2016	Access Road Left Side	km 6.2	Hawksbeard
8/20/2016	Access Road Left Side	km 6.8	Hawksbeard
8/20/2016	Access Road Right Side	km 6.5-6.8	Hawksbeard
8/20/2016	Access Road Right Side	km 6.8-7.6	Hawksbeard
8/20/2016	Access Road Left Side	km 7.3	Hawksbeard
8/20/2016	Access Road Left Side	km 7.6	Hawksbeard
8/20/2016	Access Road Right Side	km 7.6-8.0	Hawksbeard
8/20/2016	Access Road Left Side	km 8	Hawksbeard
8/20/2016	Access Road Left Side	km 8.1	Hawksbeard
8/20/2016	Access Road Left Side	km 8.4	Hawksbeard
8/20/2016	Access Road Right Side	km 8.0-9.0	Hawksbeard
8/20/2016	Access Road Left Side	km 9	Hawksbeard

Invasive Plant Survey Date	Site Location	Site Description	Species Observed
8/20/2016	Access Road Left Side	km 9.7	Hawksbeard
8/20/2016	Access Road Right Side	km 9.0-9.1	Hawksbeard
8/20/2016	Access Road Right Side	km 9.1-9.7	Hawksbeard
8/20/2016	Access Road Right Side	km 9.7-9.8	Hawksbeard
8/20/2016	Access Road Right Side	km 9.8-10.0	Hawksbeard
8/20/2016	Access Road Left Side	km 10	Hawksbeard
8/20/2016	Access Road Left Side	km 10.7	Hawksbeard
8/20/2016	Access Road Right Side	km 10.0-10.5	Hawksbeard
8/20/2016	Access Road Right Side	km 10.5-11.0	Hawksbeard
8/20/2016	Access Road Left Side	km 11	Hawksbeard
8/20/2016	Access Road Left Side	km 11.1	Hawksbeard
8/20/2016	Access Road Left Side	km 11.2	Hawksbeard
8/20/2016	Access Road Left Side	km 11.5	Hawksbeard
8/20/2016	Access Road Right Side	km 11.0-11.8	Hawksbeard
8/20/2016	Access Road Left Side	km 12	Hawksbeard
8/20/2016	Access Road Left Side	km 12.5	Hawksbeard
8/20/2016	Access Road Left Side	km 13	Hawksbeard
8/20/2016	Access Road Left Side	km 13.2	Hawksbeard
8/20/2016	Access Road Left Side	km 13.4	Hawksbeard
8/20/2016	Access Road Left Side	km 13.6	Hawksbeard
8/20/2016	Access Road Left Side	km 14.4	w.sw.clover
8/20/2016	Access Road Right Side	km 11.0-11.8	Hawksbeard
8/20/2016	Access Road Right Side	km 11.8-15.3	Hawksbeard
8/20/2016	Access Road Left Side	km 15.3	w.sw.clover
8/20/2016	Access Road Left Side	km 15.7	w.sw.clover
8/20/2016	Access Road Left Side	km 15.9	w.sw.clover
8/20/2016	Access Road Right Side	km 15.3-15.9	w.sw.clover
8/20/2016	Access Road Right Side	km 15.9-16.4	w.sw.clover
8/20/2016	Access Road Left Side	km 16.4	w.sw.clover
8/20/2016	Access Road Left Side	km 16.5	w.sw.clover
8/20/2016	Access Road Left Side	km 16.8	Hawksbeard
8/20/2016	Access Road Left Side	km 17.1	Hawksbeard
8/20/2016	Access Road Right Side	km 16.4-18.2	w.sw.clover
8/20/2016	Access Road Left Side	km 18.2	w.sw.clover
8/20/2016	Access Road Right Side	km 18.2-18.3	w.sw.clover
8/20/2016	Access Road Left Side	km 18.3	w.sw.clover
8/20/2016	Access Road Right Side	km 18.5-19	Hawksbeard
8/20/2016	Access Road Right Side	km 19.2	Hawksbeard

