Minto Mine

Water Licence QZ14-031

Quartz Mining Licence QML-0001

2015 Annual Report

Prepared by:
Minto Explorations Ltd.
Minto Mine

March 2016

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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 2015 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 (2015)

Licence	Section	Clause	Requirement
WUL QZ14-031			
WUL QZ14-031	16		Summary of the review of the *Spill Contingency Plan* including any changes needed.
WUL QZ14-031	18		Summary list of all spills for 2015.
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 Ito December 31 of each year.
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.
		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.
		c	A record of any major maintenance carried out on any physical works.
		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.

Licence	Section	Clause	Requirement
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.
		f	Details of updates to the Water Balance and Water Quality Model.
		g	Results and interpretations of the QA/QC Program.
		h	Any other reports that are required to be submitted as part of the Annual Report by this Licence.
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
WUL QZ14-031	86		The Licensee shall include data relating to the Surface Water Surveillance Program in the Monthly and Annual Reports.
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.
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.
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.
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.
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.
	99	b	The Licensee shall submit these Geotechnical Engineer's Inspection and Data Reviews as part of the Annual Report.

Licence	Section	Clause	Requirement
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.
WUL QZ14-031	104		Results and interpretations of the QA/QC program shall be provided in the Annual Report.
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.
		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.
		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.
		d	Updated predictions for operations and Permanent Closure water quality, including discussion of any variances identified and associated implications on site water management.
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.
WUL QZ14-031	114	a	Annual reporting on reclamation research activities.
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

Licence	Section	Clause	Requirement
QML-0001	D (Site Activities)	a	Summary of construction activities associated with the Undertaking
		b	Summary of mining activities
		c	Map showing the status of all structures, works, and installations associated with the Undertaking
		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
		e	Total amount and the average head grade of ore milled
		f	Total amount of concentrate produced and removed from the Undertaking
		g	Total amount of tailings deposited in each of the tailings facilities
		h	Total amount of waste rock removed from the mine and the amount deposited into each deposit location
		i	Total amount of waste rock stored in each waste rock storage facility;
		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
		k	Summary of any updates to estimates of ore reserves and the life of the mine, including reserve category, tonnage and grade
		l	Total amount and the average grade of each ore stockpiled
		m	remaining reserve life of the mine
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
		b	as-built drawing report of the 220 kW vertical stirred mill rougher/scavenger concentrate regrinding system the year following the installation
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
		b	any update to the *Site Characterization Report* referred to in 13.1of QML-0001
		c	summary of invasive plants that have been identified on site and measures taken to control or remove invasive plants
		d	summary of spills and accidents that occurred at the site and measures taken respond to any spills or accidents
		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

Licence	Section	Clause	Requirement
QML-0001		f	summary of any site improvements undertaken to address sediment and erosion control
QML-0001	D (Physical Monitoring)	a	summary of any underground stability incidents
		b	summary of data collected to date as part of the Physical Monitoring Program
		c	details of results, including data collected, for the physical monitoring program
QML-0001	D (Reclamation and Closure)	a	any temporary closure or permanent closure that has occurred during the year
		b	summary of activities related to care and maintenance of the Undertaking, including any temporary closure activities if applicable
		c	summary of progressive and ongoing reclamation activities
		d	summary of proposed development and production and reclamation activities for the coming year
		e	summary of reclamation research and results
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')
		b	a copy of the annual report prepared by Minto Explorations Ltd., identified in paragraph 6.1 of the Framework
		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

Licence	Section	Clause	Requirement
QML-0001		f	summary of any site improvements undertaken to address sediment and erosion control
QML-0001	D (Physical Monitoring)	a	summary of any underground stability incidents
		b	summary of data collected to date as part of the Physical Monitoring Program
		c	details of results, including data collected, for the physical monitoring program
QML-0001	D (Reclamation and Closure)	a	any temporary closure or permanent closure that has occurred during the year
		b	summary of activities related to care and maintenance of the Undertaking, including any temporary closure activities if applicable
		c	summary of progressive and ongoing reclamation activities
		d	summary of proposed development and production and reclamation activities for the coming year
		e	summary of reclamation research and results
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')
		b	a copy of the annual report prepared by Minto Explorations Ltd., identified in paragraph 6.1 of the Framework
		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

capstone
MINTO MINE

MINTO MINE

WATER LICENSE
QZ14-031/QML-0001
2015 ANNUAL REPORT

FIGURE 1-1
CURRENT CONDITIONS

MARCH 2016

1:13,500 *when printed on 11 x 17 inch paper*

0 50 100 200 300 400 500 Meters

ALEXCO ENVIRONMENTAL GROUP

Aerial imagery obtained from Challenger Geomatics.
Imagery acquired September 9th 2014.

Datum: NAD 83 Projection: UTM Zone 8N

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(*Last edited by: mducharme;2016-03-15/09:37 AM*)

MINTO MINE

WATER LICENCE QZ96-006/QML-0001 2014 ANNUAL REPORT

FIGURE X

CURRENT CONDITONS

MARCH 2015

capstone MINTO MINE

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when printed on 11 by 17 inch paper

0 125 250 500 750

Meters

ACCESS

Aerial imagery obtained from Challenger Geomatics. Imagery acquired September 9th 2014.

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2 Site Activities

Operation of the Minto Mine continued in 2015, with the production of 36.4 million pounds (Mlb) of copper from the milling of 1.39 million tonnes (Mt) of ore.

Surface mining for the year totaled 2.04 M bank cubic meters (BCM). Between January and May 2015, 74,000 BCM of material was mined from the Area 2 pit. These activities recovered ore from beneath the pit's access ramp, and from the pillars between the pit and the adjacent M-zone underground that had been completed in 2014. In August, mining of Minto North pit began with construction of an access road, removal and stockpiling of topsoil from within the pit footprint, and stripping of waste rock and soil overburden. The first ore release from the pit was seen in November.

Underground mining of the Area 118 zone in the Minto South Underground continued, having been resumed after the completion of M-zone in late 2014.

Waste rock produced from mining activities was hauled to various waste rock dumps 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. The year saw Minto process a substantial quantity of partially oxidized ore stockpiled from mining of the Main and Area 2 pits.

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

2.1 Exploration

No exploration drilling occurred at Minto in 2015; however, a program of in-fill drilling aimed at upgrading some of Minto's probable reserves to proven reserves continued from 2014. The two areas targeted were the Area 2 Stage 3 pit footprint and the Area 118 UG ore zone. A total of 4,071 metres (m) of core drilling in 21 holes was completed in the first quarter of the year.

One geotechnical hole, measuring 329 m and targeting the Minto East underground zone, was completed in December.

In July, Minto undertook a program of underground diamond drilling with 453 m in 12 holes, all aimed at delineating a vertically plunging part of the Area 118 zone.

2.2 Infrastructure and Construction Projects

To access the Minto North pit, Minto constructed a haul road from the Main Waste Dump to the Minto North pit. The maximum grade of the road was designed at 10% and the haul road follows the topography in the area closely. The haul road surface was first grubbed with material set aside for reclamation purposes at a later date. Road material was utilized from the earliest benches of the Minto North pit. The haul road was constructed with a cut and fill design with all material following specifications as outlined in Minto's licences.

2.3 Mining Activities

Section 2.3 discusses the mining activities for 2015 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 late 2014, after the completion of the M-Zone underground mining project, Minto began a project to recover remnant ore from beneath the pit's access ramp, and from the pillars between the pit and the underground workings. This work continued until May of 2015, releasing 12,000 BCM of waste rock and 62,000 BCM of ore within the calendar year.

In August 2015, mining of Minto North pit began with construction of an access road, removal and stockpiling of topsoil from within the pit footprint, and stripping of waste rock and soil overburden. The first ore release from the pit was seen in November.

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 (2015)

	Waste / Overburden (BCM)	Ore (BCM)	Ore (t)
Area 2 Pit	11,978	62,465	170,782
Minto North Pit	1,882,778	80,224	212,632
Totals	**1,894,756**	**142,689**	**383,414**

2.3.2 Underground Mining

After completion of the M-Zone in 2014, mining activities resumed in the Minto South Underground complex. Production began in the 118 zone and ran continuously throughout 2015, producing 457,000 tonnes of ore and 100,000 tonnes of waste rock.

2.3.3 Waste Rock Management

Waste rock dump development continued in 2015, as per the *Minto Mine Waste Rock and Overburden Management Plan*. Table 2-2, below, 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 (2015)

Material Type	Destination	BCM
Waste Rock - Low-grade	Mill Valley Fill Extension 2 (MVFE2)	131,997
Waste Rock - Mixed	Main Waste Dump Expansion (MWDE)	1,652,378
Waste Rock - SAT	Main Pit South Wall Buttress	82,420
Waste Rock - Mixed	Area 2 Backfill	2553
Total		**1,869,348**

Table 2-3: Waste Dump Location and Storage Volumes (2015)

Dump Location	Quantity Stored as of December 31, 2014 (m3)
Main Pit Buttress	4,072,754
Southwest Dump	12,117,903
Mill Valley Fill Extension	1,441,040
Reclamation Overburden Dump	4,304,347
Main Waste Dump	8,168,182
Main Waste Dump Expansion	1,652,378
Mill Valley Fill Extension 2	131,997
Total Waste Dumped	**31,888,601**

2.3.4 Tailings Management

The year began with the deposition of slurry tailings into the Main Pit Tailings Management Facility (MPTMF). The first tailings were deposited to the Area 2 Pit Tailings Management Facility (A2PTMF) in 2015. The following table lists the deposition schedule.

Table 2-4: Tailings Deposition Schedule in 2015

Tailings Management Facility	Date Range	Quantity Deposited (dry metric tonnes)
MPTMF	Jan 1 – Mar 20	281,000
A2PTMF	Mar 21 – Jun 15	323,000
MPTMF	Jun 16 – Jul 18	125,000
A2PTMF	Jul 19 – Dec 31	610,000
Total 2015 Tailings		**1,340,000**

A total of 1,340,000 dry metric tonnes (dmt) of tailings were discharged to the two pits in 2015, 30% of which went to the MPTMF and 70% to the A2PTMF. Since November 2012, the Main Pit has received 3,347,000 tonnes of tailings.

Deposition to the A2PTMF was 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 734.9m. A small beach has formed beneath the deposition point.

Prior to the 2015 freshet season, Minto installed a pipeline and pump system to transfer water from the MPTMF to the A2PTMF. Over the four-day period between March 23 and March 27, the system was used to move 146,000 m^3 of water (average rate of 37,000 m^3/day).

In mid-June, 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.

Deposition in the MPTMF was from a point near the middle of the pit via a floating tailings line. This year saw the appearance of a tailings beach around the discharge point as the water level dropped. The highest point of the tailings beach is at 787.5m elevation. At year-end, the water level was measured at 786.2 m, as compared to the reading one year prior at 787.0 m.

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 end-of-pipe temperature, combined with the erosive effect of the tailings stream, melts through the ice at the discharge point.

As per the *Tailings Management Plan*, a bathymetric survey of the pit was completed in May 2015, with the goal of mapping the tailings surface. The survey succeeded in building a consistent profile of the tailings / water contact; in combination with a surface survey of the exposed tailings beach, Minto has estimated that the settled density of the tailings deposit in the MPTMF is 1.38 t/m^3 (dry density).

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 2015. 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.

- North stockpile – setup location for Minto's secondary crushing contractor. Storage location for ore grading more than 2.0% Cu.
- West stockpile – sulfide ore grading 1.0% - 2.0% Cu.

- East stockpile – partially oxidized ore from Area 2 and Stage 5 of the Main Pit.
- South stockpile – sulfide ore grading 0.5% - 1.0% Cu.
- Oxide stockpile – partially oxidized ore from the Main Pit.
- Low-grade ore / blue stockpile – sulfide ore grading 0.5% - 1.0% Cu.

In addition to the above, which are used for temporary storage of ore, Minto maintains a stockpile of several ore types at the crusher, 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 (2015)

	December 31, 2014			December 31, 2015		
	Mass (tonnes)	Cu (%)	Ag (g/t)	Mass (tonnes)	Cu (%)	Ag (g/t)
Red	0	-	-			
Yellow	0	-	-			
Green	2,554	1.32	4.26	41,839	1.24	519
Blue	326,297	0.66	2.08	92,121	0.68	624
POX	345,646	1.11	3.03	94,439	0.95	897
LG POX	55,389	0.65	1.11			
Portal Ore Pad	390	2.36	6.82	24,364	2.22	541
Live Pile	19,728	0.89	2.70	22,660	1.13	256
Total Ore	**750,004**	**0.88**	**2.47**	**275,423**	**1.03**	**2,837**

Figure 2-1: Minto Ore Stockpiles (2015)

2.3.6 Operating Results

Ore processing and metal production results for the 2015 calendar year are summarized in Table 2-6, below.

Table 2-6: Operating Results (2015)

Metal Production	Quantity
Copper (t)	16,515
Gold (kg)	501,212
Silver (kg)	5,302,936
Ore Milled	
Ore processed (t)	1,387,958
Copper grade (%)	1.38
Gold grade (g/t)	0.49
Silver grade (g/t)	4.97
Recoveries	
Copper (%)	86.2
Gold (%)	73.6
Silver (%)	76.9
Concentrates Produced	
Copper concentrate (dmt)	45,703.0
Copper (%)	36.1
Gold (g/t)	10.97
Silver (g/t)	116.03

2.3.7 Concentrate Shipments

Minto produced 50,857.4 metric tonnes of concentrate at 10.14% moisture content, which corresponds to 45,703.0 dmt. The average concentrate grades are listed in Table 2-6, above. 1140 truckloads of concentrate were shipped from Minto in 2015: 531 via the winter ice bridge and 609 during the summer barge season.

2.4 Mine Access Road

2.4.1 Traffic

From January 1 to April 10th 2015, access across the Yukon River was over an ice bridge during which time, 1,462 heavy vehicles and 753 light vehicles travelled across the ice bridge. Between April 10th to June 5th, 2015 there was no land access to the mine site. On June 5th, 2015 the summer tug and barge operation started for the season. During the barge operating season, 2,001 heavy and 1,567 light vehicles accessed the Minto Mine via the mine access road. The barge operating season ended November 9, 2015. Establishment of the 2016 ice bridge started in December 2015.

2.4.2 Access Control Issues

No access control issues were experienced in 2015.

2.4.3 Planned Access Road Maintenance for 2016

Beyond routine maintenance work, no major projects or upgrades are planned for 2016 with regard to the access road.

2.5 Accidents and Incidents

2.5.1 Incidents

In 2015, Minto Mine experienced, 0 loss time accidents, fifteen medical aids and eight 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 2015. The first incident was a hare that had been run over by a vehicle on the Access Road on March 28, 2015. The second communication with the Conservation Officer was due to a dead calf moose being discovered on bench in the Main Pit on April 25, 2015. The moose was badly decomposed and it had likely been on the bench for some time; it is not known how the calf moose got on to the bench.

2.5.3 Reportable Spills

In 2015, three reportable spills occurred at Minto Mine, summarized in Table 2-7, below.

Table 2-7: Reportable Spills (2015)

Date	Volume (L)	Substance	Cause
August 4, 2015	200	Diesel	A cracked fitting in the generator fuel tank cause the tank to spill fuel. An inspection had been completed in previous 24 hours but cracked fitting was not found during the inspection.
August 13, 2015	10	Waste Oil	In the process of pumping waste oil storage tank to drums, the pumping movement of the system forced the delivery end of the hose to work its way out of the bung hole of the barrel, causing a spill. The direct cause of the accident was failure to secure the delivery end of the hose.
September 22, 2015	1200	Emulsion	At 13:00 an underground boom truck was being used to load a tote of emulsion onto the truck bed. The operator could not lift the tote to truck deck and tried to move it around the back of the truck. In doing so, the tote began to drag on the ground, causing it to spin and the chains to loosen, thus tipping the tote over.

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, utilizing spills pads, soil excavation, soil treatment in the LTF, and in-situ remediation treatment aided by 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 2016 Minto Mine Spill Contingency Plan is provided in Appendix A.

3 Proposed Mining for 2016

Section 3 discusses the proposed mining for 2016 at the Minto Mine, including open pit and underground mining.

3.1 Proposed Open Pit Mining for 2016

2016 will see the completion of Minto North pit. The exact completion date will depend on productivity and operational decisions but it is expected to be in fall, 2016.

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 2016

Underground mining is currently expected to finish in April 2016 with the completion of the Area 118 zone. Further zones beyond Area 118 are being evaluated for economic viability.

4 Mineral Reserves and Mine Life

Minto Mine’s 2015 updated mineral resources and reserves were not published at the time of writing this report and as such there is no update from the 2014 reserves and therefore mineral reserves and mine life are not included in this report.

5 Environmental Monitoring

Environmental monitoring programs are outlined in the *Environmental Monitoring, Surveillance and Reporting Plan* (EMSRP) and the results for the monitoring conducted in 2015 are provided in this section. These programs include the water monitoring program, geochemical monitoring program, meteorological monitoring program, physical monitoring program, aquatic environmental monitoring program, terrestrial environmental monitoring program, and quality assurance and quality control program. Where possible, the 2015 results have been compared to historical results to identify trends and compare 2015 values with previous values

5.1 Surface Water Surveillance Program

Details of the Surface Water Surveillance Program, including sampling station locations and monitoring frequency, are outlined in the EMSRP 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 WTP. The WUL water quality objectives were compared to the water quality result statistic summary at station W2.

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 and Figure 5-1, below. All surveillance monitoring sites in use in 2015 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 Monitoring Site Descriptions and UTM Coordinates (2015)

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	Upgradient of South Diversion Ditch	385351	6944072
W35	South Diversion Ditch	385223	6944427
W36	Minto Creek detention structure (MCDS)	385892	6945191
W37	100 m downstream of MCDS (W36 collection sump) and upstream of Water Storage Pond	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

Station	Description	UTM Coordinates – Zone 8	
		Easting	Northing
W51	Area 2 Stage 3 Pit	*	*
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.

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QZ14-031/QML-0001
2015 ANNUAL REPORT

FIGURE 5-1

SURFACE WATER SURVEILLANCE PROGRAM MONITORING STATION LOCATIONS

MARCH 2016

▲ Surface Water Surveillance Program Monitoring Station Locations

1:14,000 *when printed on 11 x 17 inch paper*

0 250 500
Meters

ALEXCO ENVIRONMENTAL GROUP

Aerial imagery obtained from Challenger Geomatics. Imagery acquired September 9th 2014. Hydrology data provided by Minto Explorations Ltd, May 2009.

Datum: NAD 83 Projection: UTM Zone 8N

D:\Project\AllProjects\Minto\gis\mxd\Reports\Annual_Report\2015-2016\Fig5-1_WQ_20160329.mxd
(*Last edited by: amatlashevska; 3/29/2016/10:05 AM*)

5.1.1 Monitoring Conformance

2015 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 5.14.

Table 5-2: Water Quality Sampling Monitoring Conformance Summary (2015)

Site Name	2015 WQ sampling events*	2015 Reason(s) for non-conformance events
W1	N/A	N/A
W2	35	Seasonal conditions (site dry and / or frozen).
W3	103	Sampled as per schedule.
W4	35	Sampled as per schedule.
W5	32	Site inaccessible for 3 weeks. Sampled as per schedule otherwise.
W6	6	Seasonal conditions (site frozen).
W7	10	Seasonal conditions (site dry and / or frozen).
W8	0	Site dry and / or inaccessible for all of 2015.
W8a	46	Site dry or inaccessible for parts of 2015. Sampled as per schedule otherwise.
W10	8	Seasonal conditions (site dry and / or frozen).
W12	13	Sampled as per schedule.
W12A	0	No discharge from W12A in 2015.
W14	12	Sampled as per schedule.
W15	74	Seasonal conditions (site dry and / or frozen).
W16	53	Seasonal conditions (site frozen and / or unsafe) and human error.
W16a	15	Sampled as per schedule.
W17	108	Sampled as per schedule.
W30	8	Seasonal conditions (site dry and / or frozen).
W33	5	Seasonal conditions (site dry and / or frozen).
W35	72	Seasonal conditions (site dry and / or frozen).
W36	12	Sampled as per schedule.
W37	4	Site conditions (site dry).
W45	8	Site conditions (site unsafe).
W46	11	Seasonal conditions (site frozen).
W47	6	Site conditions (site dry and / or unsafe).
W50	9	Site conditions (site dry).
MC-1	40	Seasonal conditions (site dry and / or frozen).
WTP	29	Water was treated from the Water Treatment Plant including the RO in 2015. No treated water was discharged directly to Minto Creek, rather all treated water was conveyed first to the Water Storage Pond. Sampling was only conducted when water was being treated and conveyed to the Water Storage Pond.
RO		
W51	0	Site not established.
W52	0	Site not established.

Site Name	2015 WQ sampling events*	2015 Reason(s) for non-conformance events
W53	0	Site not established.
W54	0	Site not established.
W55	0	Site dry.
C4	4	Seasonal conditions (site frozen).
C10	2	Seasonal conditions (site frozen).
MN	2	Sampled when water present.
MN-0.2	4	Seasonal conditions (site frozen).
MN-0.5	4	Seasonal conditions (site frozen).
MN-1.5	3	Seasonal conditions (site frozen).
MN-2.5	5	Seasonal conditions (site frozen).
MN-4.5	3	Seasonal conditions (site frozen).
UG1	35	Sampled as per schedule.

5.1.2 W2 – Minto Creek at Lower Road Crossing Water Quality

Station W2 2007 to 2015 water quality result statistics are summarized in Table 5-3, below. Thirty-five routine samples were collected from station W2 during the 2015 monitoring period. The station W2 2007-2015 copper, aluminum, cadmium and selenium concentrations are further displayed in Figure 5-2 and

*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 5-3.

Table 5-3: W2 Water Quality Results Summary (2007-2015)

W2	Water Quality Objective (WUL Clause 11)	2007 - 2014 Summary Statistics			2015 Summary Statistics		
Parameters		Mean	Min	Max	Mean	Min	Max
pH	6.0-9.0	8.1	7.03	8.46	8.19	7.67	8.33
TSS (mg/L)		57.6	0.5	2600	15.3	0.5	219
Nutrients (mg/L)							
Ammonia Nitrogen	0.25	0.0411	0.0005	**0.83**	0.0268	0.0057	0.09
Nitrate Nitrogen	9.1	1.8158	0.0025	**9.4**	0.182	0.01	1.38
Nitrite Nitrogen	0.06	0.0107	0.0005	**0.36**	0.0036	0.0025	0.025
Dissolved Metals (mg/L)							
Aluminum	0.1	0.0206	0.0015	**0.201**	0.0121	0.0057	0.0389
Arsenic	0.005	0.00051	0.0001	0.0018	0.00045	0.00025	0.00071
Cadmium	0.00015	0.000028	0.000005	**0.00104**	0.000007	0.000005	0.000055
Chromium	0.001	0.0007	0.0002	**0.0031**	0.0005	0.0005	0.0005
Copper	0.013	0.00328	0.001	**0.0227**	0.0025	0.00146	0.00651
Iron	1.1	0.1837	0.01	0.905	0.0891	0.0339	0.261
Lead	0.004	0.00011	0.00005	0.0009	0.0001	0.0001	0.0001
Molybdenum	0.073	0.00301	0.00018	0.015	0.0016	0.0012	0.0046
Nickel	0.11	0.0011	0.0002	0.004	0.0007	0.0005	0.0014

W2 Parameters	Water Quality Objective (WUL Clause 11)	2007 - 2014 Summary Statistics			2015 Summary Statistics		
		Mean	Min	Max	Mean	Min	Max
Selenium	0.0001	**0.00066**	0.00005	**0.0026**	**0.00013**	0.00005	**0.00049**
Zinc	0.03	0.0035	0.0005	0.02	0.0025	0.0025	0.0025

Bold values indicate exceedances of the WUL standards

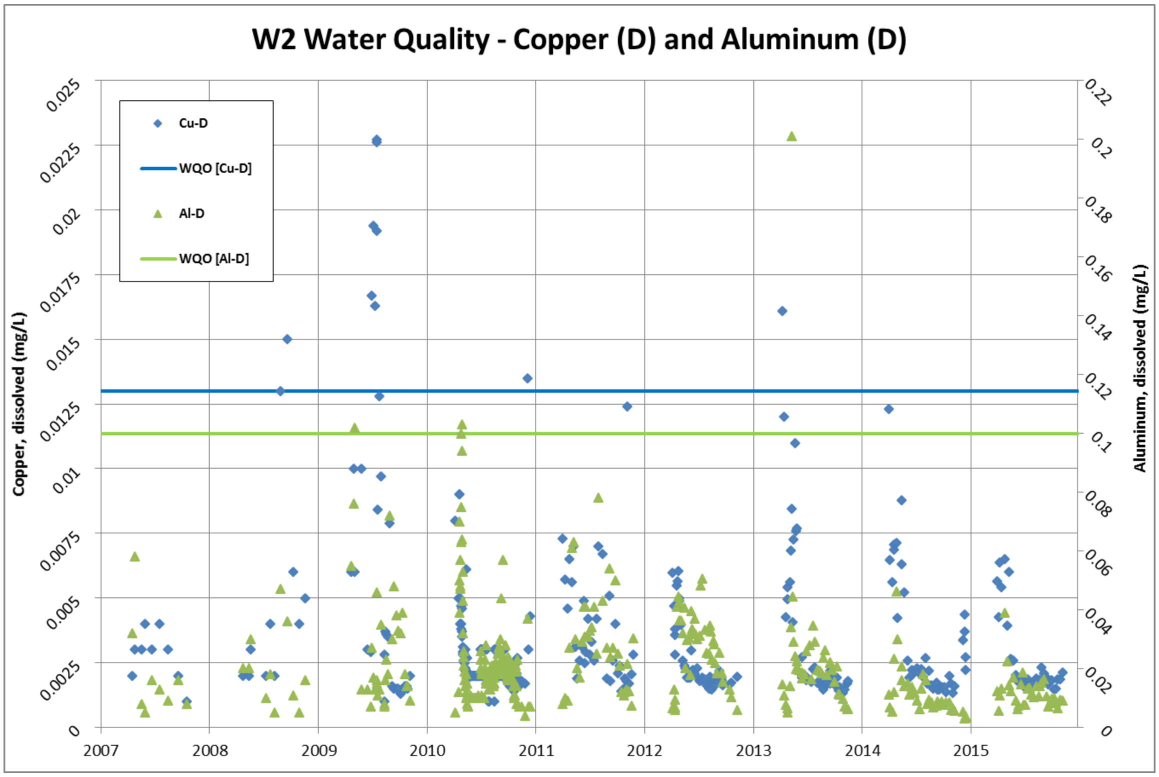
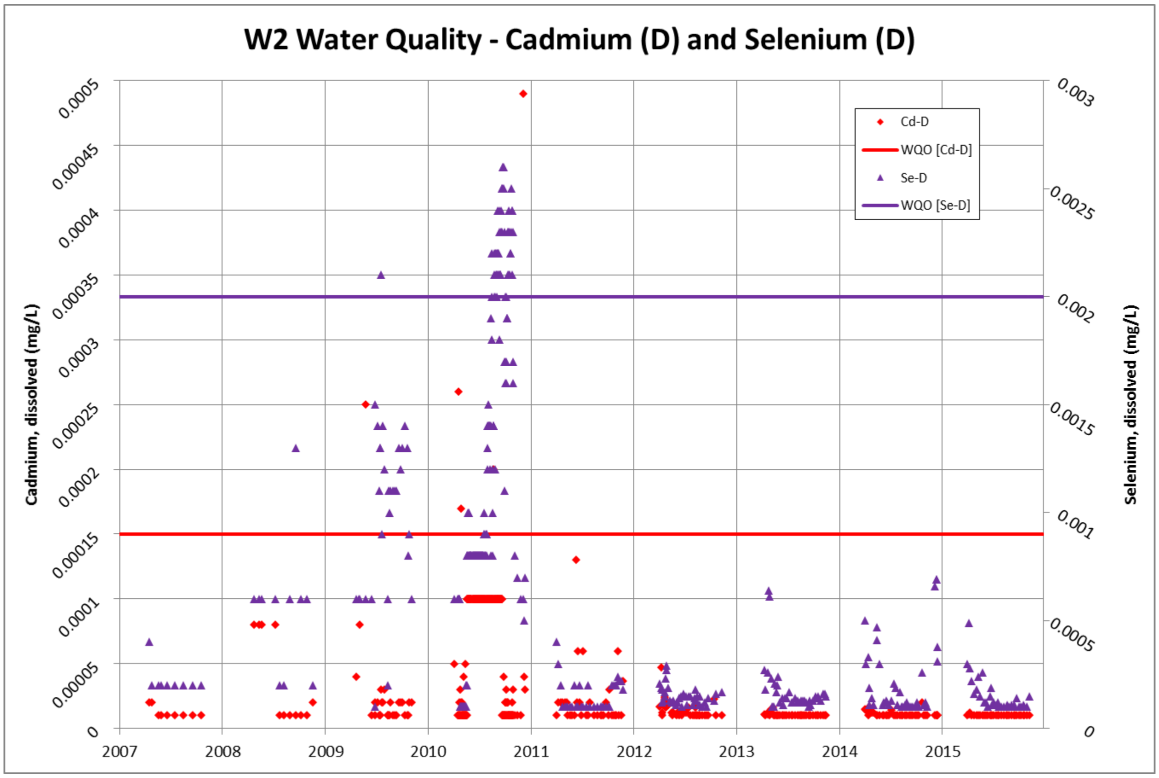


Figure 5-2: W2 Copper and Aluminum Concentrations (2007-2015)



*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 5-3: W2 Cadmium and Selenium Concentrations (2007-2015)

5.1.3 W3 – Minto Creek, at the Federal Metal Mining Effluent Regulations (MMER) Compliance Point

Station W3 2007 to 2015 water quality result statistics are summarized in Table 5-4, below. One hundred and three routine samples were collected from station W3 during the 2015 monitoring period. The station W3 2007-2015 copper, aluminum, cadmium and selenium concentrations are further displayed in Figure 5-4 and Figure 5-5.

Table 5-4: W3 Water Quality Results Summary (2007-2015)

W3	2007 - 2014 Summary Statistics			2015 Summary Statistics		
Parameters	**Mean**	**Min**	**Max**	**Mean**	**Min**	**Max**
pH	8.08	7.4	8.6	8.19	7.77	8.46
TSS (mg/L)	7.9	1	985	4.2	1	63.9
Nutrients (mg/L)						
Ammonia Nitrogen	0.0603	-0.01	0.62	0.047	0.011	0.62
Nitrate Nitrogen	3.275	0.02	18.7	0.643	0.084	2.93
Nitrite Nitrogen	0.052	0.001	4.13	0.0094	0.005	0.0474
Dissolved Metals (mg/L)						
Aluminum	0.0232	0.0024	0.373	0.0081	0.003	0.057
Arsenic	0.000359	0.00019	0.0014	0.00027	0.0002	0.00041
Cadmium	0.0010169	0.000005	0.565	0.000011	0.00001	0.000029
Chromium	0.00114	0.0001	0.004	0.001	0.001	0.001
Copper	0.00545	0.001	0.067	0.00426	0.00148	0.0177
Iron	0.0475	0.005	0.75	0.0311	0.0074	0.182
Lead	0.000295	0.000009	0.0603	0.0002	0.0002	0.00036
Molybdenum	0.00593	0.00066	0.103	0.0049	0.0032	0.0079
Nickel	0.001168	0.0005	0.006	0.0011	0.001	0.0026
Selenium	0.001078	0.0001	0.0348	0.0004	0.00005	0.00108
Zinc	0.00655	0.00067	0.143	0.0051	0.005	0.0082

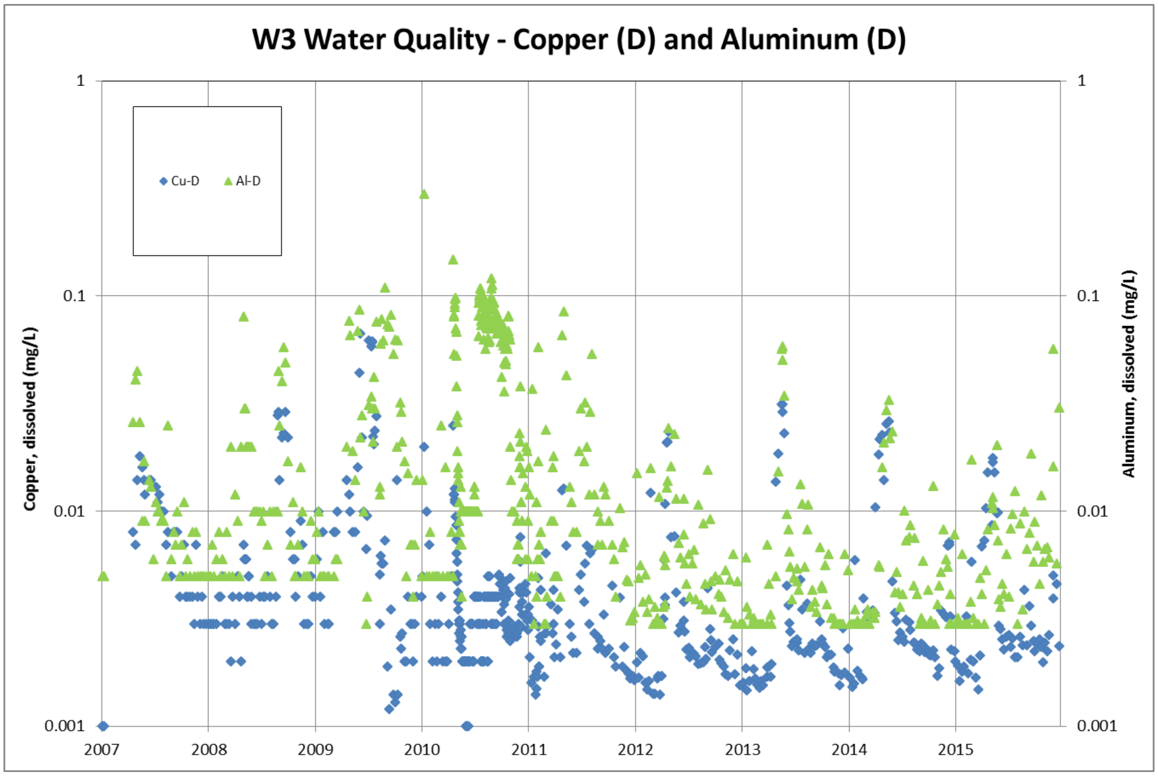


Figure 5-4: W3 Copper and Aluminum Concentrations (2007-2015)

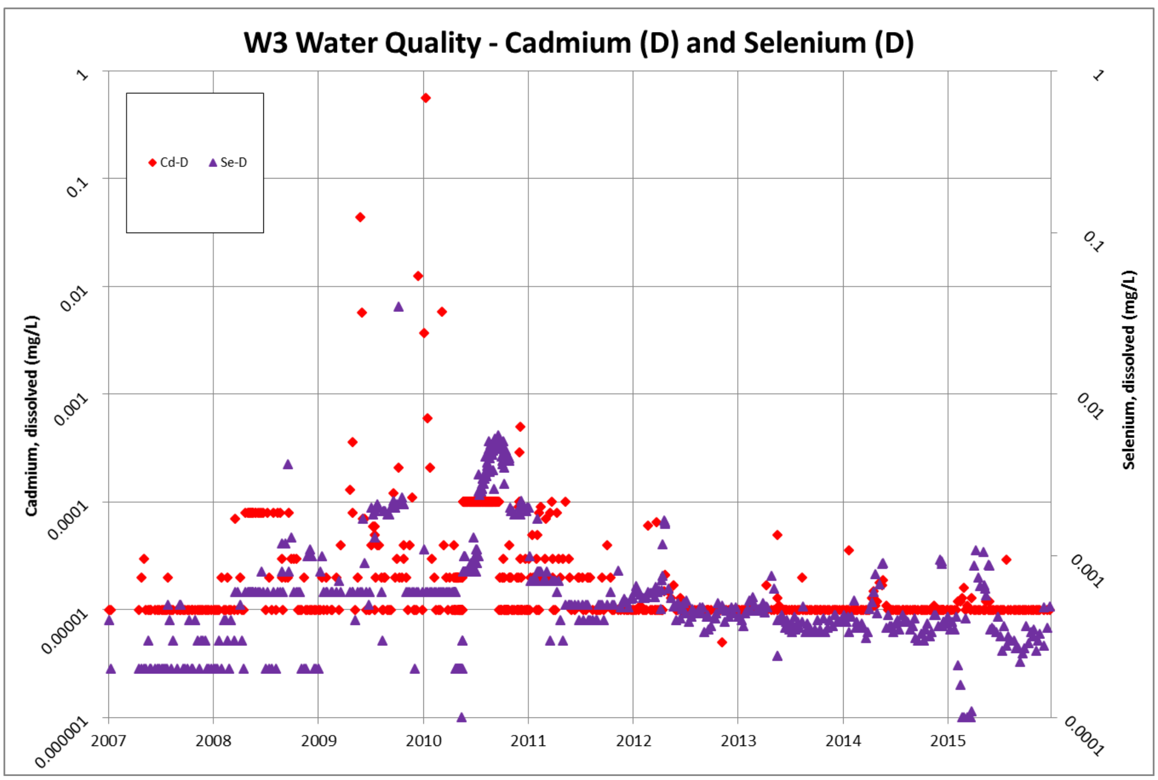


Figure 5-5: W3 Cadmium and Selenium Concentrations (2007-2015)

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

Station W4 2011 to 2015 water quality result statistics are summarized in Table 5-5, below. Thirty-five routine samples were collected from station W4 during the 2015 monitoring period.

Table 5-5: W4 Water Quality Results Summary (2011-2015)

W4	2011 - 2014 Summary Statistics			2015 Summary Statistics		
Parameters	**Mean**	**Min**	**Max**	**Mean**	**Min**	**Max**
pH	7.97	5.48	8.26	7.81	5.81	8.15
TSS (mg/L)	23.3	1	270	10.6	1	66.3
Nutrients (mg/L)						
Ammonia Nitrogen	0.0435	0.005	2.4	0.0155	0.005	0.035
Nitrate Nitrogen	0.081	0.02	0.849	0.057	0.02	0.153
Nitrite Nitrogen	0.0066	0.005	0.05	0.005	0.005	0.0061
Dissolved Metals (mg/L)						
Aluminum	0.015	0.003	0.167	0.009	0.003	0.0256
Arsenic	0.00046	0.0001	0.00105	0.00041	0.0001	0.0006
Cadmium	0.000019	0.00001	0.0014	0.00001	0.00001	0.00001
Chromium	0.001	0.001	0.002	0.001	0.001	0.001
Copper	0.00114	0.00031	0.004	0.00078	0.0002	0.00189
Iron	0.0406	0.0052	0.307	0.0206	0.005	0.0677
Lead	0.0002	0.0002	0.0004	0.0002	0.0002	0.0002
Molybdenum	0.0011	0.001	0.0021	0.0011	0.001	0.0013
Nickel	0.001	0.001	0.002	0.001	0.001	0.001
Selenium	0.00014	0.00005	0.00044	0.00014	0.00005	0.00023
Zinc	0.0052	0.005	0.0278	0.005	0.005	0.0062

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

Station W5 2011 to 2015 water quality result statistics are summarized in Table 5-6, below. Thirty-two routine samples were taken during the 2015 monitoring period.

Table 5-6: W5 Water Quality Results Summary (2011-2015)

W5	2011 - 2014 Summary Statistics			2015 Summary Statistics		
Parameters	Mean	Min	Max	Mean	Min	Max
pH	7.96	7.58	8.25	7.96	7.65	8.09
TSS (mg/L)	41.8	1	340	17.2	1	98.7
Nutrients (mg/L)						
Ammonia Nitrogen	0.0258	0.005	0.382	0.0228	0.0051	0.14
Nitrate Nitrogen	0.06	0.02	0.4	0.06	0.02	0.19
Nitrite Nitrogen	0.0068	0.005	0.05	0.005	0.005	0.005
Dissolved Metals (mg/L)						
Aluminum	0.0152	0.003	0.0588	0.0102	0.003	0.0299
Arsenic	0.00051	0.00036	0.00086	0.00044	0.00039	0.00052
Cadmium	0.000011	0.00001	0.000031	0.00001	0.00001	0.00001
Chromium	0.001	0.001	0.001	0.001	0.001	0.001
Copper	0.00139	0.00047	0.00694	0.00108	0.00053	0.00375
Iron	0.107	0.0108	0.712	0.023	0.009	0.119
Lead	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002
Molybdenum	0.0011	0.001	0.0015	0.0012	0.001	0.0018
Nickel	0.001	0.001	0.002	0.001	0.001	0.001
Selenium	0.00015	0.00005	0.00029	0.00016	0.00011	0.00024
Zinc	0.005	0.005	0.0082	0.0064	0.005	0.0355

5.1.6 W6 – Tributary on the North side of Minto Creek

Station W6 2007 to 2015 water quality result statistics are summarized in Table 5-7, below. Six routine samples were taken during the 2015 monitoring period.

Table 5-7: W6 Water Quality Results Summary (2007-2015)

W6	2007 - 2014 Summary Statistics			2015 Summary Statistics		
Parameters	**Mean**	**Min**	**Max**	**Mean**	**Min**	**Max**
pH	8.01	7.34	8.4	8.03	7.88	8.16
TSS (mg/L)	85.3	1	1160	91.3	1	301
Nutrients (mg/L)						
Ammonia Nitrogen	0.0574	0.005	0.5	0.023	0.017	0.032
Nitrate Nitrogen	0.41	0.01	8.09	0.026	0.02	0.037
Nitrite Nitrogen	0.0088	0.005	0.07	0.0053	0.005	0.007
Dissolved Metals (mg/L)						
Aluminum	0.0143	0.003	0.097	0.0095	0.0068	0.0148
Arsenic	0.00045	0.0002	0.001	0.00043	0.00038	0.00048
Cadmium	0.000046	0.00001	0.00023	0.00001	0.00001	0.00001
Chromium	0.0013	0.0004	0.002	0.001	0.001	0.001
Copper	0.00301	0.0008	0.043	0.00108	0.00095	0.00128
Iron	0.0631	0.01	0.2	0.0773	0.0543	0.112
Lead	0.00021	0.0001	0.0005	0.0002	0.0002	0.0002
Molybdenum	0.00156	0.00027	0.015	0.001	0.001	0.001
Nickel	0.0011	0.001	0.003	0.0011	0.001	0.0013
Selenium	0.0003	0.00005	0.002	0.00006	0.00005	0.00011
Zinc	0.0075	0.002	0.049	0.005	0.005	0.005

5.1.7 W7 – North Flowing Tributary to Minto Creek

Station W7 2007 to 2015 water quality result statistics are summarized in Table 5-8, below. Ten routine samples were taken during the 2015 monitoring period.

Table 5-8: W7 Water Quality Results Summary (2007-2015)

W7	2007 - 2014 Summary Statistics			2015 Summary Statistics		
Parameters	Mean	Min	Max	Mean	Min	Max
pH	7.97	5.74	8.41	7.9	5.51	8.3
TSS (mg/L)	32.8	1	400	32.2	1	161
Nutrients (mg/L)						
Ammonia Nitrogen	0.0381	0.005	0.34	0.0263	0.0051	0.045
Nitrate Nitrogen	0.114	0.02	0.324	0.086	0.02	0.196
Nitrite Nitrogen	0.019	0.005	0.14	0.005	0.005	0.005
Dissolved Metals (mg/L)						
Aluminum	0.0218	0.0031	0.096	0.0072	0.003	0.0109
Arsenic	0.00046	0.0002	0.001	0.00034	0.0002	0.00042
Cadmium	0.000035	0.00001	0.0001	0.00001	0.00001	0.00001
Chromium	0.0012	0.0004	0.002	0.001	0.001	0.001
Copper	0.00216	0.00074	0.0154	0.00139	0.00084	0.00357
Iron	0.2199	0.0124	1.06	0.0682	0.0102	0.12
Lead	0.00021	0.0001	0.0017	0.00023	0.0002	0.0005
Molybdenum	0.00127	0.00013	0.002	0.0014	0.001	0.0018
Nickel	0.0013	0.0005	0.004	0.0011	0.001	0.0023
Selenium	0.00024	0.00005	0.0022	0.00025	0.00013	0.00058
Zinc	0.0059	0.001	0.01	0.005	0.005	0.005

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

Station W10 2007 to 2015 water quality result statistics are summarized in Table 5-9, below. Eight routine samples were taken during the 2015 monitoring period.

Table 5-9: W10 Water Quality Results Summary (2007-2015)

W10	2007 - 2014 Summary Statistics			2015 Summary Statistics		
Parameters	**Mean**	**Min**	**Max**	**Mean**	**Min**	**Max**
pH	7.37	6	8.4	7.76	6.24	8.57
TSS (mg/L)	8.6	1	77	16	1	65
Nutrients (mg/L)						
Ammonia Nitrogen	0.0827	0.0057	1.1	0.0592	0.0067	0.31
Nitrate Nitrogen	0.052	0.01	0.397	0.168	0.02	0.801
Nitrite Nitrogen	0.0125	0.005	0.05	0.0202	0.005	0.05
Dissolved Metals (mg/L)						
Aluminum	0.1515	0.0049	0.418	0.0581	0.003	0.255
Arsenic	0.00045	0.0001	0.002	0.0004	0.0001	0.00133
Cadmium	0.000055	0.00001	0.0007	0.00001	0.00001	0.000014
Chromium	0.0011	0.0004	0.002	0.001	0.001	0.001
Copper	0.04109	0.00023	0.138	0.01698	0.0002	0.0885
Iron	0.8374	0.0445	10.1	4.8317	0.005	38.2
Lead	0.00022	0.0001	0.0022	0.0002	0.0002	0.0002
Molybdenum	0.00085	0.00003	0.001	0.0011	0.001	0.0015
Nickel	0.0017	0.001	0.0038	0.0013	0.001	0.0021
Selenium	0.00017	0.00005	0.0005	0.00007	0.00005	0.00016
Zinc	0.0091	0.005	0.062	0.005	0.005	0.005

5.1.9 W12 – Water in the Main Pit

Station W12 2007 to 2015 water quality result statistics are summarized in Table 5-10, below. Thirteen routine water quality samples were taken in the 2015 monitoring period. The 2007-2015 W12 copper, aluminum, cadmium and selenium concentrations are further displayed in Figure 5-6 and Figure 5-7, below.

Table 5-10: W12 Water Quality Results Summary (2007-2015)

W12	2007 - 2014 Summary Statistics			2015 Summary Statistics		
Parameters	Mean	Min	Max	Mean	Min	Max
pH	8.07	7.27	10.6	8.05	6.2	8.31
TSS (mg/L)	19.4	1	251	17.2	1	69.4
Nutrients (mg/L)						
Ammonia Nitrogen	2.1165	0.005	24	2.5628	0.005	4.3
Nitrate Nitrogen	21.05	0.01	141	14.766	0.02	26
Nitrite Nitrogen	0.5143	0.007	8.78	1.119	0.005	2.83
Dissolved Metals (mg/L)						
Aluminum	0.0258	0.0016	0.124	0.016	0.0037	0.0277
Arsenic	0.00079	0.00027	0.003	0.00042	0.0001	0.00055
Cadmium	0.000056	0.00001	0.00049	0.000033	0.00001	0.000061
Chromium	0.001	0.0004	0.0025	0.001	0.001	0.001
Copper	0.06952	0.00046	0.476	0.01663	0.00098	0.0373
Iron	0.0491	0.005	0.386	0.0245	0.005	0.231
Lead	0.00022	0.0001	0.0005	0.0002	0.0002	0.0002
Molybdenum	0.03152	0.003	0.0732	0.0797	0.001	0.0972
Nickel	0.0015	0.0005	0.0036	0.0017	0.001	0.0038
Selenium	0.00501	0.0003	0.0098	0.01207	0.00005	0.0207
Zinc	0.006	0.001	0.031	0.0052	0.005	0.0062

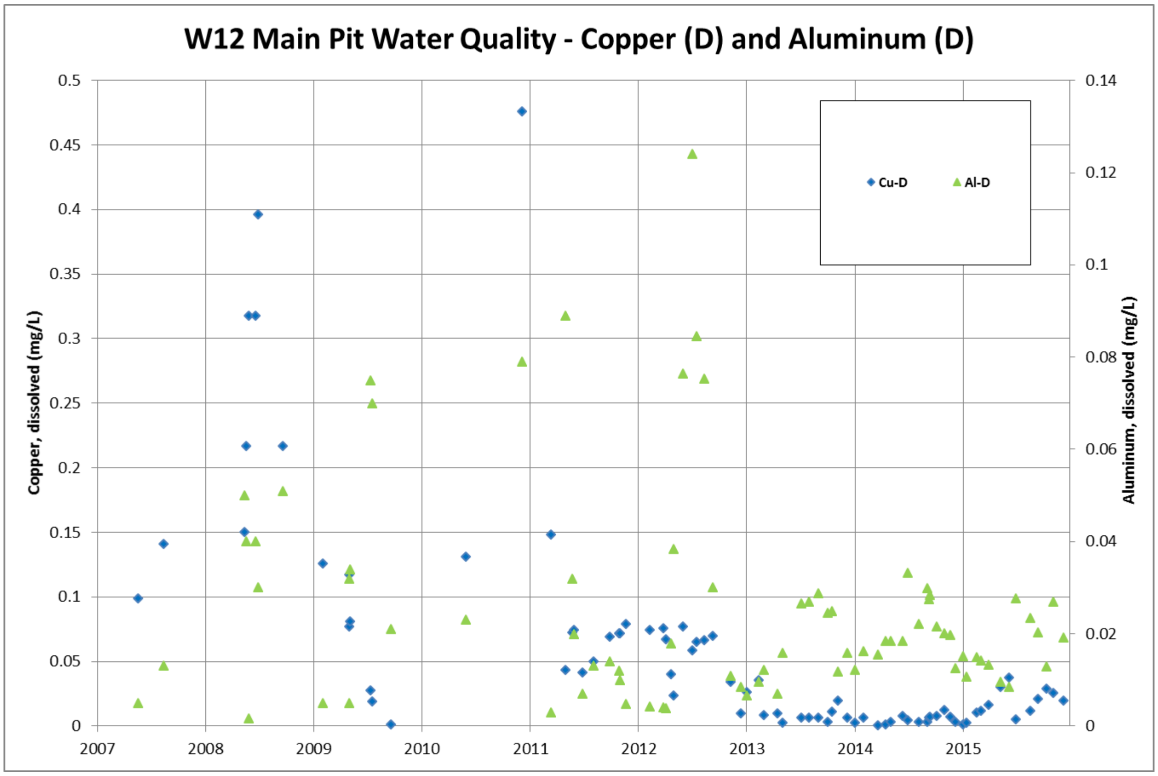


Figure 5-6: W12 Copper and Aluminum Concentrations (2007-2015)

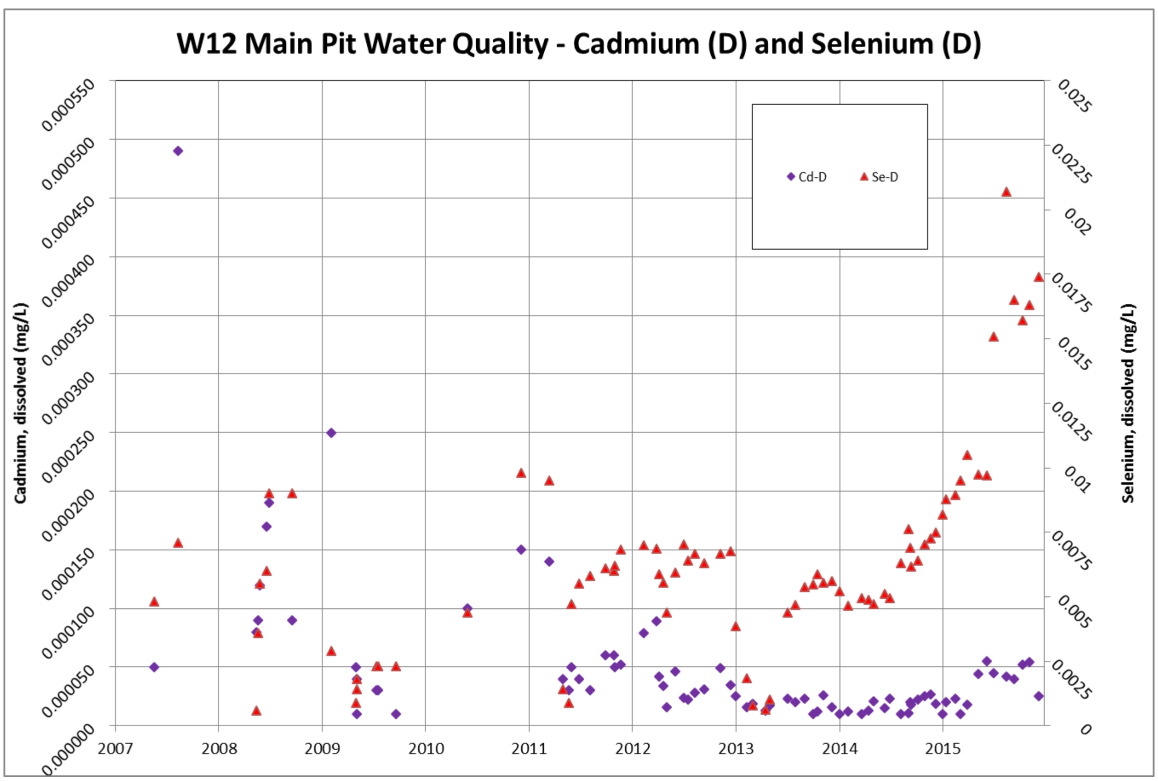


Figure 5-7: W12 Cadmium and Selenium Concentrations (2007-2015)

5.1.10 W12A – Discharge in the Main Pit

There was no discharge from the Main Pit in 2015 and no discharge from the Main Pit in previous years.

5.1.11 W14 – Tailings Thickener Overflow

Station W14 2007 to 2015 water quality result statistics are summarized in Table 5-11, below. Twelve routine samples were taken during the 2015 monitoring period.

Table 5-11: W14 Water Quality Results Summary (2007-2015)

W14	2007 - 2014 Summary Statistics			2015 Summary Statistics		
Parameters	**Mean**	**Min**	**Max**	**Mean**	**Min**	**Max**
pH	7.91	7.29	8.38	8.26	7.98	8.69
TSS (mg/L)	133.6	5	1120	73.6	22.4	162
Nutrients (mg/L)						
Ammonia Nitrogen	2.4	0.05	8	5.3	1.5	13
Nitrate Nitrogen	35.9	12.3	86.7	31.2	15.3	50.7
Nitrite Nitrogen	0.685	0.139	2.04	1.3336	0.0183	3.06
Dissolved Metals (mg/L)						
Aluminum	0.1407	0.0337	1.91	0.0744	0.0342	0.121
Arsenic	0.00066	0.0002	0.0052	0.00047	0.00034	0.00073
Cadmium	0.000054	0.00001	0.0003	0.000016	0.00001	0.000041
Chromium	0.001	0.0004	0.0036	0.001	0.001	0.001
Copper	0.01702	0.0002	0.723	0.01035	0.00076	0.0922
Iron	0.1133	0.005	4.8	0.0158	0.005	0.0737
Lead	0.00022	0.0001	0.0011	0.0002	0.0002	0.0002
Molybdenum	0.0911	0.0458	0.166	0.1347	0.093	0.181
Nickel	0.0013	0.0005	0.0082	0.0014	0.001	0.0022
Selenium	0.03635	0.00166	0.229	0.0244	0.0111	0.0423
Zinc	0.0055	0.001	0.028	0.0052	0.005	0.007

5.1.12 W15 – Upper Minto Creek Stormwater Collection Point

Station W15 2007 to 2015 water quality result statistics are summarized in Table 5-12, below. Seventy-four routine water quality samples were taken in the 2015 monitoring period. The 2007-2015 W15 copper, aluminum, cadmium and selenium concentrations are further displayed in Figure 5-8 and Figure 5-9, below.

Table 5-12: W15 Water Quality Results Summary (2007-2015)

W15	2007 - 2014 Summary Statistics			2015 Summary Statistics		
Parameters	Mean	Min	Max	Mean	Min	Max
pH	7.91	6.39	8.48	7.98	6.11	8.33
TSS (mg/L)	18.2	1	370	14.9	1	105
Nutrients (mg/L)						
Ammonia Nitrogen	0.1013	0.005	1.2	0.2441	0.005	5.3
Nitrate Nitrogen	8.64	0.01	56.1	28.534	0.02	265
Nitrite Nitrogen	0.0815	0.005	0.402	0.2129	0.005	3.78
Dissolved Metals (mg/L)						
Aluminum	0.0625	0.0035	2.65	0.0184	0.003	0.0833
Arsenic	0.000552	0.0002	0.002	0.00053	0.0001	0.0022
Cadmium	0.000049	0.00001	0.00234	0.000019	0.00001	0.00006
Chromium	0.00109	0.00022	0.003	0.0011	0.001	0.0053
Copper	0.02327	0.0057	0.415	0.02568	0.0002	0.101
Iron	0.4765	0.007	6.48	0.1391	0.005	0.45
Lead	0.00022	0.000031	0.0027	0.0002	0.0002	0.00024
Molybdenum	0.00263	0.0001	0.019	0.0119	0.001	0.113
Nickel	0.001363	0.0009	0.008	0.0012	0.001	0.0028
Selenium	0.00183	0.0001	0.0124	0.0062	0.00005	0.0504
Zinc	0.00598	0.001	0.041	0.0058	0.005	0.0149

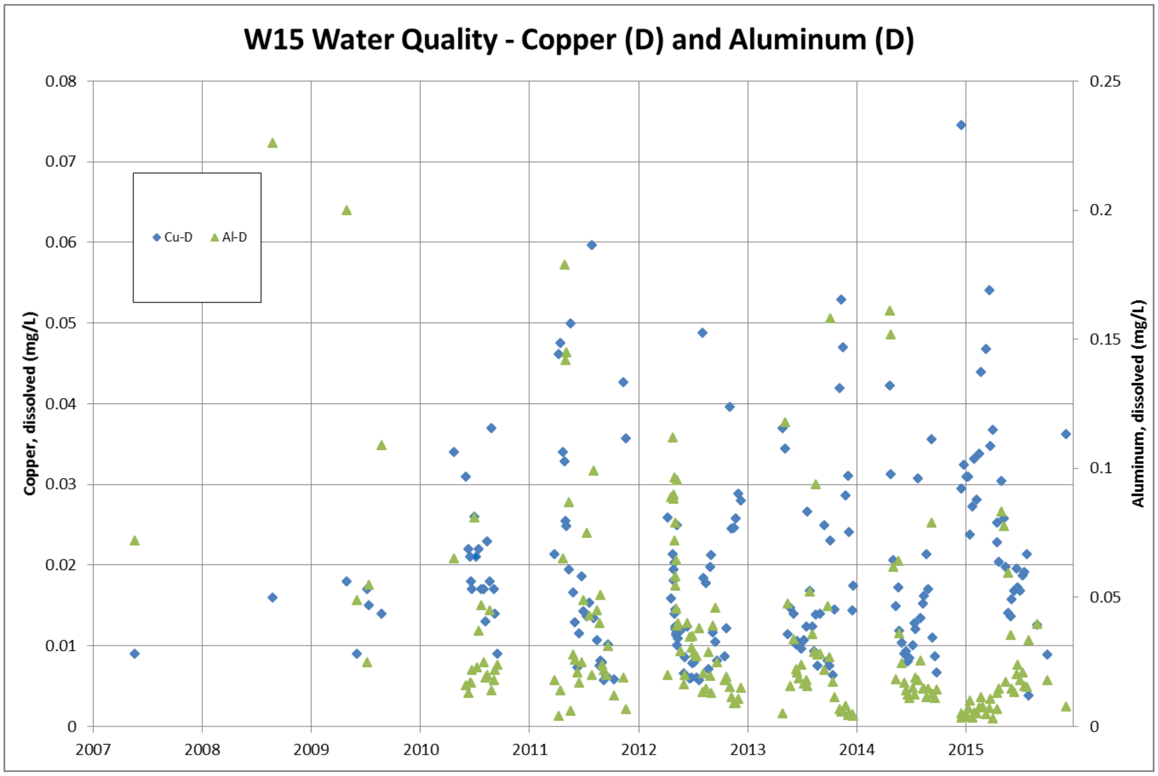


Figure 5-8: W15 Copper and Aluminum Concentrations (2007-2015)

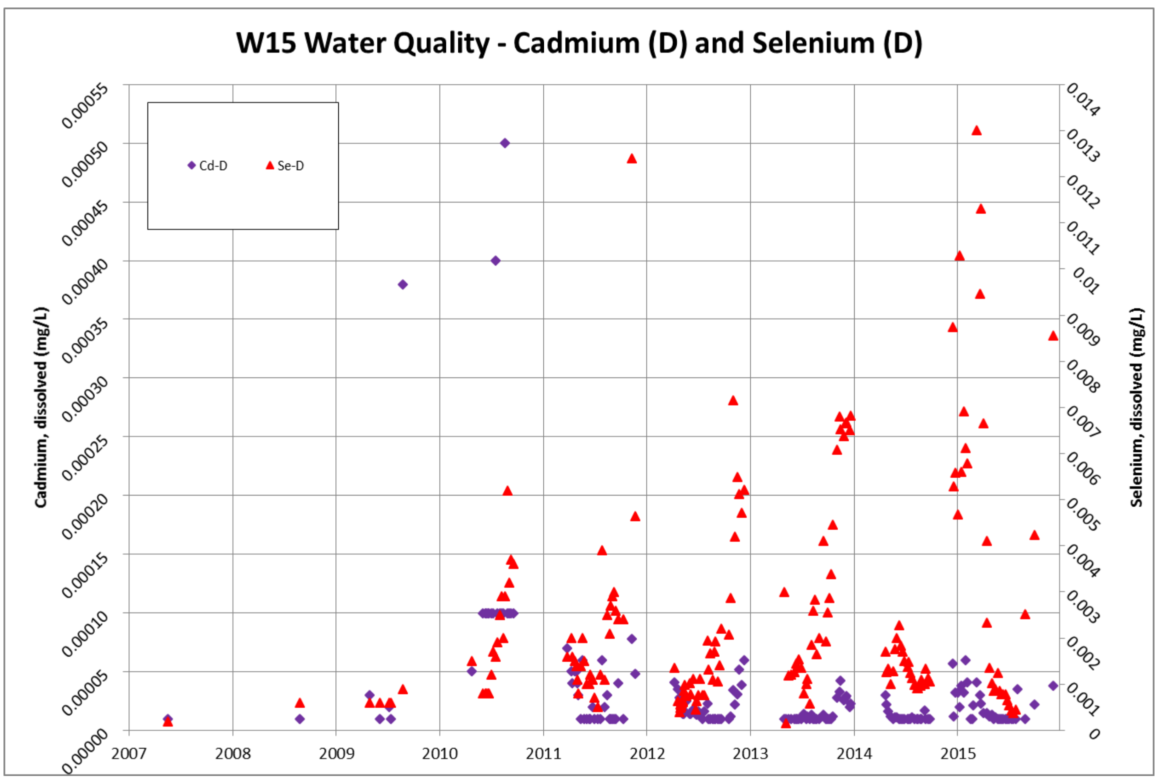


Figure 5-9: W15 Cadmium and Selenium Concentrations (2007-2015)

5.1.13 W16 – Water Storage Pond

Station W16 2007 to 2015 water quality result statistics are summarized in Table 5-13, below. Fifty-three routine water quality samples were taken in the 2015 monitoring period. The 2007-2015 W16 copper, aluminum, cadmium and selenium concentrations are further displayed in Figure 5-10 and Figure 5-11, below.

Table 5-13: W16 Water Quality Results Summary (2007-2015)

W16	Effluent Quality Standards (WUL Clause 9)	2007 - 2014 Summary Statistics			2015 Summary Statistics		
Parameters		Mean	Min	Max	Mean	Min	Max
pH	6.0-9.0	7.97	6.74	8.76	8.05	7.67	8.56
TSS (mg/L)	15	7.7	0.5	**181**	6.8	0.5	**25.1**
Nutrients (mg/L)							
Ammonia Nitrogen	0.75	0.1549	0.0025	**2**	0.118	0.024	0.29
Nitrate Nitrogen	27.3	3.699	0.01	**35**	1.784	0.345	3.99
Nitrite Nitrogen	0.18	0.1132	0.0012	**8.62**	0.0705	0.0095	**0.295**
Dissolved Metals (mg/L)							
Aluminum	0.3	0.01868	0.0015	0.234	0.0146	0.0043	0.0531
Arsenic	0.015	0.000401	0.00005	0.0015	0.00032	0.00011	0.00054
Cadmium	0.00015	0.00004	0.000005	**0.00557**	0.000011	0.000005	0.000095
Chromium	0.003	0.00066	0.00013	**0.0172**	0.0005	0.0005	0.0005
Copper	0.039	0.02608	0.002	**0.123**	0.0106	0.00158	0.0246
Iron	3.3	0.1339	0.0066	1.36	0.0763	0.0079	0.264
Lead	0.012	0.00012	0.00002	0.0008	0.0001	0.0001	0.0001
Molybdenum	0.219	0.00606	0.0005	0.0271	0.0058	0.0019	0.0107
Nickel	0.33	0.00111	0.00025	0.009	0.0005	0.0005	0.0012
Selenium	0.006	0.001216	0.00005	**0.0064**	0.00071	0.00034	0.00147
Zinc	0.09	0.00496	0.001	0.0828	0.0029	0.0025	0.0087

Bold values indicate exceedances of the WUL standards

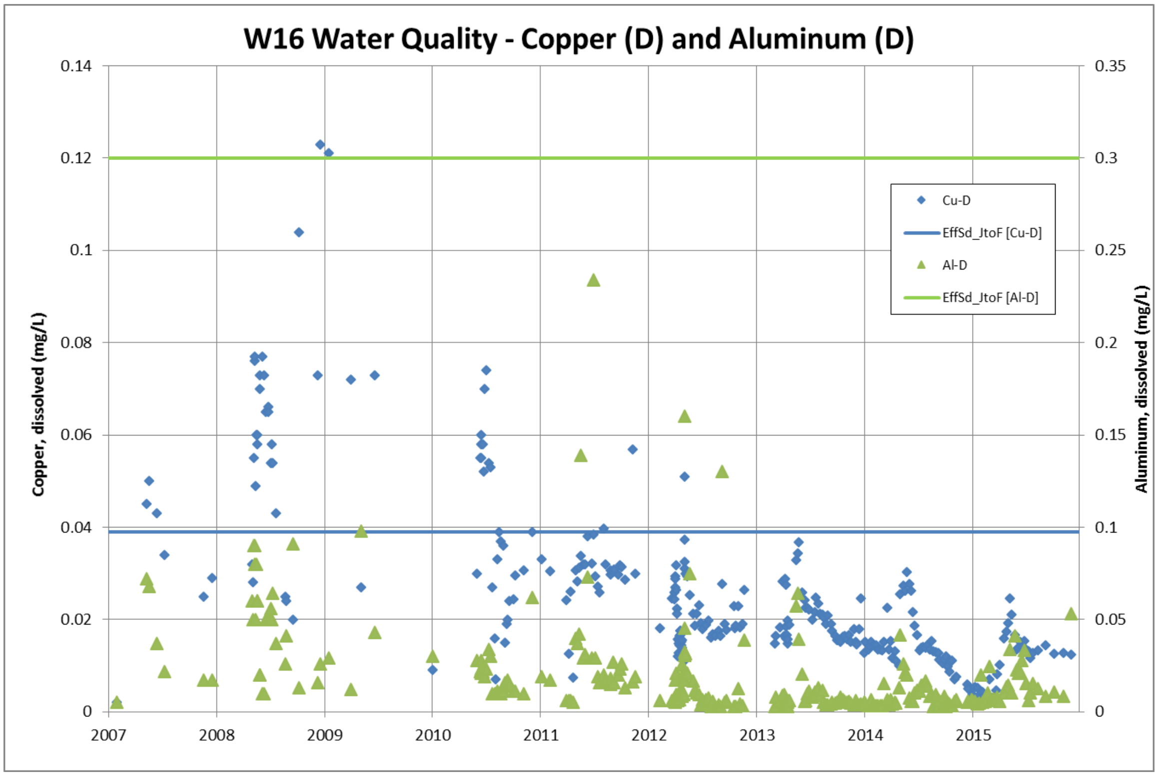
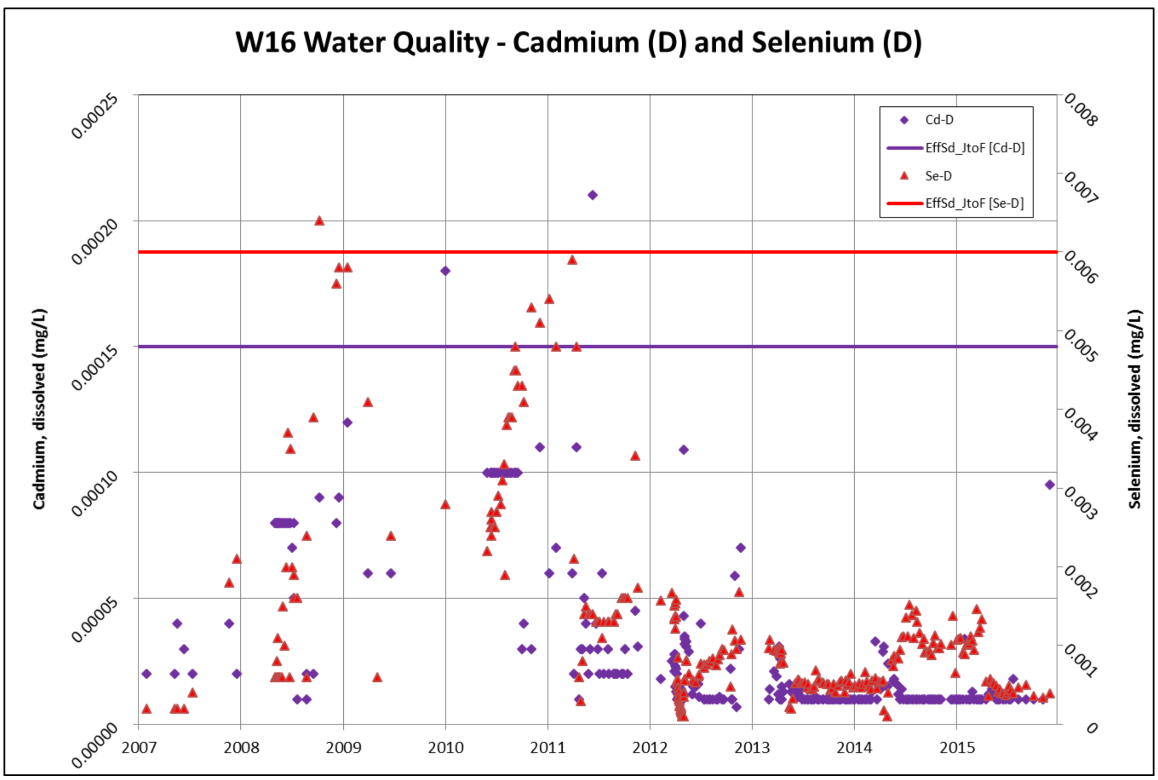


Figure 5-10: W16 Copper and Aluminum Concentrations (2007-2015)



*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 5-11: W16 Cadmium and Selenium Concentrations (2007-2015)

5.1.14 W30 – Headwaters Minto Creek (northwest fork)

Station W30 2009 to 2015 water quality result statistics are summarized in Table 5-14, below. Eight routine water quality samples were taken during the 2015 monitoring period.

Table 5-14: W30 Water Quality Results Summary (2009-2015)

W30	2009 - 2014 Summary Statistics			2015 Summary Statistics		
Parameters	Mean	Min	Max	Mean	Min	Max
pH	7.63	6.15	8.33	8.22	7.85	8.34
TSS (mg/L)	22	1	1110	4.7	1.6	10.1
Nutrients (mg/L)						
Ammonia Nitrogen	0.108	0.005	0.56	0.066	0.025	0.29
Nitrate Nitrogen	3.528	0.01	78.6	3.39	1.16	7.57
Nitrite Nitrogen	0.0375	0.005	0.579	0.0182	0.005	0.0789
Dissolved Metals (mg/L)						
Aluminum	0.0768	0.001	0.217	0.0083	0.0035	0.0151
Arsenic	0.00129	0.0003	0.054	0.00047	0.00024	0.00057
Cadmium	0.001958	0.00001	0.143	0.000014	0.00001	0.000021
Chromium	0.0013	0.0004	0.0149	0.001	0.001	0.001
Copper	0.0358	0.0067	0.179	0.0275	0.011	0.0385
Iron	0.2722	0.001	0.783	0.0496	0.0191	0.102
Lead	0.00022	0.0001	0.001	0.0002	0.0002	0.0002
Molybdenum	0.00189	0.0002	0.0098	0.0031	0.0026	0.0043
Nickel	0.0014	0.001	0.024	0.001	0.001	0.001
Selenium	0.00633	0.0003	0.343	0.00232	0.0013	0.00296
Zinc	0.006	0.001	0.013	0.0051	0.005	0.0057

5.1.15 W33 – Above Tailings Diversion Ditches

Station W33 2009 to 2015 water quality result statistics are summarized in Table 5-15, below. Five routine water quality samples were taken during the 2015 monitoring period.

Table 5-15: W33 Water Quality Results Summary (2009-2015)

W33	2009 - 2014 Summary Statistics			2015 Summary Statistics		
Parameters	**Mean**	**Min**	**Max**	**Mean**	**Min**	**Max**
pH	7.62	5.98	8.25	7.8	7.59	8.1
TSS (mg/L)	11.2	1	218	5.2	1	13.2
Nutrients (mg/L)						
Ammonia Nitrogen	0.0619	0.005	0.5	0.064	0.044	0.14
Nitrate Nitrogen	1.477	0.01	60.4	15.135	0.2	35.6
Nitrite Nitrogen	0.0095	0.005	0.05	0.0948	0.005	0.251
Dissolved Metals (mg/L)						
Aluminum	0.0502	0.003	0.31	0.032	0.0258	0.0526
Arsenic	0.00036	0.0001	0.001	0.00038	0.00035	0.00042
Cadmium	0.000035	0.00001	0.0001	0.00001	0.00001	0.00001
Chromium	0.0012	0.0004	0.0022	0.001	0.001	0.001
Copper	0.01384	0.0002	0.106	0.01036	0.00861	0.0159
Iron	0.1601	0.005	0.956	0.173	0.12	0.224
Lead	0.00021	0.0001	0.0007	0.0002	0.0002	0.0002
Molybdenum	0.00099	0.0002	0.003	0.001	0.001	0.0013
Nickel	0.0015	0.001	0.003	0.0015	0.0012	0.0019
Selenium	0.0003	0.00005	0.006	0.00025	0.0001	0.00048
Zinc	0.0062	0.002	0.01	0.005	0.005	0.005

5.1.16 W35 – Storm Water Collection Point – South Diversion Ditch

Station W35 2013 to 2015 water quality result statistics are summarized in Table 5-16, below. Seventy-two routine water quality samples were taken during the 2015 monitoring period.

Table 5-16: W35 Water Quality Results Summary (2013-2015)

W35	2013 - 2014 Summary Statistics			2015 Summary Statistics		
Parameters	**Mean**	**Min**	**Max**	**Mean**	**Min**	**Max**
pH	7.85	6.77	8.16	8	7.67	8.26
TSS (mg/L)	34.6	1	465	14.5	1	72.8
Nutrients (mg/L)						
Ammonia Nitrogen	0.0436	0.016	0.16	0.062	0.011	0.19
Nitrate Nitrogen	1.821	0.02	5.17	9.1	0.45	21.6
Nitrite Nitrogen	0.0451	0.005	0.335	0.0205	0.005	0.0509
Dissolved Metals (mg/L)						
Aluminum	0.0315	0.0134	0.0712	0.0278	0.0091	0.104
Arsenic	0.00035	0.00026	0.00048	0.0003	0.00023	0.00035
Cadmium	0.000014	0.00001	0.000046	0.000013	0.00001	0.000024
Chromium	0.001	0.001	0.001	0.001	0.001	0.001
Copper	0.031	0.017	0.0533	0.0348	0.027	0.0487
Iron	0.1337	0.0276	0.323	0.0379	0.0144	0.126
Lead	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002
Molybdenum	0.0013	0.001	0.0044	0.0019	0.001	0.0055
Nickel	0.0013	0.001	0.0016	0.0011	0.001	0.0015
Selenium	0.00021	0.00005	0.00048	0.00025	0.00012	0.00046
Zinc	0.005	0.005	0.005	0.005	0.005	0.005

5.1.17 W36 – Minto Creek Detention Structure Pond

Station W36 2009-2010, 2012-2013, and 2015 water quality result statistics are summarized in Table 5-17, below. Twelve routine water quality samples were taken during the 2015 monitoring period.

Table 5-17: W36 Water Quality Results Summary (2009-2010, 2012-2013, 2015)

W36	2009-2010, 2012- 2013 Summary Statistics			2015 Summary Statistics		
Parameters	**Mean**	**Min**	**Max**	**Mean**	**Min**	**Max**
pH	8.01	6.82	8.41	8.3	7.86	8.49
TSS (mg/L)	53	1	625	7.1	1	42.7
Nutrients (mg/L)						
Ammonia Nitrogen	0.0442	0.0056	0.15	0.035	0.021	0.057
Nitrate Nitrogen	7.72	0.01	17	14.65	5.92	37.2
Nitrite Nitrogen	0.0748	0.0072	0.273	0.0127	0.005	0.0282
Dissolved Metals (mg/L)						
Aluminum	0.0239	0.003	0.117	0.0088	0.0034	0.0198
Arsenic	0.00058	0.0003	0.0023	0.00052	0.00026	0.00113
Cadmium	0.00004	0.00001	0.00014	0.000024	0.00001	0.000061
Chromium	0.001	0.0004	0.0038	0.001	0.001	0.001
Copper	0.044	0.022	0.094	0.0483	0.0194	0.0723
Iron	0.1177	0.022	0.69	0.0632	0.0079	0.103
Lead	0.00024	0.0001	0.0009	0.0002	0.0002	0.0002
Molybdenum	0.00769	0.002	0.0168	0.0092	0.0056	0.0162
Nickel	0.0013	0.001	0.005	0.0013	0.001	0.0027
Selenium	0.00295	0.0003	0.0104	0.0063	0.00271	0.0121
Zinc	0.0515	0.001	0.846	0.0793	0.005	0.312

5.1.18 W45 – Area 2 Pit

Station W45 2012 to 2015 water quality result statistics are summarized in Table 5-18, below. Eight routine water quality samples were taken during the 2015 monitoring period.

Table 5-18: W45 Water Quality Results Summary (2012-2015)

W45	2012 - 2014 Summary Statistics			2015 Summary Statistics		
Parameters	**Mean**	**Min**	**Max**	**Mean**	**Min**	**Max**
pH	8.02	7.86	8.18	8.1	7.9	8.27
TSS (mg/L)	35	1	291	23.5	1.6	49.7
Nutrients (mg/L)						
Ammonia Nitrogen	7.59	0.92	37	2.96	0.072	7.1
Nitrate Nitrogen	22.56	2.57	77.2	17.31	1.65	33.9
Nitrite Nitrogen	1.128	0.209	2.53	0.5446	0.0223	1.59
Dissolved Metals (mg/L)						
Aluminum	0.0237	0.0032	0.337	0.0183	0.0034	0.0382
Arsenic	0.00143	0.00086	0.00234	0.00063	0.00036	0.00103
Cadmium	0.000138	0.00001	0.000358	0.000171	0.00001	0.000517
Chromium	0.001	0.001	0.001	0.001	0.001	0.001
Copper	0.0895	0.0121	0.276	0.06736	0.00109	0.268
Iron	0.0838	0.005	0.726	0.0654	0.005	0.26
Lead	0.00023	0.0002	0.00066	0.0002	0.0002	0.0002
Molybdenum	0.0275	0.0132	0.0467	0.066	0.0033	0.117
Nickel	0.0015	0.001	0.0033	0.0013	0.001	0.0018
Selenium	0.0038	0.00089	0.0298	0.01181	0.00048	0.0239
Zinc	0.0129	0.005	0.0421	0.017	0.005	0.0673

5.1.19 W46 – Minto Creek, Downstream of W7 and W6

Station W46 2012 to 2015 water quality result statistics are summarized in Table 5-19, below. Eleven routine water quality samples were taken during the 2015 monitoring period.

Table 5-19: W46 Water Quality Results Summary (2012-2015)

W46	2012 - 2014 Summary Statistics			2015 Summary Statistics		
Parameters	Mean	Min	Max	Mean	Min	Max
pH	8.1	7.61	8.33	8.13	8.01	8.27
TSS (mg/L)	21.4	1	78.1	10.1	1	41.9
Nutrients (mg/L)						
Ammonia Nitrogen	0.0334	0.0099	0.16	0.031	0.013	0.048
Nitrate Nitrogen	0.285	0.02	2.46	0.339	0.088	1.08
Nitrite Nitrogen	0.0058	0.005	0.0242	0.0055	0.005	0.0084
Dissolved Metals (mg/L)						
Aluminum	0.0111	0.003	0.0449	0.0083	0.003	0.0199
Arsenic	0.0005	0.0003	0.00078	0.00039	0.00031	0.00047
Cadmium	0.00001	0.00001	0.000018	0.000011	0.00001	0.000019
Chromium	0.001	0.001	0.001	0.001	0.001	0.001
Copper	0.00259	0.00089	0.0108	0.00231	0.00138	0.00393
Iron	0.2454	0.0183	0.646	0.0764	0.0186	0.153
Lead	0.0002	0.0002	0.0002	0.0002	0.0002	0.00022
Molybdenum	0.002	0.001	0.007	0.0024	0.0017	0.0036
Nickel	0.0012	0.001	0.0021	0.001	0.001	0.0011
Selenium	0.0002	0.00005	0.00068	0.00023	0.00005	0.00043
Zinc	0.0054	0.005	0.015	0.0052	0.005	0.0071

5.1.20 W47 – Area 118 Pit Water

Station W47 2015 water quality result statistics are summarized in Table 5-20, below. Six routine water quality samples were taken at W47 during the 2015 monitoring period.

Table 5-20: W47 Water Quality Results Summary (2015)

W47	2015 Summary Statistics		
Parameters	**Mean**	**Min**	**Max**
pH	8.06	8.02	8.1
TSS (mg/L)	29.7	2.3	86.8
Nutrients (mg/L)			
Ammonia Nitrogen	18	16	25
Nitrate Nitrogen	37.5	30.3	60.1
Nitrite Nitrogen	1.049	0.857	1.5
Dissolved Metals (mg/L)			
Aluminum	0.0115	0.0057	0.0275
Arsenic	0.00226	0.00111	0.00259
Cadmium	0.000008	0.000005	0.000015
Chromium	0.0005	0.0005	0.0005
Copper	0.02703	0.00614	0.0931
Iron	0.0211	0.0025	0.0799
Lead	0.0001	0.0001	0.0001
Molybdenum	0.0201	0.0153	0.0331
Nickel	0.0021	0.0019	0.0023
Selenium	0.00124	0.00094	0.00185
Zinc	0.003	0.0025	0.0057

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

Station W50 water quality result statistics for 2008 to 2015 are summarized in Table 5-21, below, and are compared to the WUL Effluent Quality Standards (WUL Clause 9). Nine routine water quality samples were taken during the 2015 monitoring period. The 2008-2015 copper, aluminum, cadmium and selenium concentrations are displayed in Figure 5-12 and Figure 5-13, and are compared to WUL Effluent Quality Standards (Clause 9).

Table 5-21: W50 Water Quality Results Summary (2008-2015)

W50	Effluent Quality Standards (WUL Clause 9)	2008 - 2014 Summary Statistics			2015 Summary Statistics		
Parameters		Mean	Min	Max	Mean	Min	Max
pH	6.0-9.0	8.05	6.82	8.4	8.07	7.97	8.16
TSS (mg/L)	15	6.2	0.5	**42**	3.3	1.2	8.6
Nutrients (mg/L)							
Ammonia Nitrogen	0.75	0.0776	0.0025	**1**	0.077	0.031	0.18
Nitrate Nitrogen	27.3	4.372	0.01	16.2	2.33	1.56	3.53
Nitrite Nitrogen	0.18	0.0194	0.0025	0.158	0.0383	0.0094	0.0668
Dissolved Metals (mg/L)							
Aluminum	0.3	0.019	0.0015	0.12	0.0102	0.003	0.0295
Arsenic	0.015	0.0004	0.0002	0.0031	0.00033	0.00023	0.00046
Cadmium	0.00015	0.000019	0.000005	**0.00028**	0.000007	0.000005	0.000013
Chromium	0.003	0.00058	0.0002	0.0017	0.0005	0.0005	0.0005
Copper	0.039	0.01567	0.0005	**0.075**	0.01404	0.00833	0.0186
Iron	3.3	0.0495	0.0025	0.3	0.0948	0.0105	0.234
Lead	0.012	0.00015	0.00005	0.0008	0.0001	0.0001	0.0001
Molybdenum	0.219	0.00711	0.0005	0.019	0.0053	0.0032	0.0082
Nickel	0.33	0.001	0.0005	0.003	0.0005	0.0005	0.0005
Selenium	0.006	0.00131	0.00005	0.0049	0.00092	0.00062	0.00143
Zinc	0.09	0.0033	0.0005	0.018	0.0025	0.0025	0.0025

Bold values indicate exceedances of the WUL standards

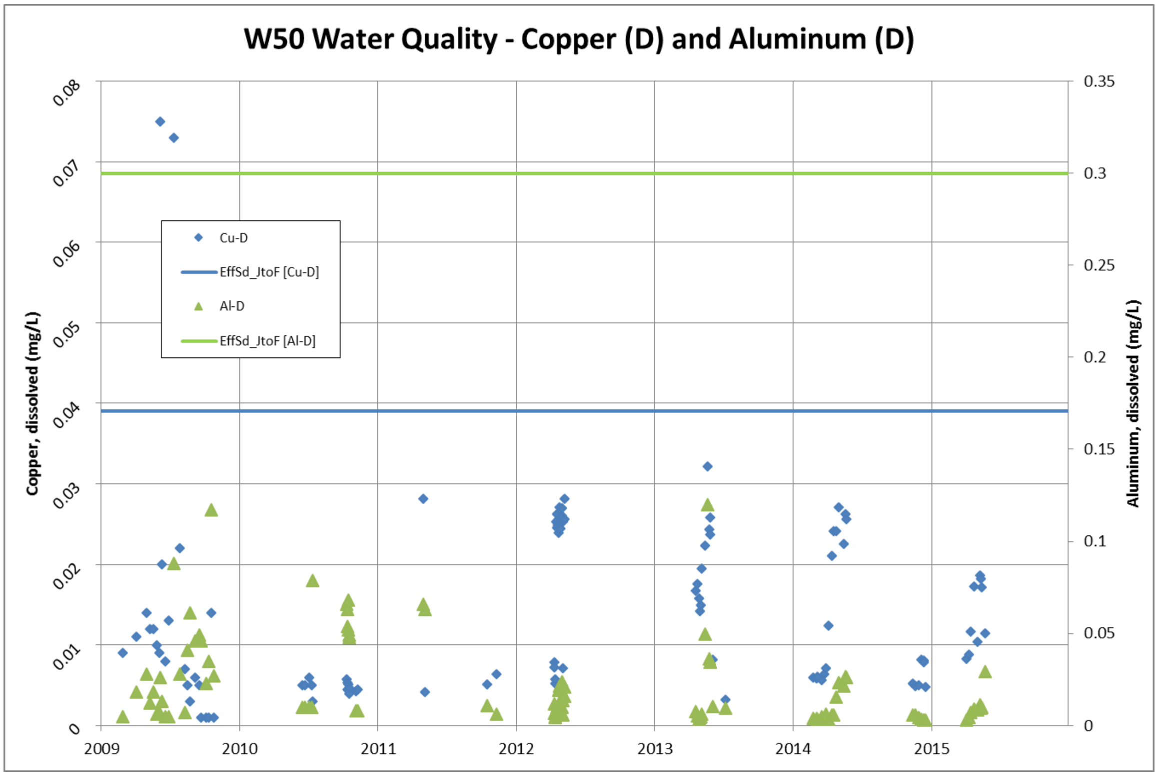
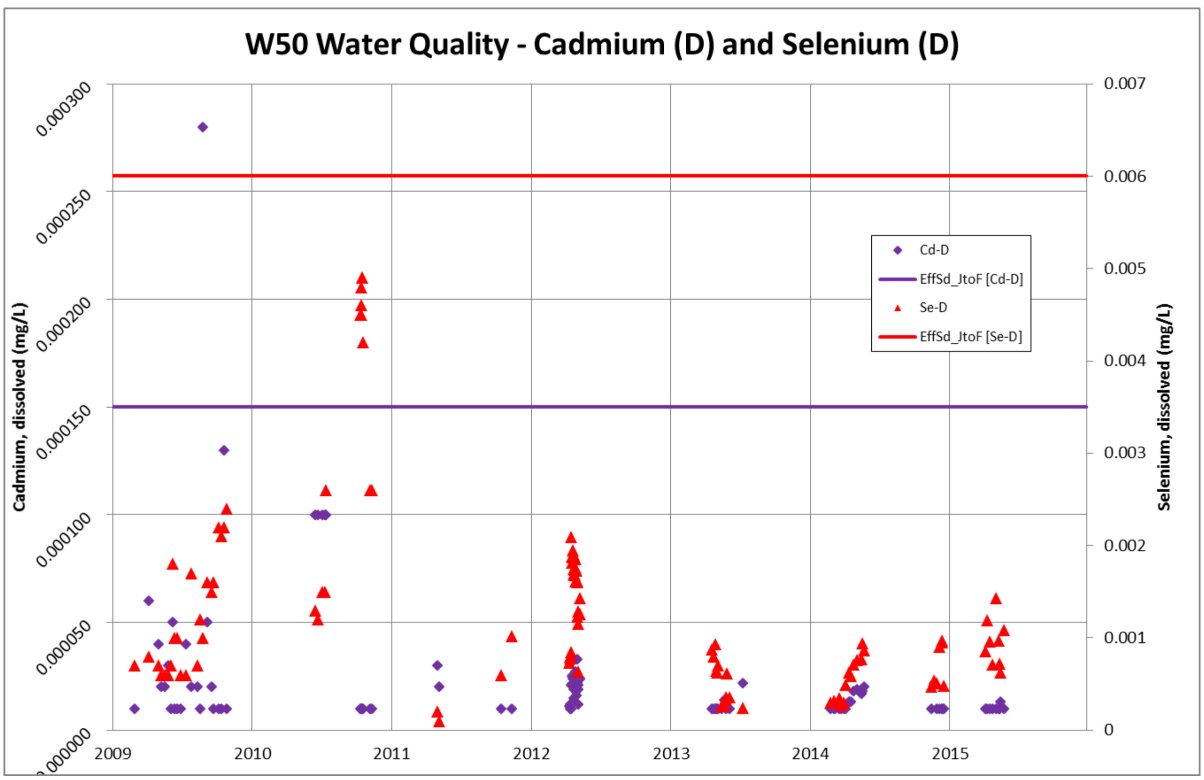


Figure 5-12: W50 Copper and Aluminum Concentrations (2008-2015)



*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 5-13: W50 Cadmium and Selenium Concentrations (2008-2015)

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

Station MC-1 2009 to 2015 water quality result statistics are summarized in Table 5-22, below. Thirty-seven routine water quality samples were taken during the 2015 monitoring period.

Table 5-22: MC-1 Water Quality Results Summary (2009-2015)

MC-1	2009 - 2014 Summary Statistics			2015 Summary Statistics		
Parameters	**Mean**	**Min**	**Max**	**Mean**	**Min**	**Max**
pH	8.05	6.82	8.4	8.07	7.97	8.16
TSS (mg/L)	6.4	1	42	3.3	1.2	8.6
Nutrients (mg/L)						
Ammonia Nitrogen	0.0811	0.005	1	0.077	0.031	0.18
Nitrate Nitrogen	4.372	0.02	16.2	2.33	1.56	3.53
Nitrite Nitrogen	0.0199	0.005	0.158	0.0383	0.0094	0.0668
Dissolved Metals (mg/L)						
Aluminum	0.0193	0.003	0.12	0.0102	0.003	0.0295
Arsenic	0.00045	0.00027	0.0031	0.00033	0.00023	0.00046
Cadmium	0.000024	0.00001	0.00028	0.00001	0.00001	0.000013
Chromium	0.00101	0.0004	0.002	0.001	0.001	0.001
Copper	0.01567	0.001	0.075	0.01404	0.00833	0.0186
Iron	0.0509	0.005	0.3	0.0948	0.0105	0.234
Lead	0.00026	0.0001	0.001	0.0002	0.0002	0.0002
Molybdenum	0.00712	0.001	0.019	0.0053	0.0032	0.0082
Nickel	0.0013	0.001	0.005	0.001	0.001	0.001
Selenium	0.0003	0.00005	0.0022	0.00017	0.00005	0.00067
Zinc	0.0054	0.001	0.018	0.005	0.005	0.005

5.1.23 WTP and RO – Treated Water

Water quality sites WTP and RO represent water treated from the Water Treatment Plant without the RO and water treated from the plant with the RO, respectively. Minto utilized the water treatment plant including the RO in 2015. The water treated from the water treatment plant including RO conveyed water to the Water Storage Pond and no treated water was directly discharged into Minto Creek.

Table 5-23: Treated Water Quality Results Summary (2009-2015)

Treated Water Summary – Water Treatment Plant with RO	Effluent Quality Standards (WUL Clause 9)	2012 - 2014 Summary Statistics			2015 Summary Statistics		
Parameters		Mean	Min	Max	Mean	Min	Max
pH	6.0-9.0	7.44	**5.25**	8.24	7.43	**5.75**	8.15
TSS (mg/L)	15	1.9	0.5	30.6	1.6	0.5	10
Nutrients (mg/L)							
Ammonia Nitrogen	0.75	0.3217	0.0058	**2**	0.37	0.11	**2.5**
Nitrate Nitrogen	27.3	3.757	0.375	9.88	2.056	0.759	8.7
Nitrite Nitrogen	0.18	0.0697	0.0025	**0.993**	**0.2959**	0.0753	**1.74**
Dissolved Metals (mg/L)							
Aluminum	0.3	0.0215	0.0015	0.0859	0.0124	0.0015	0.14
Arsenic	0.015	0.00012	0.00005	0.0005	0.00007	0.00005	0.00041
Cadmium	0.00015	0.000023	0.000005	**0.000937**	0.000007	0.000005	0.000039
Chromium	0.003	0.0005	0.0002	0.0005	0.0005	0.0005	0.0005
Copper	0.039	0.00193	0.0001	**0.049**	0.00088	0.0001	0.0111
Iron	3.3	0.0228	0.0025	0.98	0.0043	0.0025	0.0142
Lead	0.012	0.00011	0.0001	0.00041	0.0001	0.0001	0.0001
Molybdenum	0.219	0.0097	0.0005	0.0476	0.0075	0.0005	0.0762
Nickel	0.33	0.0007	0.0005	0.0033	0.0006	0.0005	0.0022
Selenium	0.006	0.00106	0.00005	0.00441	0.00112	0.00012	**0.00987**
Zinc	0.09	0.0032	0.0025	0.0137	0.0025	0.0025	0.0025

Bold values indicate exceedances of the WUL standards

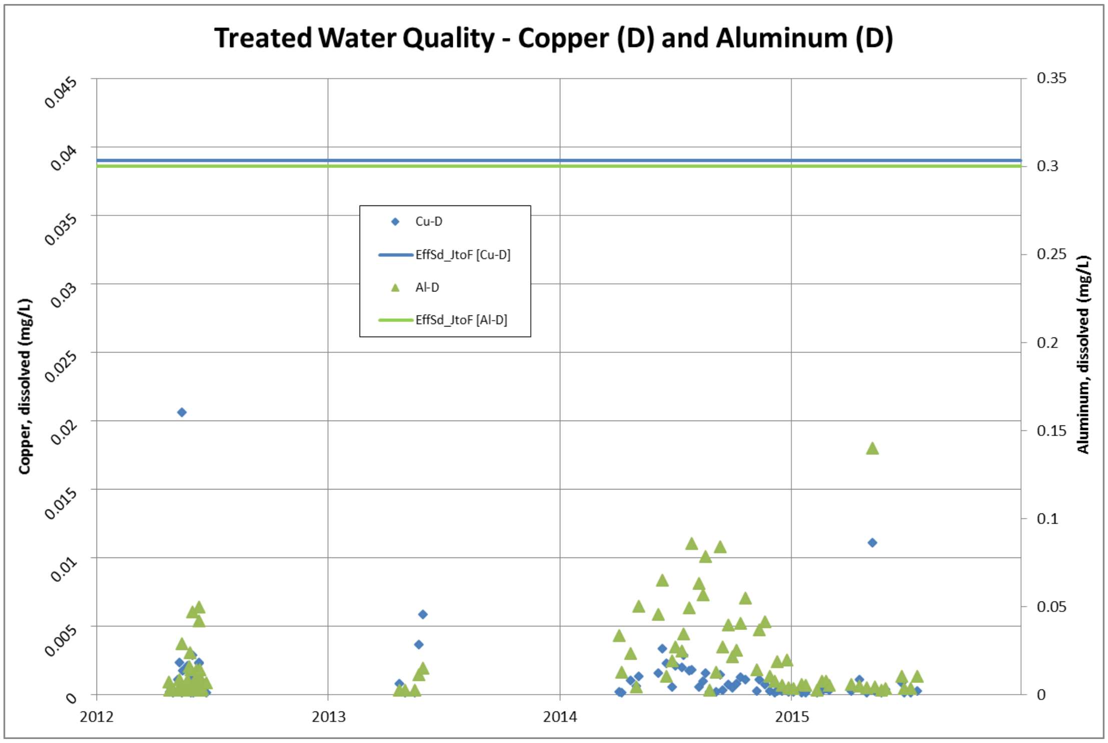
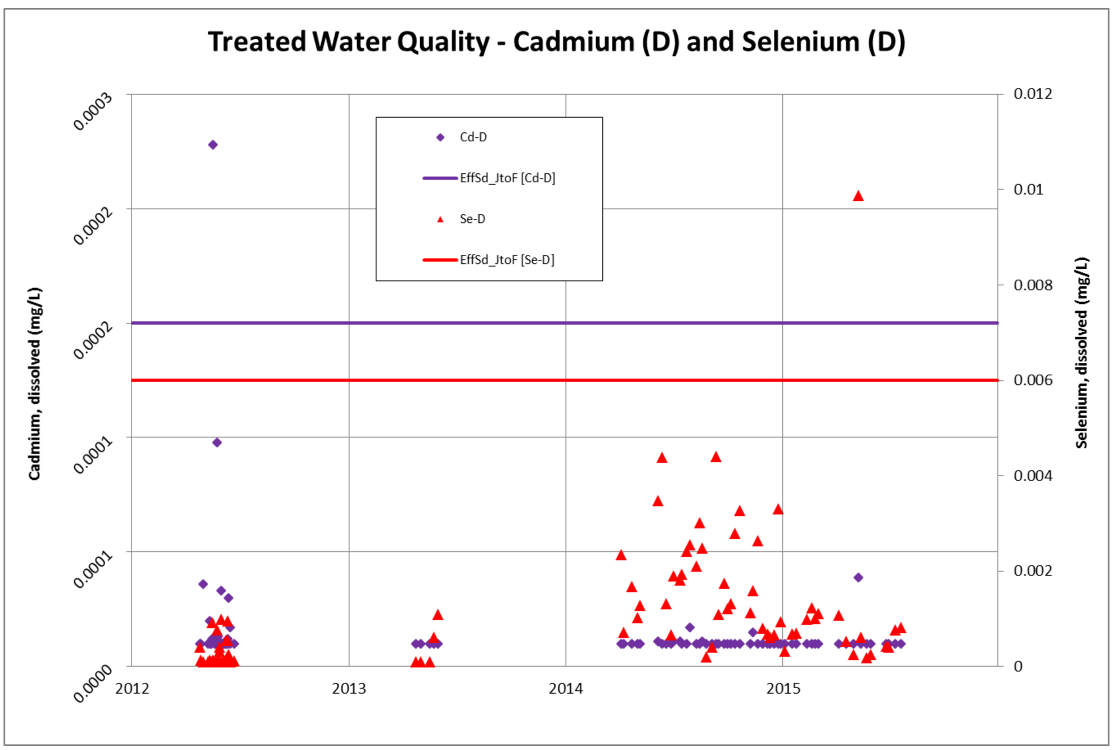


Figure 5-14: Treated Water Copper and Aluminum Concentrations (2012-2015)



*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 5-15: Treated Water Cadmium and Selenium Concentrations (2012-2015)

5.1.24 W51 – Area 2 Stage 3 Pit

Area 2 Stage 3 Pit was not developed in 2015; therefore, water quality results are not available.

5.1.25 W52 – Ridgetop North Pit and TMF

The Ridgetop North Pit was not developed in 2015; therefore, water quality results are not available.

5.1.26 W53 – Ridgetop South Pit

The Ridgetop South Pit was not developed in 2015; therefore, water quality results are not available.

5.1.27 W54 – Main Pit Dam Seepage

The Main Pit Dam was not developed in 2015; therefore, water quality results are not available.

5.1.28 W55 – Tailings Diversion Ditch

The tailings diversion ditch was found to be dry in 2015. There are no historical summary statistics to present as the site was a new addition to WUL QZ14-031.

5.1.29 W62 – MVFES2 Collection Sump

Area 2 Stage 3 Pit was not developed in 2015; therefore, water quality results are not available.

5.1.30 C4 – Tributary on the south side of Minto Creek

Station C4 2012 to 2015 water quality result statistics are summarized in Table 5-24, below. Four routine water quality samples were taken during the 2015 monitoring period.

Table 5-24: C4 Water Quality Results Summary (2012-2015)

C4	2012 - 2014 Summary Statistics			2015 Summary Statistics		
Parameters	Mean	Min	Max	Mean	Min	Max
pH	8.02	7.59	8.29	8.15	8.01	8.24
TSS (mg/L)	347.6	3.3	1260	48.4	2.3	140
Nutrients (mg/L)						
Ammonia Nitrogen	0.132	0.005	0.36	0.055	0.039	0.074
Nitrate Nitrogen	0.201	0.02	2.31	0.04	0.02	0.052
Nitrite Nitrogen	0.0104	0.005	0.05	0.005	0.005	0.005
Dissolved Metals (mg/L)						
Aluminum	0.0329	0.0088	0.0622	0.0168	0.0106	0.0278
Arsenic	0.00166	0.00029	0.00559	0.00092	0.00071	0.00121
Cadmium	0.000012	0.00001	0.000029	0.00001	0.00001	0.000013
Chromium	0.001	0.001	0.0013	0.001	0.001	0.001
Copper	0.00219	0.00095	0.00952	0.00119	0.00097	0.00134

C4	2012 - 2014 Summary Statistics			2015 Summary Statistics		
Parameters	Mean	Min	Max	Mean	Min	Max
Iron	1.847	0.056	14.2	0.588	0.322	0.778
Lead	0.0002	0.0002	0.00022	0.0002	0.0002	0.0002
Molybdenum	0.0015	0.001	0.0068	0.001	0.001	0.0012
Nickel	0.0025	0.001	0.0061	0.0019	0.0017	0.0021
Selenium	0.00012	0.00005	0.00068	0.00006	0.00005	0.00011
Zinc	0.005	0.005	0.005	0.005	0.005	0.005

5.1.31 C10 – Tributary on the south side of Minto Creek

Station C10 2012 to 2015 water quality result statistics are summarized in

Table **5-25**, below. Two routine water quality samples were taken during the 2015 monitoring period.

Table 5-25: C10 Water Quality Results Summary (2012-2015)

C10	2012 - 2014 Summary Statistics			2015 Summary Statistics		
Parameters	Mean	Min	Max	Mean	Min	Max
pH	8.13	7.73	8.37	8.16	8.13	8.19
TSS (mg/L)	455.8	2.3	2210	13.6	1	26.3
Nutrients (mg/L)						
Ammonia Nitrogen	0.0884	0.005	0.2	0.032	0.024	0.039
Nitrate Nitrogen	0.153	0.02	0.417	0.07	0.022	0.117
Nitrite Nitrogen	0.0136	0.005	0.05	0.005	0.005	0.005
Dissolved Metals (mg/L)						
Aluminum	0.3929	0.0091	5.84	0.0154	0.0132	0.0176
Arsenic	0.00147	0.0004	0.00551	0.00064	0.00054	0.00075
Cadmium	0.000033	0.00001	0.000344	0.00001	0.00001	0.00001
Chromium	0.0016	0.001	0.0093	0.001	0.001	0.001
Copper	0.00361	0.00091	0.0339	0.0013	0.00097	0.00162
Iron	2.105	0.141	19.9	0.436	0.358	0.514
Lead	0.0007	0.0002	0.00772	0.0002	0.0002	0.0002
Molybdenum	0.0011	0.001	0.0019	0.001	0.001	0.001
Nickel	0.0033	0.001	0.0215	0.0018	0.0016	0.0021
Selenium	0.00007	0.00005	0.00014	0.00009	0.00005	0.00012
Zinc	0.0088	0.005	0.0603	0.005	0.005	0.005

5.1.32 MN – Minto North Pit Water

Station MN 2015 water quality result statistics are summarized in Table 5-26, below. Two routine water quality samples were taken during the 2015 monitoring period.

Table 5-26: MN Water Quality Results Summary (2015)

MN	2015 Summary Statistics		
Parameters	**Mean**	**Min**	**Max**
pH	7.8	7.63	7.96
TSS (mg/L)	122	101	142
Nutrients (mg/L)			
Ammonia Nitrogen	28.7	6.4	51
Nitrate Nitrogen	262	183	342
Nitrite Nitrogen	10.04	8.17	11.9
Dissolved Metals (mg/L)			
Aluminum	0.0166	0.009	0.0241
Arsenic	0.00028	0.0002	0.00036
Cadmium	0.000022	0.00001	0.000035
Chromium	0.001	0.001	0.001
Copper	0.1853	0.0945	0.276
Iron	0.345	0.241	0.449
Lead	0.0002	0.0002	0.0002
Molybdenum	0.0121	0.0077	0.0164
Nickel	0.0028	0.0014	0.0041
Selenium	0.00881	0.00421	0.0134
Zinc	0.0058	0.005	0.0066

5.1.33 MN-0.2 – Upper West Arm of McGinty Creek

Station MN-0.2 2015 water quality result statistics are summarized in Table 5-27, below. Four routine water quality samples were taken during the 2015 monitoring period.