Invasive Plant Survey Date	Site Location	Site Description	Species Observed
8/20/2016	Access Road Left Side	km 19.2	Hawksbeard
8/20/2016	Access Road Left Side	km 19.3	Hawksbeard
8/20/2016	Access Road Left Side	km 20	Hawksbeard
8/20/2016	Access Road Left Side	km 20.4	Hawksbeard
8/20/2016	Access Road Left Side	km 20.6	Hawksbeard
8/20/2016	Access Road Right Side	km 20-21	Hawksbeard
8/20/2016	Access Road Left Side	km 21	Hawksbeard
8/20/2016	Access Road Left Side	km 21.1	Hawksbeard
8/20/2016	Access Road Left Side	km 22	Hawksbeard
8/20/2016	Access Road Right Side	km 22	w.sw.clover
8/20/2016	Access Road Left Side	km 23	w.sw.clover
8/20/2016	Access Road Right Side	km 24.1-24.5	Hawksbeard
8/20/2016	Access Road Left Side	km 24.5	Hawksbeard
8/20/2016	Access Road Left Side	km 25.5	Hawksbeard
8/20/2016	Access Road Left Side	km 25.9	Hawksbeard
8/20/2016	Access Road Left Side	km 26.2	Hawksbeard
8/20/2016	Access Road Left Side	km 26.4	w.sw.clover
8/20/2016	Access Road Right Side	km 26-26.5	Hawksbeard
8/20/2016	Access Road Right Side	km 26.6-27	Hawksbeard
8/20/2016	Access Road Left Side	km 27	Hawksbeard
8/20/2016	West Landing	-	Foxtail
8/20/2016	West Landing	-	Hawksbeard
8/20/2016	West Landing	-	w.sw.clover
8/20/2016	West Landing	-	Pineapple
8/20/2016	East Landing	-	Hawksbeard
8/20/2016	East Landing	-	w.sw.clover

14.4 Vegetation Metal Uptake Plan

The Vegetation Metal Uptake (VMU) program details are provided in the 2016 Vegetation Metal Uptake Report (Appendix S) and the Minto Mine Environmental Monitoring and Surveillance Plan. The main objectives of the first round of the VMU program were to utilize previously established or documented conditions, monitoring results or predictive efforts; establish a network of plots for monitoring both soil and vegetation metal concentrations; and allow for an ongoing evaluation of the extent and degree that metals from mining activity is affecting vegetation in close proximity to the project site.

These objectives were met for the first round of this program by establishing 16 exposure sites and five control sites. Vegetation samples were collected from each target species (blueberry, horsetail, Labrador tea, lichen, and willow) that were present at the sites. Soil samples were also collected at each location for every distinguishable soil horizon. Samples were sent to an accredited laboratory to conduct analysis for specific Constituents of Potential Concern (COPC), which included: Aluminum (Al), Antimony (Sb), Arsenic (As), Cadmium (Cd), Chromium (Cr), Copper (Cu), Iron (Fe), Lead (Pb), Manganese (Mn), Molybdenum (Mo), Nickle (Ni), Selenium (Se), and Zinc (Zn). The COPCs results were compared between control and exposure site and between unrinsed and rinsed samples to attempt to quantify the effects of mine related activity on vegetation metal concentrations.

For vegetation, two separate tests were conducted to compare the data: a paired sample Wilcoxon statistical test, and a two sample Wilcoxon statistical test. Paired sample tests were conducted between unrinsed and rinsed samples for each species. It was found that lichen and willow species presented a statistically significant difference between unrinsed and rinsed samples. However, results between the rinsed and unrinsed samples were highly variable; some metals were greater for rinsed samples then unrinsed, suggesting that rinsing was not always removing dust particulates. Additionally, there appeared to be other processes involved since some metals increased after rinsing. As such, it was determined that this comparison adds a level of complexity and variability that does not improve the ability of the program to determine whether metals are coming from dust settling on the plant or from uptake from the soils. Two sample tests were conducted between species collected at exposure and control sites to determine if there were any statistically significant differences between the two. Lichen was found to have statistically higher arsenic (As), cadmium (Cd), iron (Fe), and lead (Pb) at the exposure sites; willow had higher As, Fe, and Pb; Labrador tea and horsetail had higher copper (Cu) and Fe.