Table 5-27: MN-0.2 Water Quality Results Summary (2015)

MN-0.2	2015 Summary Statistics		
Parameters	**Mean**	**Min**	**Max**
pH	7.48	7.32	7.67
TSS (mg/L)	19.4	1.2	60
Nutrients (mg/L)			
Ammonia Nitrogen	0.054	0.02	0.11
Nitrate Nitrogen	0.065	0.02	0.2
Nitrite Nitrogen	0.0162	0.005	0.05
Dissolved Metals (mg/L)			
Aluminum	0.1075	0.0715	0.137
Arsenic	0.00131	0.0004	0.00388
Cadmium	0.00001	0.00001	0.00001
Chromium	0.001	0.001	0.0011
Copper	0.0022	0.00168	0.00323
Iron	2.934	0.208	10.3
Lead	0.0002	0.0002	0.0002
Molybdenum	0.001	0.001	0.001
Nickel	0.0016	0.0012	0.0019
Selenium	0.00008	0.00005	0.00012
Zinc	0.005	0.005	0.005

5.1.34 MN-0.5 – West Arm of McGinty Creek

Station MN-0.5 2015 water quality result statistics are summarized in Table 5-28, below. Four routine water quality samples were taken during the 2015 monitoring period.

Table 5-28: MN-0.5 Water Quality Results Summary (2015)

MN-0.5	2015 Summary Statistics		
Parameters	**Mean**	**Min**	**Max**
pH	7.9	7.73	8.06
TSS (mg/L)	28.1	3	106
Nutrients (mg/L)			
Ammonia Nitrogen	0.023	0.011	0.043
Nitrate Nitrogen	0.058	0.021	0.084
Nitrite Nitrogen	0.005	0.005	0.005
Dissolved Metals (mg/L)			
Aluminum	0.0272	0.0101	0.0652
Arsenic	0.00043	0.00037	0.00061
Cadmium	0.000011	0.00001	0.000014
Chromium	0.001	0.001	0.001
Copper	0.00258	0.00139	0.00441
Iron	0.139	0.104	0.254
Lead	0.0002	0.0002	0.0002
Molybdenum	0.001	0.001	0.0011
Nickel	0.0011	0.001	0.0017
Selenium	0.00013	0.00005	0.00021
Zinc	0.005	0.005	0.005

5.1.35 MN-1.5 – Upper East Arm of McGinty Creek

Station MN-1.5 2015 water quality result statistics are summarized in Table 5-29, below. Three routine water quality samples were taken during the 2015 monitoring period.

Table 5-29: MN-1.5 Water Quality Results Summary (2015)

MN-1.5	2015 Summary Statistics		
Parameters	Mean	Min	Max
pH	7.46	7.19	7.78
TSS (mg/L)	89.6	9.6	165
Nutrients (mg/L)			
Ammonia Nitrogen	0.068	0.051	0.081
Nitrate Nitrogen	0.111	0.02	0.2
Nitrite Nitrogen	0.0283	0.005	0.053
Dissolved Metals (mg/L)			
Aluminum	0.1701	0.0835	0.259
Arsenic	0.00078	0.00037	0.00113
Cadmium	0.00001	0.00001	0.000011
Chromium	0.001	0.001	0.001
Copper	0.00743	0.00468	0.00958
Iron	0.925	0.56	1.19
Lead	0.0002	0.0002	0.0002
Molybdenum	0.001	0.001	0.001
Nickel	0.0012	0.001	0.0014
Selenium	0.00005	0.00005	0.00005
Zinc	0.005	0.005	0.005

5.1.36 MN-2.5 – East Arm of McGinty Creek

Station MN-2.5 2015 water quality result statistics are summarized in Table 5-30, below. Five routine water quality samples were taken during the 2015 monitoring period.

Table 5-30: MN-2.5 Water Quality Results Summary (2015)

MN-2.5	2015 Summary Statistics		
Parameters	**Mean**	**Min**	**Max**
pH	8.02	7.77	8.28
TSS (mg/L)	80.1	2.3	341
Nutrients (mg/L)			
Ammonia Nitrogen	0.0218	0.0098	0.04
Nitrate Nitrogen	0.048	0.02	0.122
Nitrite Nitrogen	0.005	0.005	0.005
Dissolved Metals (mg/L)			
Aluminum	0.0176	0.0091	0.0351
Arsenic	0.00038	0.0003	0.00049
Cadmium	0.00001	0.00001	0.00001
Chromium	0.001	0.001	0.001
Copper	0.00193	0.00071	0.00338
Iron	0.1429	0.0225	0.288
Lead	0.0002	0.0002	0.0002
Molybdenum	0.001	0.001	0.0011
Nickel	0.0011	0.001	0.0015
Selenium	0.00008	0.00005	0.00019
Zinc	0.005	0.005	0.005

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

Station MN-4.5 2015 water quality result statistics are summarized in Table 5-31, below. Five routine water quality samples were taken during the 2015 monitoring period.

Table 5-31: MN-4.5 Water Quality Results Summary (2015)

MN-4.5	2015 Summary Statistics		
Parameters	**Mean**	**Min**	**Max**
pH	7.96	7.85	8.04
TSS (mg/L)	32.5	1	94.6
Nutrients (mg/L)			
Ammonia Nitrogen	0.02	0.011	0.037
Nitrate Nitrogen	0.046	0.027	0.081
Nitrite Nitrogen	0.005	0.005	0.005
Dissolved Metals (mg/L)			
Aluminum	0.0273	0.0162	0.0494
Arsenic	0.00041	0.0003	0.0006
Cadmium	0.000011	0.00001	0.000013
Chromium	0.001	0.001	0.001
Copper	0.00232	0.00142	0.00377
Iron	0.1291	0.0681	0.234
Lead	0.0002	0.0002	0.0002
Molybdenum	0.001	0.001	0.0011
Nickel	0.0012	0.001	0.0017
Selenium	0.00017	0.00012	0.00023
Zinc	0.005	0.005	0.005

5.1.38 UG1 – Minto South Underground Mine Dewatering

Station UG1 2015 water quality result statistics are summarized in Table 5-32, below. Six routine water quality samples were taken during the 2015 monitoring period.

Table 5-32: UG1 Water Quality Results Summary (2013-2015)

UG1	2013 - 2014 Summary Statistics			2015 Summary Statistics		
Parameters	Mean	Min	Max	Mean	Min	Max
pH	7.95	7.3	8.28	7.87	6.01	8.14
TSS (mg/L)	515.7	1.6	10500	297.9	1	3250
Nutrients (mg/L)						
Ammonia Nitrogen	31.41	0.27	230	29.3885	0.0081	75
Nitrate Nitrogen	65.792	0.303	484	49.544	0.02	125
Nitrite Nitrogen	2.4689	0.0323	12.5	1.7705	0.005	4.97
Dissolved Metals (mg/L)						
Aluminum	0.0105	0.003	0.0382	0.0284	0.0073	0.51
Arsenic	0.00166	0.00051	0.00502	0.00293	0.0012	0.00612
Cadmium	0.000039	0.00001	0.000486	0.000037	0.00001	0.000306
Chromium	0.001	0.001	0.0015	0.001	0.001	0.002
Copper	0.01871	0.00039	0.141	0.01449	0.00212	0.178
Iron	0.0234	0.005	0.159	0.0507	0.005	1.16
Lead	0.00022	0.0002	0.00204	0.00022	0.0002	0.00063
Molybdenum	0.0213	0.0062	0.0585	0.0202	0.0057	0.0421
Nickel	0.0028	0.001	0.0158	0.0037	0.001	0.0107
Selenium	0.00203	0.0001	0.031	0.00064	0.0001	0.00557
Zinc	0.0177	0.005	0.185	0.0089	0.005	0.0422

5.1.39 UG2 – Wildfire Underground Mine Dewatering

This station was not established in 2015.

5.1.40 UG3 – Copper Keel Underground Mine Dewatering

This station was not established in 2015.

5.1.41 UG4 – Minto East Underground Mine Dewatering

This station was not established in 2015.

5.2 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.

5.2.1 Effluent Monitoring Program

The Metal Mine Effluent Program requires effluent monitoring with sampling at station W3, downstream of the end of pipe discharge (Figure 5-1). Effluent monitoring samples are collected when there is a deposit of water at W3; testing occurs weekly for deleterious substances. Radium 226 and acute lethality tests are conducted quarterly due to the reduced frequency guidelines outlined in the MMER. The MMER specifies requirements for increased testing frequencies if the Radium 226 or acute lethality tests do not meet the prescribed standards as detailed in the MMER. 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.

The Effluent Monitoring Program results submitted to Environment Canada are presented in Appendix B.

5.2.2 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 (unimpacted) areas. Water quality samples must be collected four times a year, not less than one month apart, while the mine is discharging effluent. 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 are presented in Appendix B.

5.2.3 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.

The Minto Mine Phase 4 EEM is a “periodic monitoring” study, and includes a benthic invertebrate community survey, a laboratory-based fish exposure program using juvenile Chinook salmon, and a field-based characterization of the use of Minto Creek by fish. Other EEM components implemented by the Minto Mine are also presented as part of this study design (sublethal toxicity testing, effluent characterization and water quality monitoring). A fish usability assessment is not required at the Minto Mine because mercury concentrations in final effluent do not exceed 0.10 ug/L (per Environment Canada

2012). The benthic invertebrate community survey will be conducted in erosional habitat of upper Minto Creek (the immediate receiver of Minto Mine effluent), and will be evaluated using a Reference Condition Approach (RCA) consistent with the approach applied in the Minto Mine Phase 3 EEM Investigation of Cause (IOC) study. Requirements for a fish population survey will be addressed in an on-site laboratory study similar to that implemented for the Minto Mine Phase 2 EEM and in a non-lethal fish population survey in lower Minto Creek, which is the area closest to the mine previously shown to support fish. The benthic survey and will be conducted in the late summer (late August or early September) of 2016. The laboratory-based fish exposures will be implemented in the summer (late July to early September) of 2016. The field-based fish occupancy characterization will be implemented at monthly intervals in July, August and September 2016 in order to identify periods of maximum use and to potentially provide sufficient sample size for a non-lethal fish survey. Additional detail on all components of the Minto Mine Phase 4 EEM is provided in Appendix C.

5.3 Hydrology

In 2015 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.

5.3.1 Minto Creek Hydrology

Hydrological monitoring on Minto Creek is conducted in accordance with the requirements outlined in the WUL. During the 2015 monitoring period, Minto Mine maintained and collected data from the following four hydrometric stations along Minto Creek (see Figure 5-1):

- 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 2015 results of Minto Creek hydrology see the *Minto and McGinty Creek 2015 Surface Hydrology Update* in Appendix D.

5.3.2 McGinty Creek Hydrology

In 2015, hydrological monitoring on McGinty Creek was conducted as per the schedule outlined in the EMSRP. During the 2015 monitoring period, Minto Mine maintained and collected data from the following three hydrometric stations along McGinty Creek (see Figure 5-1):

- MN-0.5 (West branch of McGinty Creek);
- MN-2.5 (East branch of McGinty Creek); and
- 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 2014 results of McGinty Creek hydrology see the *Minto and McGinty Creek 2015 Surface Hydrology Update* in Appendix D.

5.4 Seepage Water Quality Monitoring Program

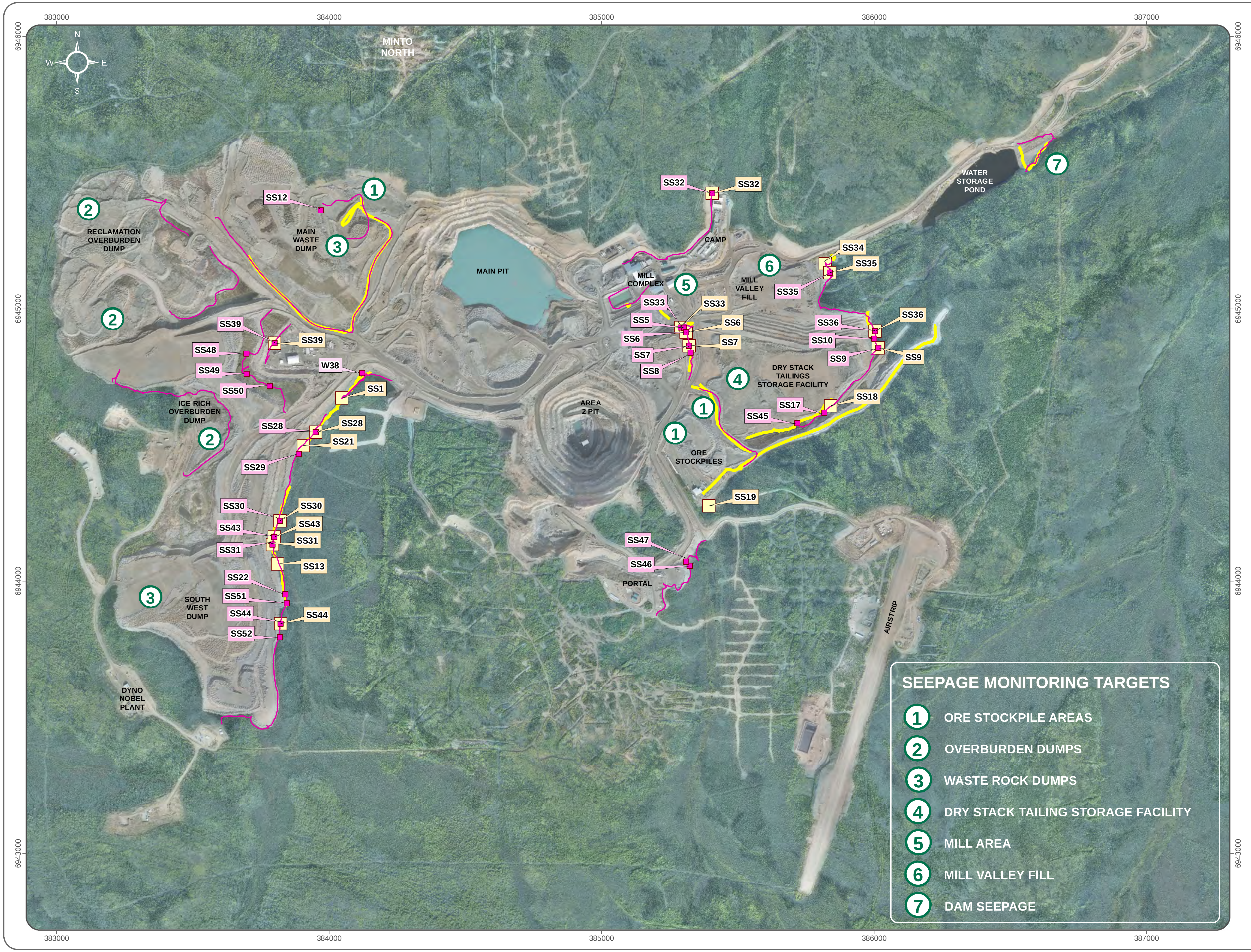
Minto Mine implements a Seepage Monitoring Plan (SMP) to assess acid rock drainage and metal leaching conditions from several sources including: pit wall seepage, ore stockpile areas, overburden dumps, waste rock dumps, DSTSF, Mill Valley Fill Extension 1 and 2, the mill area and other seepage locations. Seepage monitoring that was conducted in 2015 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. Each seepage monitoring event survey routes are recorded using the tracking function of a GPS. A map showing the 2015 survey routes and monitoring locations can be found in Figure 5-16.

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, and W37. 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 spring and fall and if water is present, a sample is collected. We have seen a good amount of variability in water flows at seepage sites. All lab results for 2015 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 2015 Seepage Monitoring Program indicate that the majority of the seepage sites identified are seasonally variable with flows observed during spring and early summer months. 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.



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SEEPAGE MONITORING PROGRAM ANUAL REPORT

FIGURE 5-13

2015 SEEPAGE MONITORING PROGRAM

FEBRUARY 2016

- Fall 2015 Seepage Survey Monitoring Stations
- Fall 2015 Seepage Survey Lines
- Spring 2015 Seepage Survey Monitoring Stations
- Spring 2015 Seepage Survey Lines

1:13,000
when printed on 11 x 17 inch paper

0 100 200 300 400 500
Meters

ALEXCO ENVIRONMENTAL GROUP

Aerial imagery obtained from Challenger Geomatics. Imagery acquired September 9th 2014.

Datum: NAD 83 Projection: UTM Zone 8N

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5.4.1 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. Water quality results for W8 and W8A are outlined in Figure 5-17 through Figure 5-25 and include historic water quality results for dissolved copper, cadmium, iron, selenium and nutrient levels for ammonia, nitrite and nitrate.

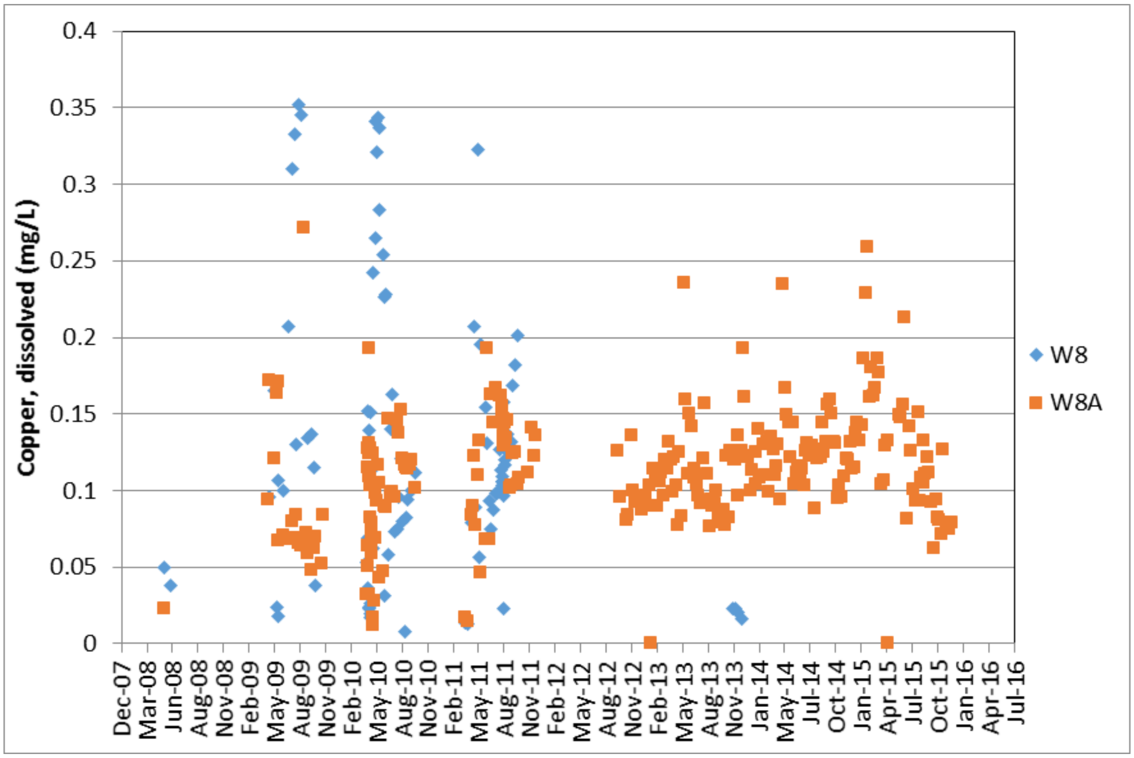


Figure 5-17 : Dissolved Copper Concentrations at W8 and W8A (2008 – 2015)

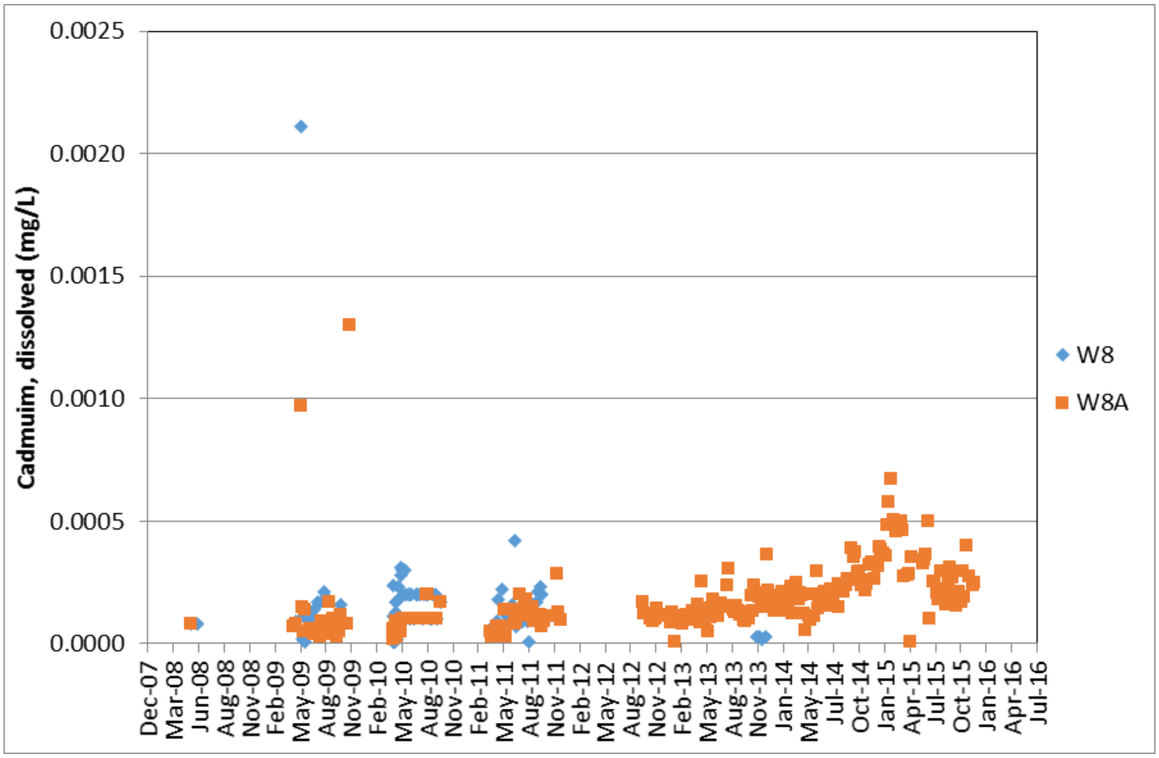


Figure 5-18: Dissolved Cadmium Concentrations at W8 and W8A (2008 – 2015)

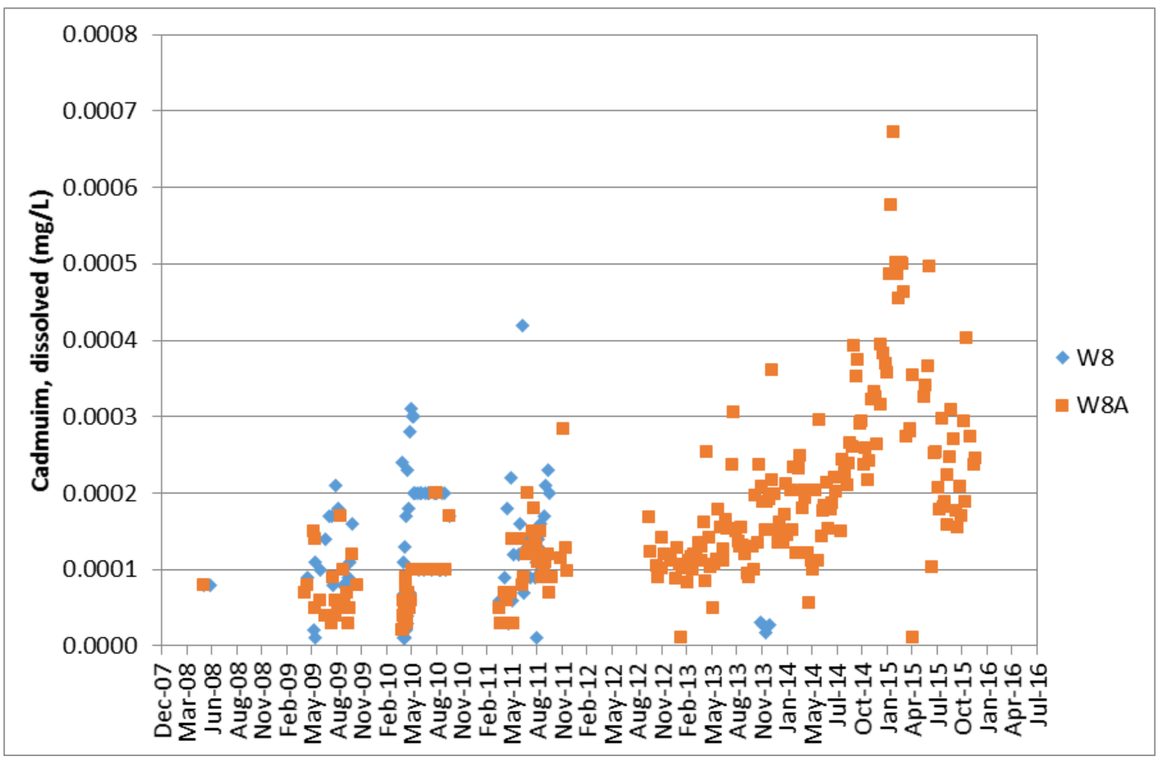


Figure 5-19: Dissolved Cadmium Concentrations at W8 and W8A, with Reduced Concentration Range (2008-2015)

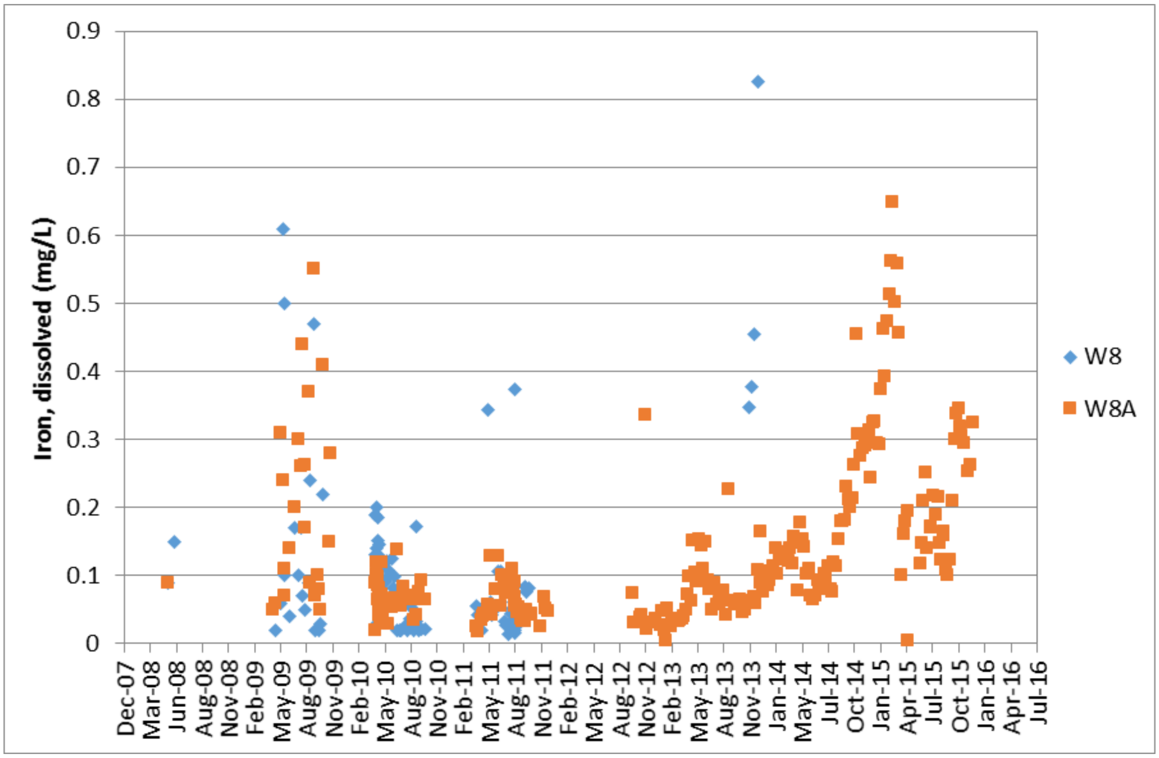


Figure 5-20: Dissolved Iron Concentrations at W8 and W8A (2008-2015)

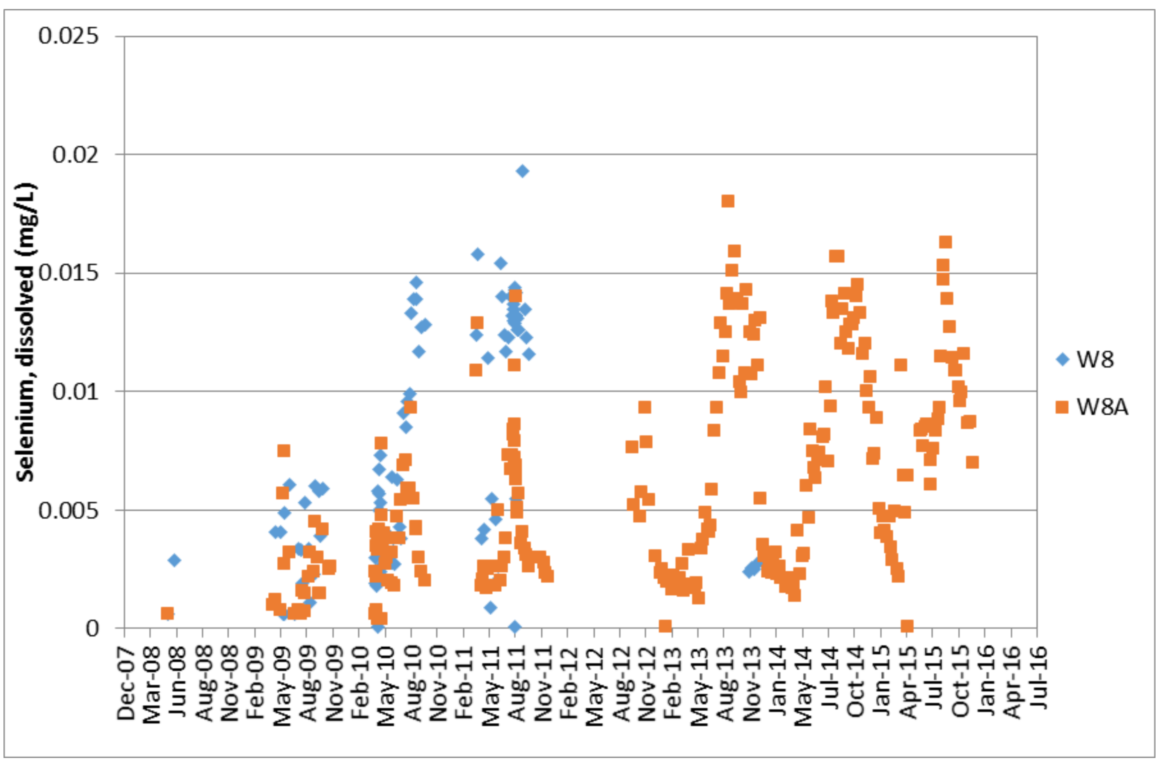


Figure 5-21: Dissolved Selenium Concentrations at W8 and W8A (2008-2015)

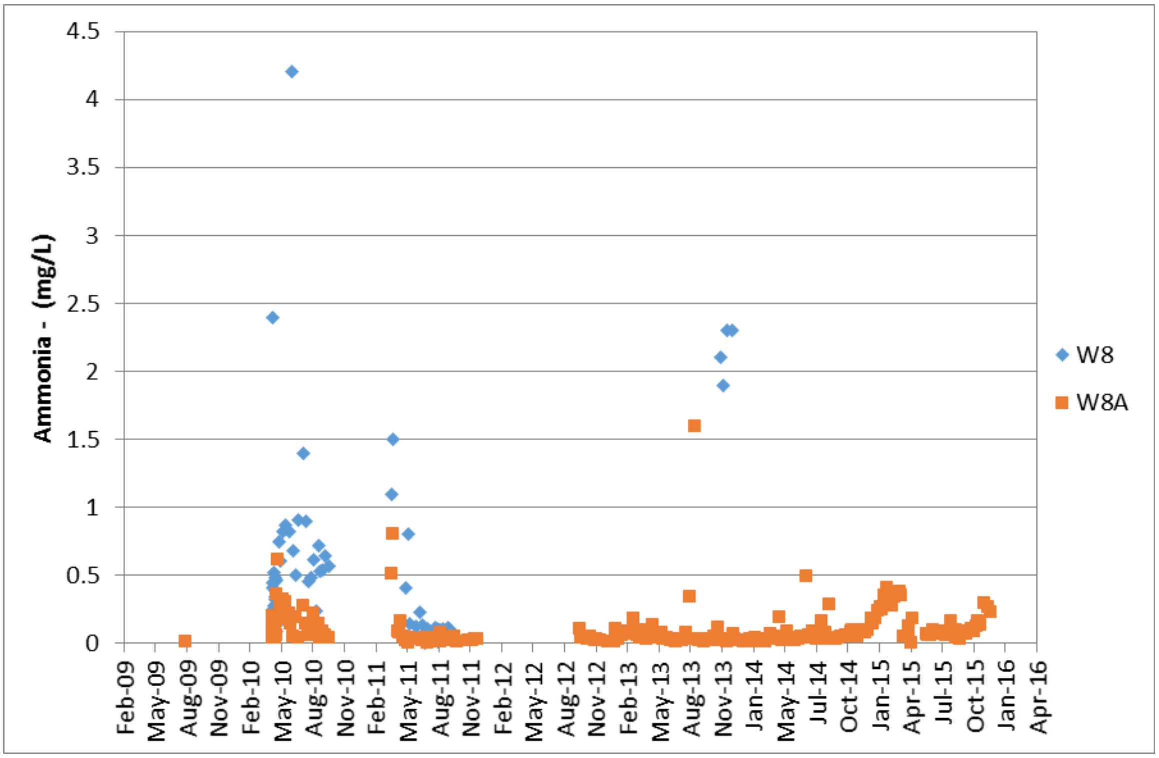


Figure 5-22: Ammonia Concentrations at W8 and W8A (2009-2015)

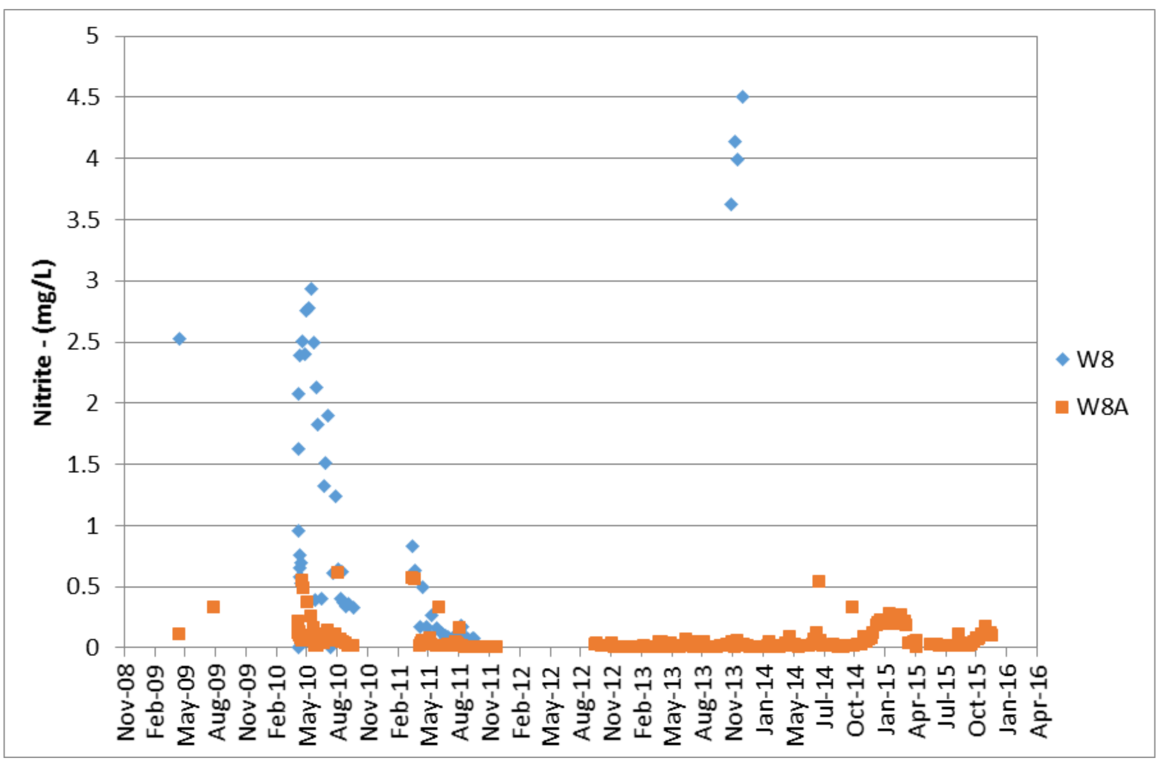


Figure 5-23: Nitrite Concentrations at W8, and W8A (2009-2015)

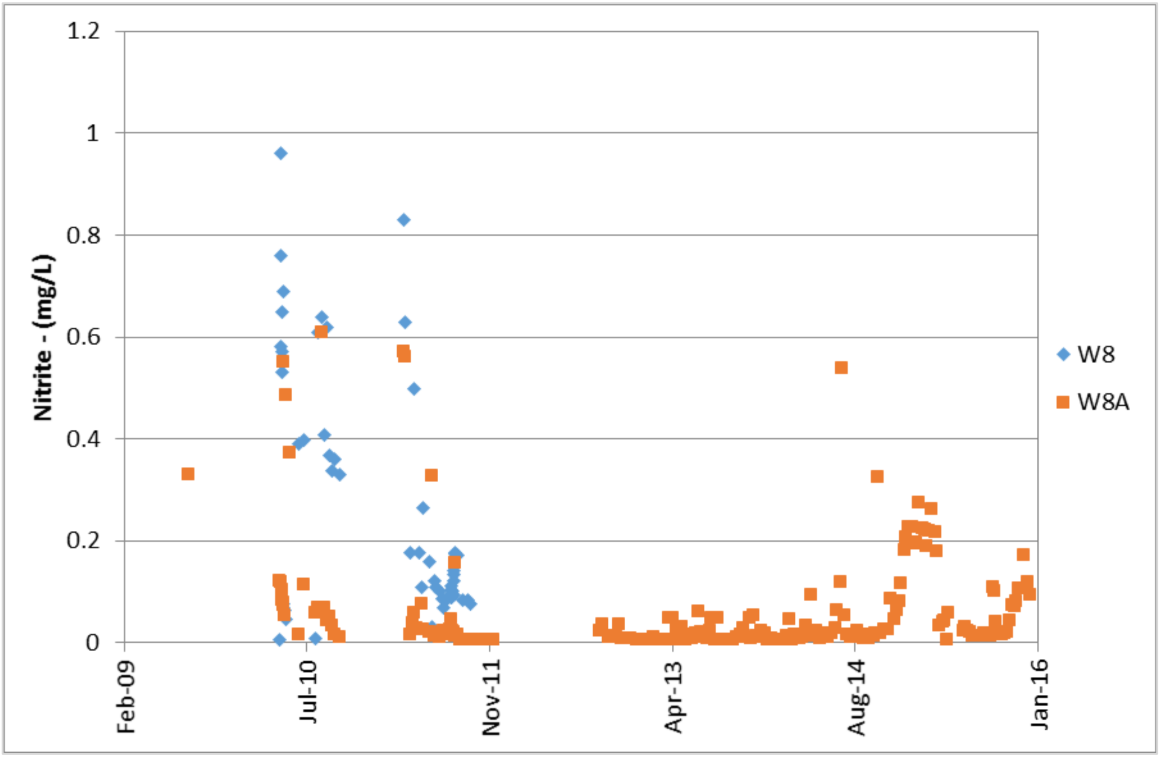


Figure 5-24: Nitrite concentrations at W8 and W8A, with Reduced Concentration Range (2009-2015)

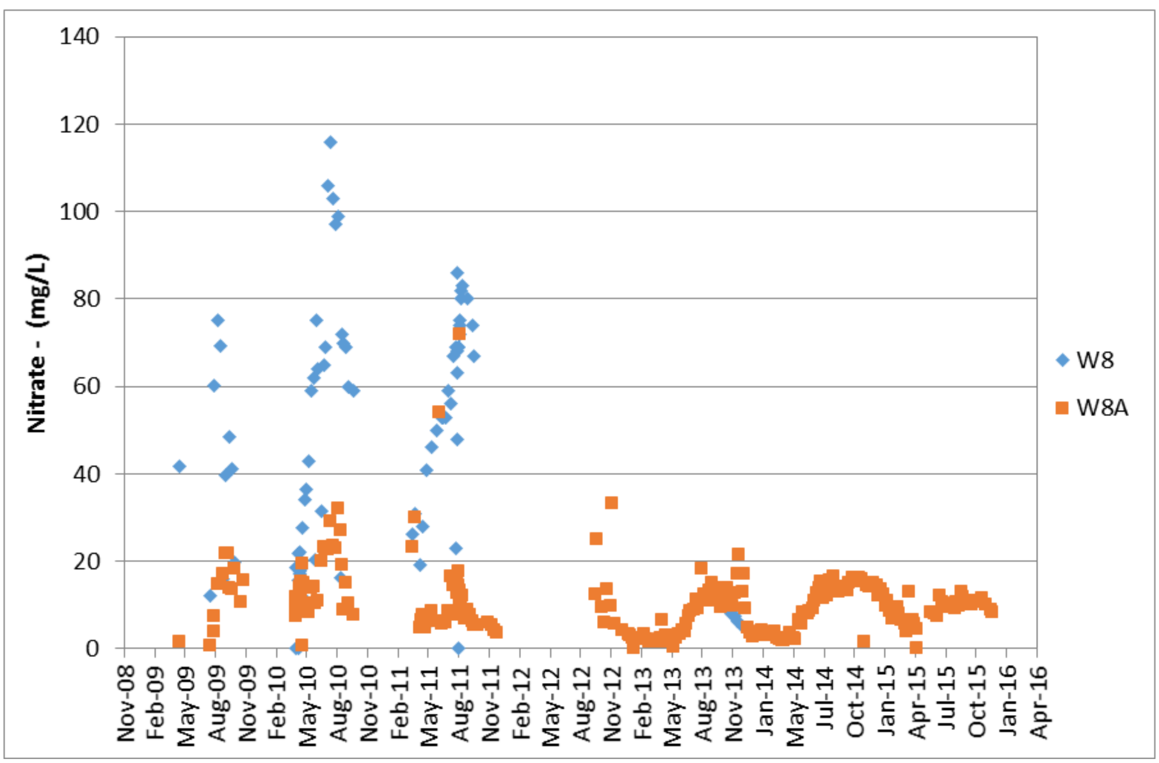


Figure 5-25: Nitrate concentrations at W8, and W8A (2009-2015)

5.4.2 Southwest Dump

Seepage was collected at stations SS1, SS13, SS21, SS22, SS28, SS29, SS30, SS31, SS39, SS43, SS44, SS48, SS49, SS50, SS51, and SS52. Additionally W32, W38, W39 and W40 were additionally 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 for W32, W38, W39, and W40 are outlined in Figure 5-26 to 5-34 and seepage water quality results are summarized in Figure 5-25 to Figure 5-55. The summary figures include historic water quality results for dissolved copper, cadmium, iron, selenium and nutrient levels for ammonia, nitrite and nitrate.

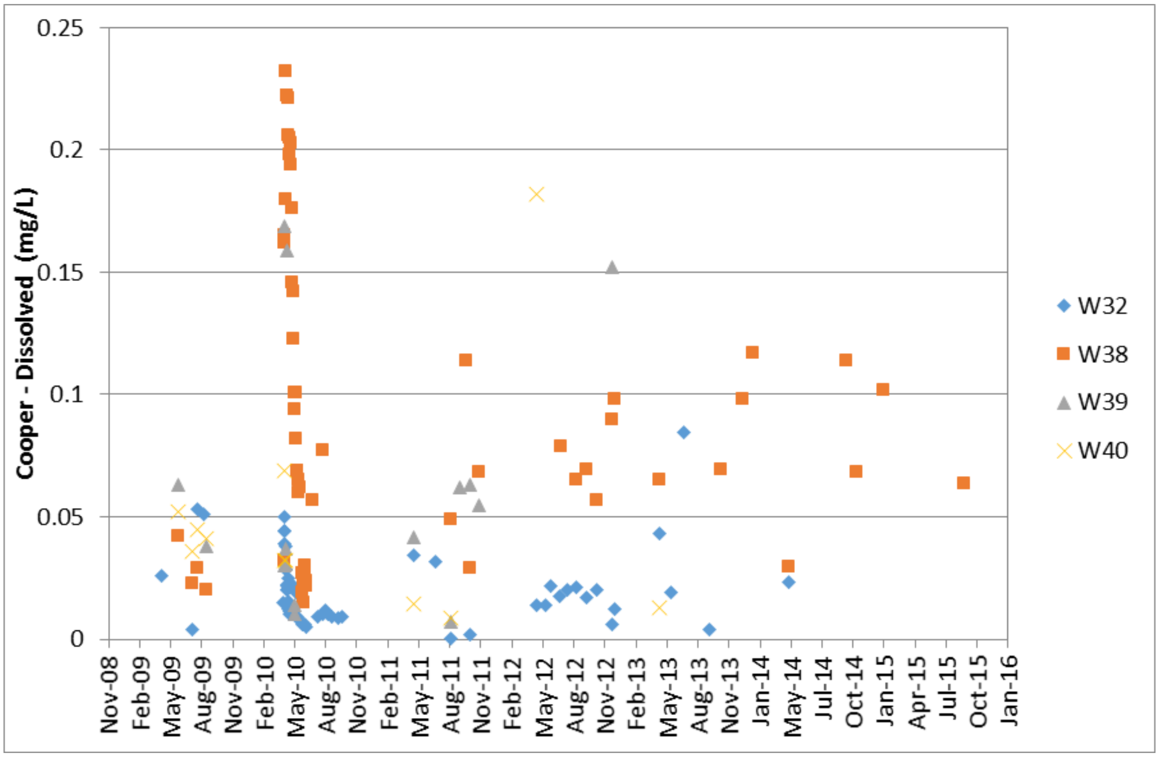


Figure 5-26: Dissolved Copper Concentrations at Toe of the SWD (2009-2015)

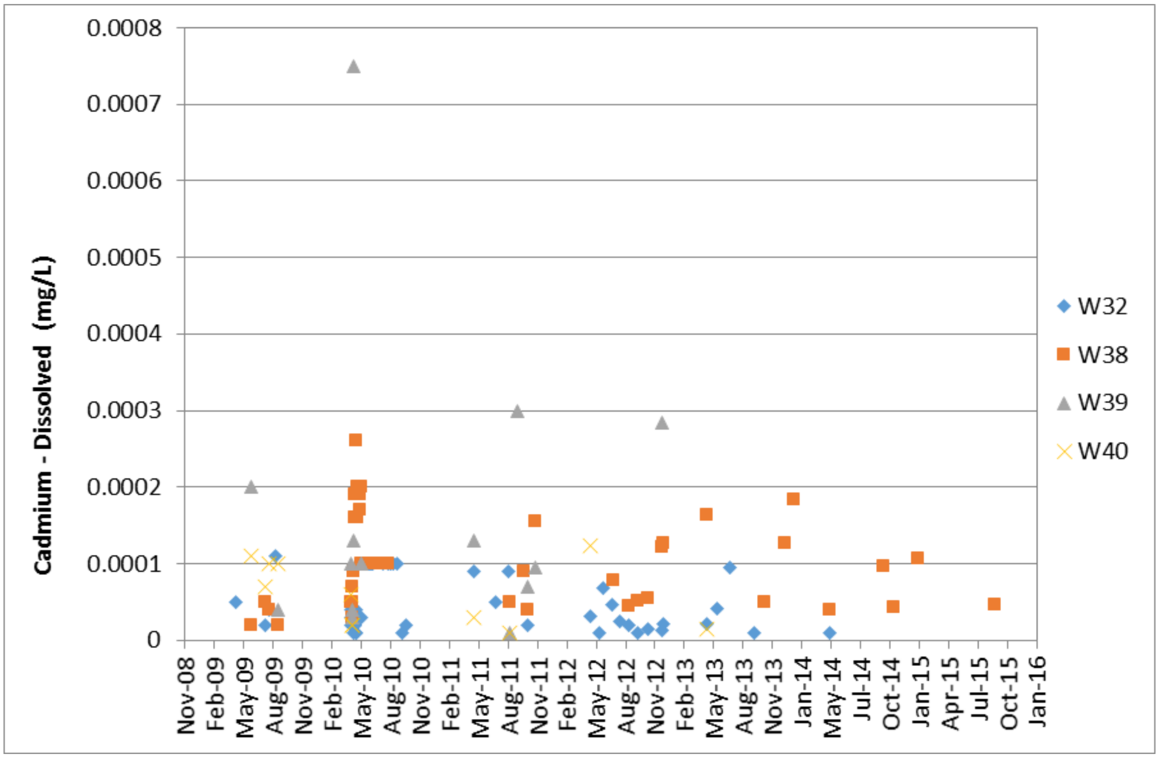


Figure 5-27: Dissolved Cadmium Concentrations at Toe of the SWD (2009-2015)

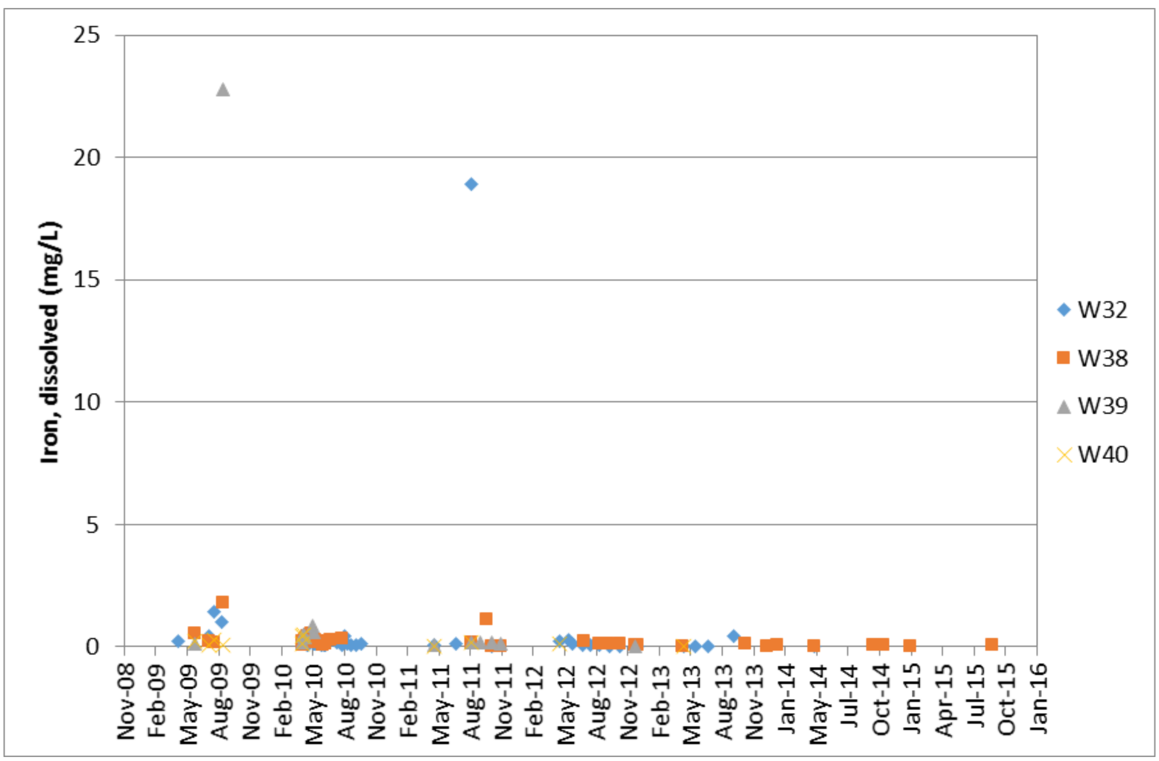


Figure 5-28: Dissolved Iron Concentrations at Toe of the SWD (2009-2015)

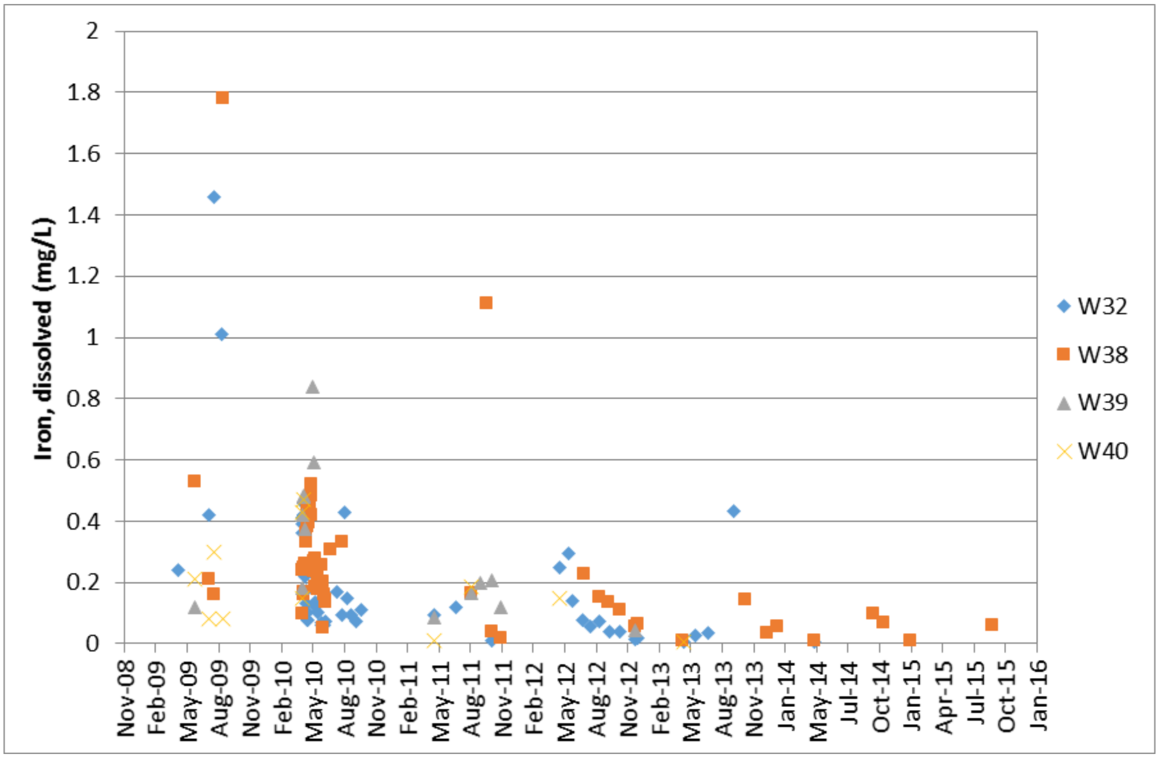


Figure 5-29: Dissolved Iron Concentrations at Toe of the SWD, with Reduced Concentration Range (2009-2015)

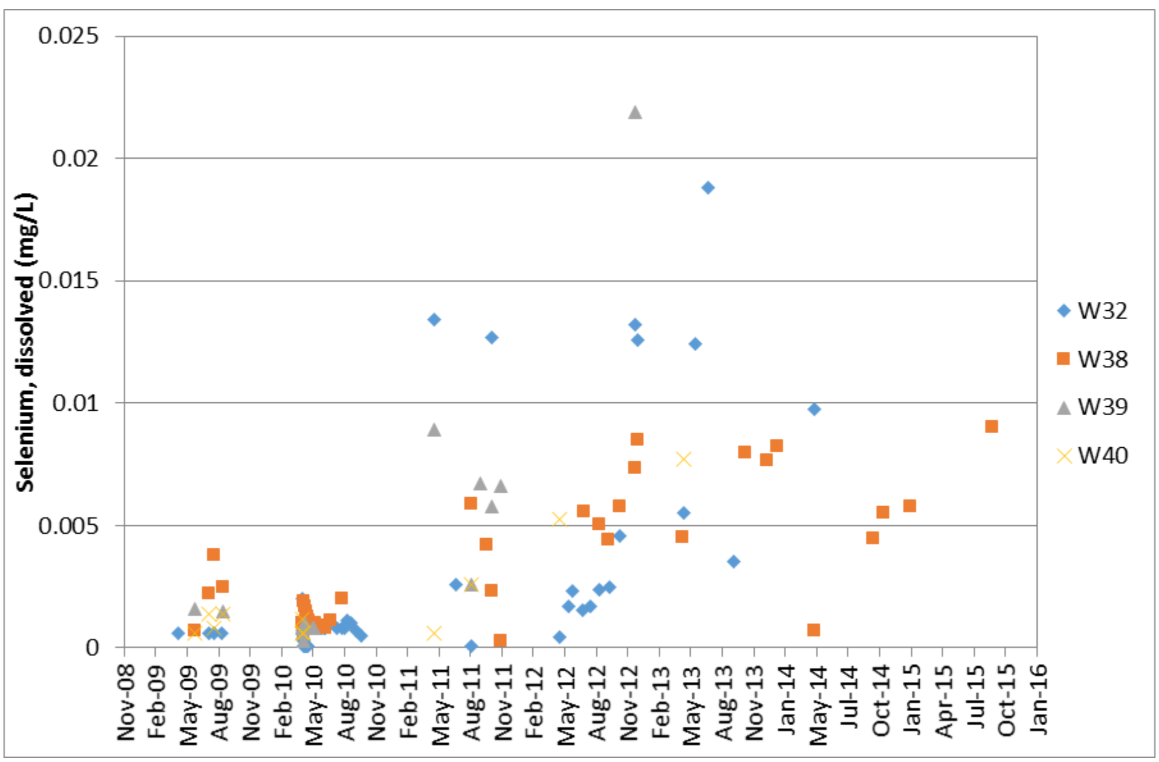


Figure 5-30: Dissolved Selenium Concentrations at Toe of the SWD (2009-2015)

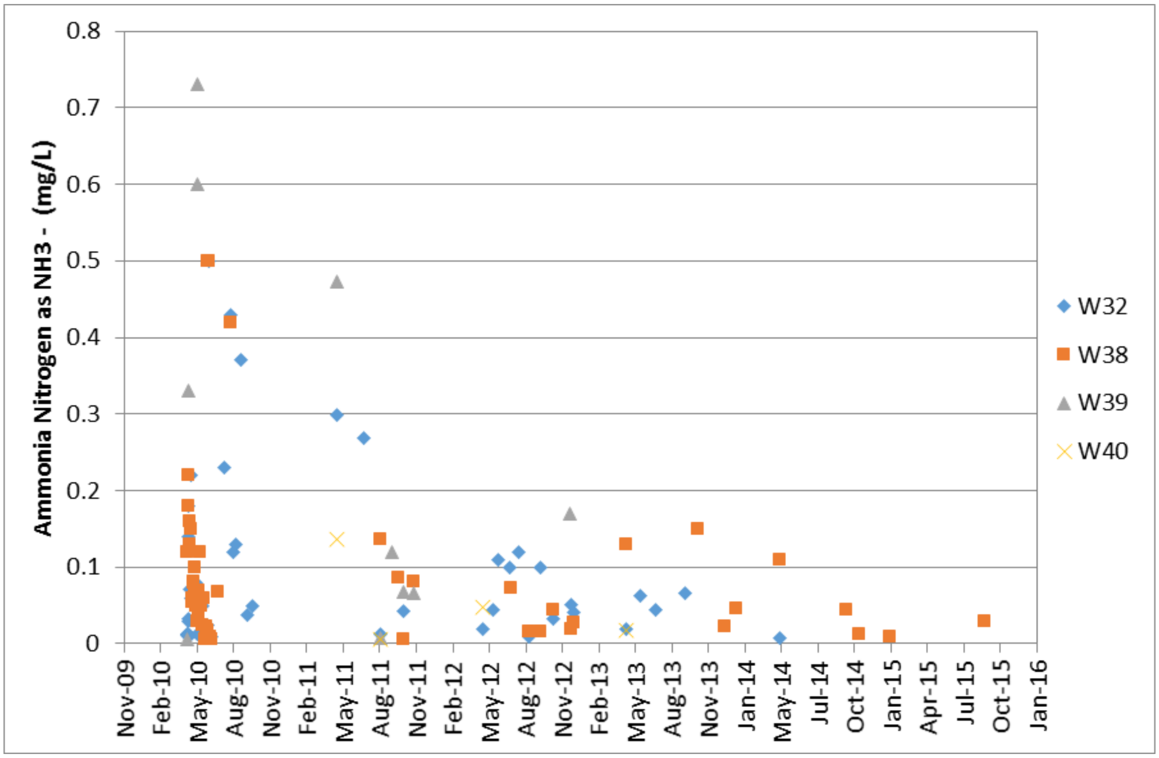


Figure 5-31: Ammonia Concentrations at Toe of the SWD (2010-2015)

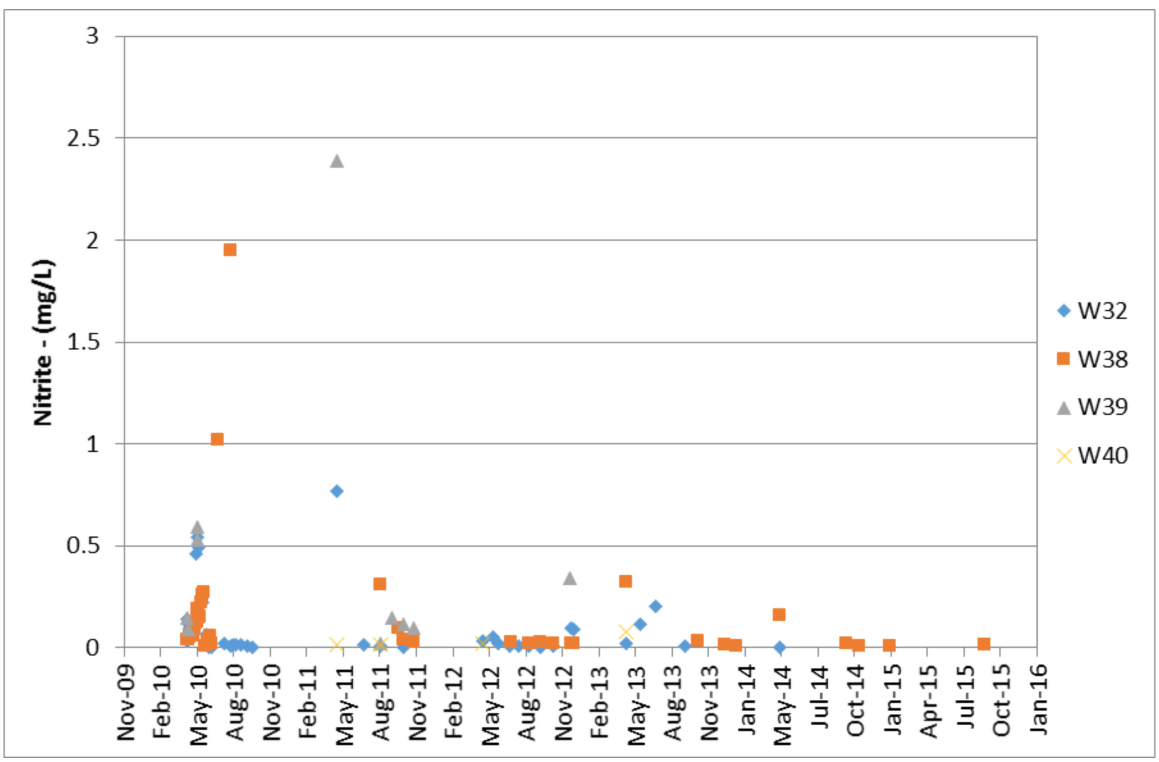


Figure 5-32: Nitrite Concentrations at Toe of the SWD (2010-2015)

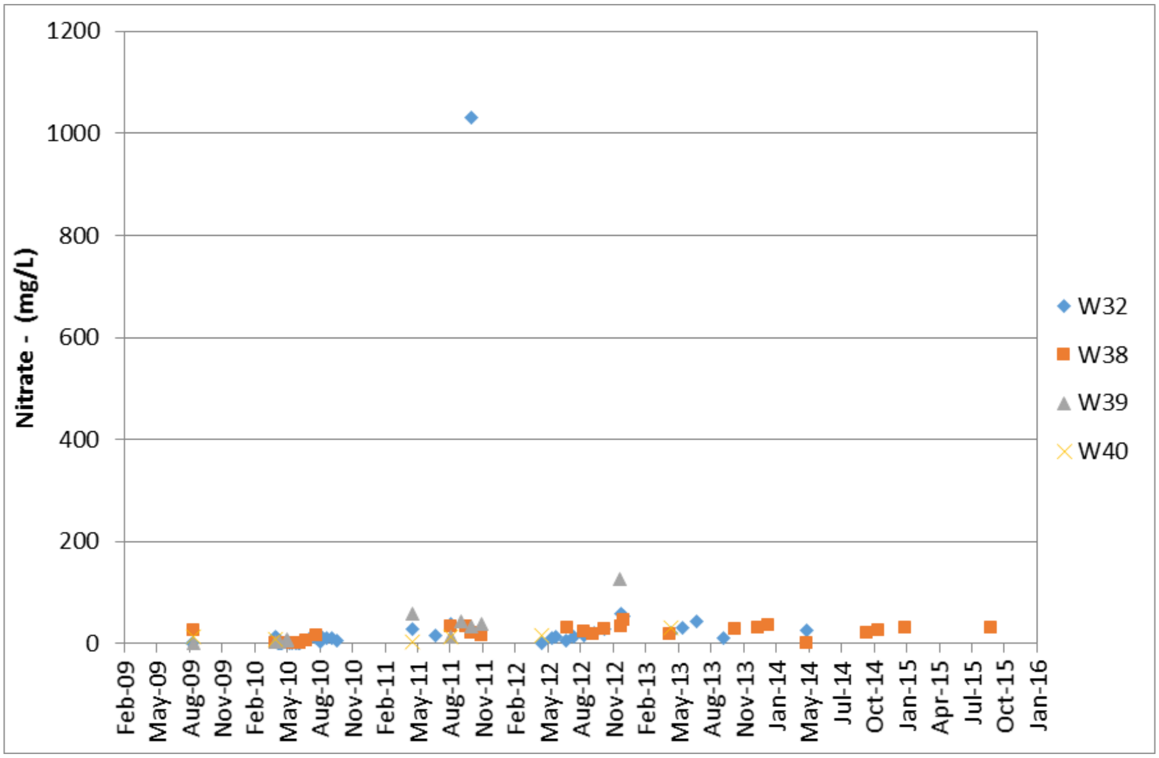


Figure 5-33: Nitrate Concentrations at Toe of the SWD (2009-2015)

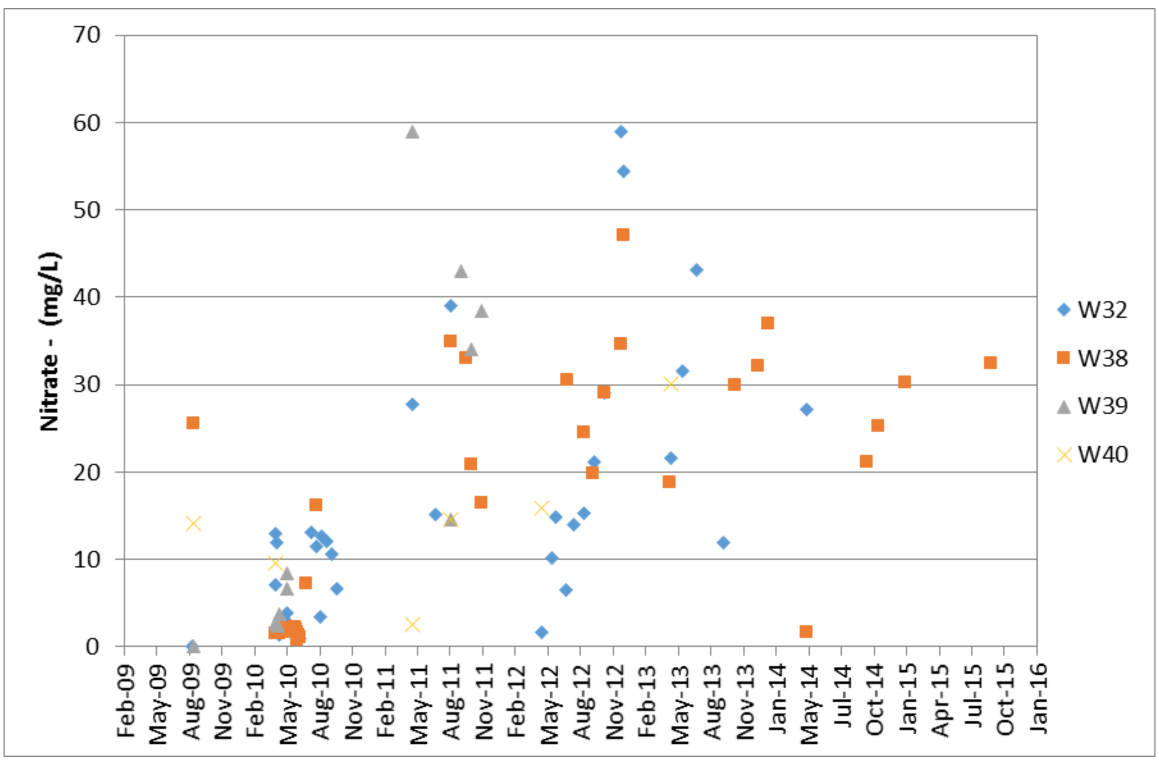


Figure 5-34: Nitrate Concentrations at Toe of the SWD, with Reduced Concentration Range (2009-2015)

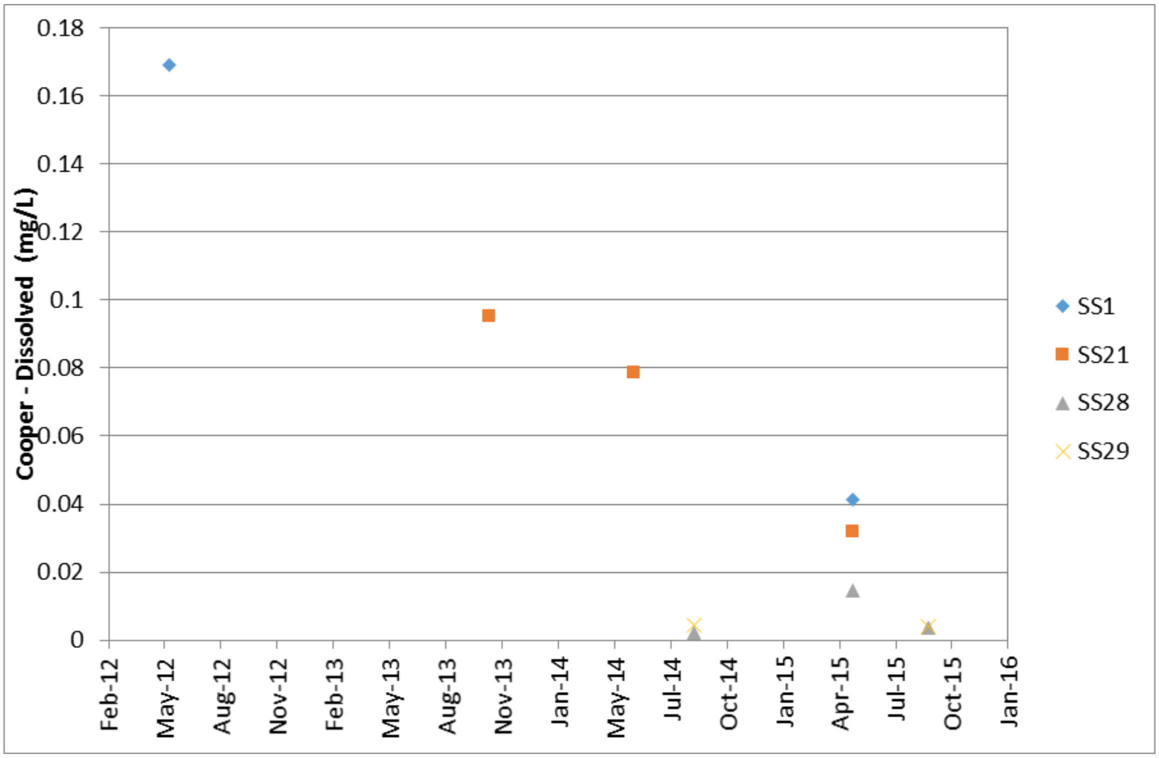


Figure 5-35: Dissolved Copper Concentrations at SS1, SS21, SS28 and SS29 (2012-2015)

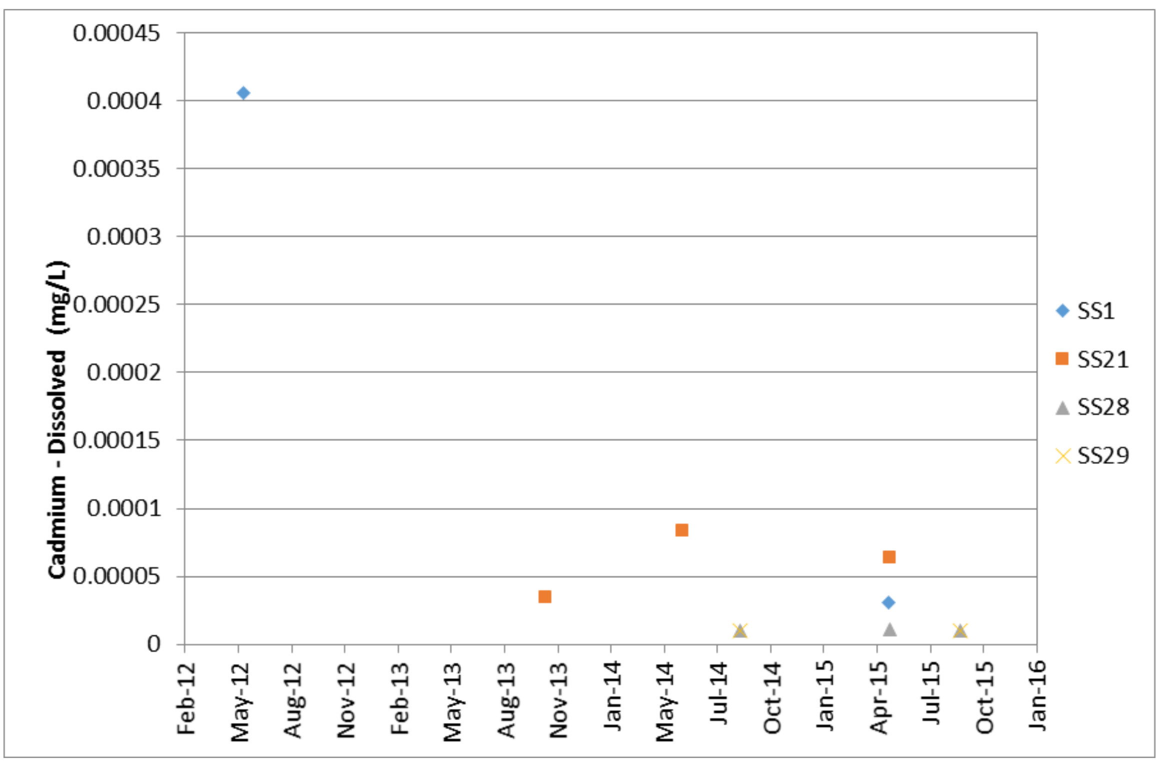


Figure 5-36: Dissolved Cadmium Concentrations at SS1, SS21, SS28 and SS29 (2012-2015)

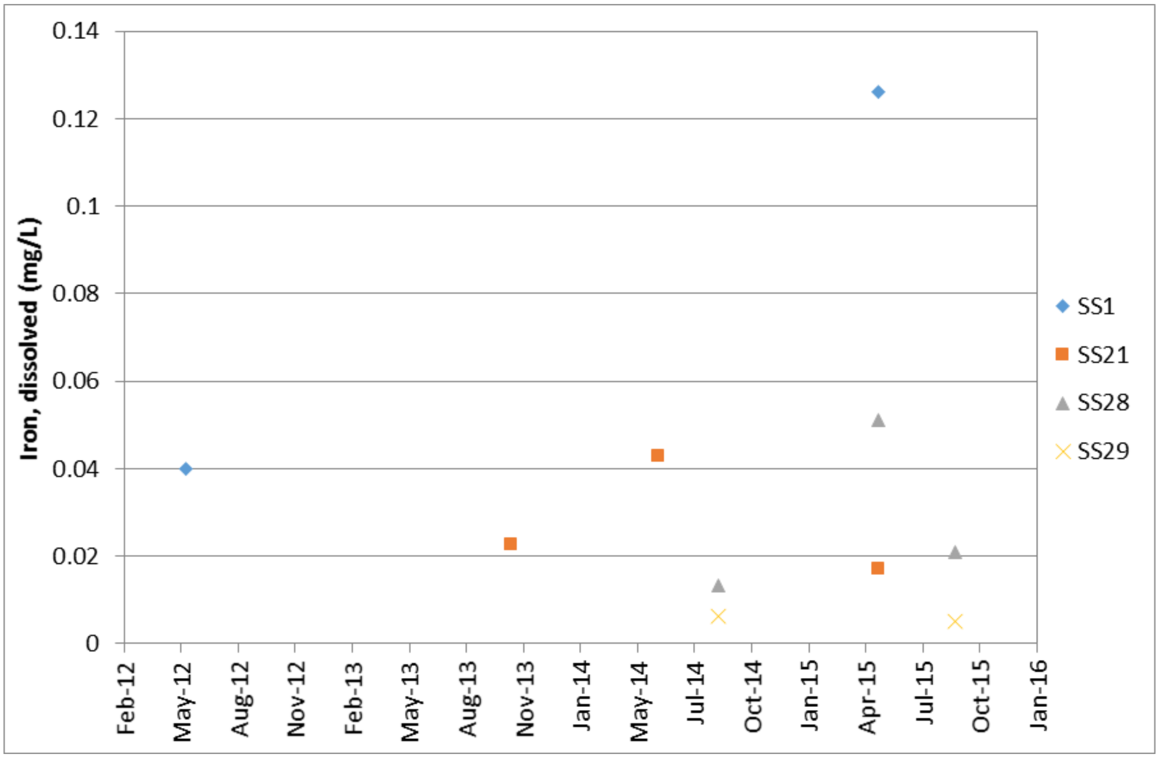


Figure 5-37: Dissolved Iron Concentrations at SS1, SS21, SS28 and SS29 (2012-2015)

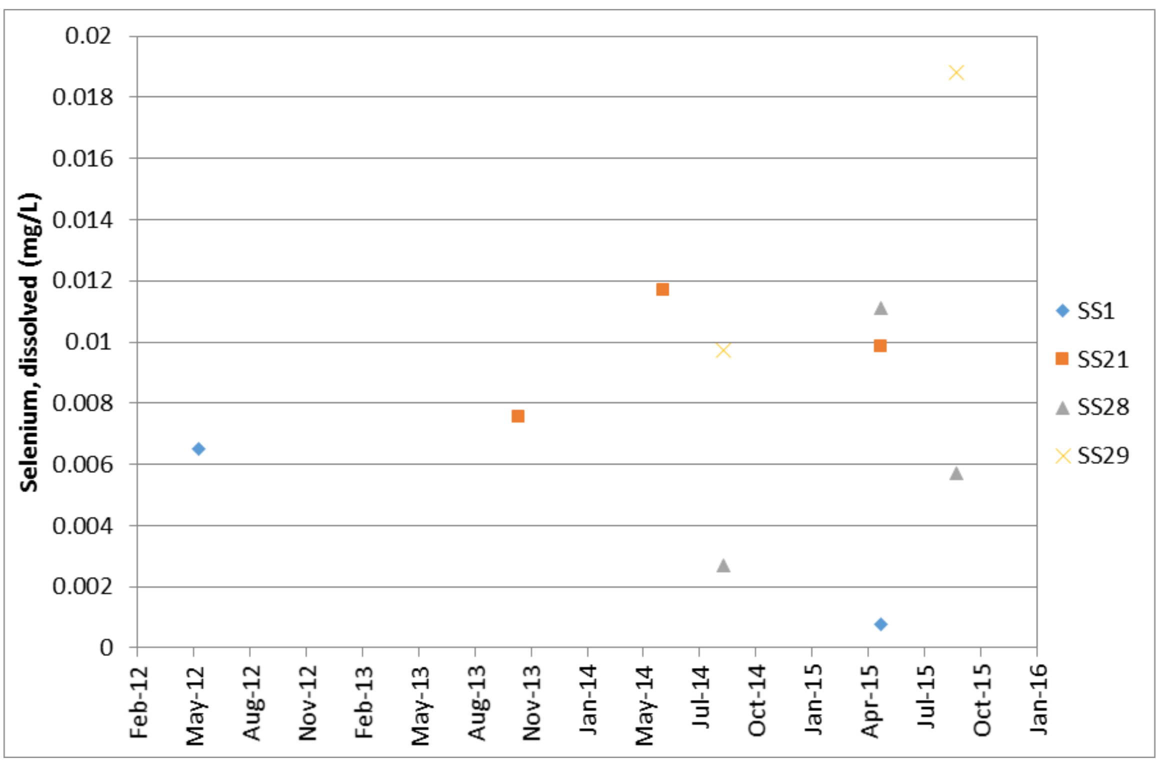


Figure 5-38: Dissolved selenium concentrations at SS1, SS21, SS28 and SS29 (2012-2015)

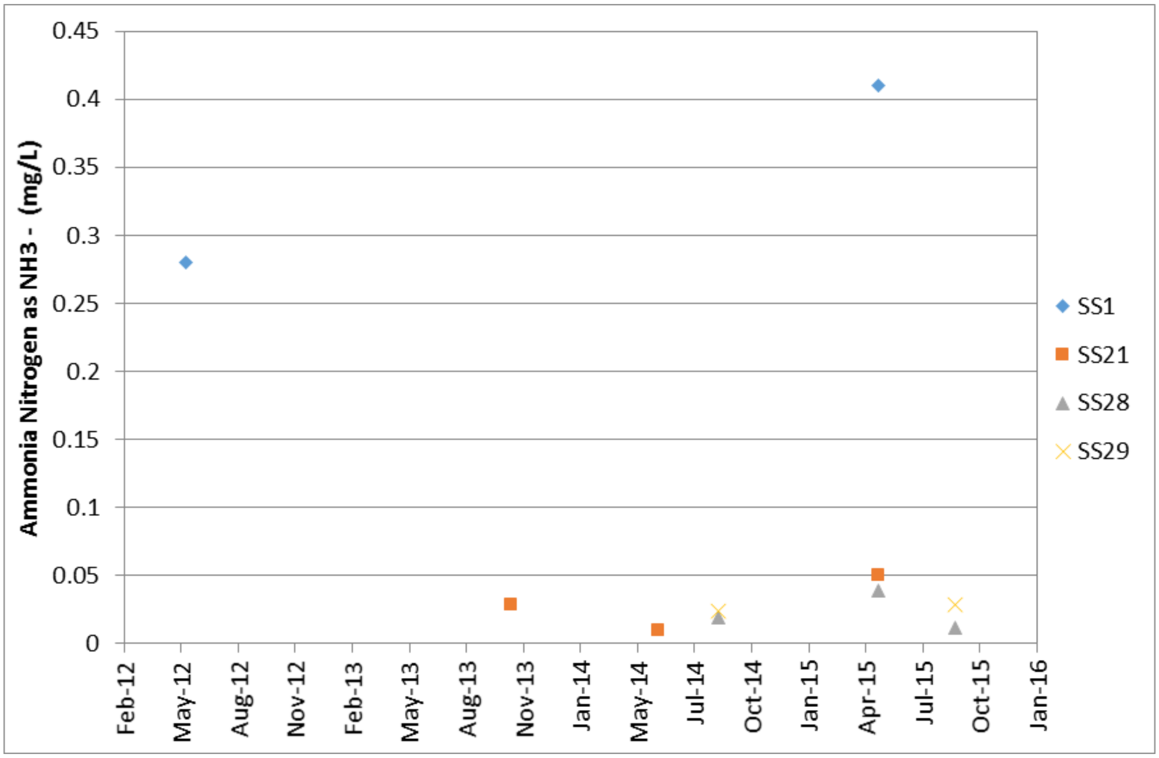


Figure 5-39: Ammonia Concentrations at SS1, SS21, SS28 and SS29 (2012-2015)

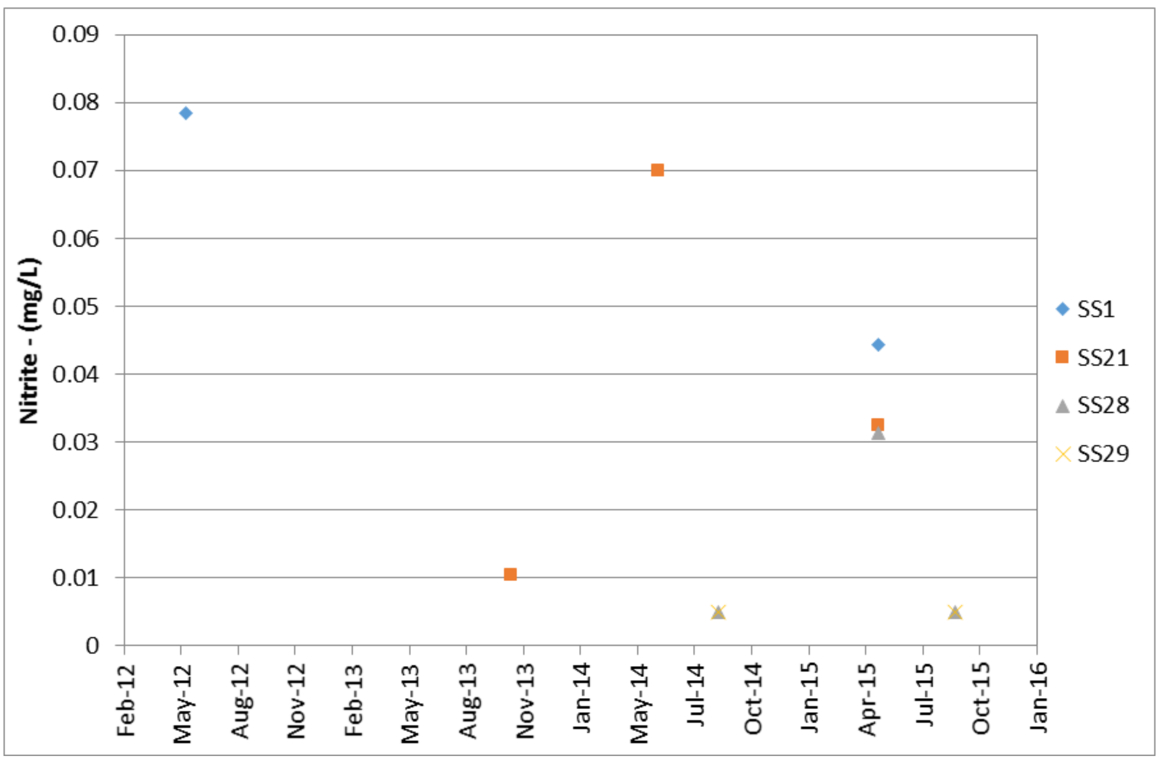


Figure 5-40: Nitrite Concentrations at SS1, SS21, SS28 and SS29 (2012-2015)

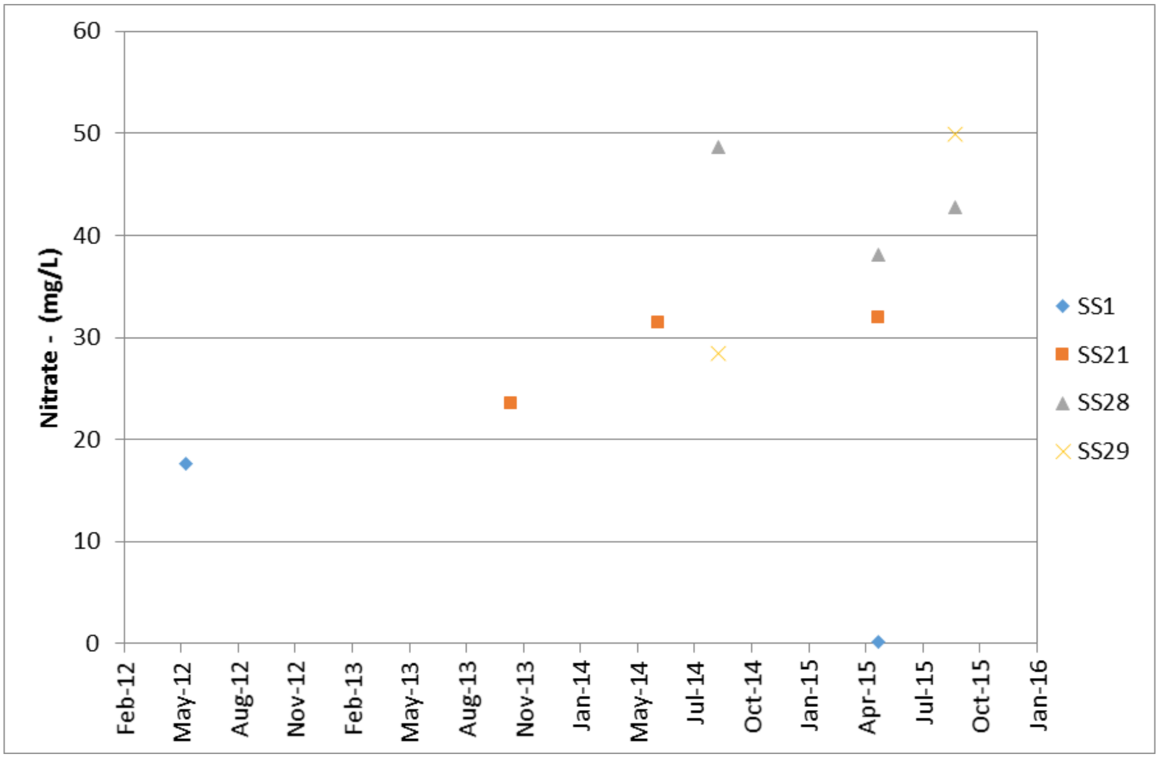


Figure 5-41: Nitrate Concentrations at SS1, SS21, SS28 and SS29 (2012-2015)

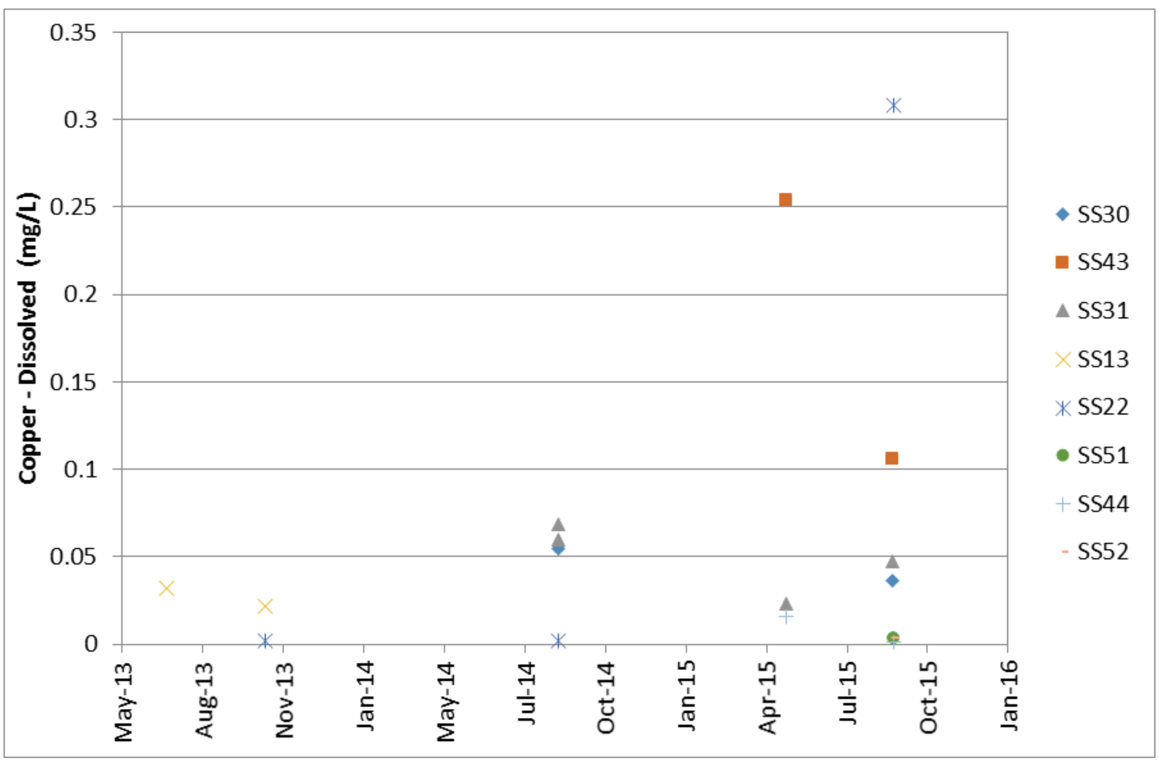


Figure 5-42: Dissolved Copper Concentrations at Toe of the SWD - SS30, SS43, SS31, SS13, SS22, SS51, SS44 and SS52 (2013-2015)

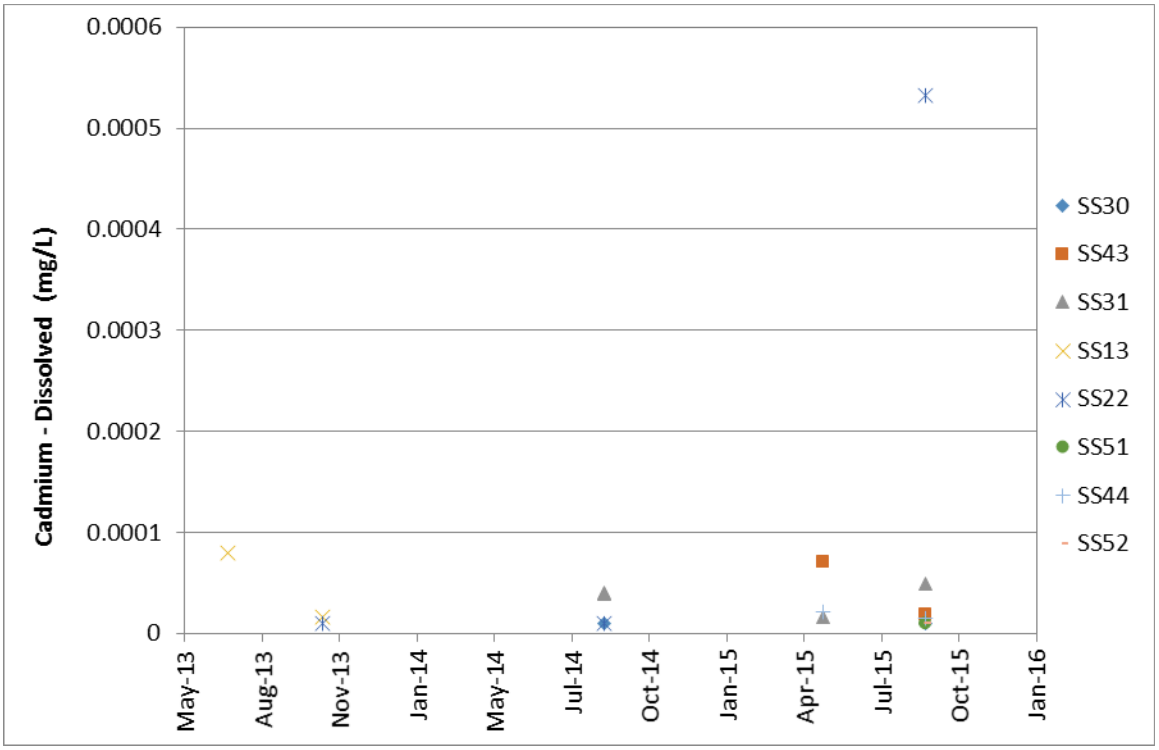


Figure 5-43: Dissolved Cadmium Concentrations at Toe of the SWD - SS30, SS43, SS31, SS13, SS22, SS51, SS44 and SS52 (2013-2015)

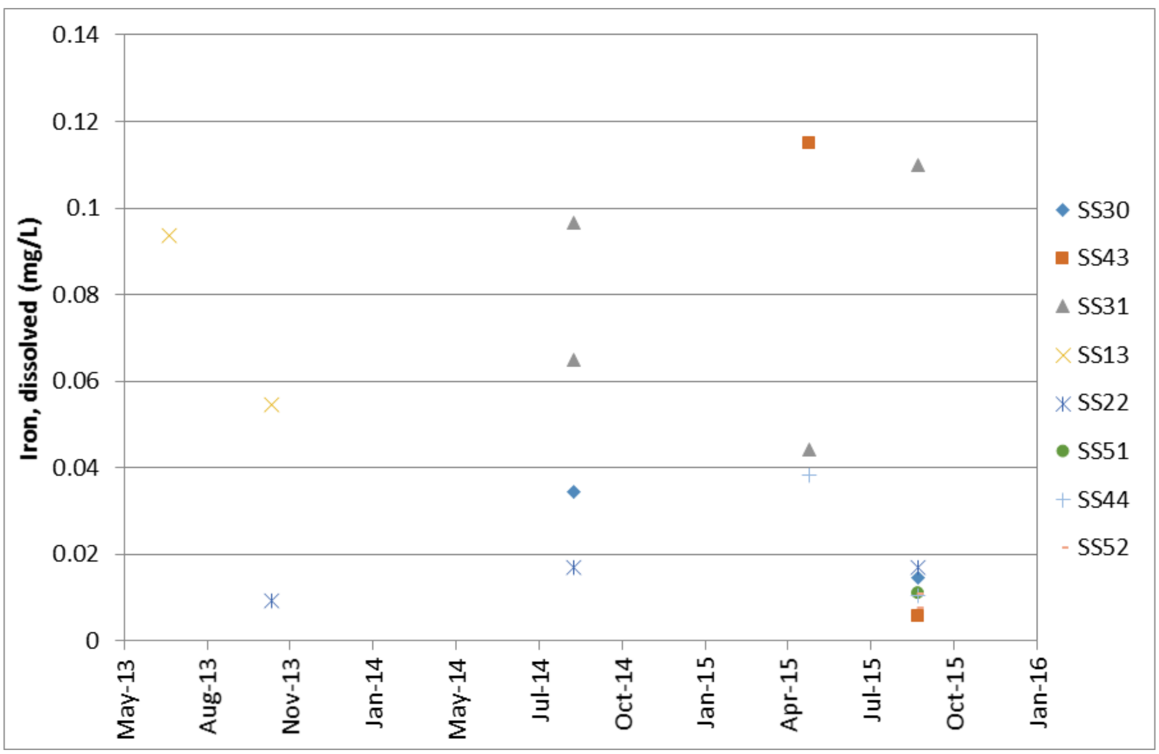


Figure 5-44: Dissolved Iron Concentrations at Toe of the SWD - SS30, SS43, SS31, SS13, SS22, SS51, SS44 and SS52 (2013-2015)

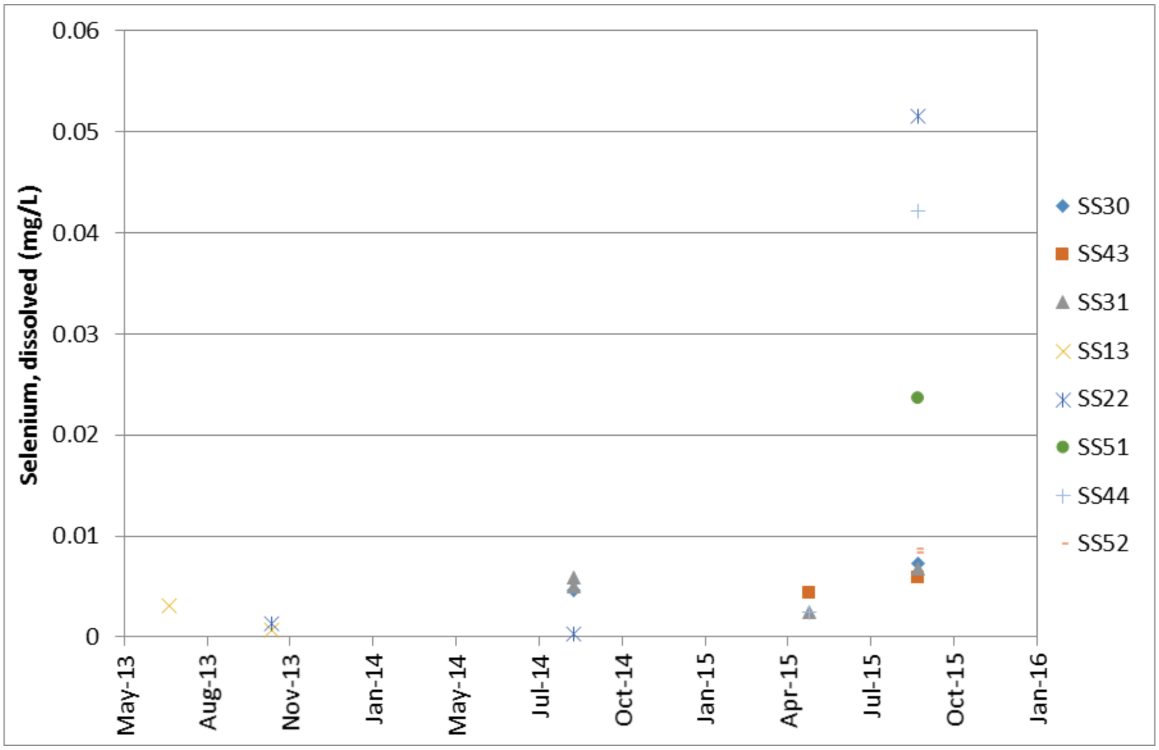


Figure 5-45: Dissolved Selenium Concentrations at Toe of the SWD - SS30, SS43, SS31, SS13, SS22, SS51, SS44 and SS52 (2013-2015)

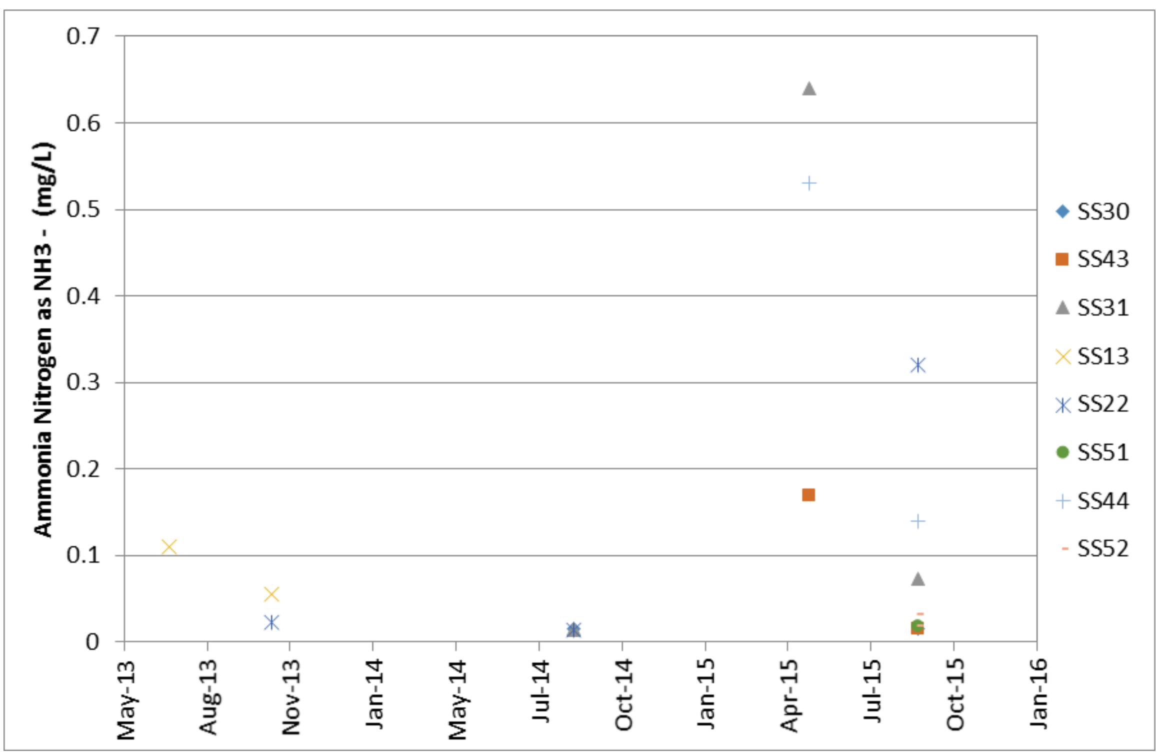


Figure 5-46: Ammonia Concentrations at Toe of the SWD - SS30, SS43, SS31, SS13, SS22, SS51, SS44 and SS52 (2013-2015)