Soil samples were compared by horizon between exposure and control sites for the 2016 sampling event. Generally, exposure sites had higher concentrations of metals when compared to control sites. The most notable differences in concentrations were increased copper, molybdenum (Mo), selenium (Se), and zinc (Zn). Out of a total of 21 sites (40 samples), two sites, S02 and S19 (one sample per site), exceeded CCME industrial guidelines for arsenic and five sites, S16, S17, S07, S06, and S05 (total of ten samples) exceeded guidelines for copper. Soil pH didn’t show much deviation between control and exposure sites, and were consistent with typical soil profiles in the area. Soil texture at control sites ranged from clay loam to sand while exposure sites ranged from silt loam to loamy sand.

Overall, results indicate an increase in metal concentrations in vegetation located at exposure sites. For metals of potential wildlife and human health concern, arsenic and lead are higher at exposure than control sites for lichen and willow. Copper is higher at exposure than control sites for horsetail and Labrador tea. Blueberry showed no response. While this increase could potentially be the result of airborne particulates from the Minto mine, the results are inconclusive due to the minimal pre-mine data, and the high variability present within the 2016 data. The sources of variation are potentially attributed to natural variability in soil and plant tissue, plant species, source types and distance to exposure sample sites, weather, field sampling conditions, laboratory variability, and small sample size. As this first program provides the basis for initial comparison, subsequent studies will help establish a trend and provide ongoing evaluation of the extent and degree that metals from mining activity is affecting vegetation in the proximity of the project site.

The complete results for the 2016 Vegetation Metal Uptake Program are presented in Appendix S.

15 Site Characterization Report

The Site Characterization Report was submitted to EMR in May 2014. As per Clause 13.1 of the QML, the report will be updated in three years from the effective date of the licence. The submission date for the update is in December 2017. No updates were made to the Site Characterization Report following its submission in May 2014.

16 Reclamation

Reclamation activities at Minto Mine progressed throughout the monitoring period with the primary focus including:

- SWD Recontouring;
- Construction of the Mill Valley Fill Stage 2 (MVFES2);
- MVFES2 Recontouring;
- Dry Stack Tailings Storage Facility (DSTSF) Recontouring;
- Main Waste Dump Expansion Recontouring; and
- Reclamation Research;

16.1 Recontouring

On August 5th, 2016 Minto submitted an updated Reclamation and Closure Plan (RCP) to the Energy Mines and Resources branch of the Yukon Government as well to the Yukon Water Board. The updated RCP advanced the closure designs of the waste rock and tailings facilities to a preliminary design level phase. After submission SRK continued to work on refining the closure designs with Minto engineers to guide the construction of the final closure landform designs for facilities that are no longer required by the operation.

After completion of the Minto North Pit in October 2016, Pelly Construction began to focus their resources to recontouring the MVFES2, DSTSF, SWD and Main Waste Dump Expansion (Figures 16-1 to 16-4). During 2016, recontouring continued from October 2016 to the end of the year and resulted in the completion of recontouring for the MVFES2 and DSTSF rock shell. The SWD recontouring was advanced significantly towards completion and recontouring of the upper bench of the Main Waste Dump Expansion was started.

Figure 16**-1: MVFES2 front face (looking west) recontoured at a maximum slope grade of 3:1.**