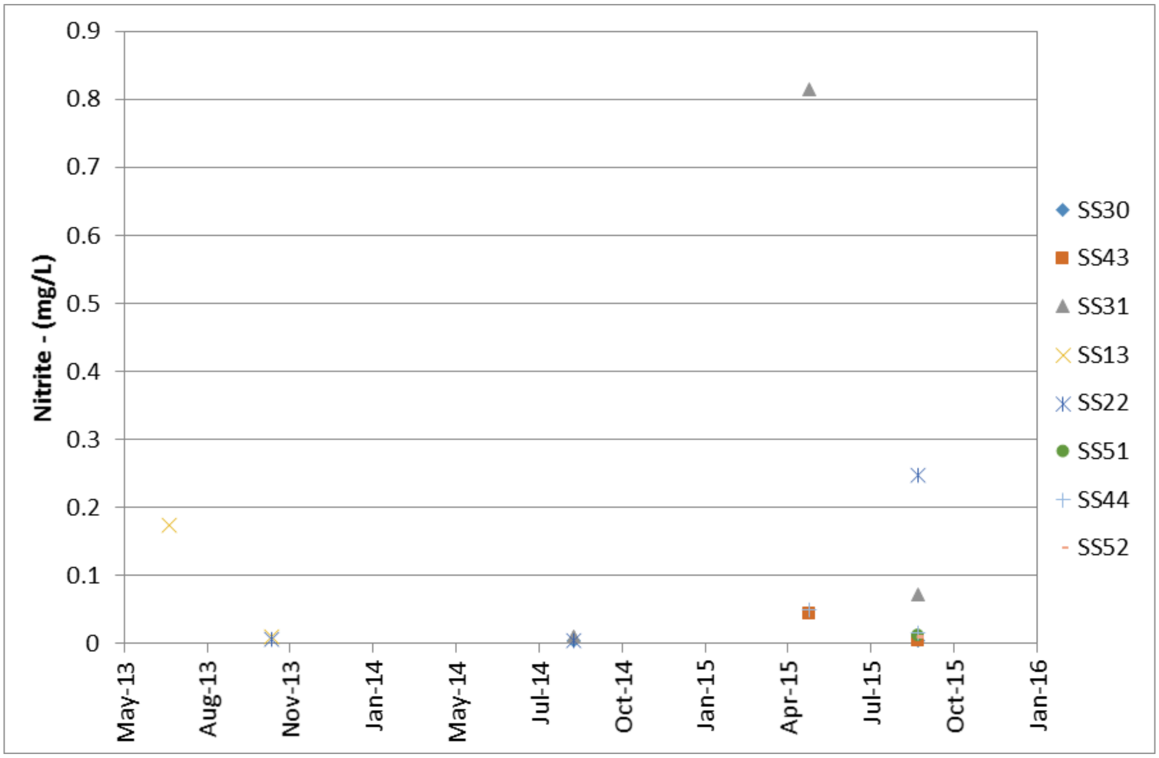


Figure 5-47: Nitrite Concentrations at Toe of the SWD - SS30, SS43, SS31, SS13, SS22, SS51, SS44 and SS52 (2013-2015)

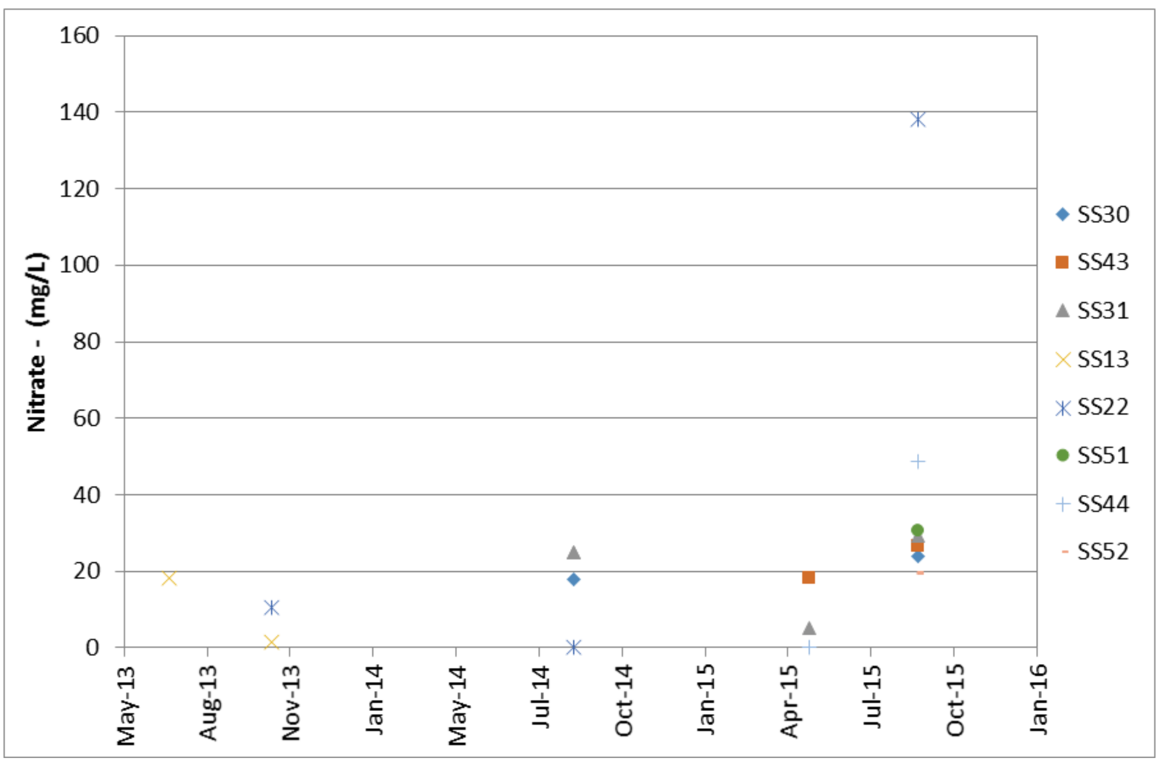


Figure 5-48: Nitrate Concentrations at Toe of the SWD - SS30, SS43, SS31, SS13, SS22, SS51, SS44 and SS52 (2013-2015)

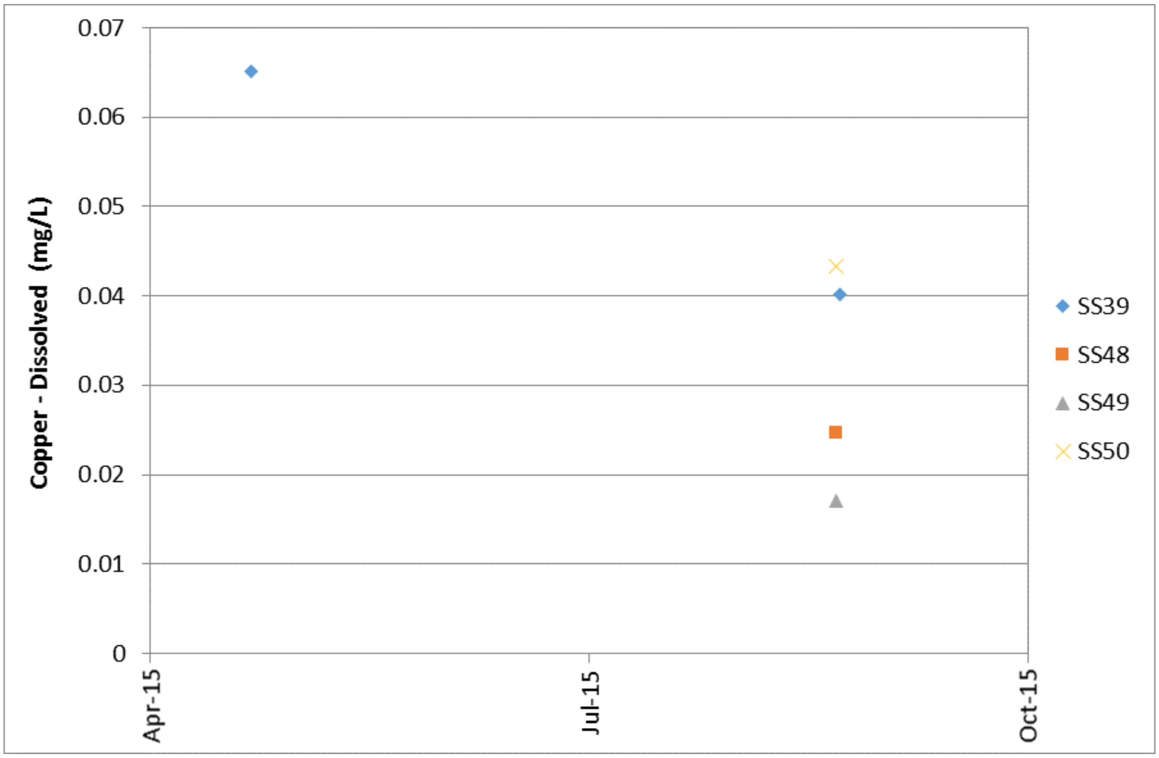


Figure 5-49: Dissolved Copper Concentrations at Toe of the SWD – SS39, SS48, SS49 and SS50 (2015)

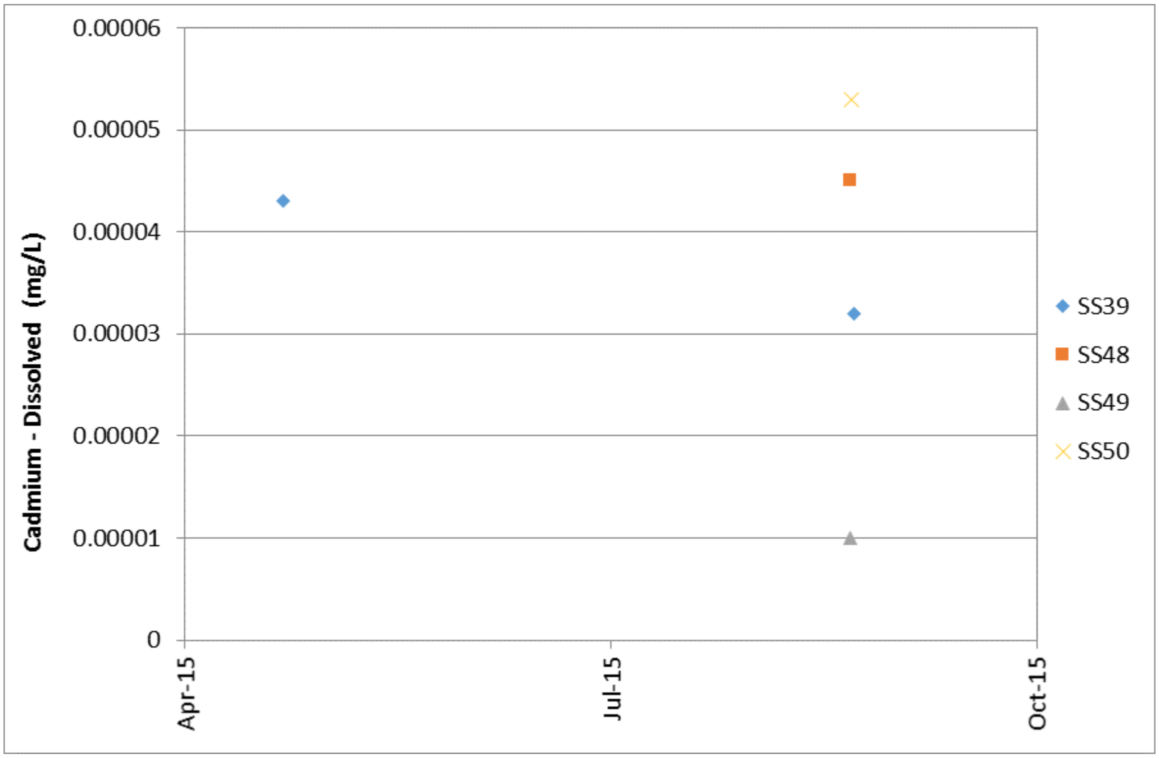


Figure 5-50: Dissolved Cadmium Concentrations at Toe of the SWD – SS39, SS48, SS49 and SS50 (2015)

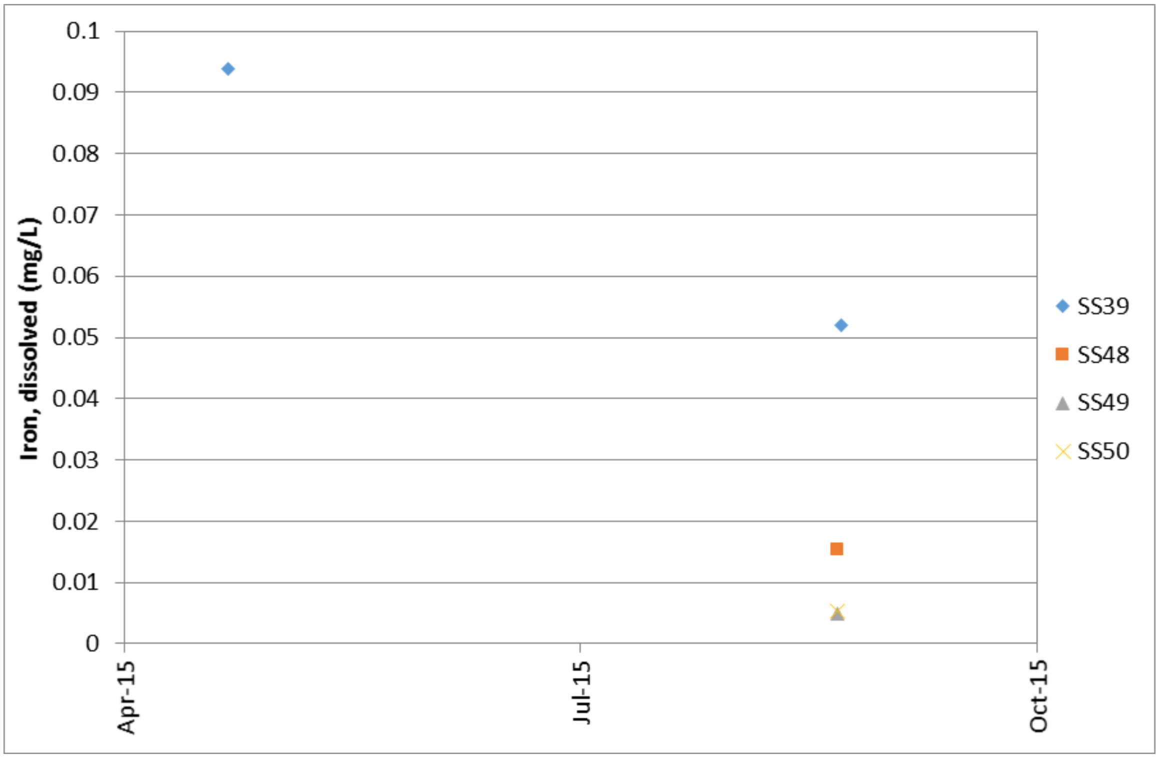


Figure 5-51: Dissolved Iron Concentrations at Toe of the SWD – SS39, SS48, SS49 and SS50 (2015)

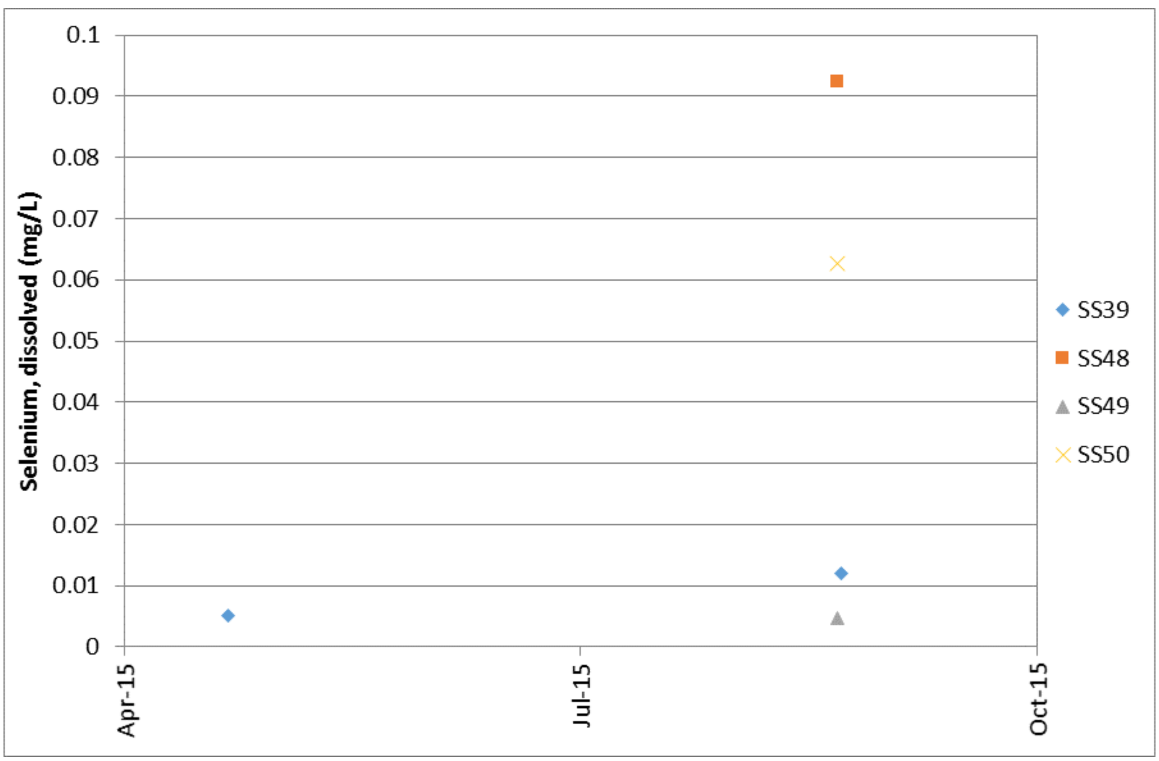


Figure 5-52: Dissolved Selenium Concentrations at Toe of the SWD – SS39, SS48, SS49 and SS50 (2015)

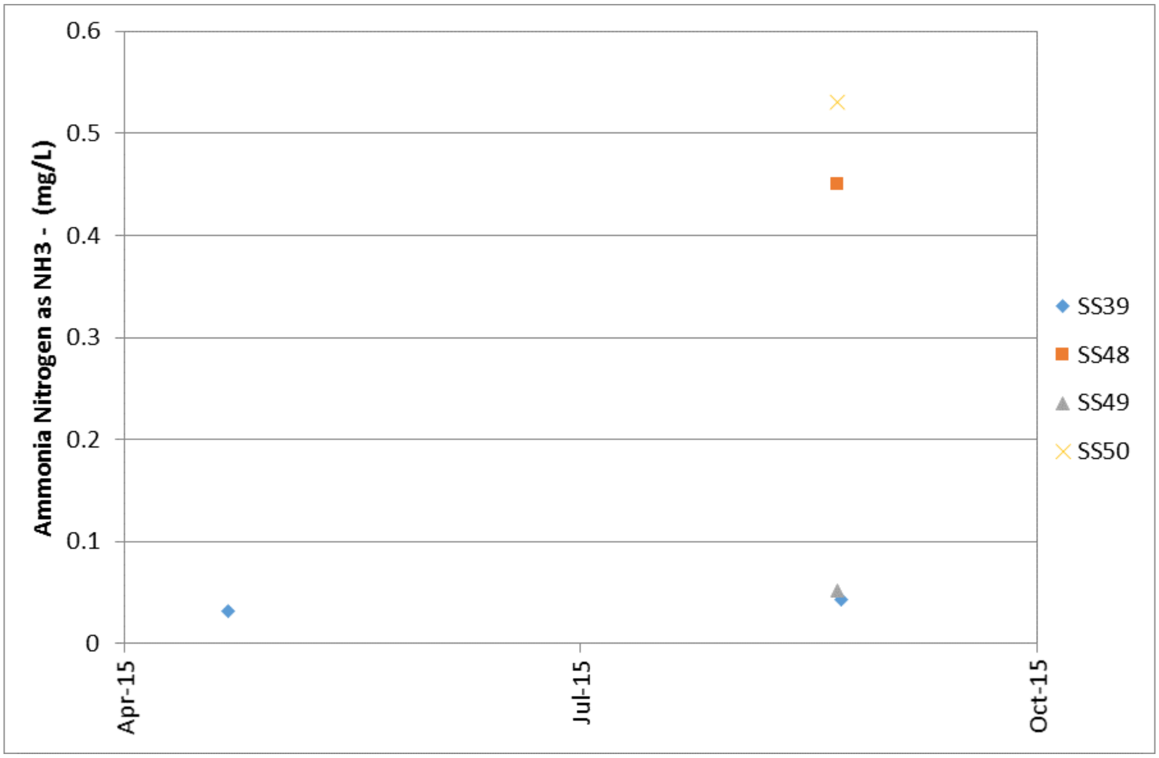


Figure 5-53: Ammonia Concentrations at Toe of the SWD – SS39, SS48, SS49 and SS50 (2015)

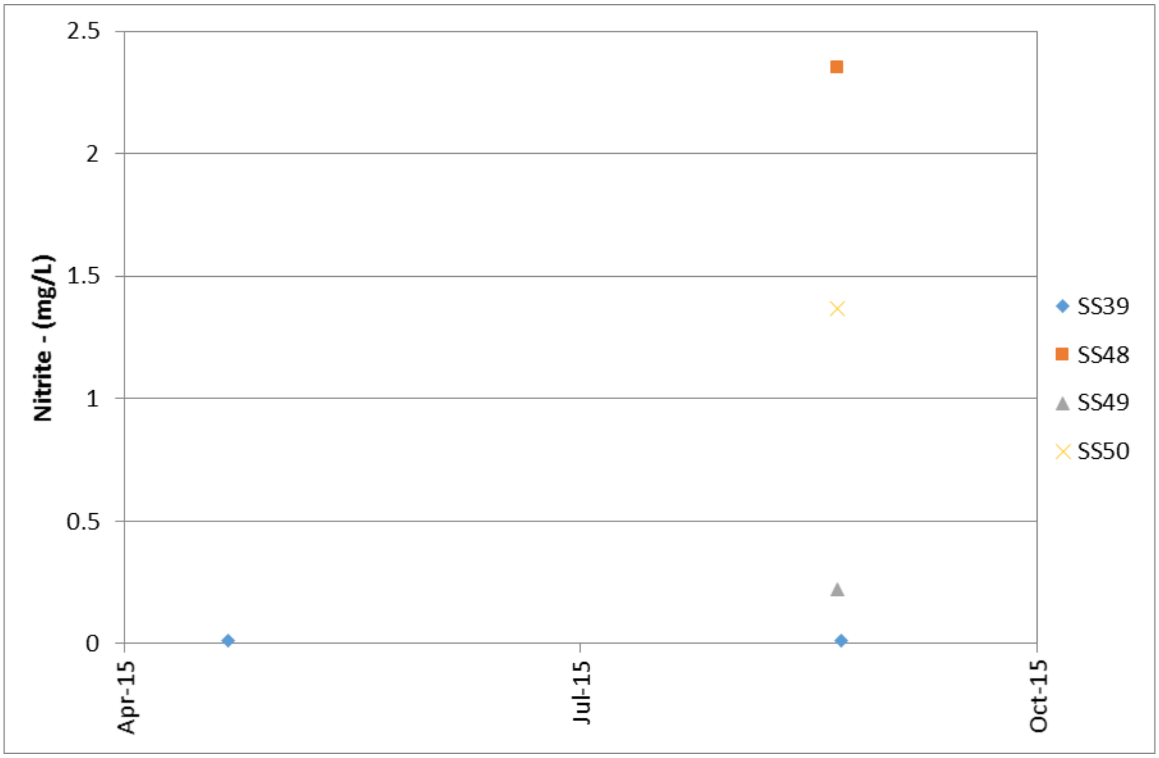


Figure 5-54: Nitrite Concentrations at Toe of the SWD – SS39, SS48, SS49 and SS50 (2015)

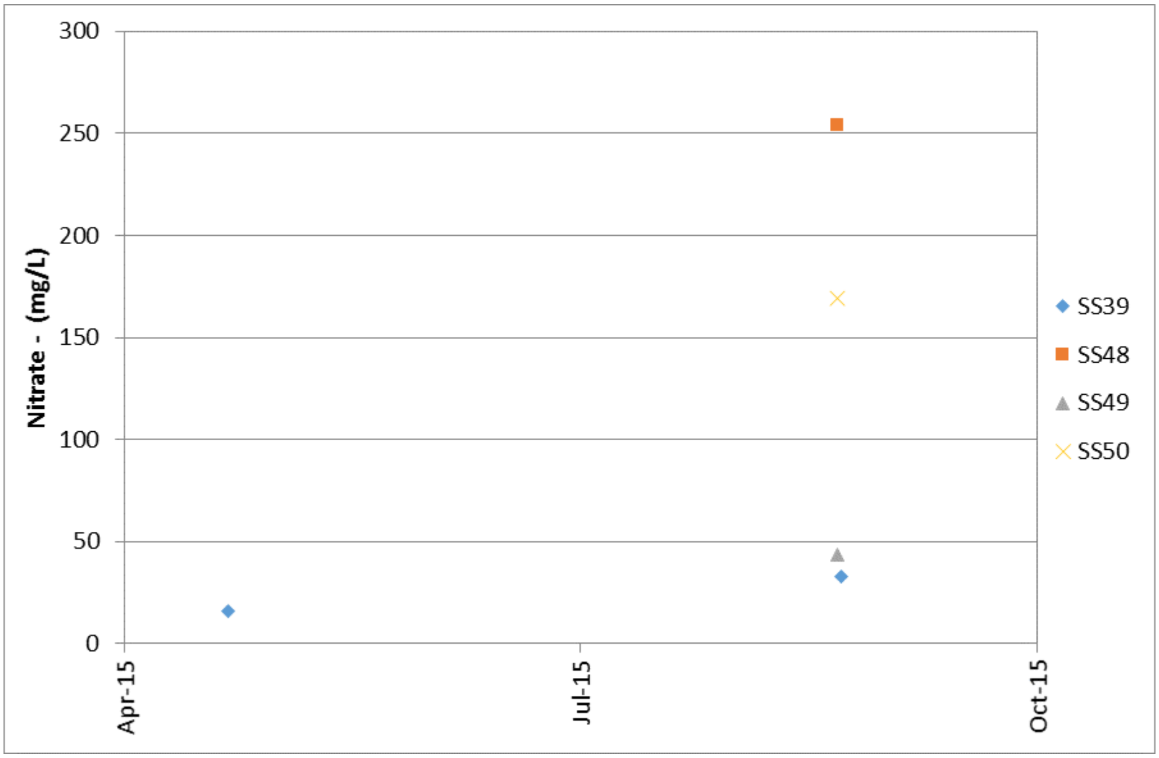


Figure 5-55: Nitrate Concentrations at Toe of the SWD – SS39, SS48, SS49 and SS50 (2015)

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

W37 is fed by seepage water from the Minto Creek Detention Structure (W36 Collection Sump), which collects water coming off the Dry Stack Tailing Storage Facility, Mill Valley Fill and overflow water from the mill pond. Water from the MCDS is pumped back to the Main Pit, therefore W37 is often dry during monthly sampling sessions and therefore gaps in data exist for this sample site. Water quality results for W37 are outlined in Figure 5-56 through Figure 5-62 and include historic water quality results for dissolved copper, cadmium, iron, selenium and nutrient levels for ammonia, nitrite and nitrate.

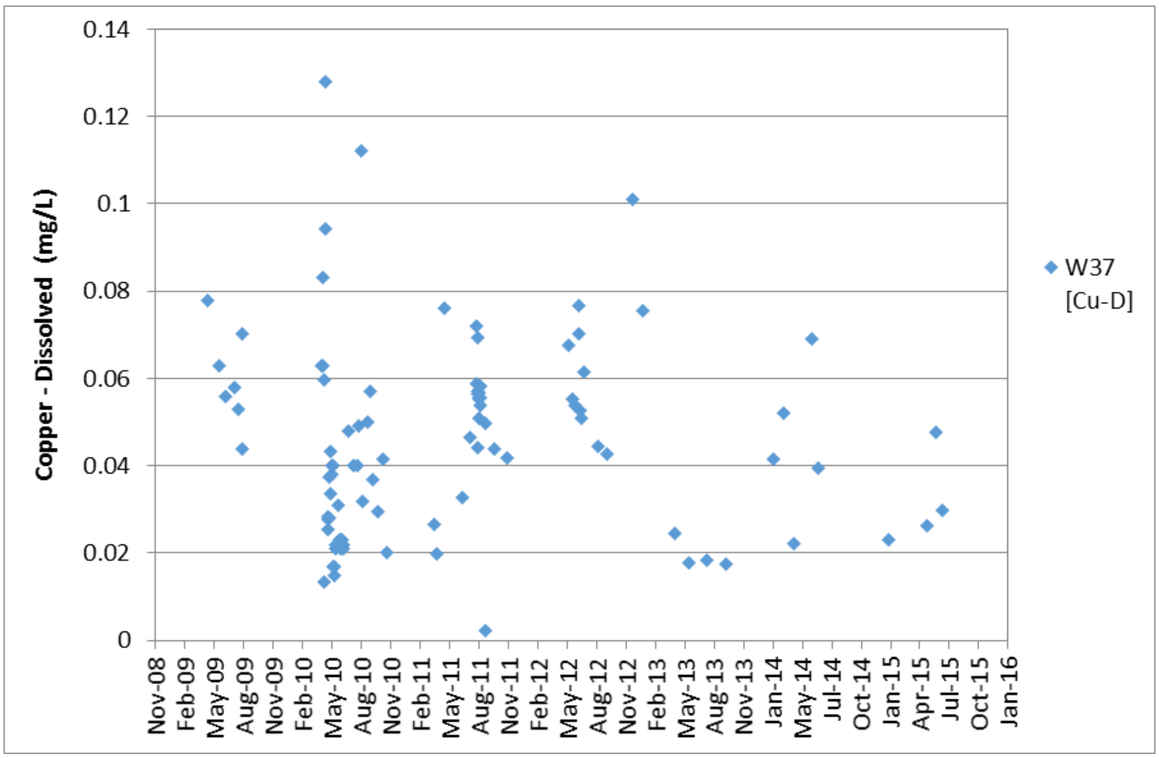


Figure 5-56: Dissolved Copper Concentrations at MCDS - W37 (2009-2015)

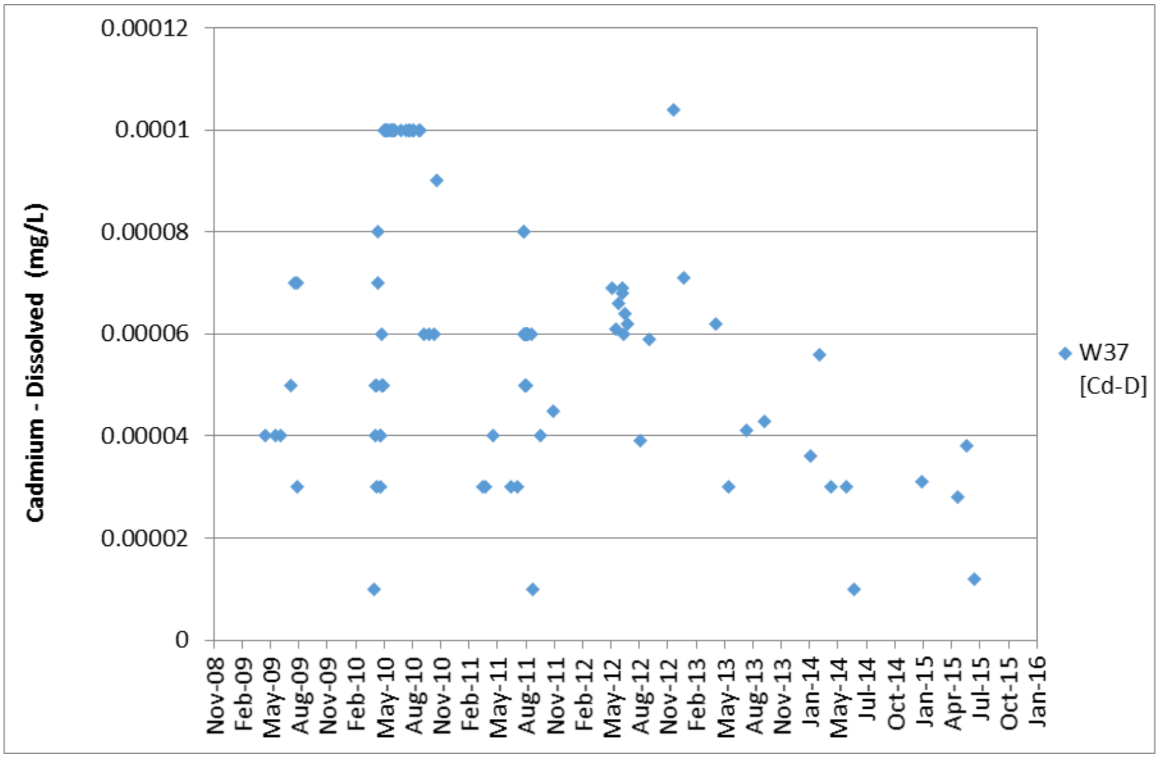


Figure 5-57: Dissolved Cadmium Concentrations at MCDS - W37 (2009-2015)

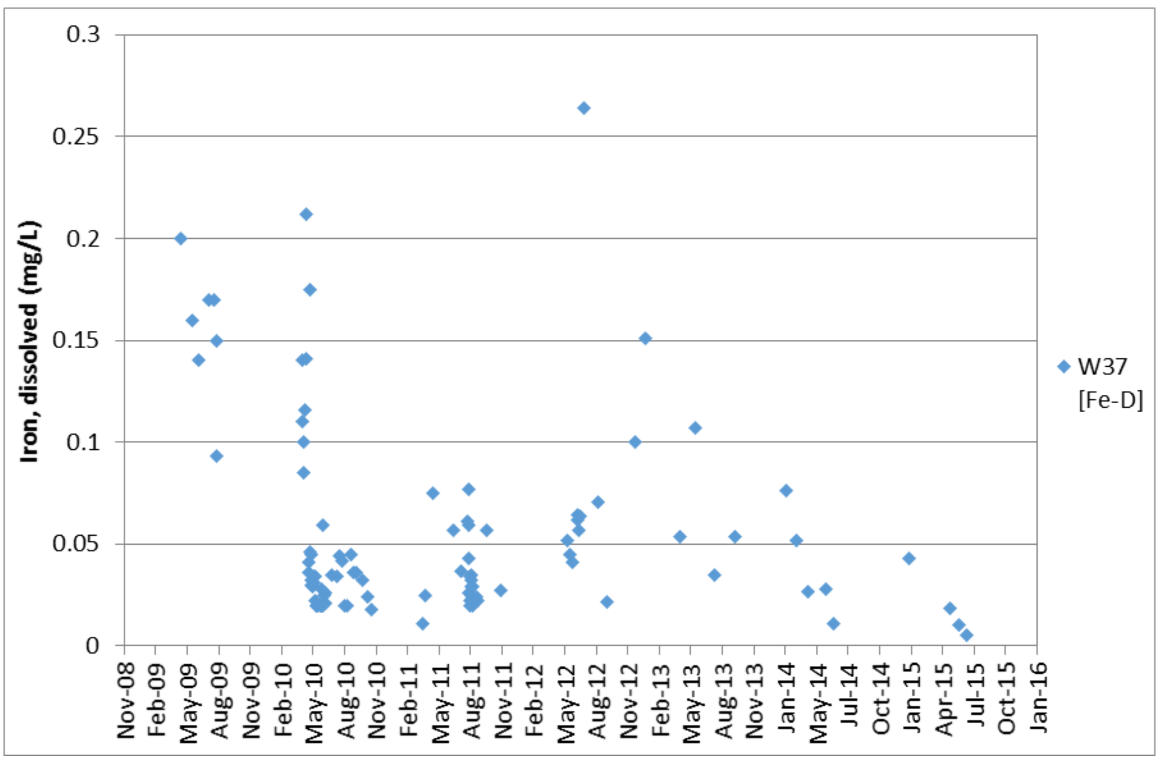


Figure 5-58: Dissolved Iron Concentrations at MCDS - W37 (2009-2015)

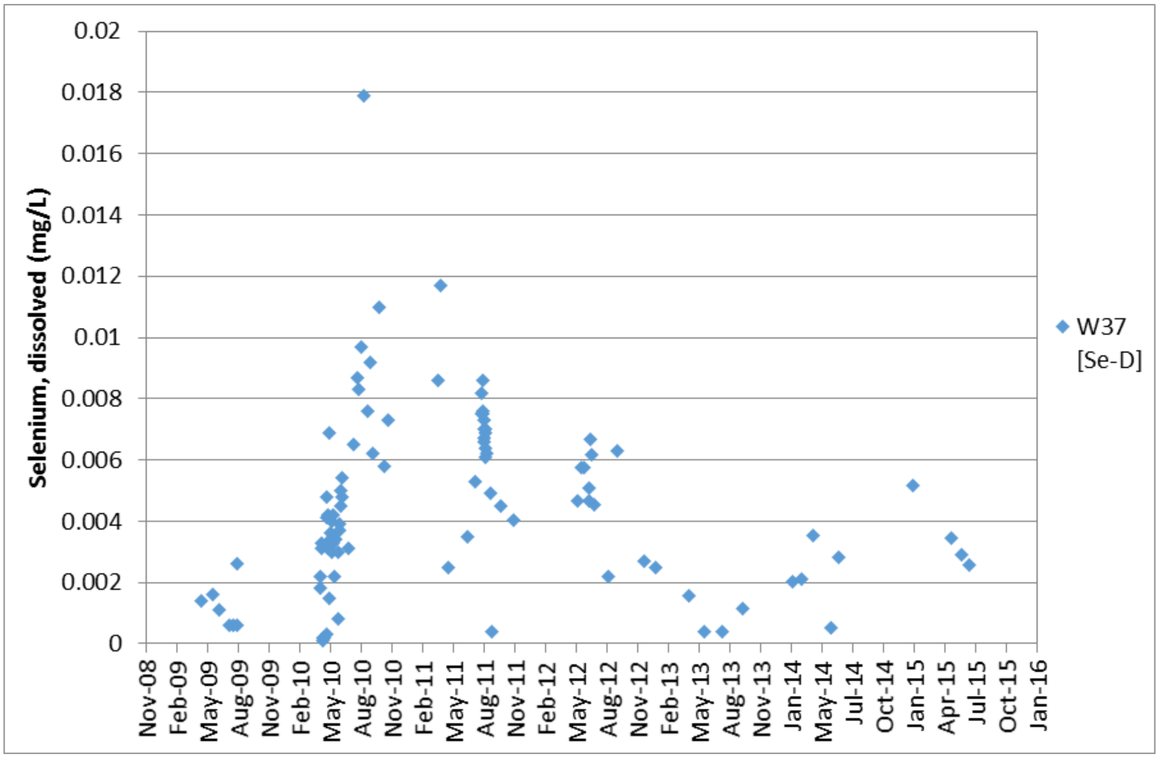


Figure 5-59: Dissolved Selenium Concentrations at MCDS - W37 (2009-2015)

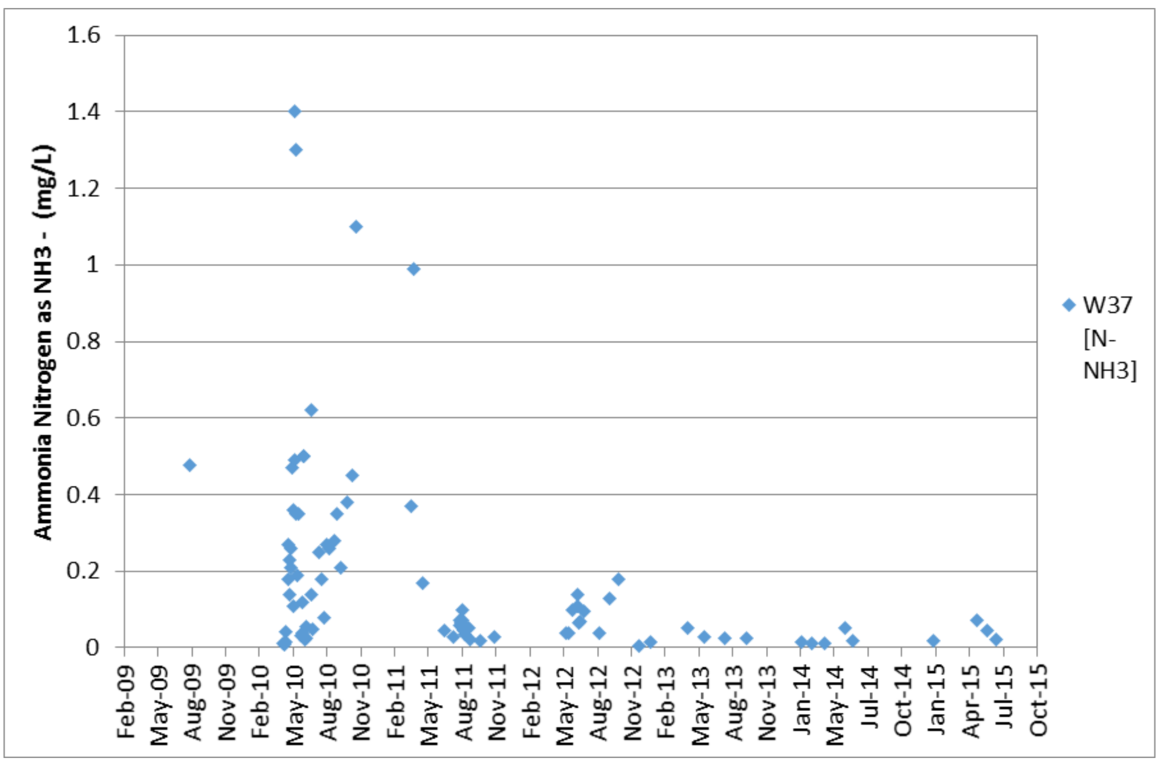


Figure 5-60: Ammonia Concentrations at MCDS - W37 (2009-2015)

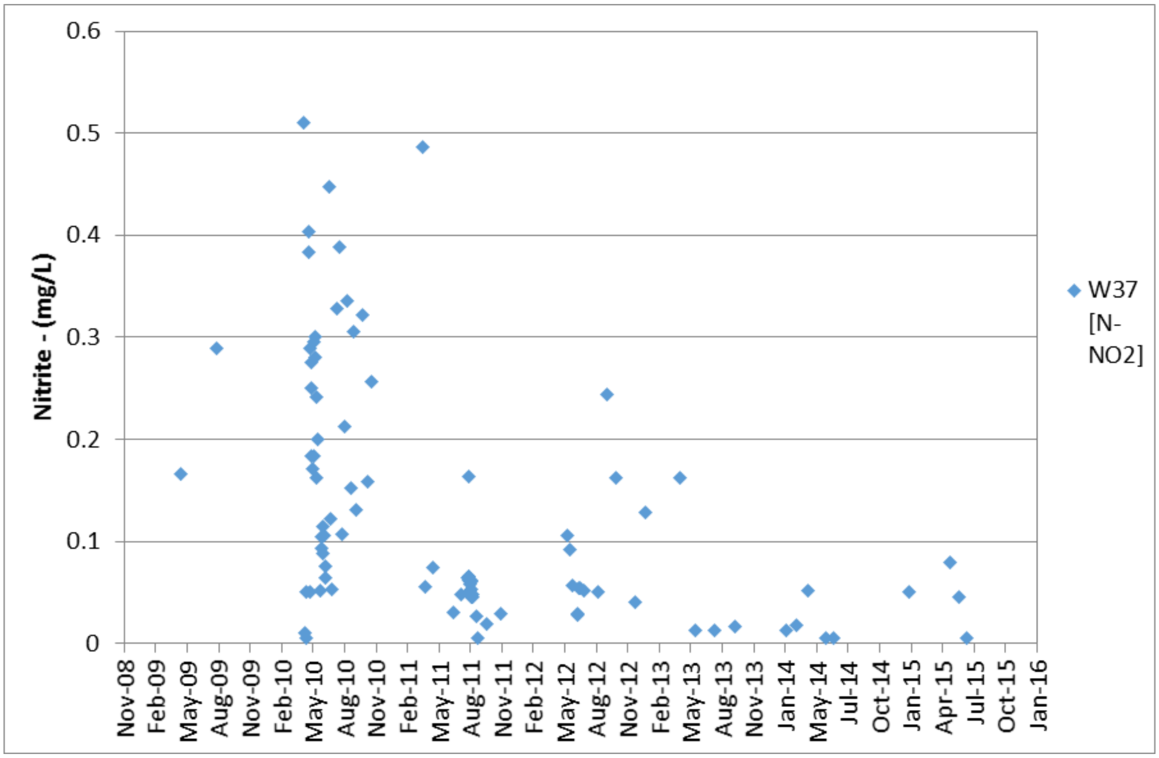


Figure 5-61: Nitrite Concentrations at MCDS - W37 (2009-2015)

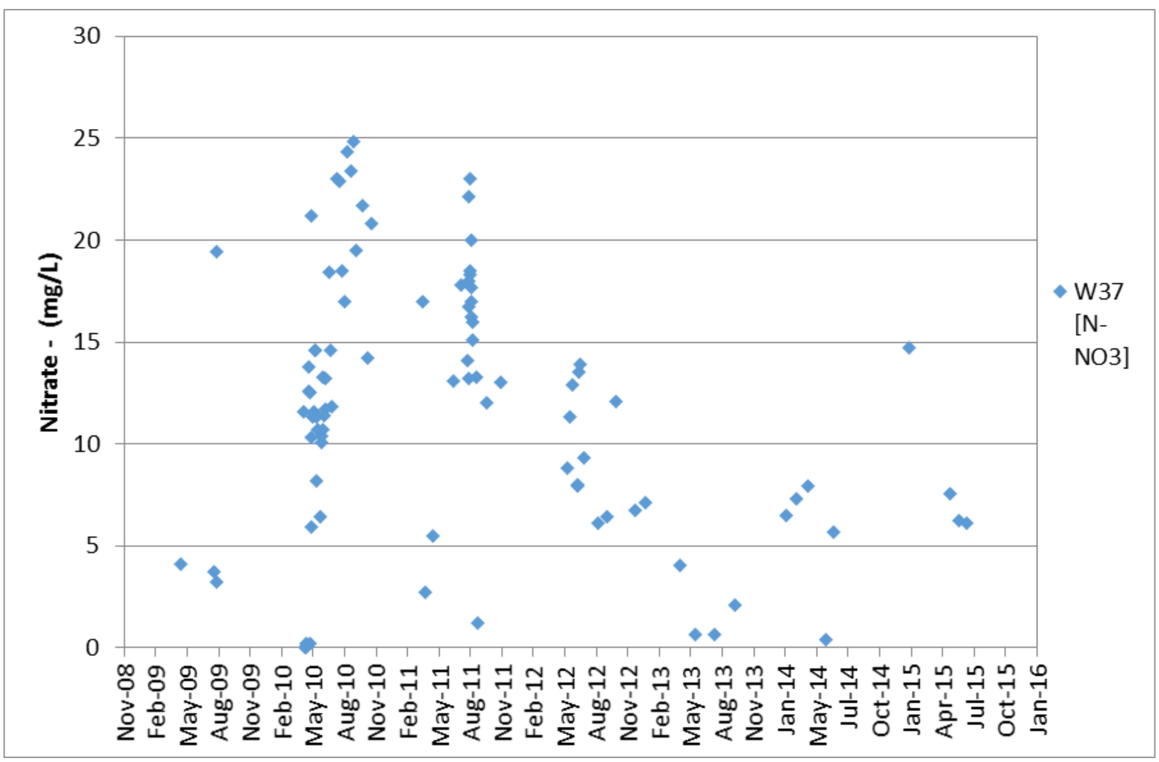


Figure 5-62: Nitrate Concentrations at MCDS - W37 (2009-2015)

5.4.4 Water Storage Pond Dam

Seepage quality at the Water Storage Pond Dam is represented from water quality at 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. Station W17 2007 to 2015 water quality result statistics are summarized in Table 5-33, below. 108 samples were collected in the 2015 monitoring period.

Water quality results for W17 are further outlined in Figure 5-63 through Figure 5-69 and include historic water quality results for dissolved copper, cadmium, iron, selenium and nutrient levels for ammonia, nitrite and nitrate.

Table 5-33: W17 Water Quality Results Summary (2007-2015)

W17	Effluent Quality Standards (WUL Clause 9)	2007 - 2014 Summary Statistics			2015 Summary Statistics		
Parameters		Mean	Min	Max	Mean	Min	Max
pH	6.0-9.0	8.13	1.7	8.5	8.11	**5.43**	8.4
TSS (mg/L)	15	2.1	0.5	**267**	1.4	0.5	13.5
Nutrients (mg/L)							
Ammonia Nitrogen	0.75	0.0326	0.01	**0.85**	0.0221	0.0025	0.23
Nitrate Nitrogen	27.3	4.635	0.01	12.4	0.953	0.01	5.28
Nitrite Nitrogen	0.18	0.05	0.0025	**7.85**	0.0025	0.0025	0.0025
Dissolved Metals (mg/L)							
Aluminum	0.3	0.006	0.0015	0.255	0.0073	0.0015	0.0554
Arsenic	0.015	0.000378	0.00005	0.0037	0.00032	0.00005	0.00048
Cadmium	0.00015	0.000035	0.0000025	0.00278	0.000005	0.000005	0.000024
Chromium	0.003	0.00068	0.00005	**0.008**	0.0005	0.0005	0.0005
Copper	0.039	0.00658	0.00031	0.031	0.00444	0.00034	0.00616
Iron	3.3	0.0116	0.0025	0.358	0.0037	0.0025	0.0132
Lead	0.012	0.000119	0.000009	0.0008	0.00012	0.0001	0.00062
Molybdenum	0.219	0.00675	0.0005	0.0224	0.0053	0.0005	0.0064
Nickel	0.33	0.001037	0.0005	0.011	0.0005	0.0005	0.0024
Selenium	0.006	0.001238	0.00005	0.005	0.00044	0.00005	0.00061
Zinc	0.09	0.00395	0.0005	0.043	0.0028	0.0025	0.0088

Bold values indicate exceedances of the WUL standards

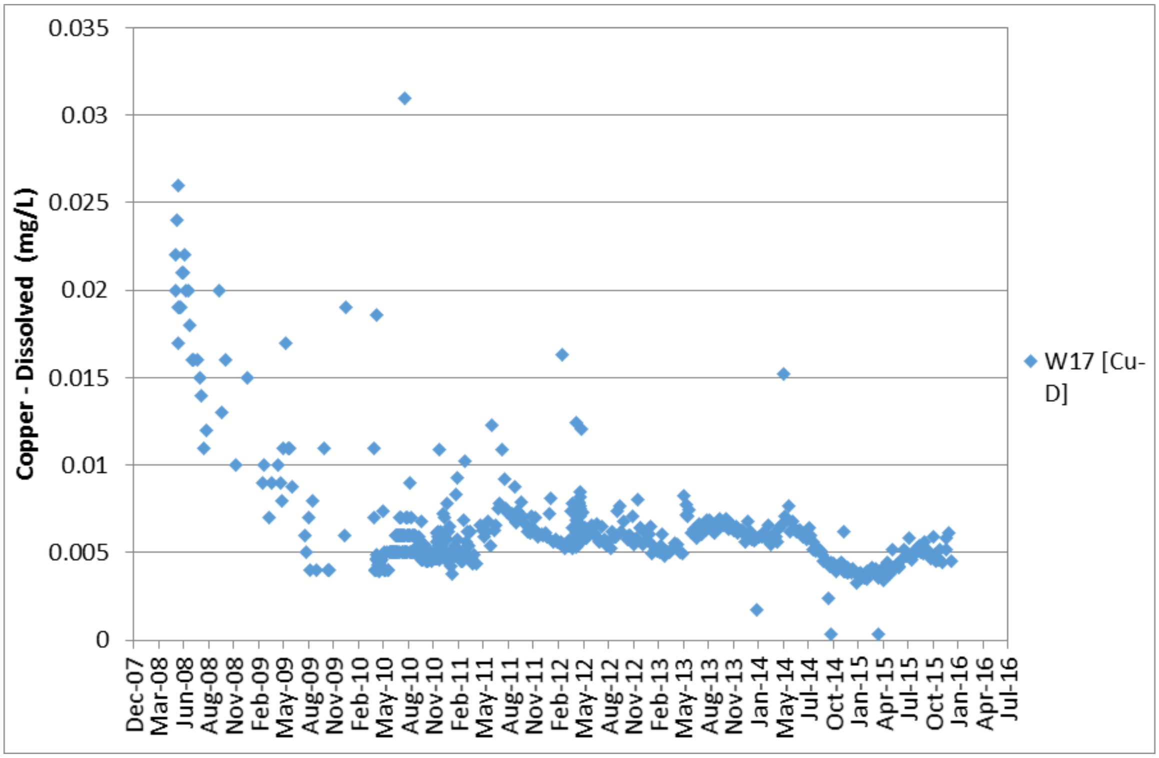
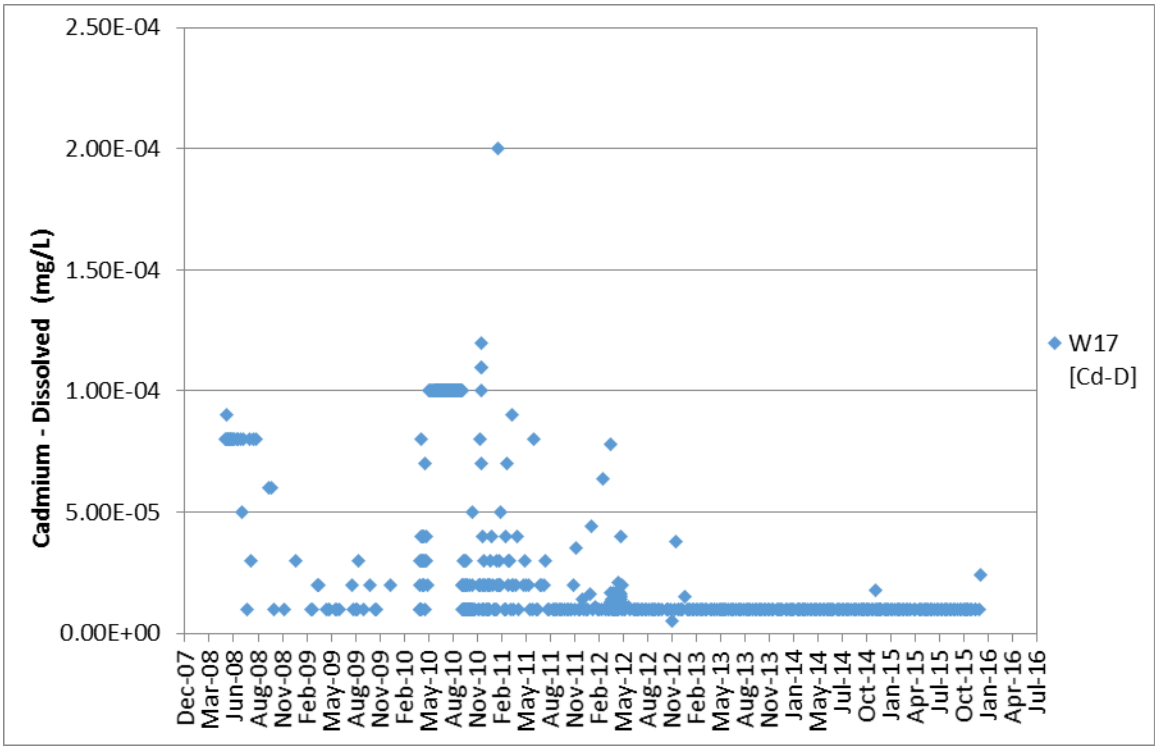
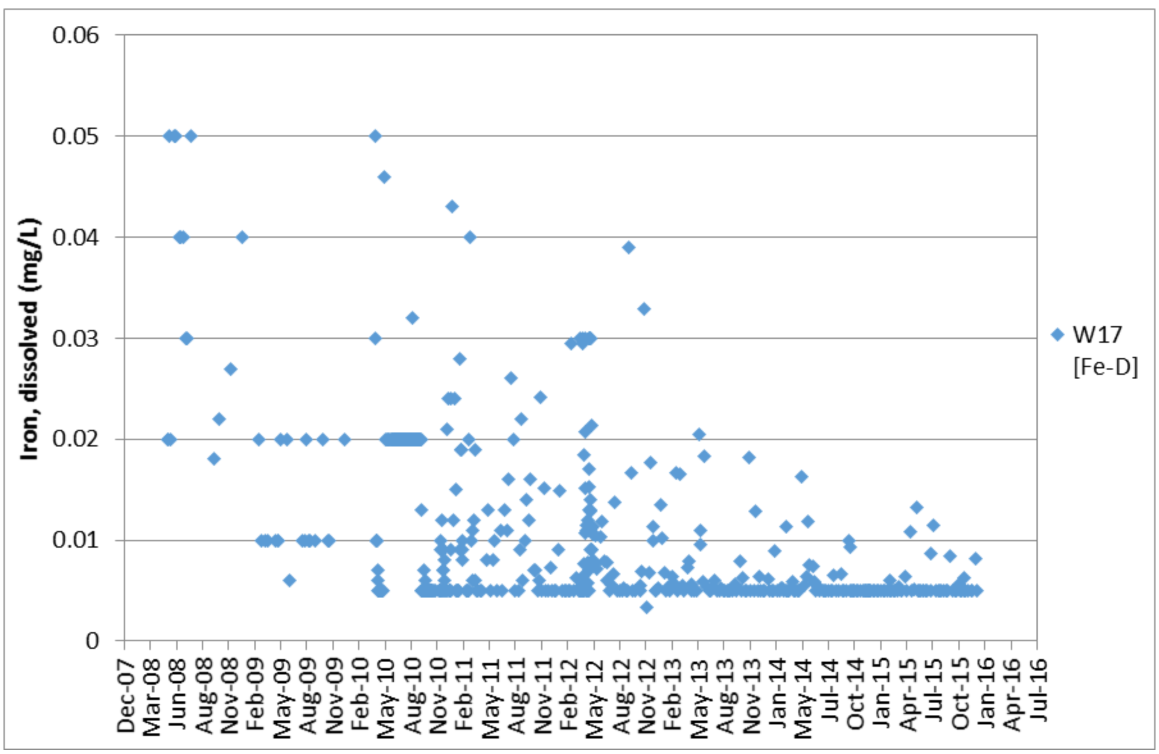


Figure 5-63: Dissolved Copper Concentrations at W17 (2007-2015)



Note: Outliers (i.e., concentrations one order of magnitude higher than the majority of samples) from August 24, 2010 (0.0016 mg/L); January 5, 2010 (0.00113 mg/L); May 27, 2009 (0.00208 mg/L); and June 3, 2009 (0.00278 mg/L) have been omitted from the above graph.