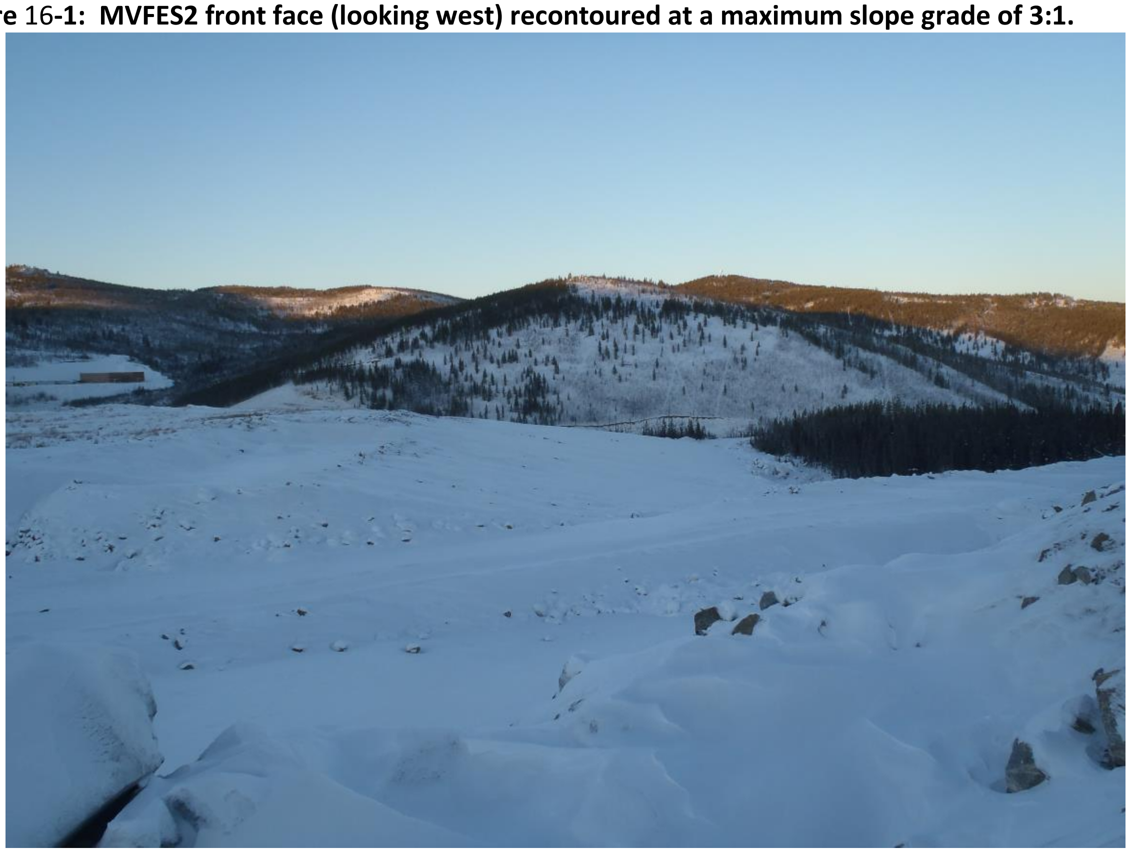


Figure 16**-2: DSTSF east slope (looking north) recontoured at a maximum slope grade of 4:1.**