Figure 5-64: Dissolved Cadmium Concentrations at W17 (2007-2015)



Note: An outlier (i.e., concentrations one order of magnitude higher than the majority of samples) from April 26, 2010 (0.358 mg/L) has been omitted from the above graph.

Figure 5-65: Dissolved Iron Concentrations at W17 (2007-2015)

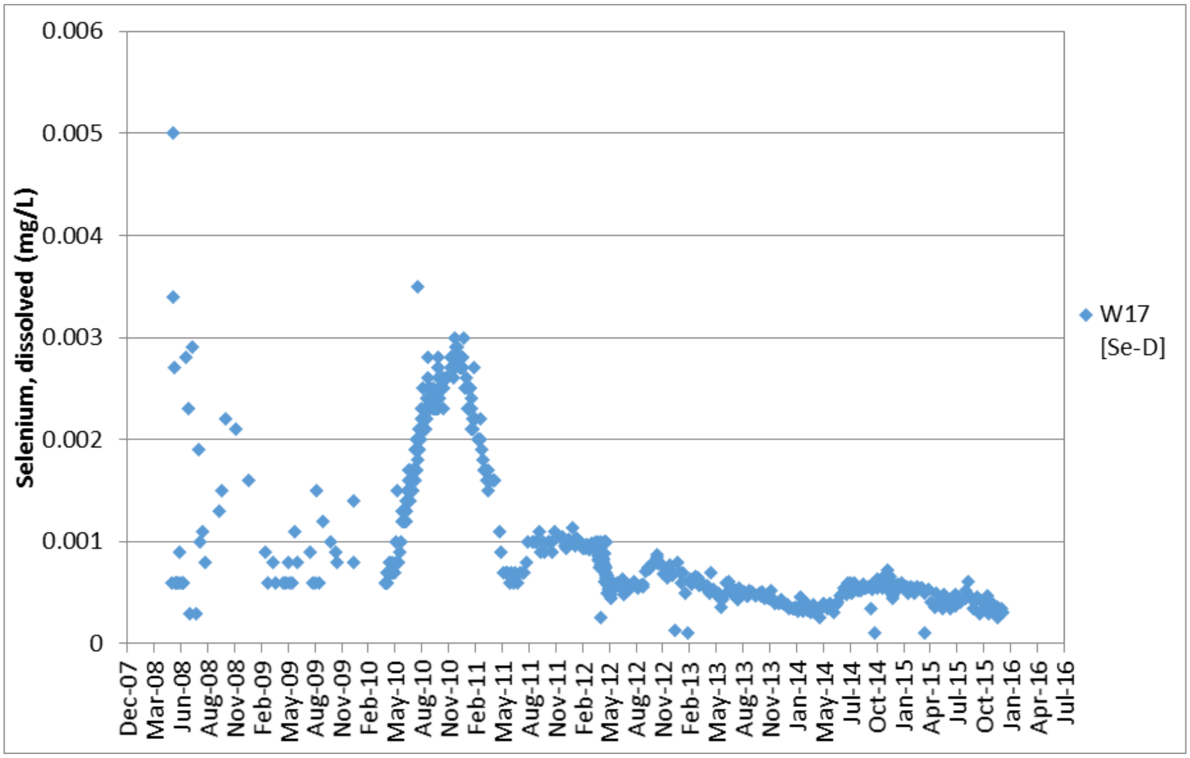
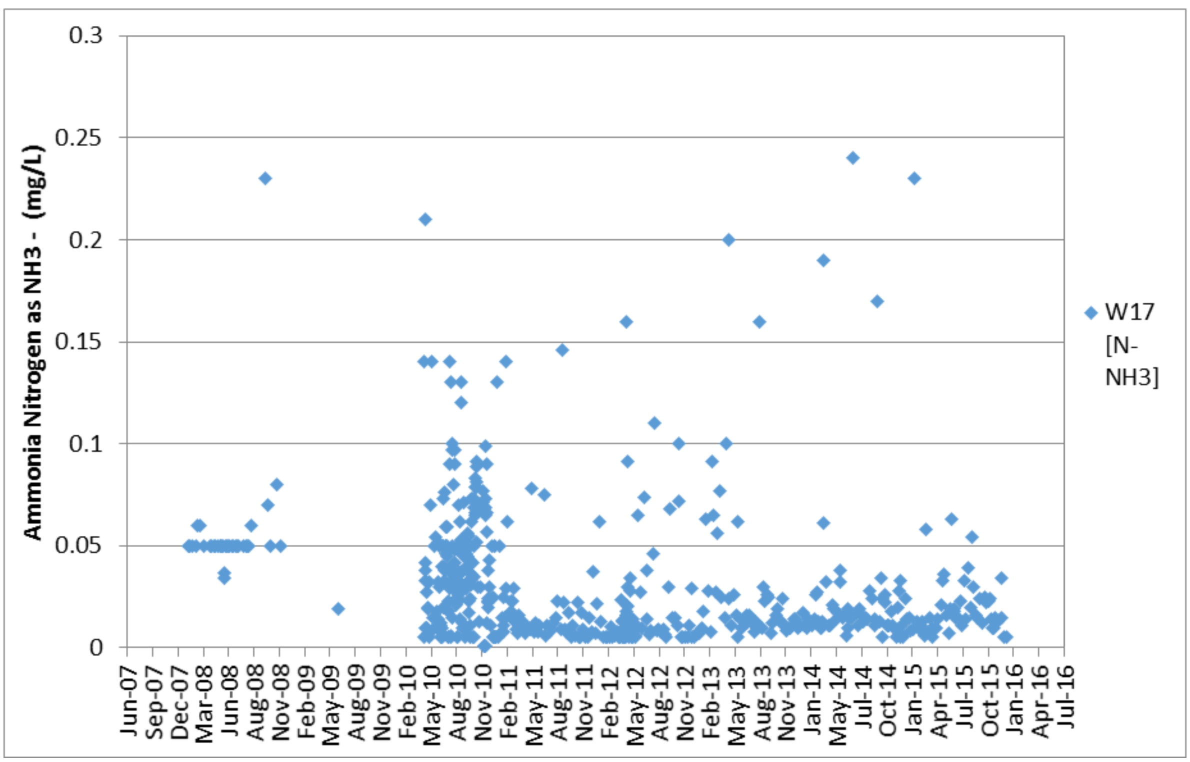
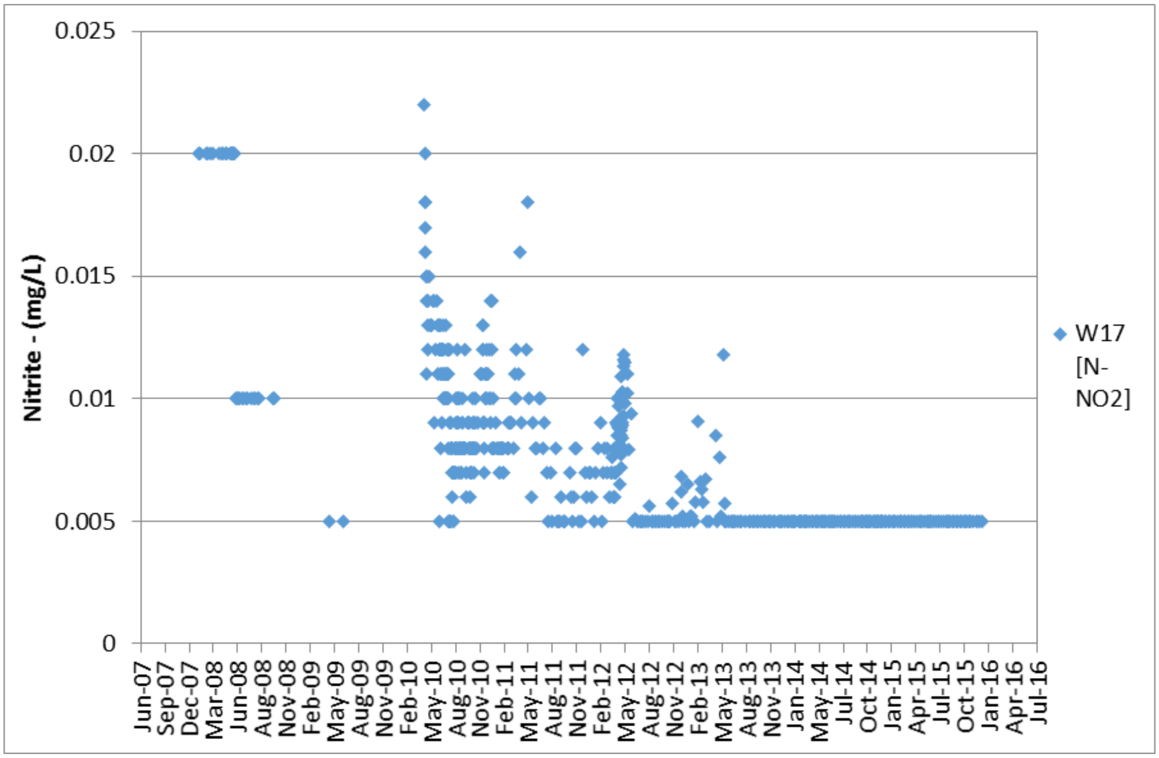


Figure 5-66: Dissolved Selenium Concentrations at W17 (2007-2015)



Note: Outliers (i.e., concentrations one order of magnitude higher than the majority of samples) from February 26, 2011 (0.85 mg/L) and April 28, 2010 (0.8 mg/L) have been omitted from the above graph.

Figure 5-67: Ammonia Concentrations at W17 (2007-2015)



Note: An outlier (i.e., concentrations one order of magnitude higher than the majority of samples) from October 20, 2007 (7.84 mg/L) has been omitted from the above graph.

Figure 5-68: Nitrite Concentrations at W17 (2007-2015)

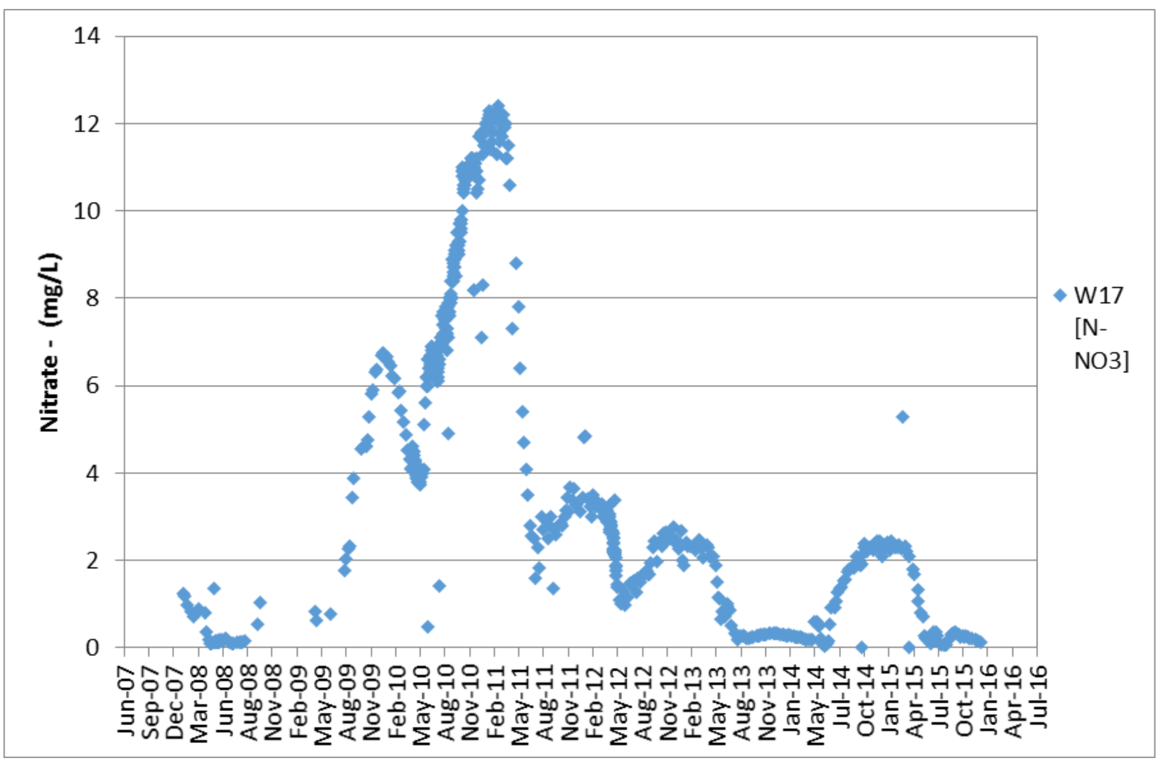


Figure 5-69: Nitrate Concentrations at W17 (2007-2015)

5.4.5 Dry Stack Tailings Storage Facility (DSTSF)

Water flows out along the tailings diversion ditch road and travels along the toe of the south side of the DSTF. Samples were taken as close to the source and to previous seepage survey locations as possible, within ±5m of the original GPS location. Seepage sites were observed along the east toe of the MVF (SS34, SS35, SS36, SS9, and SS10) upwards towards the DSTSF. The survey track then followed the south boundary of the DSTSF (SS17, SS18, and SS45) and then up the diversion ditch for the final sample (SS19). Water quality results for these sites are outlined in Figure 5-70 through Figure 5-76 and include historic water quality results for dissolved copper, cadmium, iron, selenium and nutrient levels for ammonia, nitrite and nitrate.

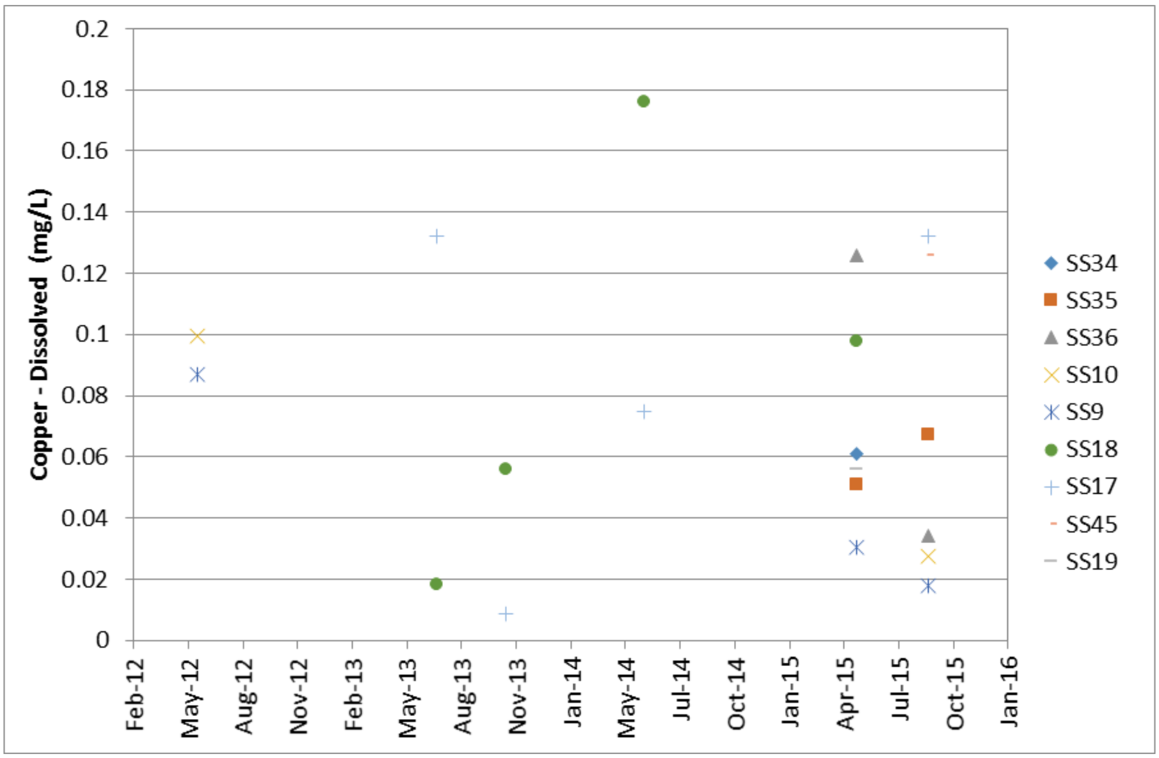


Figure 5-70: Dissolved Copper Concentrations around the DSTSF (2012-2015)

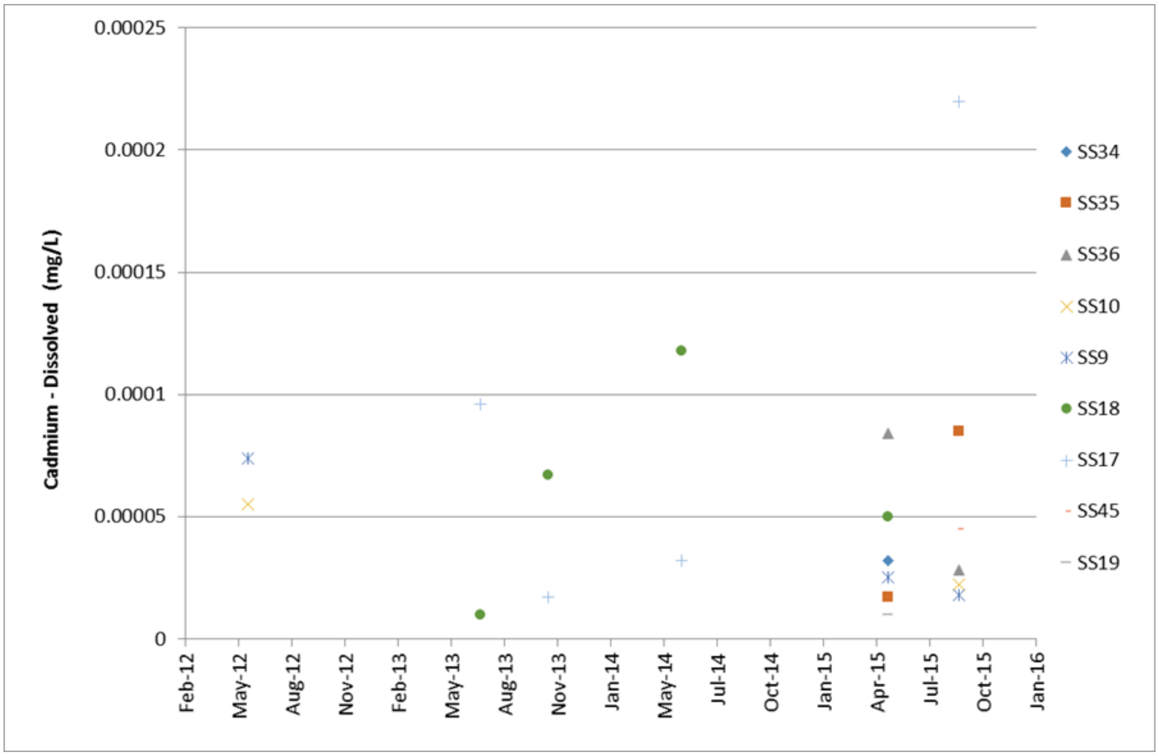


Figure 5-71: Dissolved Cadmium Concentrations around the DSTSF (2012-2015)

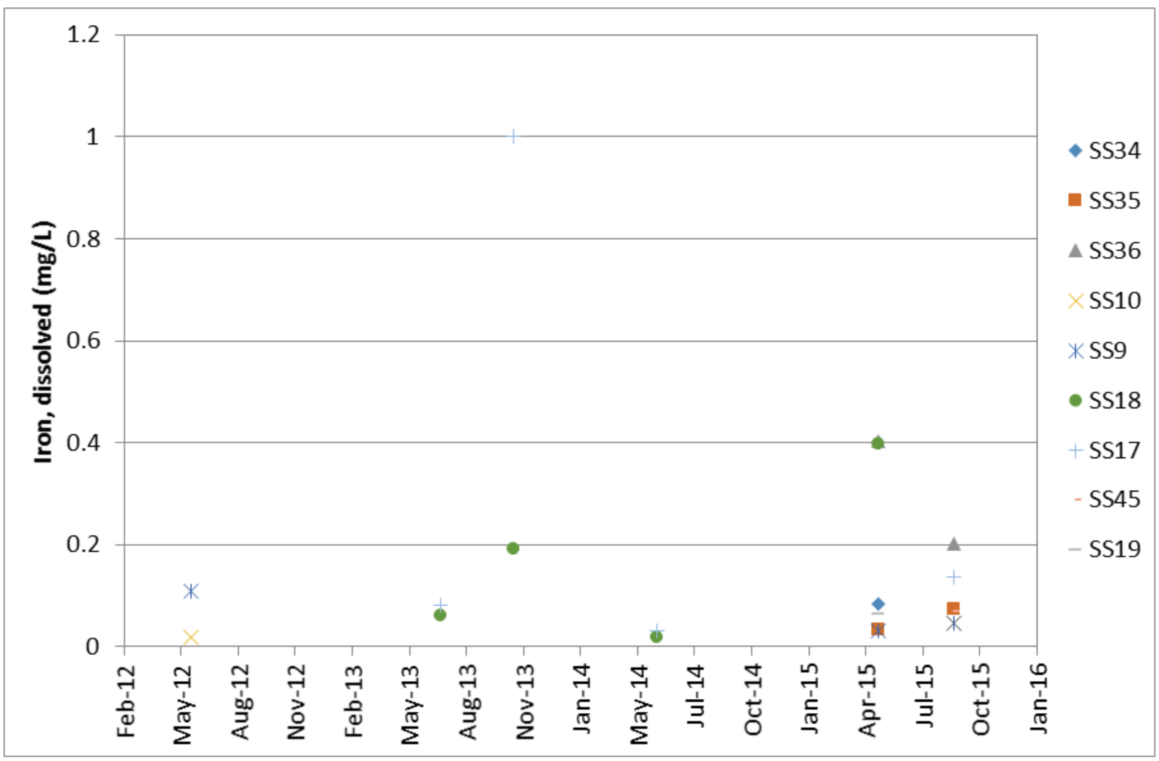


Figure 5-72: Dissolved Iron Concentrations around the DSTSF (2012-2015)

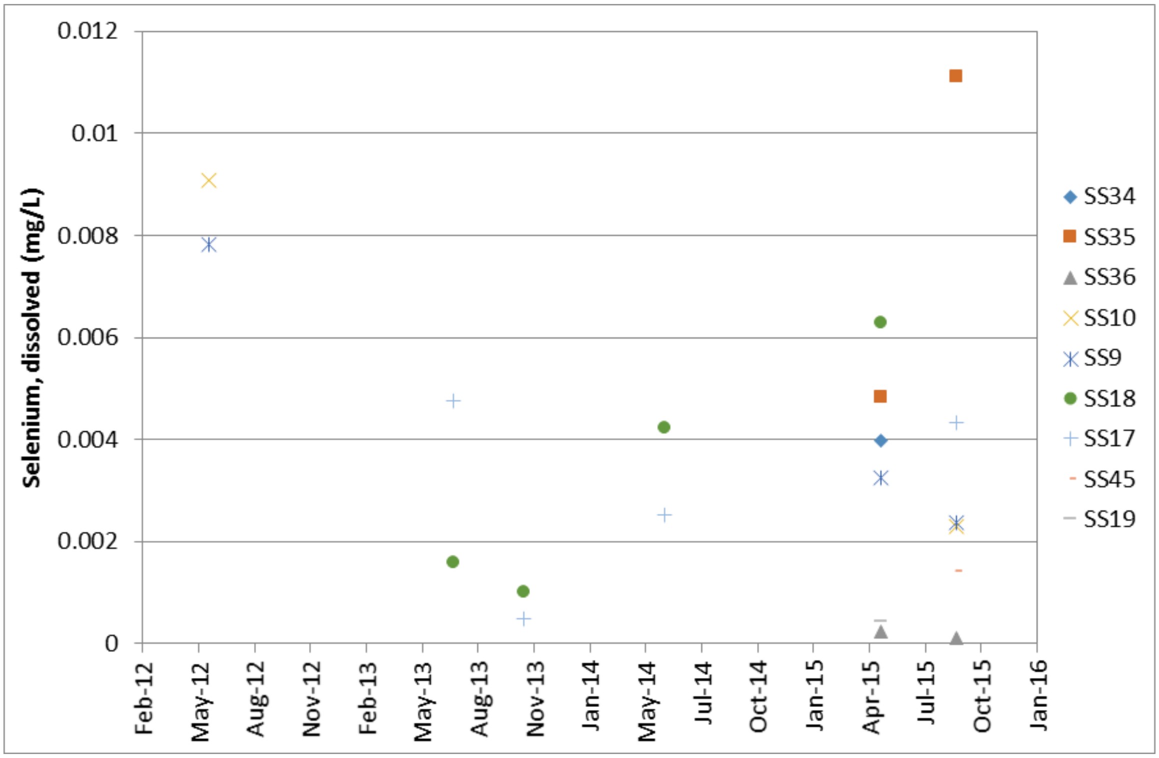


Figure 5-73: Dissolved Selenium Concentrations around the DSTSF (2012-2015)

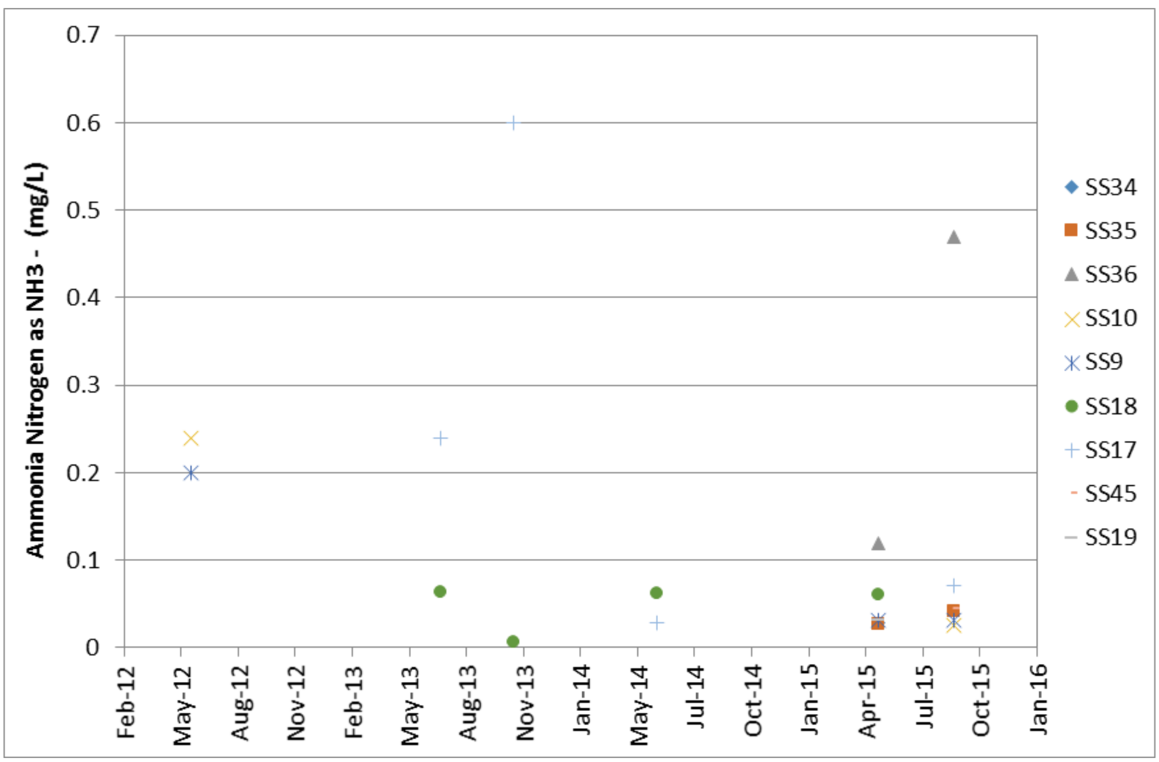


Figure 5-74: Ammonia Concentrations around the DSTSF (2012-2015)

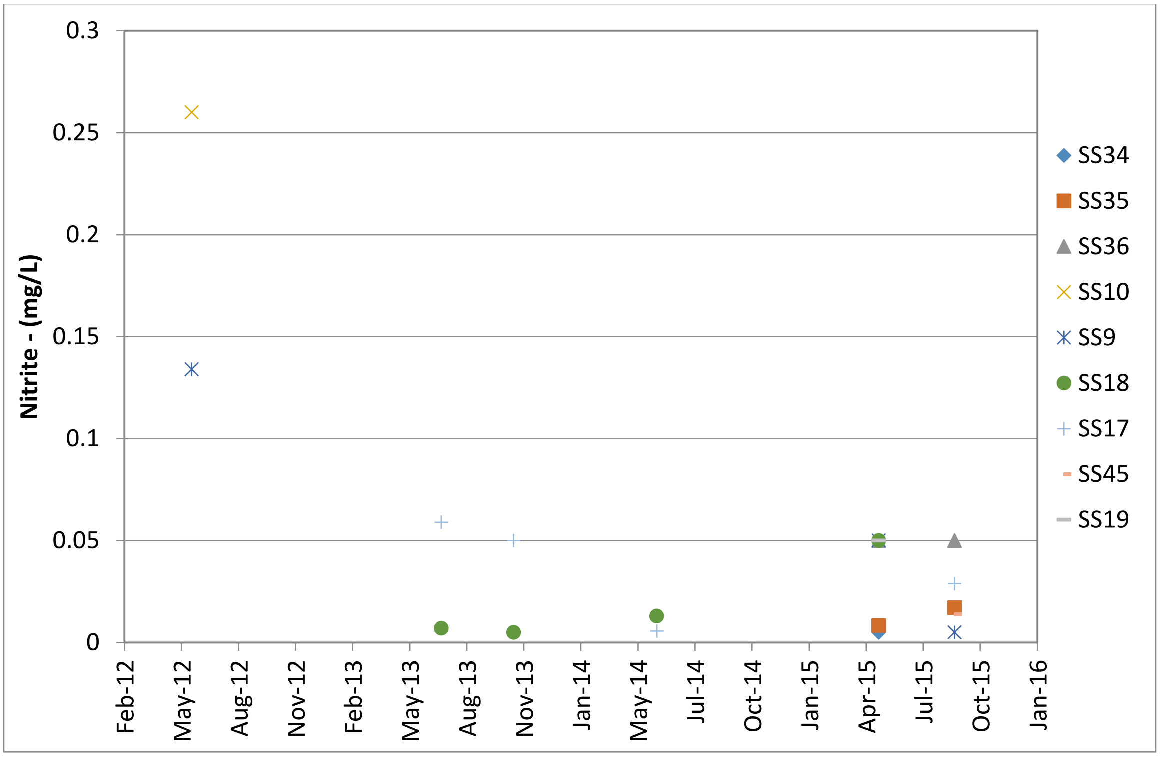


Figure 5-75: Nitrite Concentrations around the DSTSF (2012-2015)

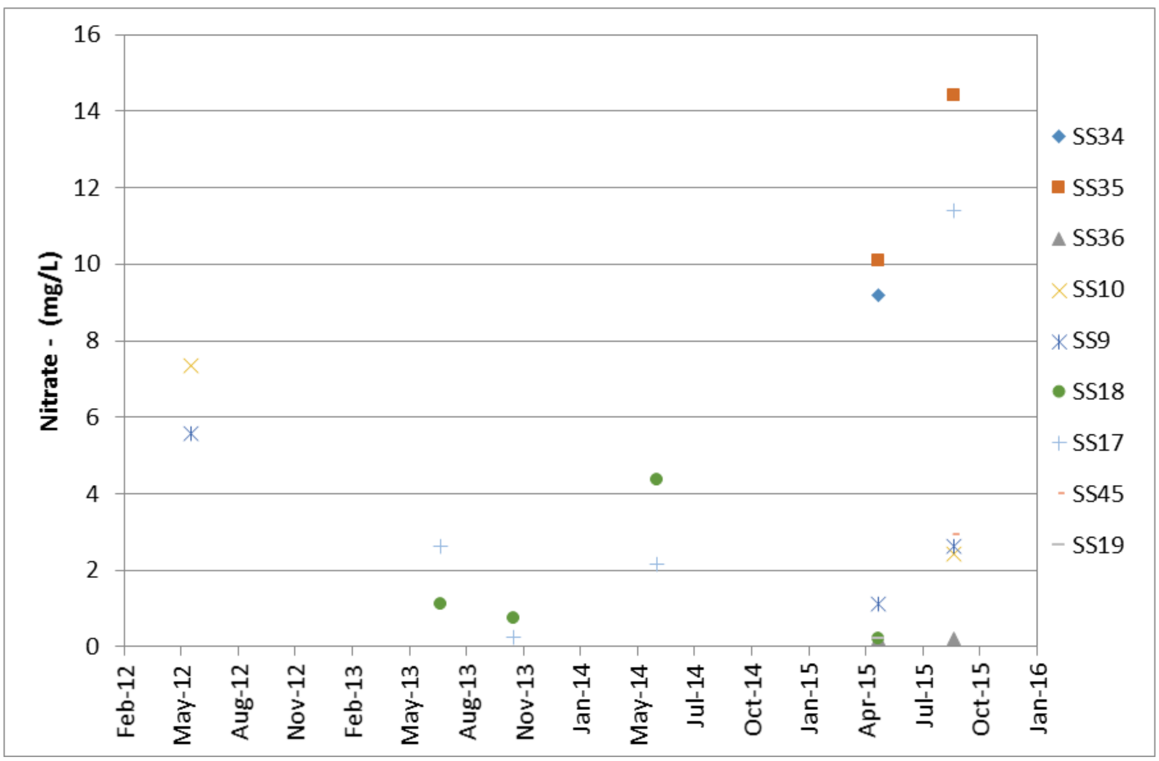


Figure 5-76: Nitrate Concentrations around the DSTSF (2012-2015)

5.4.6 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 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 5-77 through Figure 5-84 and include historic water quality results for dissolved copper, cadmium, iron, selenium and nutrient levels for ammonia, nitrite and nitrate.

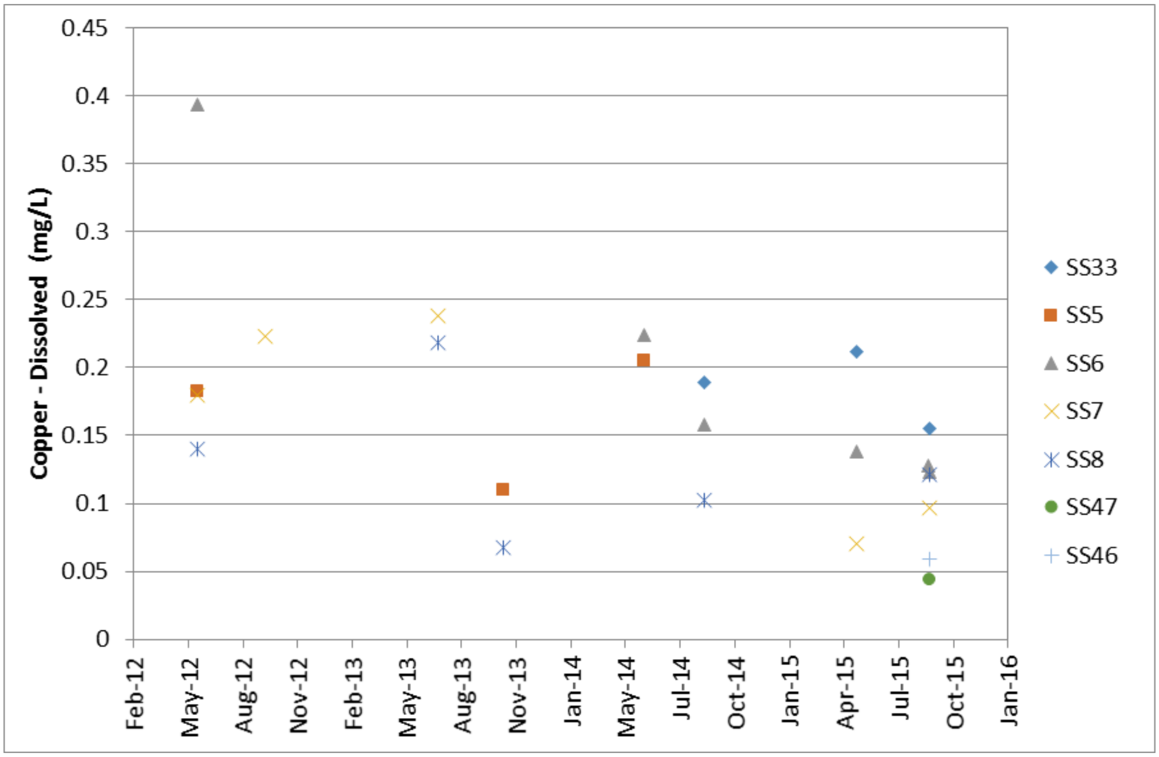


Figure 5-77: Dissolved Copper Concentrations for Seepage at the Toe of the West Stockpile and the Underground Ore Stockpile (2012-2015)

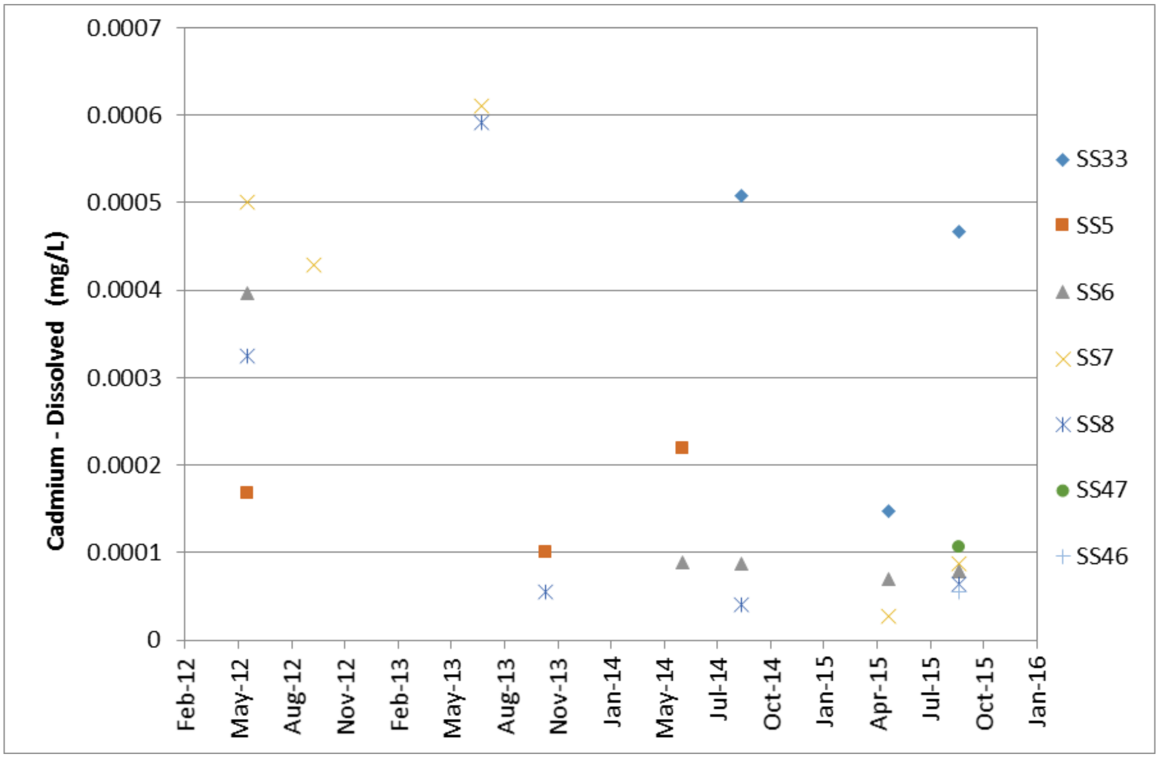


Figure 5-78: Dissolved Cadmium Concentrations for Seepage at the Toe of the West Stockpile and the Underground Ore Stockpile (2012-2015)

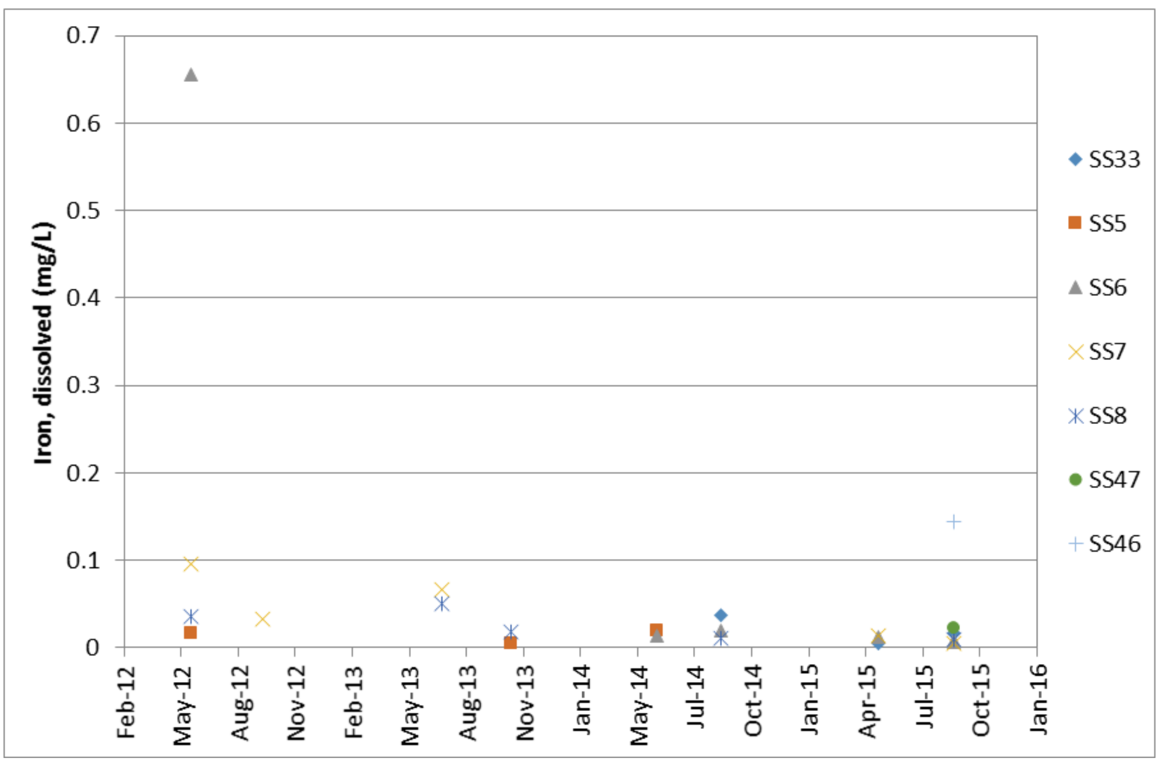


Figure 5-79: Dissolved Iron Concentrations for Seepage at the Toe of the West Stockpile and the Underground Ore Stockpile (2012-2015)

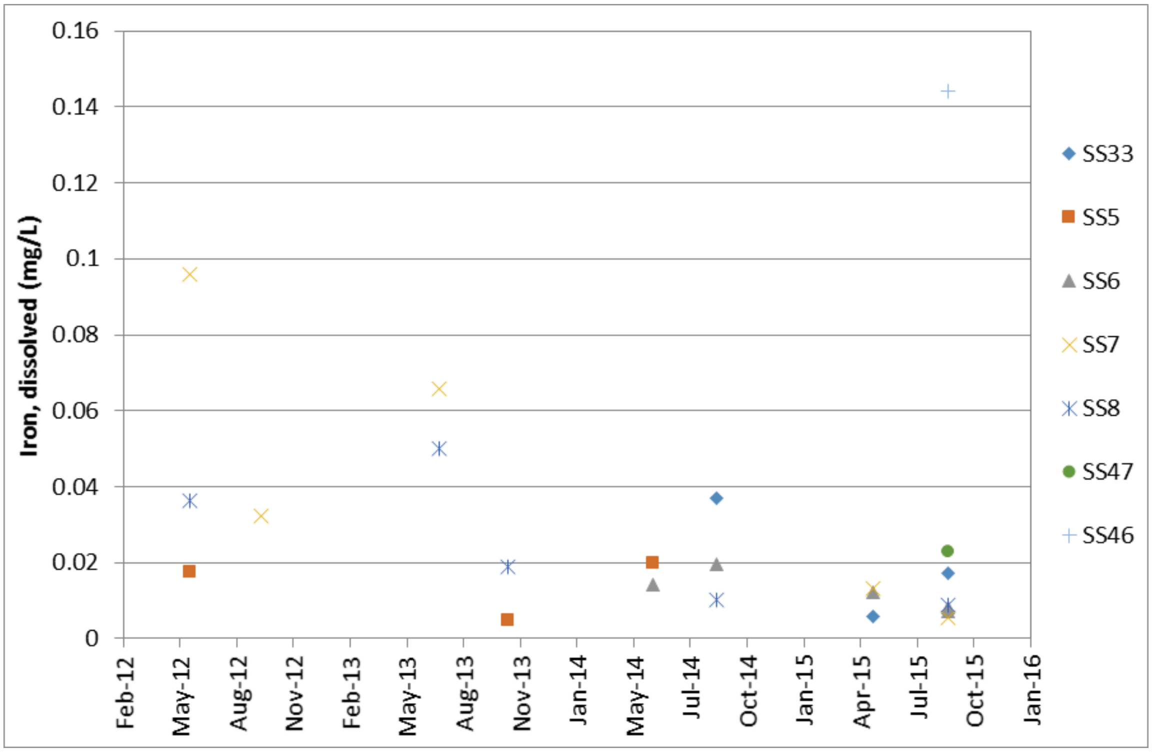


Figure 5-80: Dissolved Iron Concentrations for Seepage at the Toe of the West Stockpile and the Underground Ore Stockpile, with Reduced Concentration Range (2012-2015)

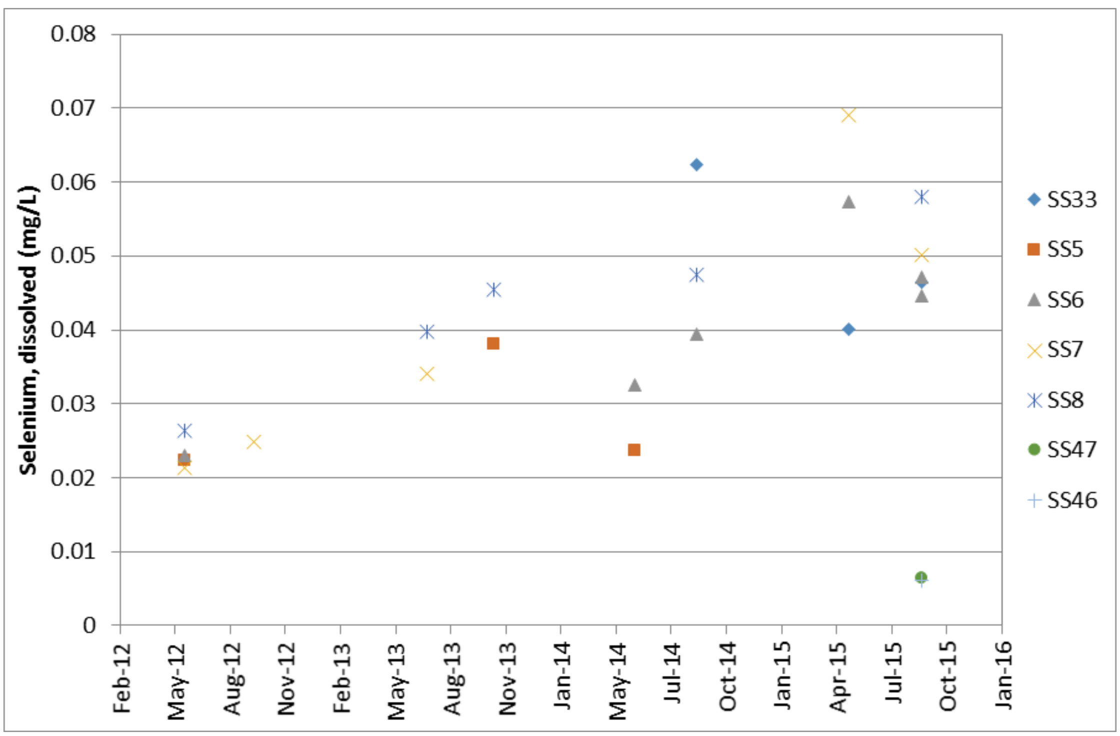


Figure 5-81: Dissolved Selenium Concentrations for Seepage at the Toe of the West Stockpile and the Underground Ore Stockpile (2012-2015)

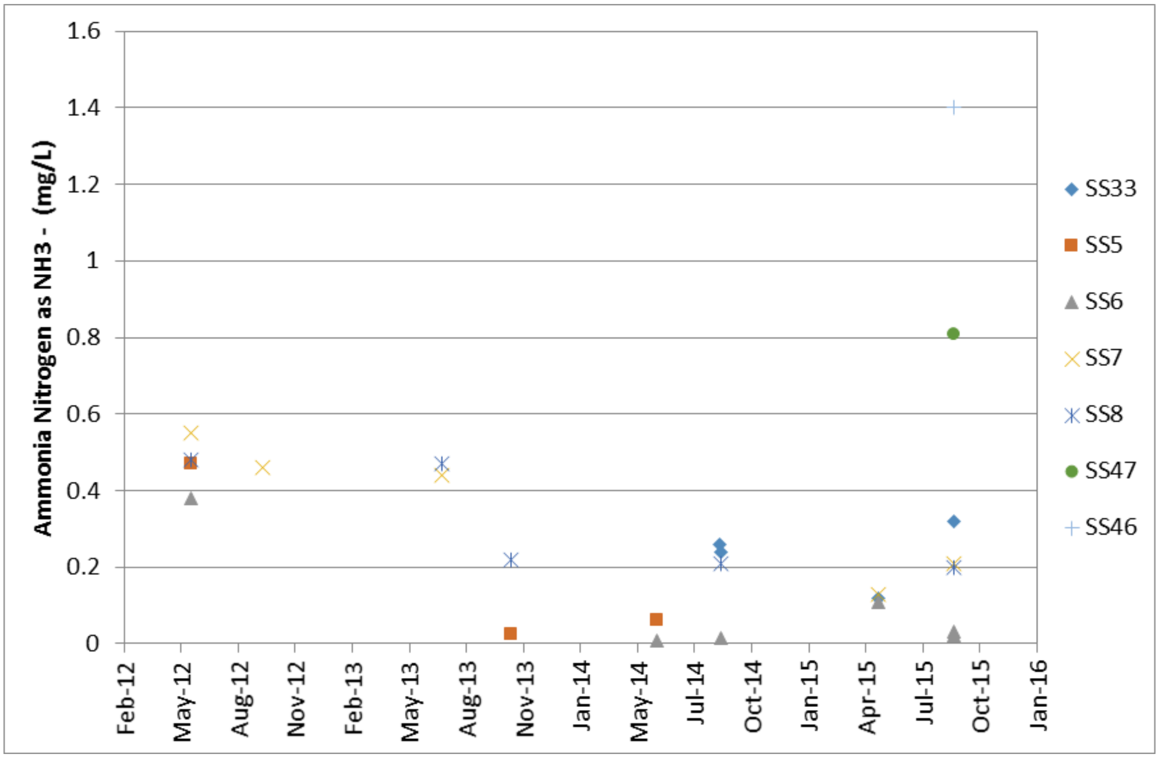


Figure 5-82: Ammonia Concentrations for Seepage at the Toe of the West Stockpile and the Underground Ore Stockpile (2012-2015)

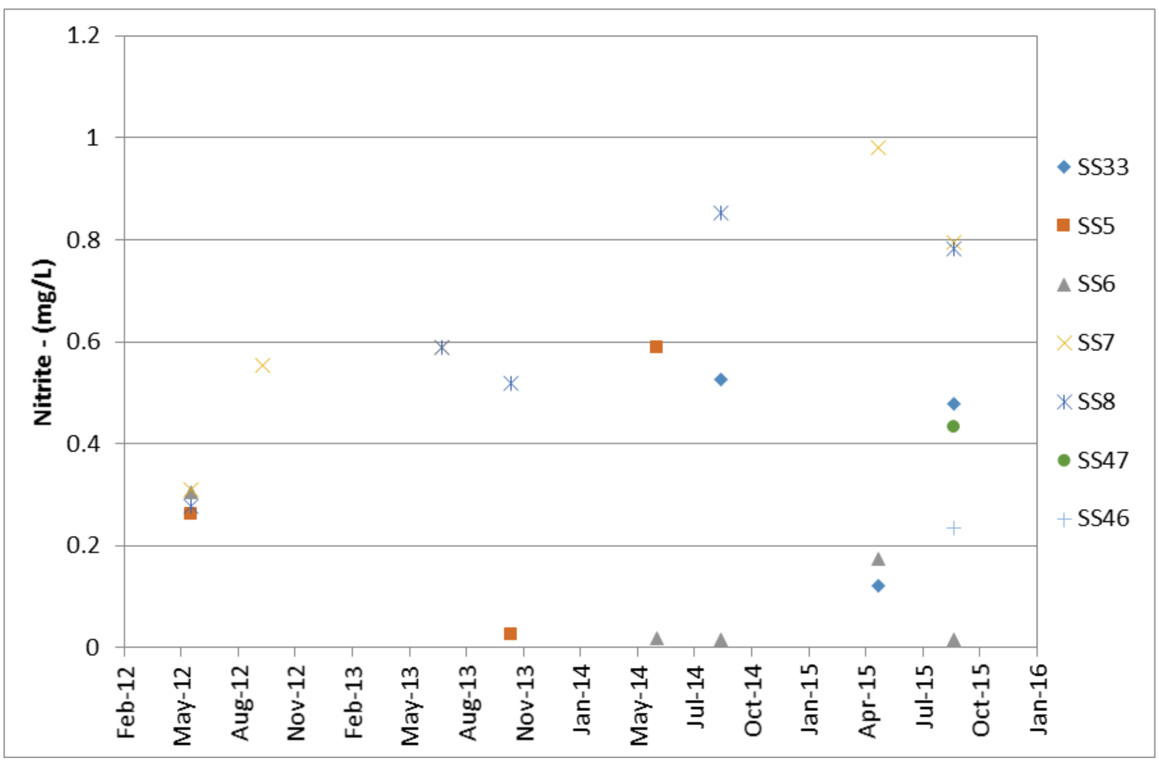


Figure 5-83: Nitrite Concentrations for Seepage at the Toe of the West Stockpile and the Underground Ore Stockpile (2012-2015)

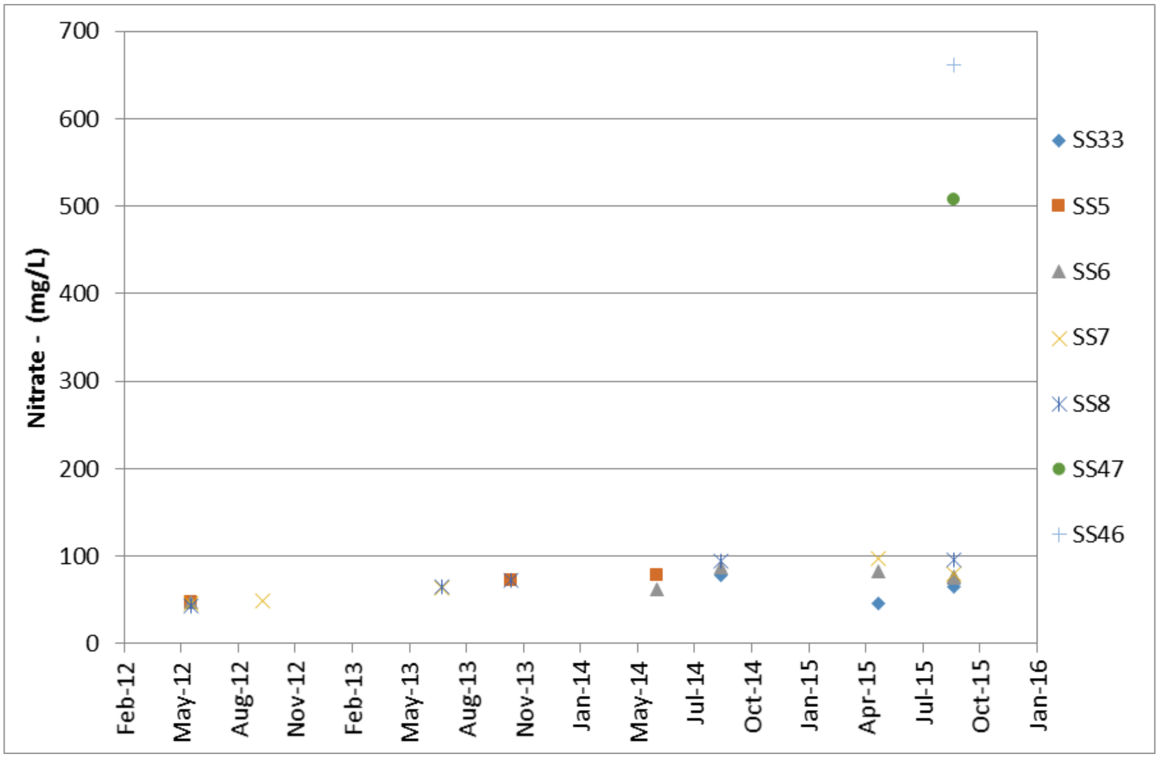


Figure 5-84: Nitrate Concentrations for Seepage at the Toe of the West Stockpile and the Underground Ore Stockpile (2012-2015)

5.4.7 Reclamation Overburden Dump (ROD)

In the 2015 Seepage Monitoring Survey, no water samples were collected from sites SS2, SS3, SS11, SS14 and SS15 as was observed in 2014. The Seepage Monitoring Program will continue to include survey tracks through the ROD.

5.4.8 Main Waste Dump

No new seeps were discovered along the toe of the Main Waste Dump (MWD). Seepage site SS12 was sampled in the fall of 2015 and the results are summarized in Figure 5-85 through Figure 5-91 and include historic water quality results for dissolved copper, cadmium, iron, selenium and nutrient levels for ammonia, nitrite and nitrate.

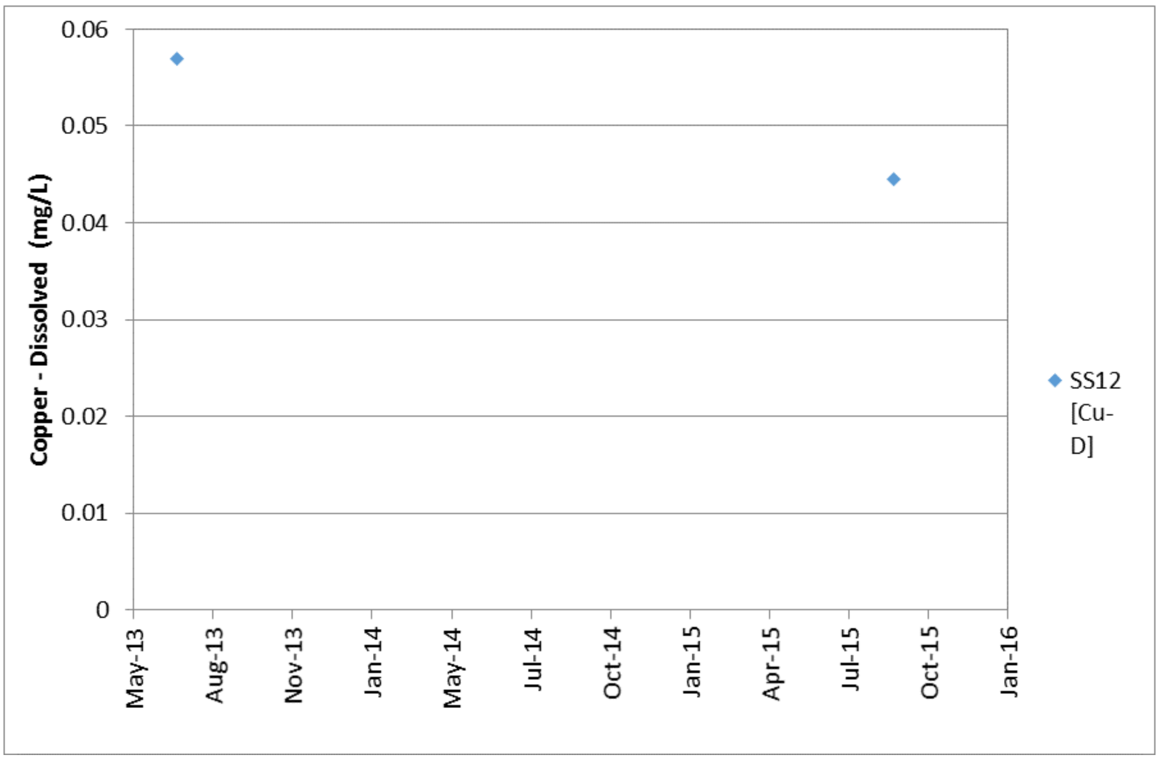


Figure 5-85: Dissolved Copper Concentrations at SS12 (2013-2015)

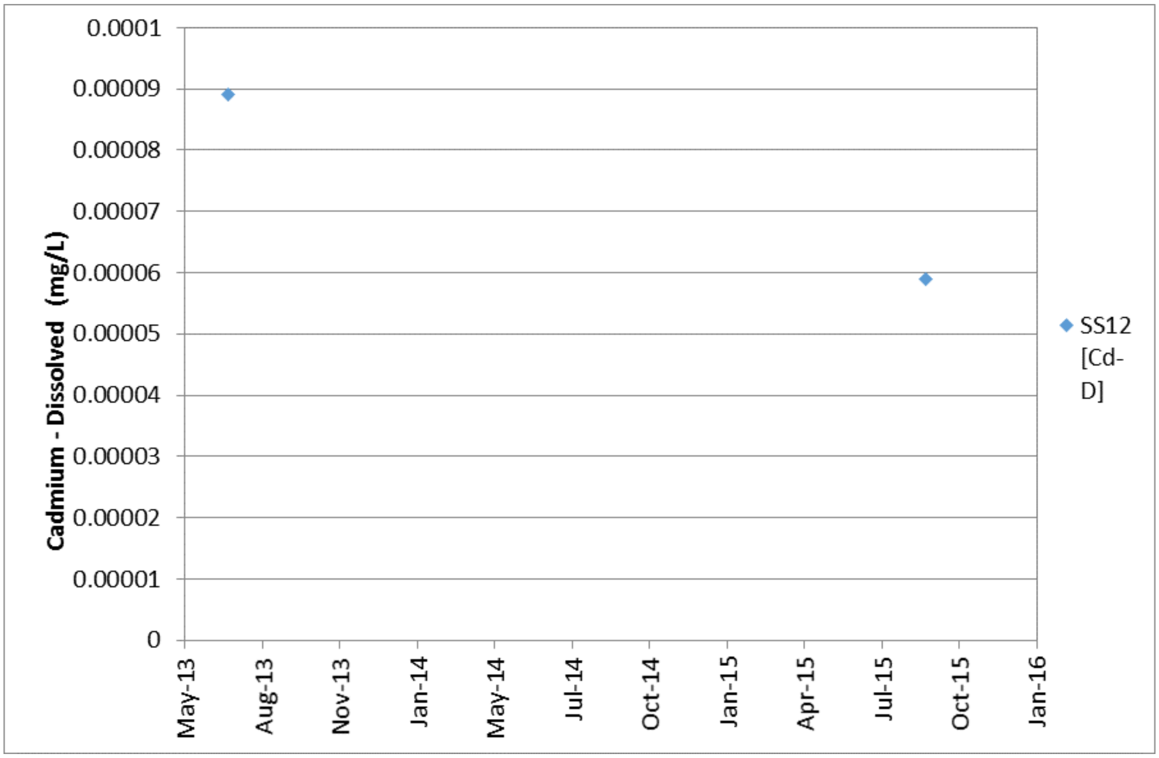


Figure 5-86: Dissolved Cadmium Concentrations at SS12 (2013-2015)

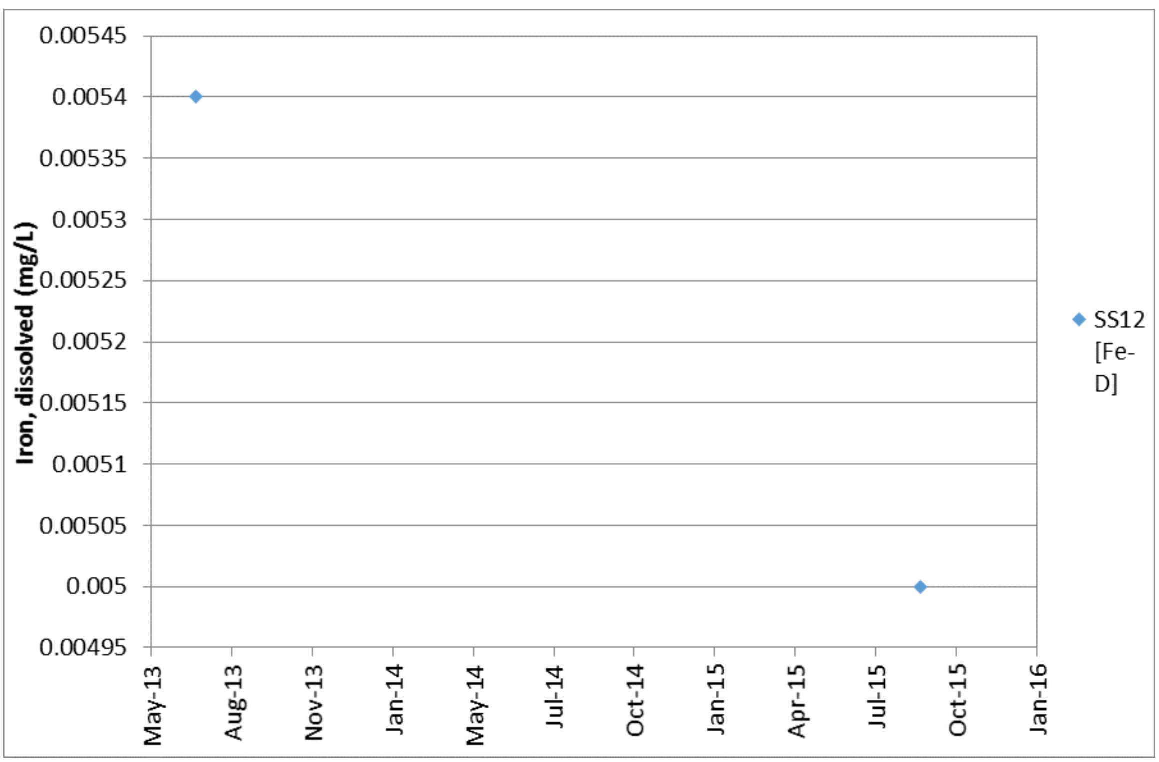


Figure 5-87: Dissolved Iron Concentrations at SS12 (2013-2015)

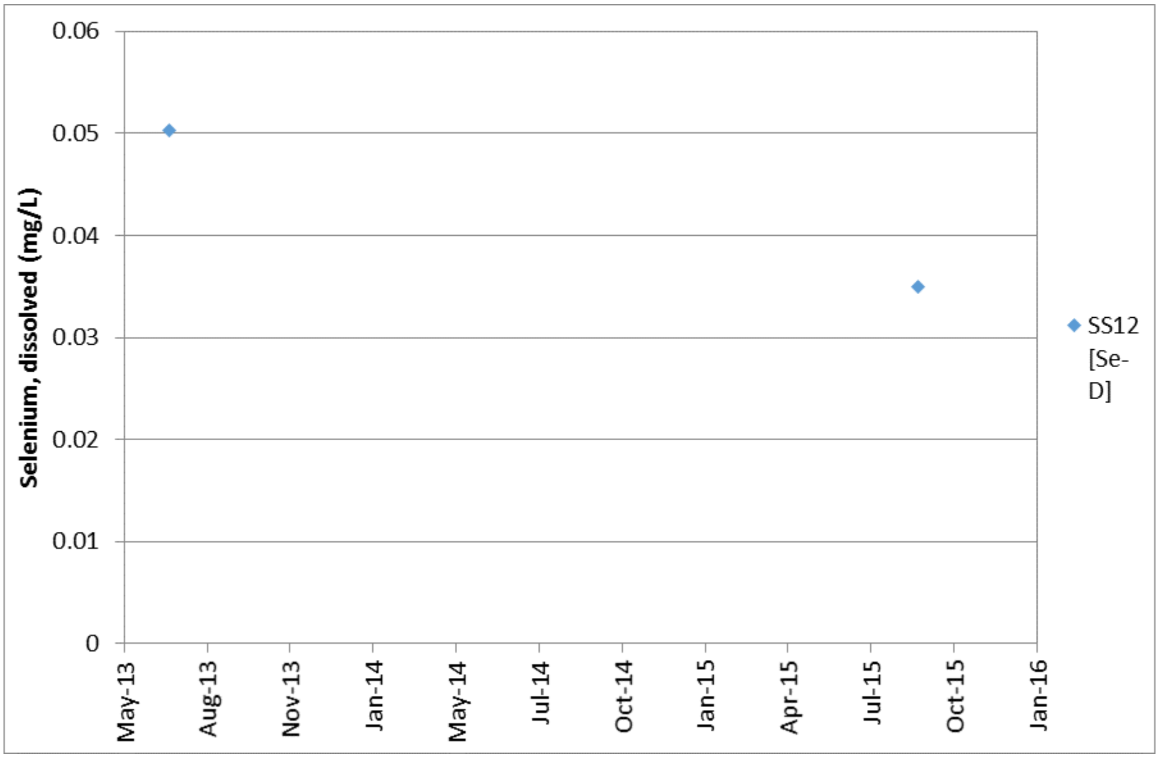


Figure 5-88: Dissolved Selenium Concentrations at SS12 (2023-2015)

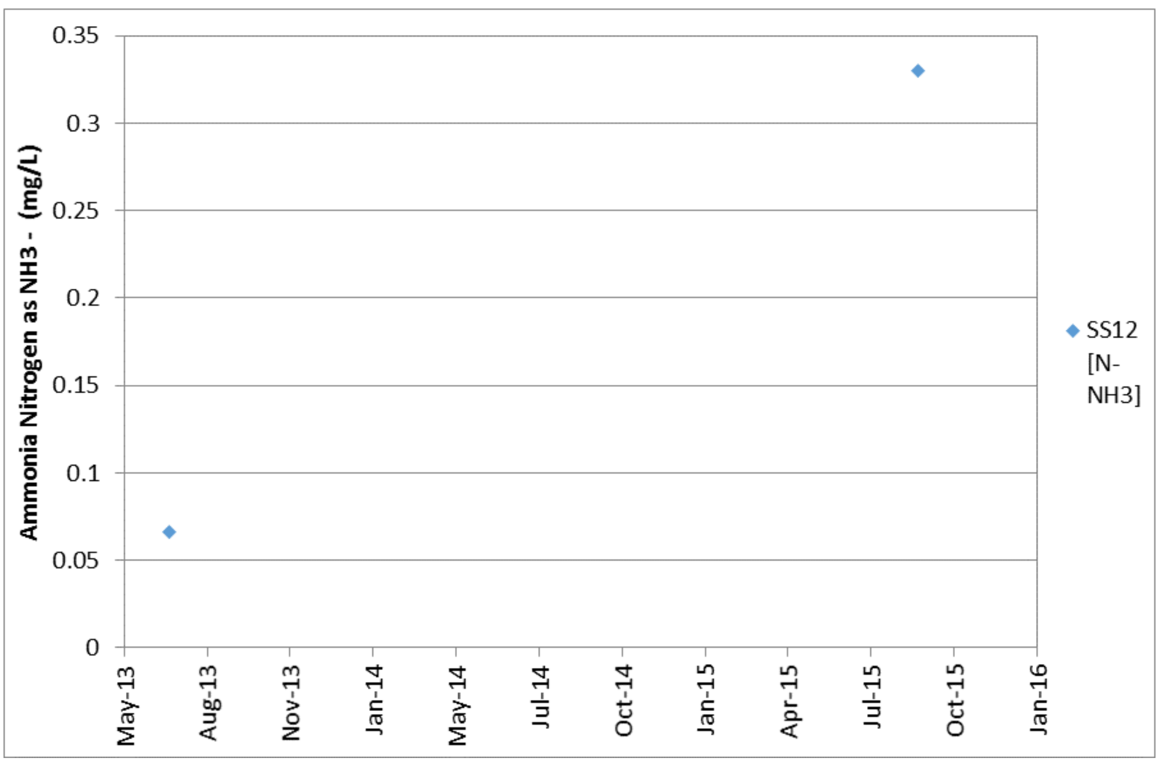


Figure 5-89: Ammonia Concentrations at SS12 (2013-2015)

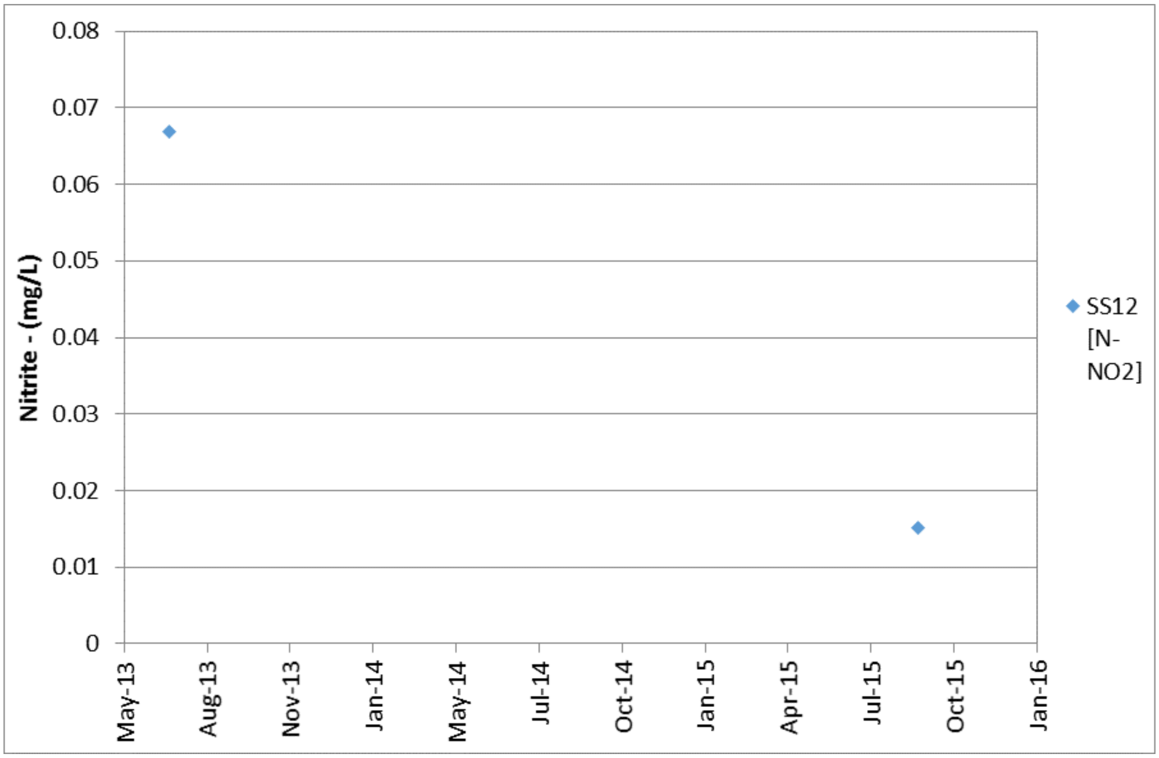


Figure 5-90: Nitrite Concentrations at SS12 (2013-2015)

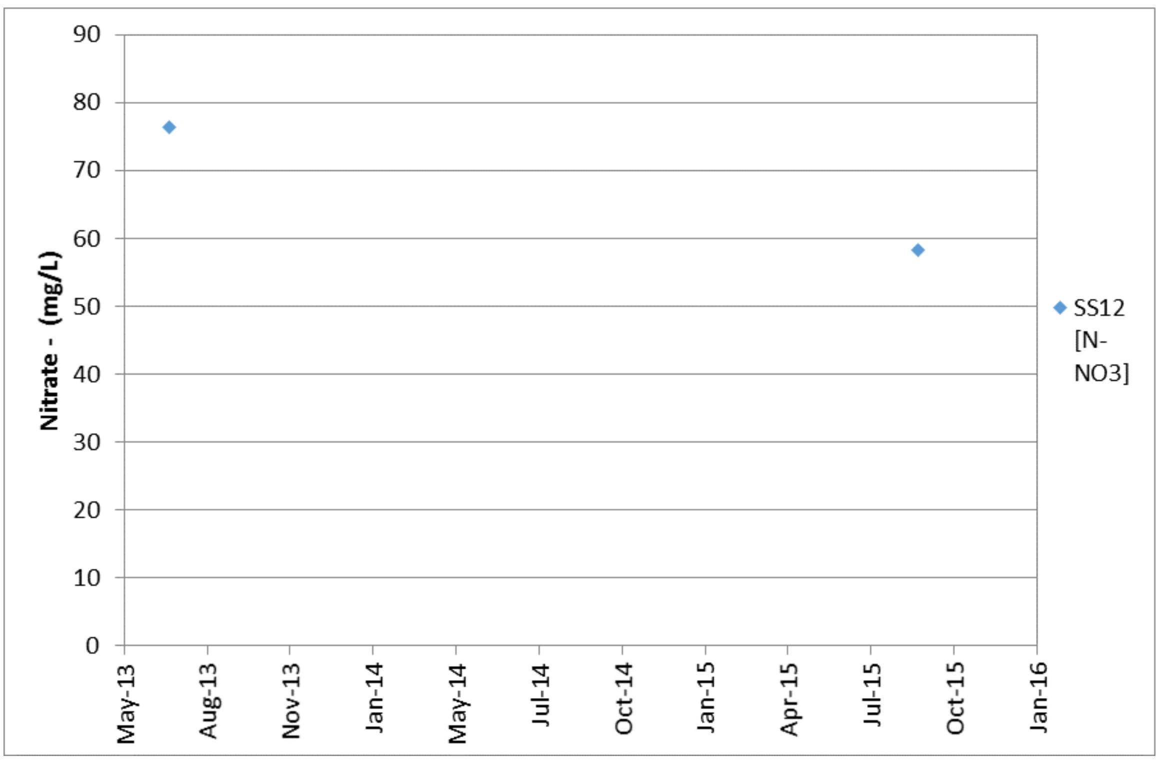


Figure 5-91: Nitrate Concentrations at SS12 (2013-2015)

5.4.9 Mill Area

SS32 was discovered in 2014 on a slope behind camp, along the mill area survey route. SS32 was sampled in both the spring and fall of 2015 and the results are displayed in Figure 5-92 through Figure 5-98.

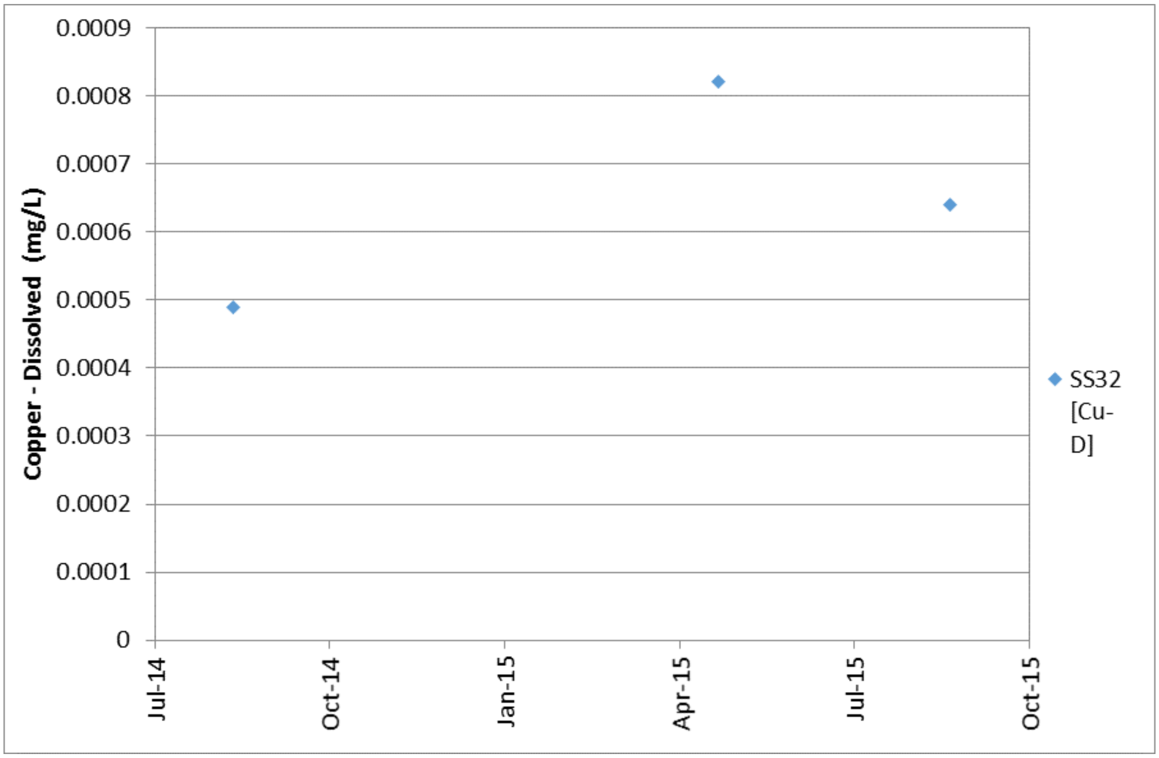


Figure 5-92: Dissolved Copper Concentrations at SS32 (2014-2015)

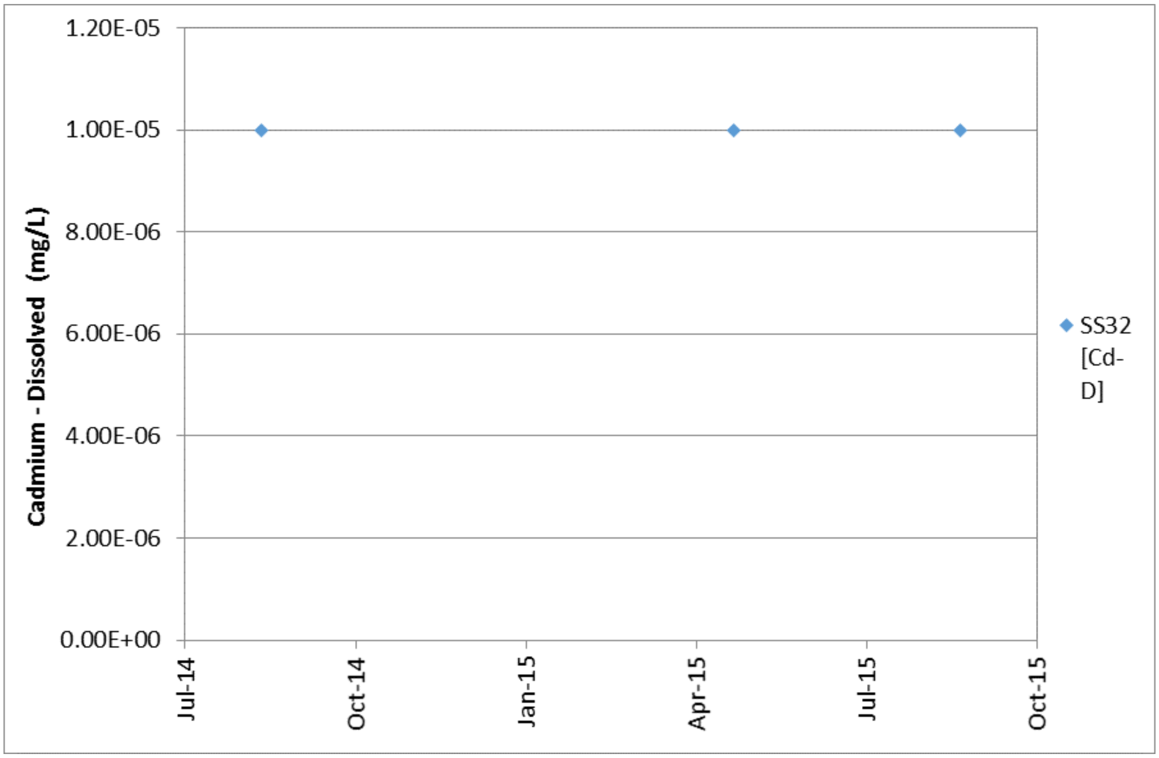


Figure 5-93: Dissolved Cadmium Concentrations at SS32 (2014-2015)

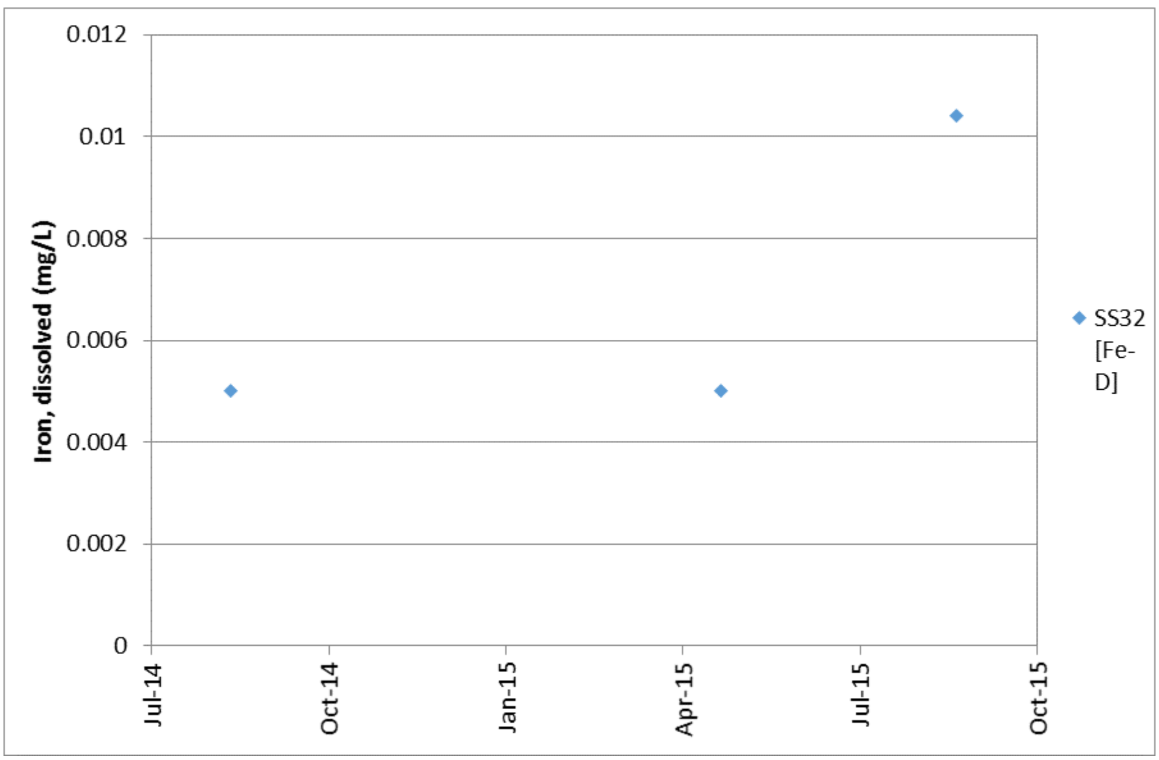


Figure 5-94: Dissolved Iron Concentrations at SS32 (2014-2015)

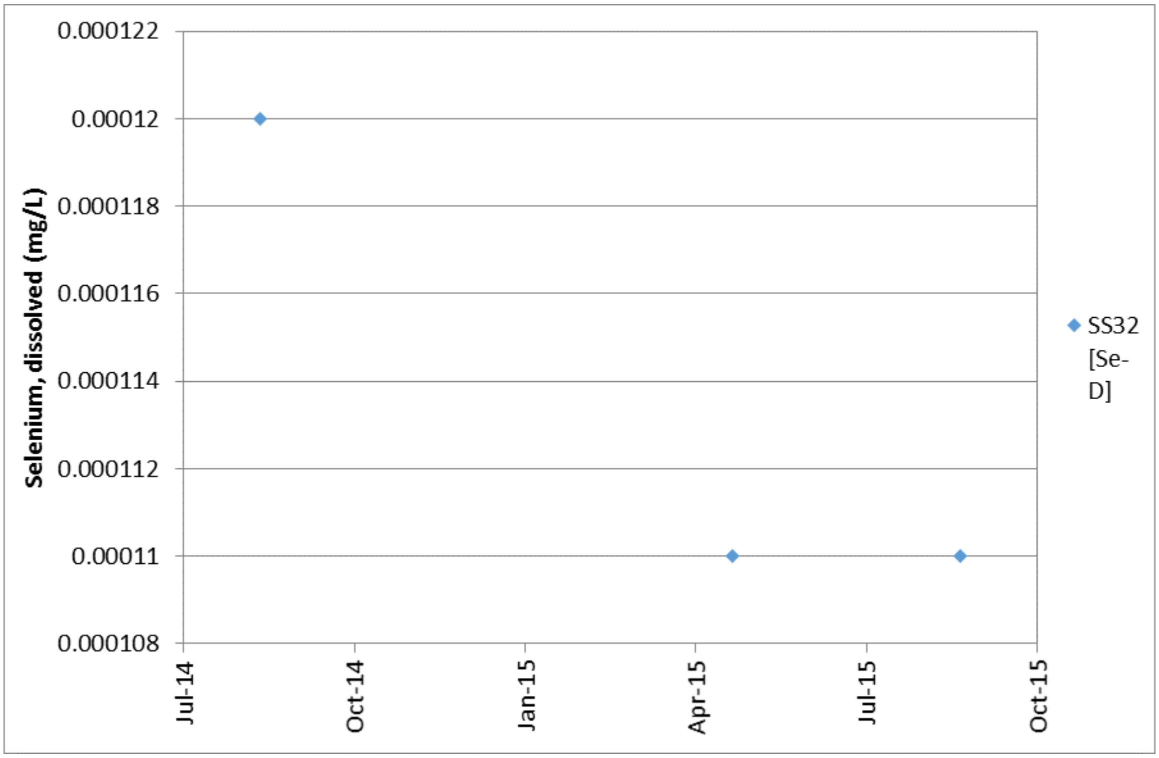


Figure 5-95: Dissolved Selenium Concentrations at SS32 (2014-2015)

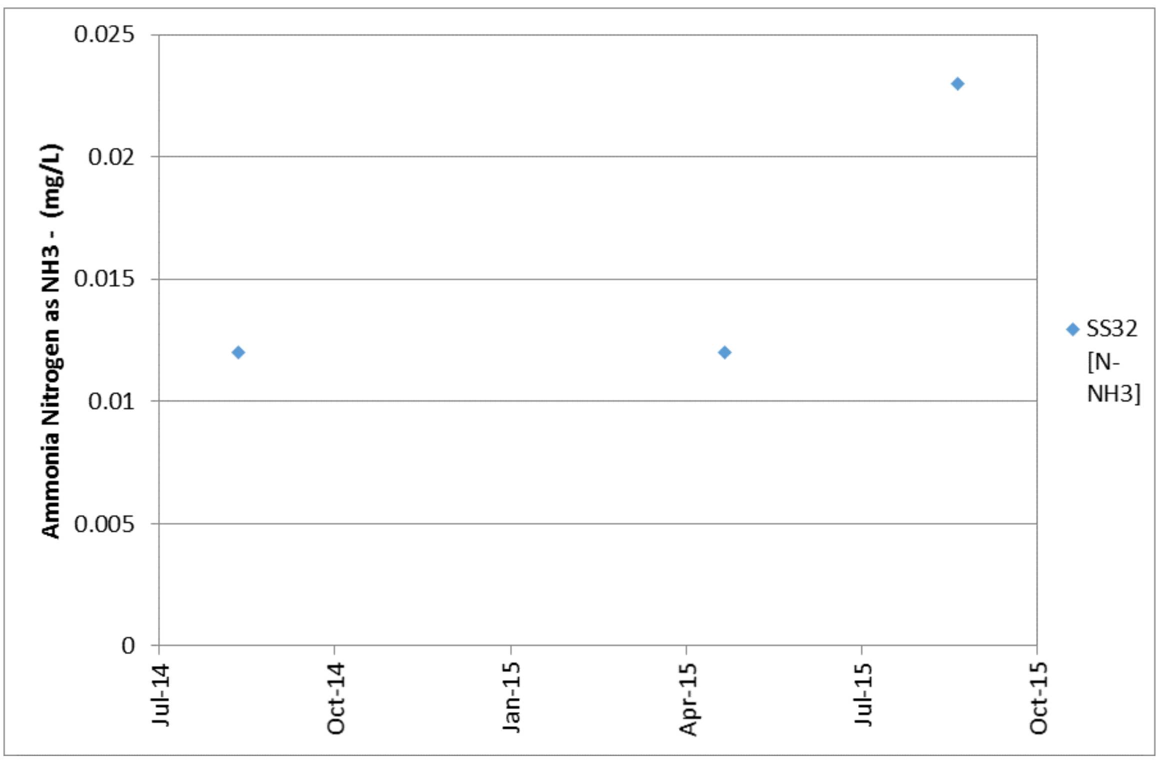


Figure 5-96: Ammonia Concentrations at SS32 (2014-2015)

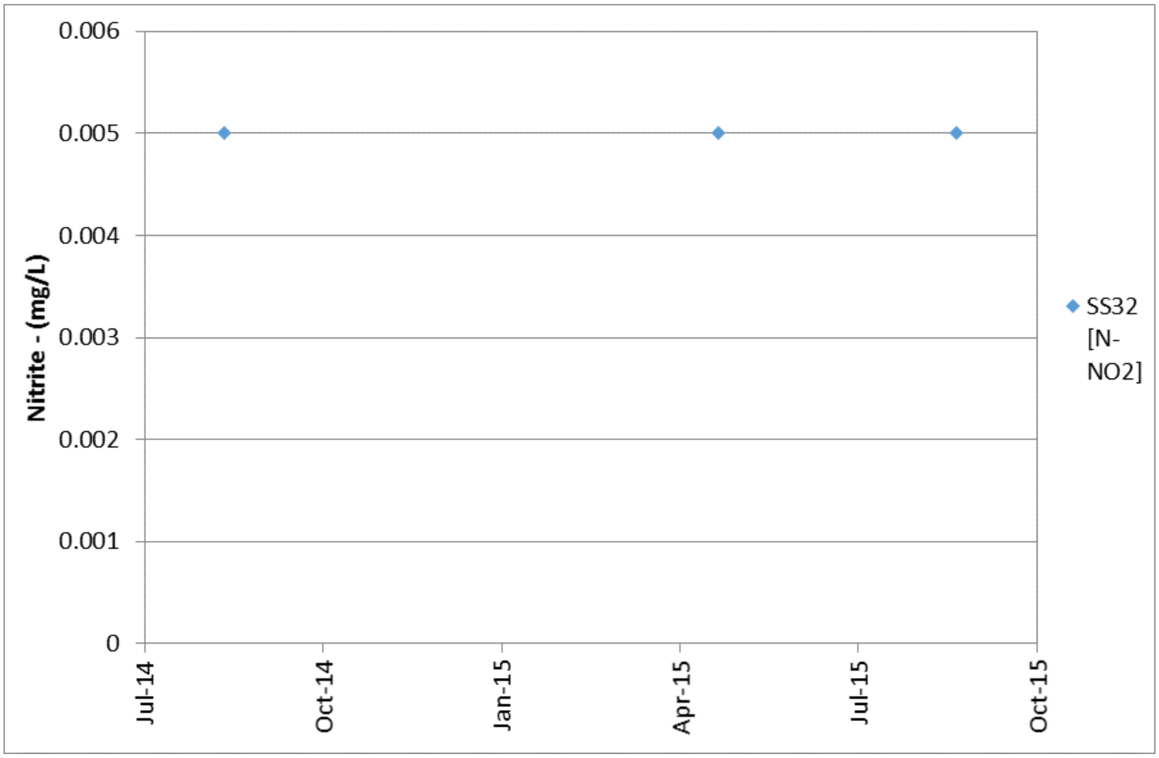


Figure 5-97: Nitrite Concentrations at SS32 (2014-2015)

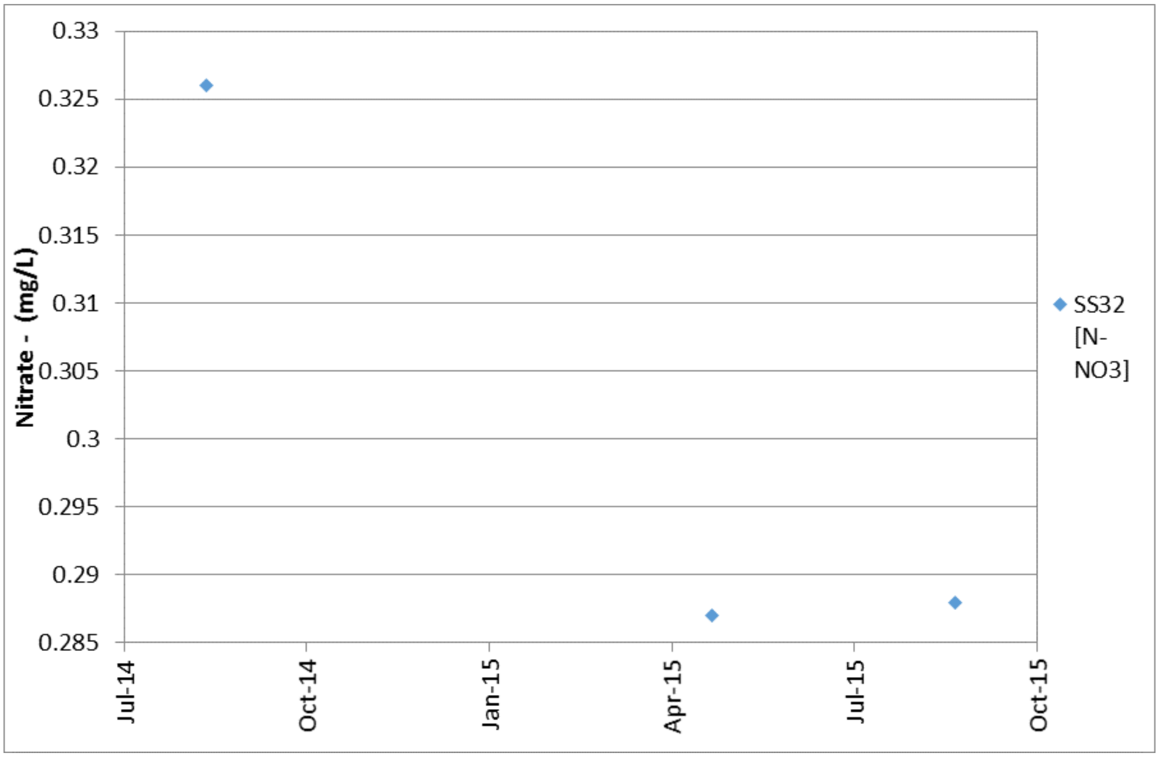


Figure 5-98: Nitrate Concentrations at SS32 (2014-2015)

5.5 Water Discharge

Minto Mine discharged approximately 328,526 m^3 of water to Minto Creek in 2015. Water quality was monitored at the end of the pipe, known as station W16A. Station W16A 2012 to 2015 water quality results statistics are summarized in Table 5-34, below, and are compared to WUL Effluent Quality Standards (Clause 9). During the 2015 monitoring period, fifteen water quality samples were taken from station W16A and sent to the external laboratory for processing. During the discharge period (April through May), W16A was further monitored with daily water quality samples provided to the mine's internal water quality laboratory.

During the 2015 discharge period, Minto Mine followed the Freshet Water Management and Discharge Plan (a component of the Adaptive Management Plan (AMP) under WUL QZ11-031). The plan outlined the steps and timelines for discharging water from the WSP and Water Treatment Plant; and diverting run-off water from un-impacted drainages such as W35 and W15. Level 2 Performance Monitoring (as per the AMP) was undertaken during the discharge period, resulting in increased frequency of water sampling to ensure that Minto met the conditions of the WUL.

The station W16A copper, aluminum, cadmium and selenium concentrations, with corresponding standards (WUL Clause 9) are displayed in Figure 5-99 and Figure 5-100.