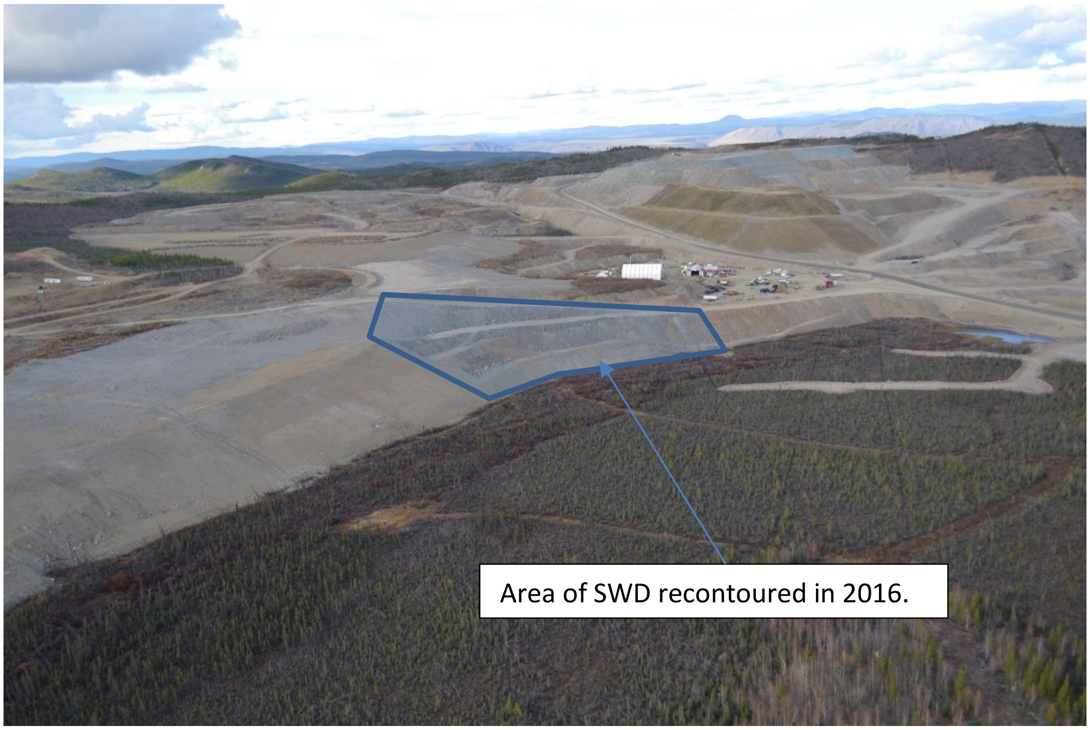


Figure 16-3: SWD area recontoured highlighted (looking north-west).

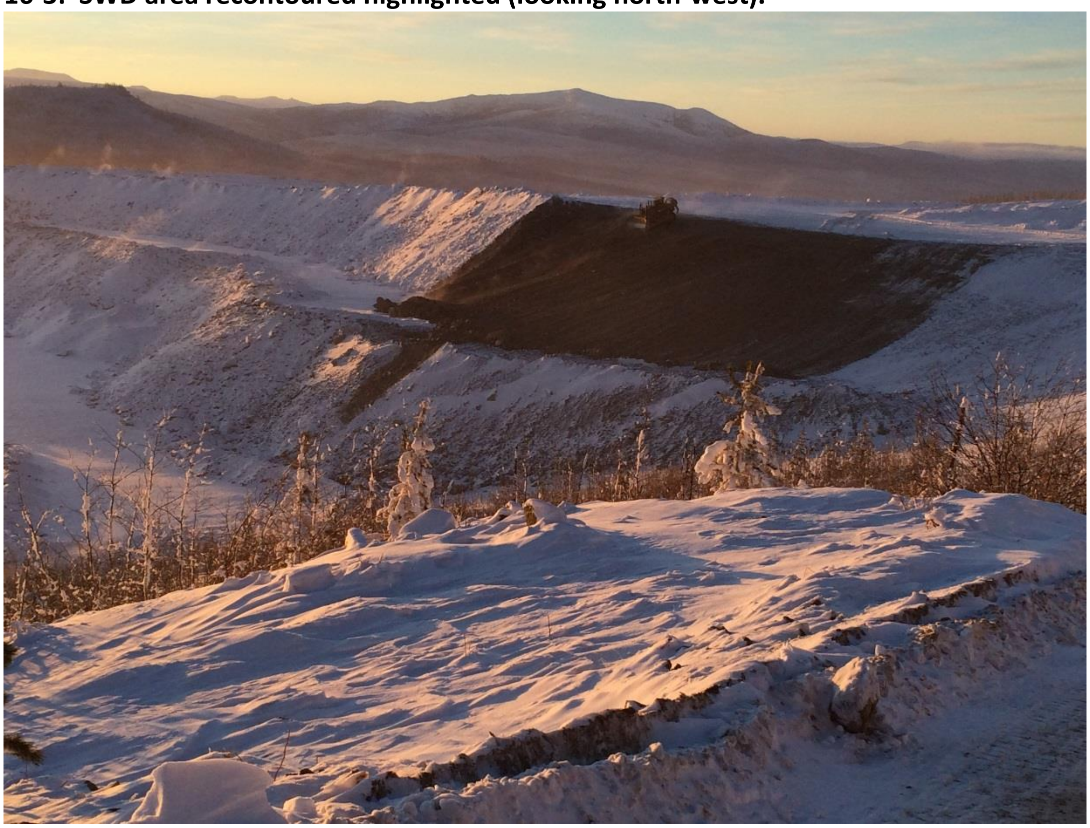


Figure 16-4: Main Waste Dump Expansion (looking west) top bench being recontoured in 2016.

16.2 Mill Valley Fill Stage 2

Minto began construction on the Mill Valley Fill Extension Stage 2 which is designed to arrest the movement of the Dry Stack Tailing Storage Facility in late 2015. The drainage blanket of the Mill Valley Fill Stage 2 was completed in March 2016. The remaining material (bulk fill) was placed until the completion of the Mill Valley Fill Stage 2 in August 2016. The total as-built volume is 1.391 Mm^3. The as-built report was submitted to EMR and the YWB in November 2016. Figure 16-5 below shows the final as-built surface.

Figure 16-5: As-built surface of the Mill Valley Fill Stage 2 Extension.

16.3 2016 Reclamation Research

Reclamation research in 2016, focused primarily on carryover research on passive treatment technologies which started in 2014 and carried through 2015.

16.3.1 Passive Water Treatment

The primary focus of the passive water treatment research in 2016, was the continual operation of the demonstration scale wetland. This commissioning period is being used to collect additional information about the on-site demonstration-scale CWTS that will aid in the final full-scale CWTS design, sizing, and construction. Table 16-1 below, summarizes the work completed in relation to the demonstration scale constructed wetland. Table 16-2 below, summarizes all of the key findings of the research that was completed in 2016. All full detailed report can be found in Appendix T.

Table 16-1: Demonstration Scale Constructed Wetland 2016 Work Summary

Item	Date	Activities	Actual
Construction	June 1-14 2014	Identify potential location for demonstration scale CWTS (Contango site visit – 1 scientist)	Completed
	June - July 2014	Engineering and geotechnical (Minto)	Completed
	July 2014	Construction (Minto)	Completed
	August 2014	Planting and bringing system online (Contango site visit – 1 scientist, 1 technologist), coordinate for local students to assist	Completed (no students available, brought 2 technologists)
Commissioning A	2014	Acclimation and maturation at constant flow rate, ~20 hr HRT	Completed
		September - Contango site visit/checkup (1 technologist, 1 scientist)	Did not occur because construction was last week of August
	2015	Continued commissioning. Operation at constant flow rate, ~20 hr HRT	Completed (at shorter HRT)
		Spring – Contango site visit/checkup (1 technologist, 1 scientist), includes micro sampling	Completed
		Summer - Increase depth from 10 cm to 20 cm (1 technologist), includes micro sampling	Completed (scientist)
		Fall – Contango site visit/checkup (1 technologist), includes micro sampling	Completed (scientist)
	2016	Minto to add sandbags prior to first site visit and begin W15 creek monitoring	Completed May/June 2016
		Spring – Contango site visit (1 scientist, 1 technologist), includes microbial sampling and tasks outlined in Table 5 of report. HRT tracer study completed, outlined in section 7 of report.	Completed June 2016
		Summer - Contango site visit/checkup (1 scientist, 1 technologist), includes microbial sampling and tasks outlined in Table 5 of report. Evapotranspiration study completed as outlined in section 9 of report. Organics were added to the CWTS as outlined in section 5.1 of report.	Completed July 2016
Commissioning B[1]		Fall - Contango site visit/checkup (1 technologist), includes microbial sampling and tasks outlined in Table 5 of report	Completed September 2016

Table 16-2: Passive Water Treatment Research Key Findings (2015-2016)

Objective	Purpose	Key Findings or Changes for Full-scale
Evaluate construction	Optimize construction and effectiveness of operation of full-scale systems	**Layout** -Outflow collection pond should have outflow at base (not top), with shutoff valve. -In 2016 sandbags were added at shores to prevent water short circuiting. Sandbags were also added to the outflow of series 1 to increase water depth.
		Soils -Use substrate with less total and leachable metals and metalloids (especially copper). -Higher sand content would improve hydrology, constructability (ability to level soils, ease of planting) and accessibility for sampling. -Organics should be mixed in bulk to soils prior to adding to cells.
Assess commissioning timelines	Allow for proper phasing of implementing full-scale systems for closure	**Water** -Commissioning-A period was complete at the end of July 2016 and the commissioning-B period (addition of organics to remediate the copper in substrates used) began July 29, 2016 and is ongoing. -Copper is being treated by the CWTS, and during the commissioning-B period the average influent concentration decreased by 37% compared to the average outflow concentration. -The wetland is achieving better treatment than suggested by inflow and outflow concentrations of the system, as soils are leaching aluminum and copper into the water. -Cadmium and zinc are also being treated in the CWTS, and during the commissioning-B period, the average outflow concentrations were 64% and 69% lower than average influent concentrations respectively. - Molybdenum and selenium experienced notably greater treatment after during the commissioning-B period. The average outflow concentrations were 21% and 41% lower than average influent concentrations respectively. -The wetland is maturing as expected and is performing beyond anticipated based on the design. - Cadmium, copper, molybdenum, and selenium % removal and *k* rates are increasing over time. Zinc % removal is increasing over time. - HRT tracer study conducted in 2016 assessed hydrology and pore volume incorporation of the CWTS and determined HRT and removal rate coefficients for full-scale sizing. Rate coefficients should be re-evaluated after commissioning-B is completed. -Evapotranspiration study conducted to determine amount of evapotranspiration occurring in the CWTS in warmer months and to incorporate into load removal models. Due to rain the results were inconclusive and should be redone in 2017.
		Soils -Soil redox not consistently reaching targeted ranges by July 2016 therefore organics were added to stimulate desired reducing conditions, which marked the end of commissioning-A and the beginning of commissioning-B. -Cell 2B consistently reaching targeted ranges by the end of 2016. -In 2015 significant amounts of metals were leaching from soil substrate into water, putting additional treatment demands on

Objective	Purpose	Key Findings or Changes for Full-scale
		system. In 2016 the amount of metals leaching from soil substrate into the water has decreased.
		Microbes -Sulphide-producing bacteria needed for copper and other metals removal have increased through the commissioning period as soil redox approached targeted ranges. Proportions are comparable to those in pilot system at similar points in commissioning. After the addition of organics which marked the end of the commissioning-A period and the beginning of the commissioning-B period, sulphide-producing bacteria continued to increase, especially in the soil and roots in the B cells. -Abundance of selenium- and nitrate-reducing organisms are similar to those in pilot testing, indicating maturation as expected. -Selenium treatment performance increased through the commissioning period as mosses continued to grow, as they can sorb dissolved selenium and harbour highest abundance of selenate-reducing microorganisms to render the selenium insoluble. After the addition of organics which marked the end of the commissioning-A period, selenium-reducing bacteria were also associated with the added organic material once it started decomposing. Therefore the CWTS has established beneficial selenium reducing bacteria in several areas of the wetland (moss, detritus, roots, and soil).
Carex aquatilis transplantation effectiveness	Determine if plant propagation and/or replanting schedule will be needed for full-scale systems	->95% survival from transplanting. -Within first 2 months a further increase of >20%. -Full-scale system could be planted more densely to bring online faster, or less densely if time is less of an issue than sourcing plants (the plants are vigorous and will fill in the wetland in due time). - By the end of 2016 the plants had densely filled in the CWTS and transplanting was considered a success.
Moss colonization/distribution		-100% survival from transplanting. -Slower to spread, needs to be started more densely. -Staking helps maintain moss in 'upstream' parts of wetland, or could be transplanted multiple times through commissioning period. - Moss continued to mature in 2016 and does not appear to require additional transplanting.

16.4 Proposed Reclamation for 2017

Proposed reclamation for 2017 includes the following:

- Placement of soil cover on the Mill Valley Fill Stage 2 Extension;
- Placement of soil cover on the Dry Stack Tailings Storage Facility;
- Placement of soil cover on the Southwest Waste Rock Dump;
- Placement of soil cover on the Main Waste Dump (including extension);
- Minor recontouring work as required;
- Phase 1 seeding of soil cover; and
- Continuation of the Passive Treatment Water Research.

17 Socio-Economic Monitoring Program

The Minto Mine Socio-Economic Monitoring Program defines a framework for monitoring direct and indirect socio-economic effects from the Minto Mine. In 2016, as per the framework, Minto tracked and collected administrative data and other information relating to the mine's direct employment, training and procurement; worker safety; and Minto contributions to cultural well-being and community wellness. The 2016 socio-economic data which Minto tracked is summarized in Appendix U.

In 2016 the Socio-Economic Tripartite group, comprised of the Yukon Government, SFN and Minto representatives published the first annual (2014) Minto Mine Socio-economic Monitoring Program report.

18 Closure

Minto trusts this document fulfills the 2016 annual reporting requirements of Minto Mine's WUL and QML.

19 References

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