Table 5-34: W16A Water Quality Results Summary (2012-2015)

W16A	Effluent Quality Standards (WUL Clause 9)	2012 - 2014 Summary Statistics			2015 Summary Statistics		
Parameters		Mean	Min	Max	Mean	Min	Max
pH	6.0-9.0	8.02	6.86	8.32	8.06	7.98	8.18
TSS (mg/L)	15	6.8	1	**55.1**	2.5	1	3.8
Nutrients (mg/L)							
Ammonia Nitrogen	0.75	0.0615	0.0169	0.26	0.082	0.032	0.17
Nitrate Nitrogen	27.3	3.553	0.549	5.2	2.47	1.54	3.5
Nitrite Nitrogen	0.18	0.014	0.005	0.0519	0.0366	0.0096	0.0586
Dissolved Metals (mg/L)							
Aluminum	0.3	0.0127	0.0033	0.0732	0.0105	0.003	0.0356
Arsenic	0.015	0.00042	0.00025	0.001	0.00035	0.00027	0.00043
Cadmium	0.00015	0.000021	0.00001	0.000089	0.00001	0.00001	0.000011
Chromium	0.003	0.00099	0.0005	0.001	0.001	0.001	0.001
Copper	0.039	0.0247	0.00793	0.0349	0.01362	0.00862	0.0195
Iron	3.3	0.0706	0.0106	0.301	0.0801	0.0105	0.199
Lead	0.012	0.00032	0.0002	0.00159	0.0002	0.0002	0.0002
Molybdenum	0.219	0.0052	0.001	0.0098	0.0057	0.0032	0.0085
Nickel	0.33	0.0011	0.001	0.005	0.001	0.001	0.001
Selenium	0.006	0.00141	0.00019	0.0021	0.0009	0.00066	0.00121
Zinc	0.09	0.005	0.005	0.005	0.005	0.005	0.005

Bold values indicate exceedances of the WUL standards

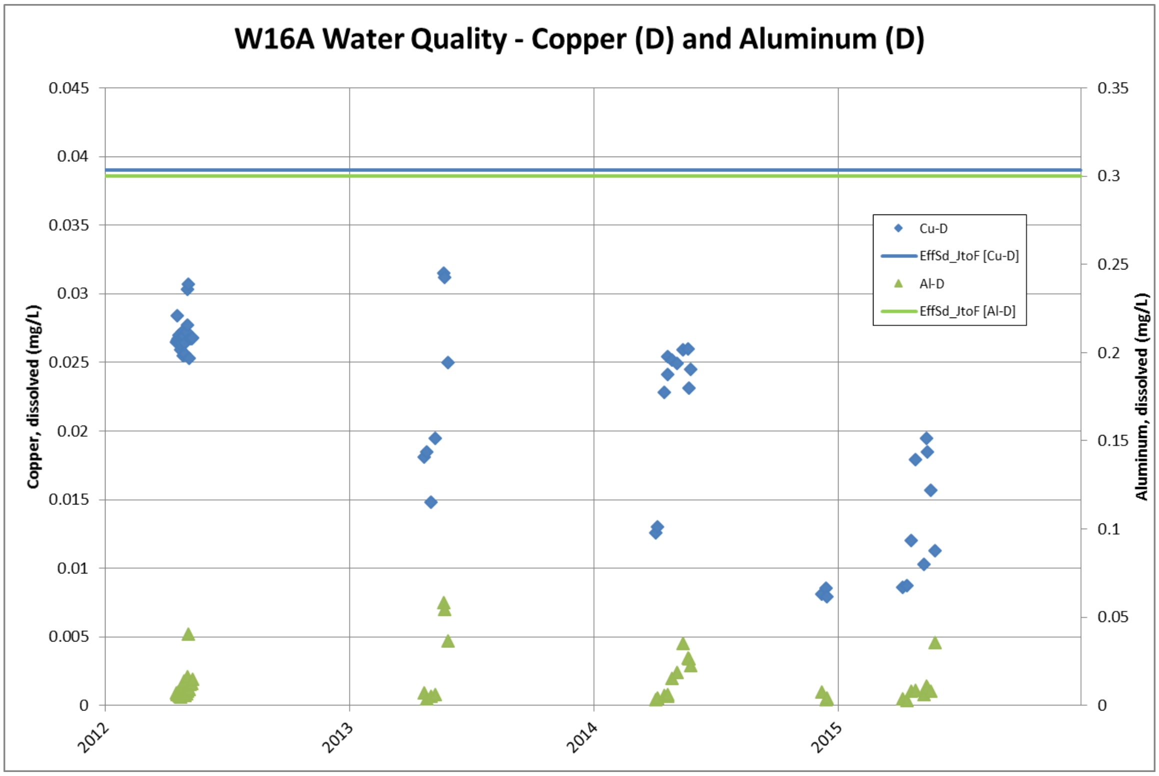
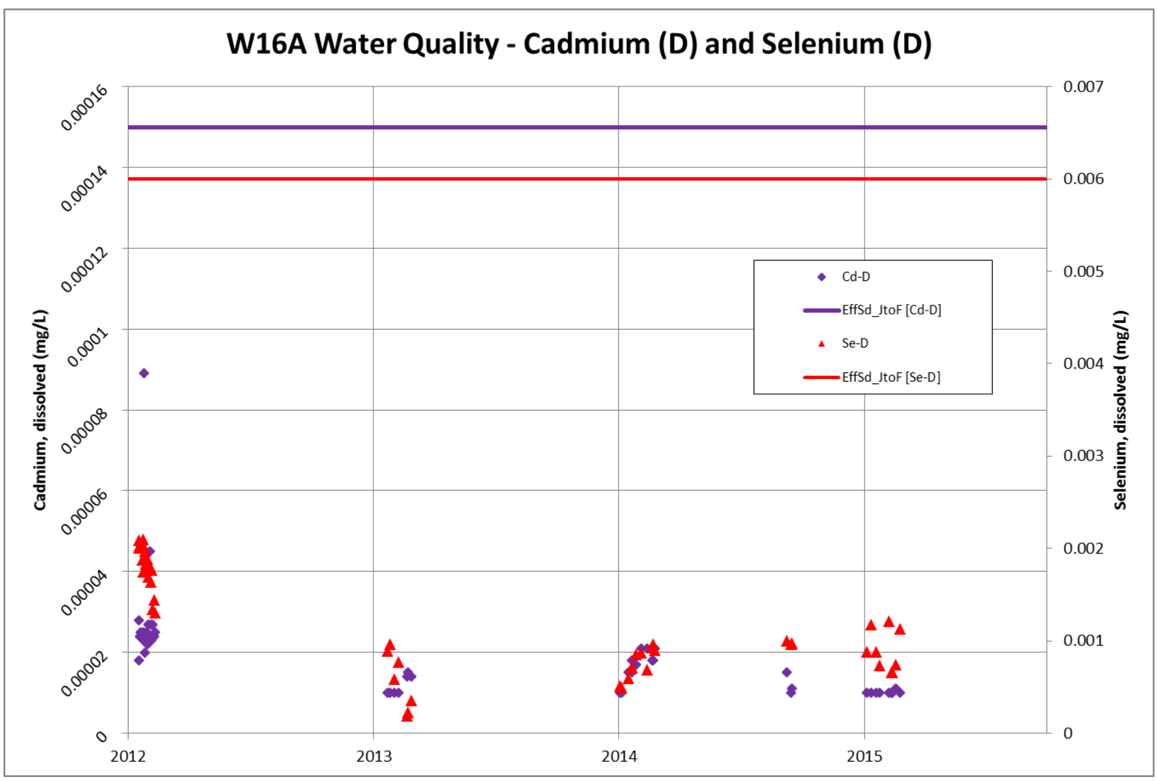


Figure 5-99: W16A Copper and Aluminum Concentrations (2012-2015)



*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 5-100: W16A Cadmium and Selenium Concentrations (2012-2015)

5.6 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 5.2 and the AEMP sediment, benthic invertebrates, fish and fish habitat is presented in Section 5.6.

5.6.1 Biological Monitoring Program

The WUL requires an Aquatic Environmental 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 F and Appendix G. Appendix F contains information with respect to the sediment, periphyton, and benthic invertebrate monitoring programs and Appendix G contains information relative to the fish monitoring programs.

5.6.1.1 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 2015 to evaluate survival and growth. Sediments collected in 2015 were largely composed of fine particles in the silt and sand size categories (Table 5-35). Mean total organic carbon (TOC) content of sediment collected from upper Minto Creek (2.3%) and lower Minto Creek (3.9%) were lower than at comparable reference areas - upper McGinty Creek (5.8%) and lower Wolverine Creek (7.2%), respectively (Table 5-35). Only mean copper concentrations in Minto Creek (both upper and lower) were greater than Interim Sediment Quality Guidelines for the protection of aquatic life (ISQG; CCME 1999) and the corresponding reference concentrations. Moving downstream, mean copper concentration decreased substantially from 147 mg/kg in upper Minto Creek to 43 mg/kg in lower Minto Creek (Figure 5-101). 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 were similar to previous toxicity testing in 2011 and continue to indicate no adverse effects associated with lower Minto Creek sediment (Minnow 2012).

Table 5-35: Sediment Chemistry Data Collected at Exposed and Reference Areas, Minto Mine (2015)

	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	%	-	-	12	6.4	4.0	22	4.6	1.5	3.0	6.0	13	5.7	6.0	22	7.2	3.3	4.0	12
	pH (1:2 soil:water)	pH units	-	-	6.68	0.36	6.33	7.26	7.62	0.13	7.40	7.76	6.92	0.22	6.56	7.10	7.86	0.06	7.82	7.94
	% Gravel (>2mm)	%	-	-	-	-	-	-	-	-	-	-	< 0.1	0	< 0.1	< 0.1	**0.41**	0.49	0.10	**1.3**
	% Sand (2.0mm - 0.063mm)	%	-	-	-	-	-	-	-	-	-	-	35	23	7.4	69	23	6.6	13	30
	% Silt (0.063mm - 4um)	%	-	-	-	-	-	-	-	-	-	-	60	22	29	87	70	6.5	64	80
	% Clay (<4um)	%	-	-	-	-	-	-	-	-	-	-	4.5	1.2	2.8	5.8	6.9	0.88	6.2	8.4
	Total Kjeldahl Nitrogen	%	-	-	0.28	0.16	0.067	0.52	0.11	0.028	0.082	0.15	0.30	0.13	0.14	0.51	0.20	0.092	0.11	0.32
	Inorganic Carbon	%	-	-	< 0.10	0	< 0.10	< 0.10	< 0.10	0	< 0.10	< 0.10	< 0.10	0	< 0.10	< 0.10	< 0.10	0	< 0.10	< 0.10
	Inorganic Carbon (as CaCO3 Equivalent)	%	-	-	< 0.80	0	< 0.80	< 0.80	< 0.80	0	< 0.80	< 0.80	< 0.80	0	< 0.80	< 0.80	< 0.80	0	< 0.80	< 0.80
	Total Carbon by Combustion	%	-	-	5.8	3.5	1.4	11	2.3	0.8	1.3	3.0	7.2	2.5	4.1	11	3.9	1.8	2.0	6.2
	Total Organic Carbon	%	-	-	5.8	3.5	1.4	11	2.3	0.8	1.3	3.0	7.2	2.5	4.1	11	3.9	1.8	2.0	6.2
Total Metals	Aluminum (Al)	mg/kg	-	-	12,066	3,494	6,630	16,400	10,330	1,863	8,950	13,400	13,840	2,176	10,400	15,800	12,980	1,272	11,400	14,300
	Antimony (Sb)	mg/kg	-	-	0.45	0.14	0.25	0.64	0.38	0.065	0.32	0.48	0.49	0.087	0.35	0.56	0.46	0.048	0.39	0.50
	Arsenic (As)	mg/kg	5.9	17	9.2	2.9	5.3	13	5.3	0.65	4.6	6.3	6.5	0.88	5.3	7.3	6.3	0.87	5.4	7.5
	Barium (Ba)	mg/kg	-	-	239	73	127	319	192	28	163	238	219	43	147	247	212	29	176	243
	Beryllium (Be)	mg/kg	-	-	0.37	0.12	0.19	0.51	0.39	0.057	0	0.48	0.80	0.12	0.60	0.88	0.40	0.055	0.34	0.47
	Bismuth (Bi)	mg/kg	-	-	< 0.20	0	< 0.20	< 0.20	< 0.20	0	< 0.20	< 0.20	< 0.20	0	< 0.20	< 0.20	< 0.20	0	< 0.20	< 0.20
	Boron (B)	mg/kg			< 5.0	0	< 5.0	< 5.0	< 5.0	0	< 5.0	< 5.0	< 5.0	0	< 5.0	< 5.0	< 5.0	0	< 5.0	< 5.0
	Cadmium (Cd)	mg/kg	0.60	3.5	0.18	0.070	0.076	0.27	0.19	0.033	0.16	0.23	0.29	0.093	0.15	0.38	0.16	0.035	0.12	0.20
	Calcium (Ca)	mg/kg	-	-	8,516	2,527	4,630	11,700	7,038	1,236	5,530	8,890	11,688	2,711	7,340	13,600	10,162	2,001	7,430	12,300
	Chromium (Cr)	mg/kg	37	90	26	7.5	15	35	23	5.1	18	31	46	7.4	34	52	30	3.2	26	34
	Cobalt (Co)	mg/kg	-	-	10	2.2	6.7	13	9.7	1.0	9.0	11	14	1.3	12	15	10	0.87	9.4	12
	Copper (Cu)	mg/kg	36	197	24	9.4	10	37	**147**	37	93	**191**	30	7.2	18	35	43	7.4	33	53
	Iron (Fe)	mg/kg	-	-	26,880	6,319	16,600	32,700	22,560	1,885	20,700	25,700	27,280	1,746	24,600	28,900	23,500	1,772	21,700	25,900
	Lead (Pb)	mg/kg	35	91	4.9	1.3	2.8	6.5	5.5	0.72	4.6	6.4	6.5	0.86	5.0	7.1	5.5	0.49	4.8	6.1
	Lithium (Li)	mg/kg	-	-	6.7	1.8	3.8	8.8	7.1	1.0	5.7	8.4	9.6	1.6	8.1	12	8.7	1.2	7.4	10
	Magnesium (Mg)	mg/kg	-	-	4,638	868	3,110	5,240	6,052	815	5,270	7,360	8,788	933	7,190	9,450	6,648	613	5,890	7,430
	Manganese (Mn)	mg/kg	-	-	642	126	460	792	**1,684**	398	1,120	**2,170**	685	138	488	799	777	149	629	946
	Mercury (Hg)	mg/kg	0.17	0.49	0.048	0.022	0.016	0.076	0.022	0.0040	0.018	0.028	0.051	0.015	0.025	0.061	0.031	0.0058	0.025	0.037
	Molybdenum (Mo)	mg/kg	-	-	0.56	0.096	0.44	0.70	**1.5**	0.34	1.1	**2.0**	0.60	0.055	0.54	0.66	0.59	0.089	0.48	0.68
	Nickel (Ni)	mg/kg	-	-	19	4.8	11	24	24	4.0	21	30	38	4.7	30	42	27	2.5	24	30
	Phosphorus (P)	mg/kg	-	-	985	202	687	1,220	893	89	793	1,010	1,003	66	909	1,090	806	30	775	848
	Potassium (K)	mg/kg	-	-	804	142	550	880	1,338	207	1,180	1,690	984	92	870	1,070	1,114	133	1,000	1,330
	Selenium (Se)	mg/kg	-	-	0.55	0.17	0.29	0.69	0.38	0.10	0.30	0.54	0.45	0.16	0.20	0.59	0.39	0.11	0.25	0.49
	Silver (Ag)	mg/kg	-	-	0.11	0.013	0.10	0.13	0.10	0.0045	0.10	0.11	0.12	0.016	< 0.10	0.13	< 0.10	0	< 0.10	< 0.10
	Sodium (Na)	mg/kg	-	-	332	87	181	399	343	60	270	422	481	56	387	531	360	31	332	411
	Strontium (Sr)	mg/kg	-	-	69	17	42	82	80	14	70	104	112	19	82	125	89	18	65	105
	Thallium (Tl)	mg/kg	-	-	0.078	0.018	0.050	0.099	0.082	0.017	0.063	0.11	0.084	0.016	0.057	0.098	0.093	0.010	0.083	0.11
	Tin (Sn)	mg/kg	-	-	< 2.0	0	< 2.0	< 2.0	< 2.0	0	< 2.0	< 2.0	< 2.0	0	< 2.0	< 2.0	< 2.0	0.0	< 2.0	< 2.0
	Titanium (Ti)	mg/kg	-	-	713	119	509	813	619	102	523	781	790	69	687	872	742	71	679	854
	Uranium (U)	mg/kg	-	-	1.2	0.39	0.60	1.6	0.74	0.19	0.59	1.1	3.4	1.1	1.7	4.5	0.89	0.20	0.64	1.1
	Vanadium (V)	mg/kg	-	-	54	11	37	66	50	6.3	43	60	70	6.3	60	76	51	4.7	47	59
	Zinc (Zn)	mg/kg	123	315	48	10	31	59	59	6.7	55	71	59	6.8	48	65	56	4.4	50	62

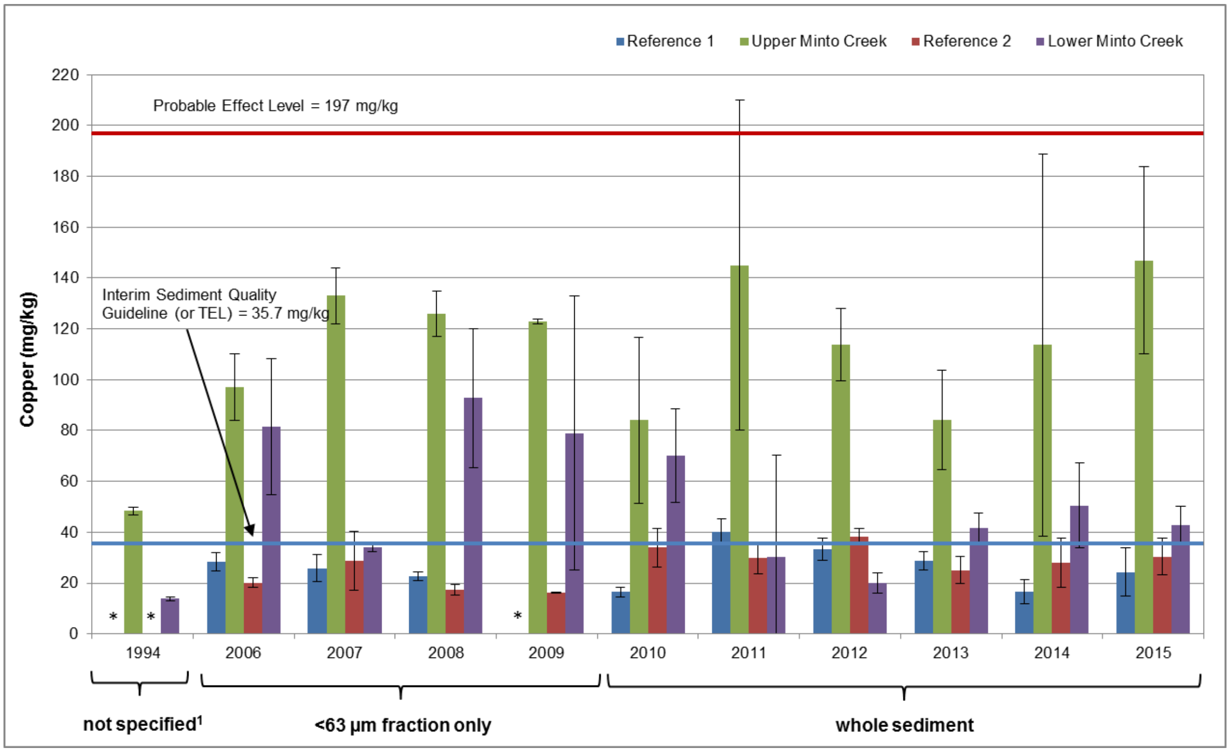
Indicates sediment concentration exceeding CSQG ISQG

Indicates sediment concentration exceeding CSQG PEL

bold Indicates sediment concentration exceeding the higher reference mean by more than two times

[a] If value was < method detection limit, summary statistics were calculated using detection limit, i.e. if value was < 0.0048, summary statistics were calculated using the value 0.0048

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

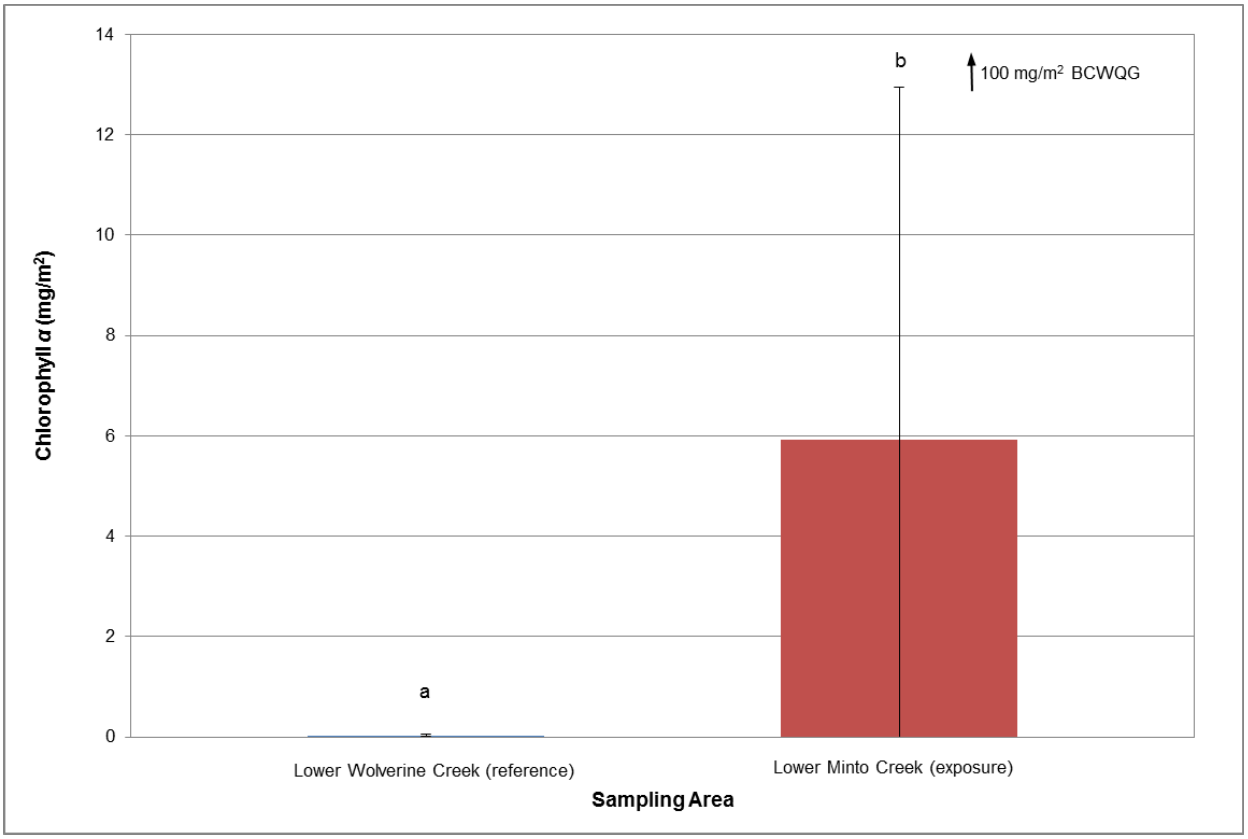


Reference 1 = Station W6 (south-flowing tributary) in 2006 to 2008 and McGinty Creek in 2010 to 2015; Reference 2 = Station W7 (north-flowing tributary) in 2006 to 2009 and Wolverine Creek in 2010 to 2015; * = no data. TEL = Threshold Effect Levels. [1] Methods were not specified, fine sediment was collected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

Figure 5-101: Mean Copper Concentrations in Sediment Collected in Minto Creek and Reference Locations) (mean ± standard deviation) (1994-2015)

5.6.1.2 Periphyton and Chlorophyll a Monitoring

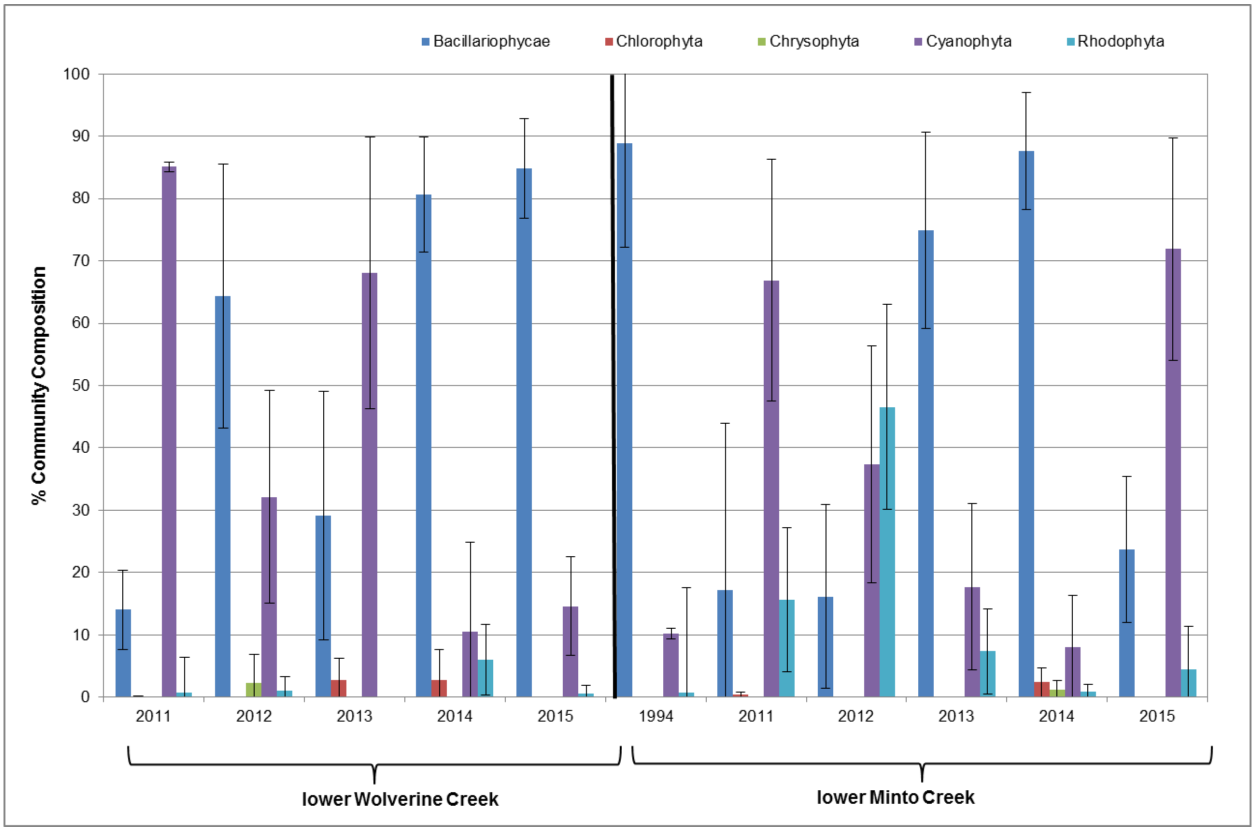
Periphyton production and community data were collected at lower Minto Creek and lower Wolverine Creek. Productivity was assessed through measurements of chlorophyll α in periphyton (used as a surrogate for the productivity of photosynthetic organisms). Concentration of chlorophyll α was significantly higher at lower Minto Creek than at lower Wolverine Creek (Figure 5-102). Chlorophyll α concentrations at both areas were well below the British Columbia Water Quality Guideline (BCWQG) of 100 mg/m^2 for the protection of aquatic life (BCMOE 1985). The production of both creeks are 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. Based on only total phosphorus, both creeks would be defined as oligotrophic as well (Dodds et al. 1998). There was little temporal change in periphyton chlorophyll α concentrations from 2012 to 2015.



*Different letters represent significant differences between sites.

Figure 5-102: Mean Chlorophyll a on Cobble Substrate in Lower Wolverine Creek and Lower Minto Creek (mean ± standard deviation), Minto Mine WUL (2015)

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. Both creeks had similar periphyton community structures with Bacillariophycae (diatoms) and Cyanophyta (blue-green algae) being the two dominant phyla. Cyanophyta made up 72% of the community at lower Minto Creek and Bacillariophycae were dominant at lower Wolverine Creek, making up 85% of the community. Temporal variability in community composition has been high in both exposure and reference areas (Figure 5-103). For example, at lower Minto Creek, Bacillariophycae were dominant in 1994, 2013, 2014; Rhodophyta in 2012 and Cyanophyta in 2011, 2015 (Figure 5-103). This lack of temporal consistency was also observed at lower Wolverine Creek, with Cyanophyta dominant in 2011 and 2013 and Bacillariophycae in 2012, 2014 and 2015 (Figure 5-103; Minnow 2013; 2014, 2015).



Data presented as mean ± standard deviation

Figure 5-103: Periphyton Community Composition in Lower Minto Creek (1994, 2011-2015) and Lower Wolverine Creek (2011-2015), Minto Mine WUL, 2015

5.6.1.3 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 density (higher), Simpson's Diversity (lower), Simpson's Evenness (lower), Bray-Curtis index (greater), percent chironomids (higher than lower Wolverine Creek only) and CA Axis-1 (higher; Table 5-36). Taxon richness and abundance of EPT taxa (Ephemeroptera [mayfly], Plecoptera [stonefly], Trichoptera [caddisfly] taxa) did not differ among areas. However, abundance of Ephemeroptera was lower, while Plecoptera was higher and Trichoptera did not differ at lower Minto Creek relative to reference areas (Appendix F). The virtual absence of Ephemeroptera (which are a sensitive taxa) could suggest a mine-related influence, this is not supported by Plecoptera and Trichoptera both of which are also sensitive taxa. Whereas similar taxon richness and abundance of EPT taxa among areas is an indicator of a healthy erosional benthic invertebrate community, lower Simpson's Diversity, lower Simpson's Evenness, higher Bray-Curtis index and higher percent chironomids in lower Minto Creek relative to reference areas could suggest some influence of the mine.

A potential decrease in number of taxa from 2012-2014 identified last year (Minnow 2015) was not supported by the 2015 data and appears to represent natural variability.

Comparisons of benthic invertebrate community metrics in 2015 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 2015 was lower than in 2012 and 2014 but higher than in 2013 (Figure 5-104). Number of taxa at lower Minto Creek in 2015 was within the historical range from 2006 onwards, but moderately lower than in 1994 (Figure 5-104).

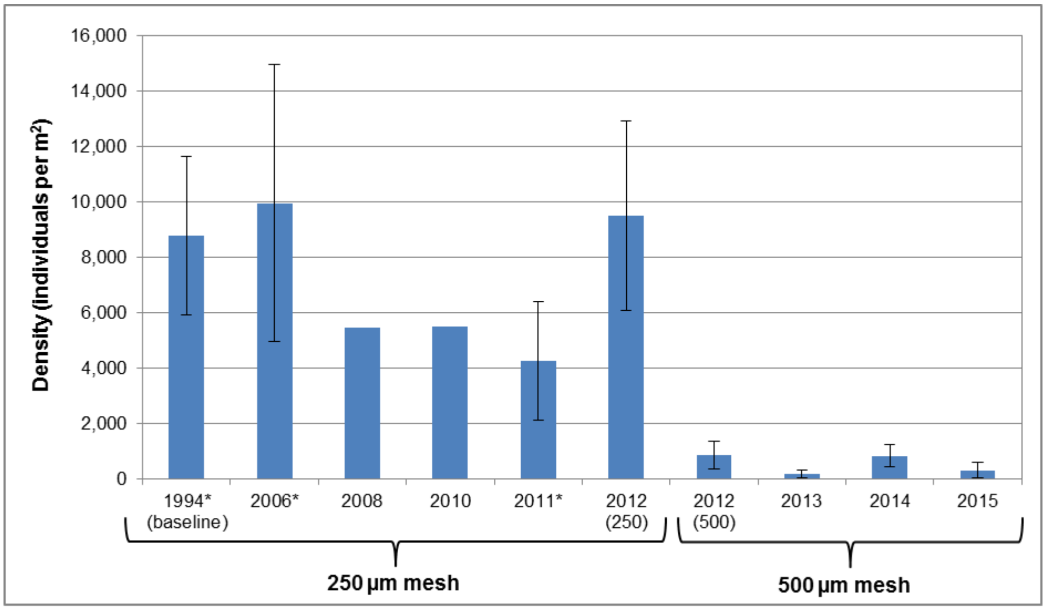
Table 5-36: Benthic Invertebrate Community Metrics and Statistical Comparisons, Minto Mine WUL (2015)

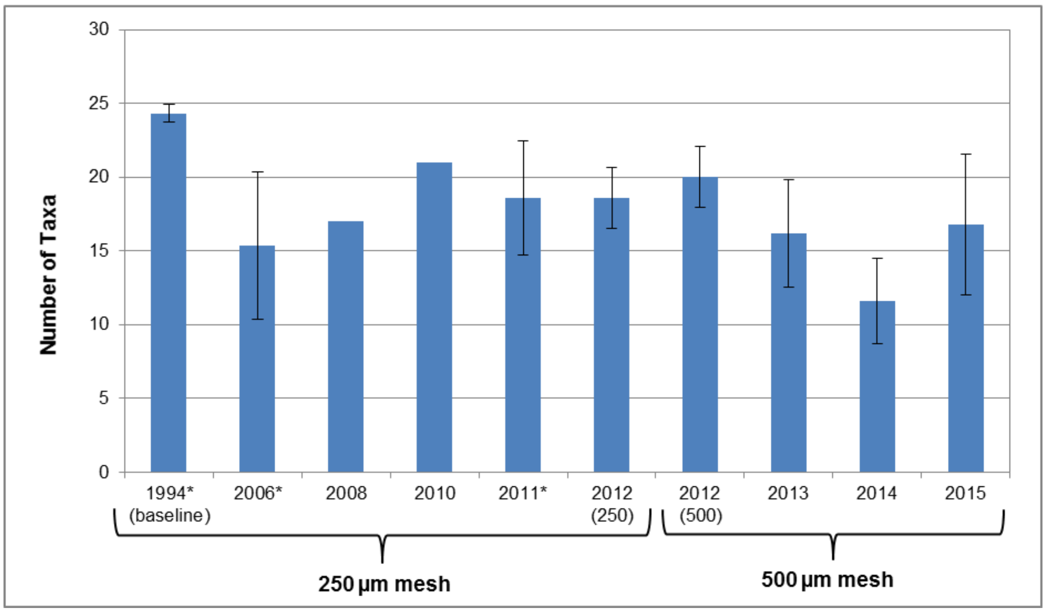
Metric	Comparison		Area Means		Statistical Contrasts		
	Exposure Site	Reference Site			Significant Difference between areas?	Direction	p-value
Density (organisms/m^2)	lower Minto Creek	lower Wolverine Creek	1,062	142	YES	Minto > Wolverine	0.003
		lower Big Creek		165	YES	Minto > Big	0.006
Number of Taxa	lower Minto Creek	lower Wolverine Creek	17	17	NO	-	0.751
		lower Big Creek		17	NO	-	0.833
Simpson's Diversity[1]	lower Minto Creek	lower Wolverine Creek	0.71	0.89	YES	Minto < Wolverine	0.009
		lower Big Creek		0.87	YES	Minto < Big	0.016
Simpson's Evenness[1]	lower Minto Creek	lower Wolverine Creek	0.23	0.60	YES	Minto < Wolverine	0.002
		lower Big Creek		0.54	YES	Minto < Big	0.006
BC Index to Combined Reference Median	lower Minto Creek	lower Wolverine Creek	0.95	0.45	YES	Minto > Wolverine	0.000
		lower Big Creek		0.57	YES	Minto > Big	0.000
EPT (%)[2]	lower Minto Creek	lower Wolverine Creek	51	58	NO	-	1.000
		lower Big Creek		38	NO	-	0.367
Chironomids (%)	lower Minto Creek	lower Wolverine Creek	42	26	NO	-	0.295
		lower Big Creek		23	YES	Minto > Big	0.073
CA Axis-1 (33.4% of total variation)	lower Minto Creek	lower Wolverine Creek	-67	319	YES	Minto < Wolverine	0.000
		lower Big Creek		248	YES	Minto < Big	0.000
CA Axis-2 (16.2% of total variation)	lower Minto Creek	lower Wolverine Creek	-19	45	NO	-	0.331
		lower Big Creek		-46	NO	-	0.849

[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, Plecoptera, Trichoptera





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

Figure 5-104: Benthic Invertebrate Community Density and Taxon Richness at Lower Minto, Minto Creek (1994-2015)

5.6.1.4 Fisheries Monitoring Program

The objectives of the 2015 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 2015 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 2015 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 October 2015, at trapping sites consistent with the 2010 mark-recapture study and the 2011 to 2014 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 seventeen or eighteen 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 2015 results of Fisheries Monitoring Program see Appendix G – Fisheries Monitoring Program, Minto Creek, 2015 Summary Report.

5.7 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, and total sunshine hours. The Meteorological Monitoring Program is comprised of the Climate Monitoring Program (Section 5.7.1) and the Snow Survey Program (Section 5.7.2) as per the EMSRP. 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.

5.7.1 Climate Monitoring Program

During 2015, 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 (Met Station 2) was installed October 15, 2010 and runs on a Campbell Scientific CR1000 datalogger. Met Station 2 consists of a 10 m tower with instrumentation to measure air temperature (Figure 5-105), incident solar radiation (Figure 5-106), precipitation – rain and snowfall (Figure 5-107), barometric pressure (Figure 5-108), evapotranspiration (Figure 5-109), relative humidity (Figure 5-110), and wind speed, direction and events (Figure 5-111 and Figure 5-112). Data are averaged over the one-hour archiving period and then saved to the datalogger.

Due to a downloading error there is a gap in the data from July 14th to July 16th, 2015.

In early 2016, Minto will be adding instrumentation to Met Station 2 including instrumentation to measure outgoing short wave radiation and pan evaporation.

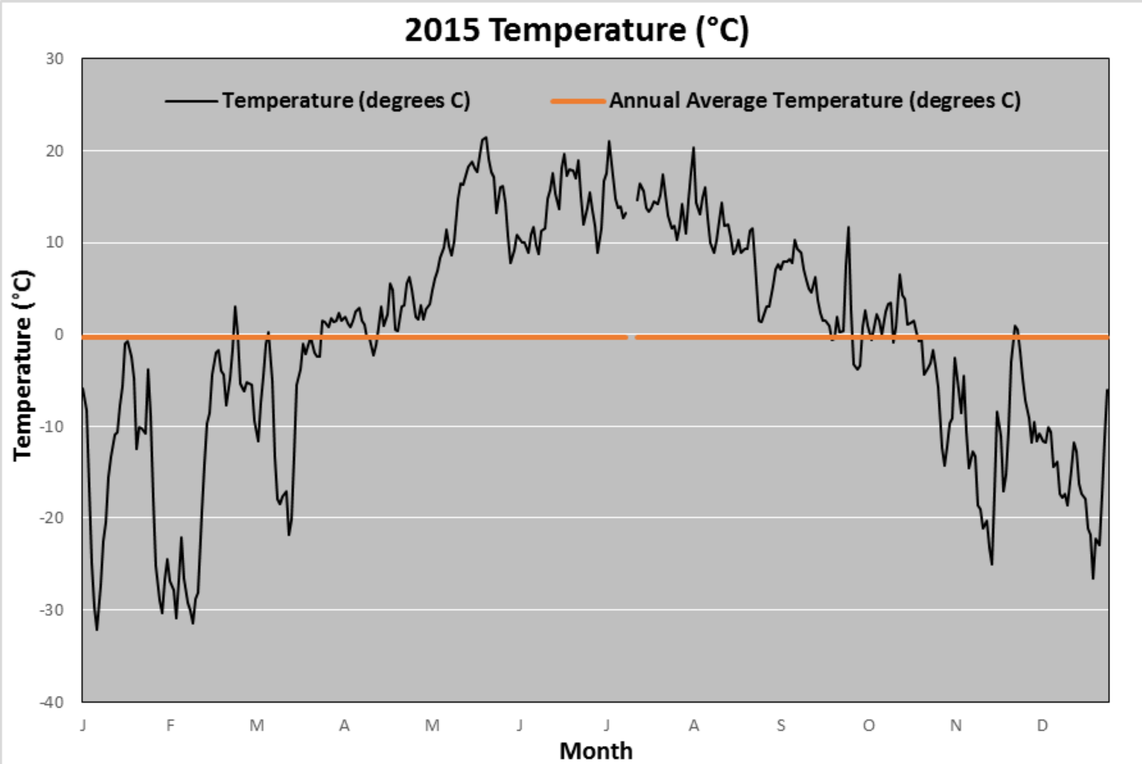


Figure 5-105: Temperature (2015)

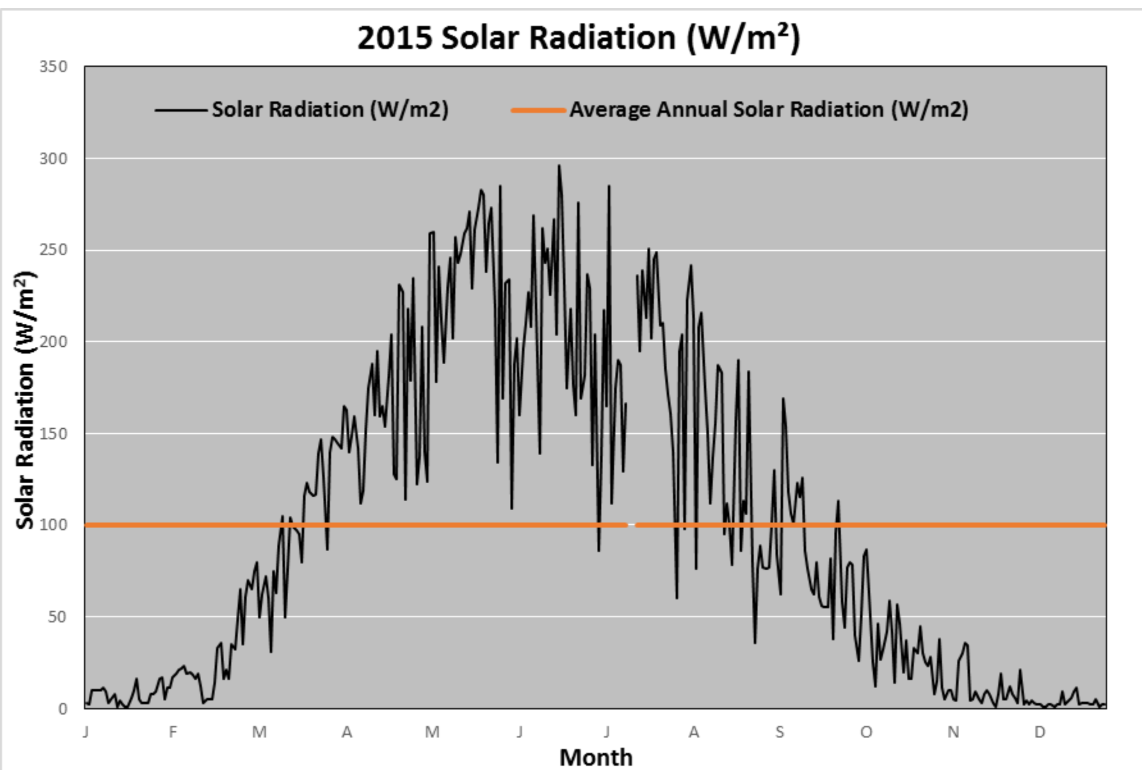


Figure 5-106: Solar Radiation (2015)

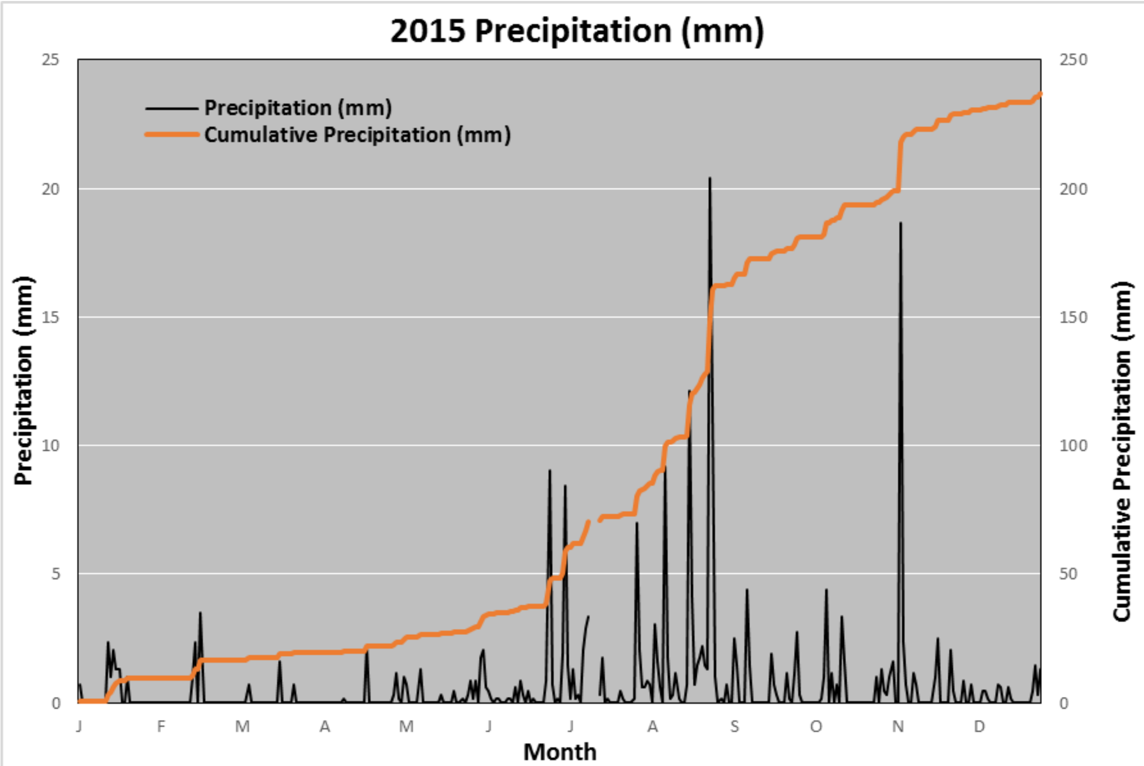


Figure 5-107: Precipitation (2015)

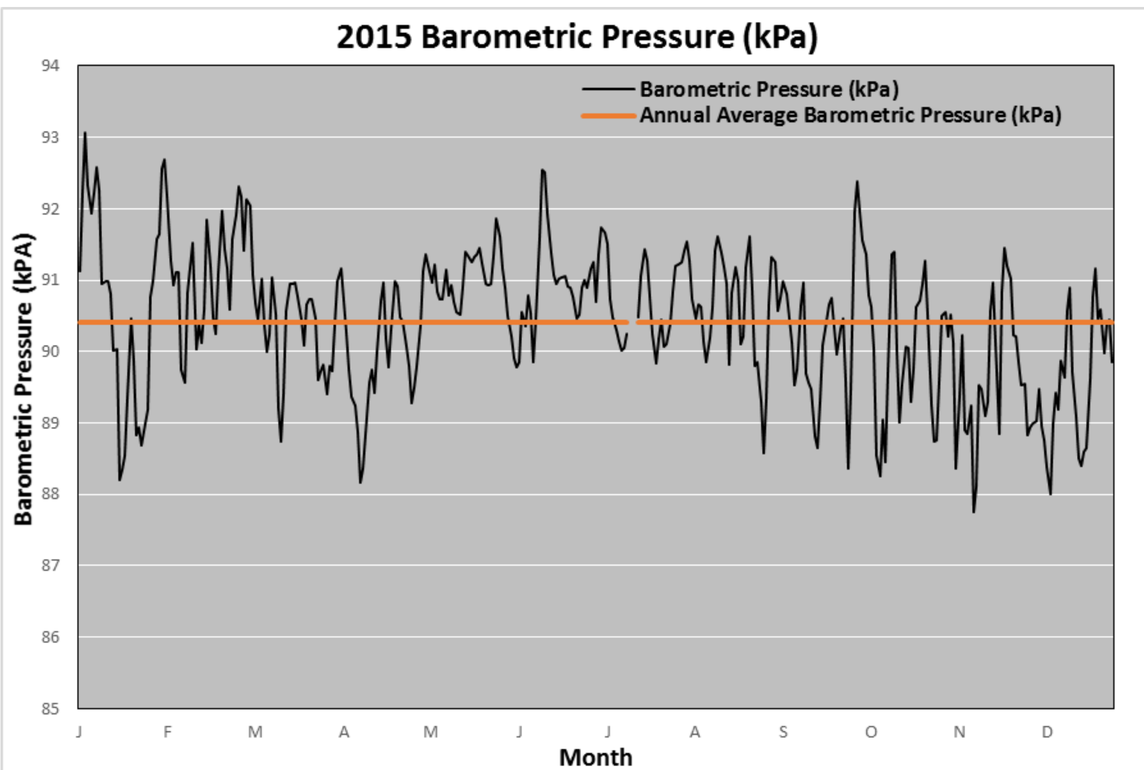


Figure 5-108: Barometric Pressure (2015)

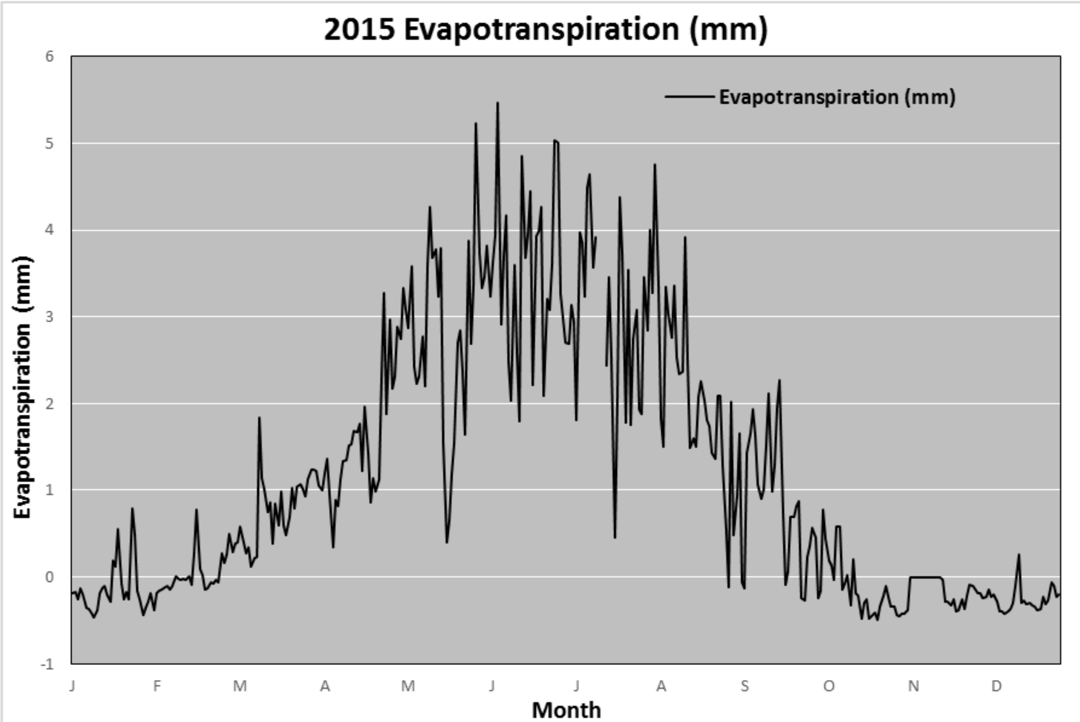


Figure 5-109: Evapotranspiration (2015)

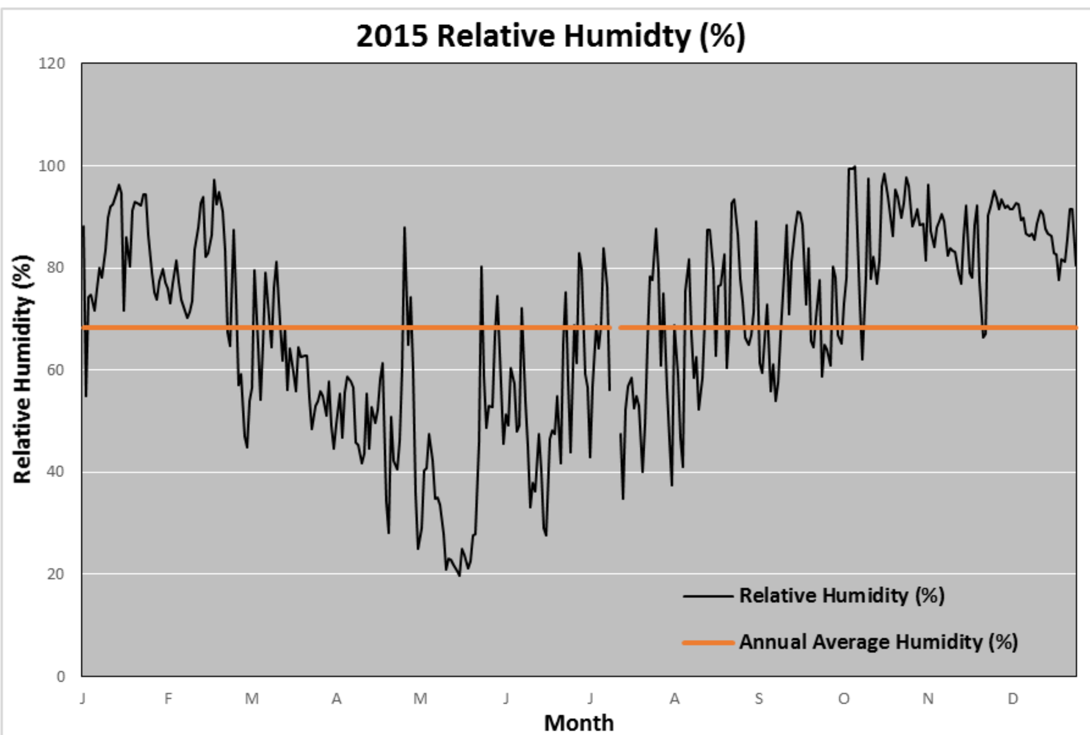


Figure 5-110: Relative Humidity (2015)

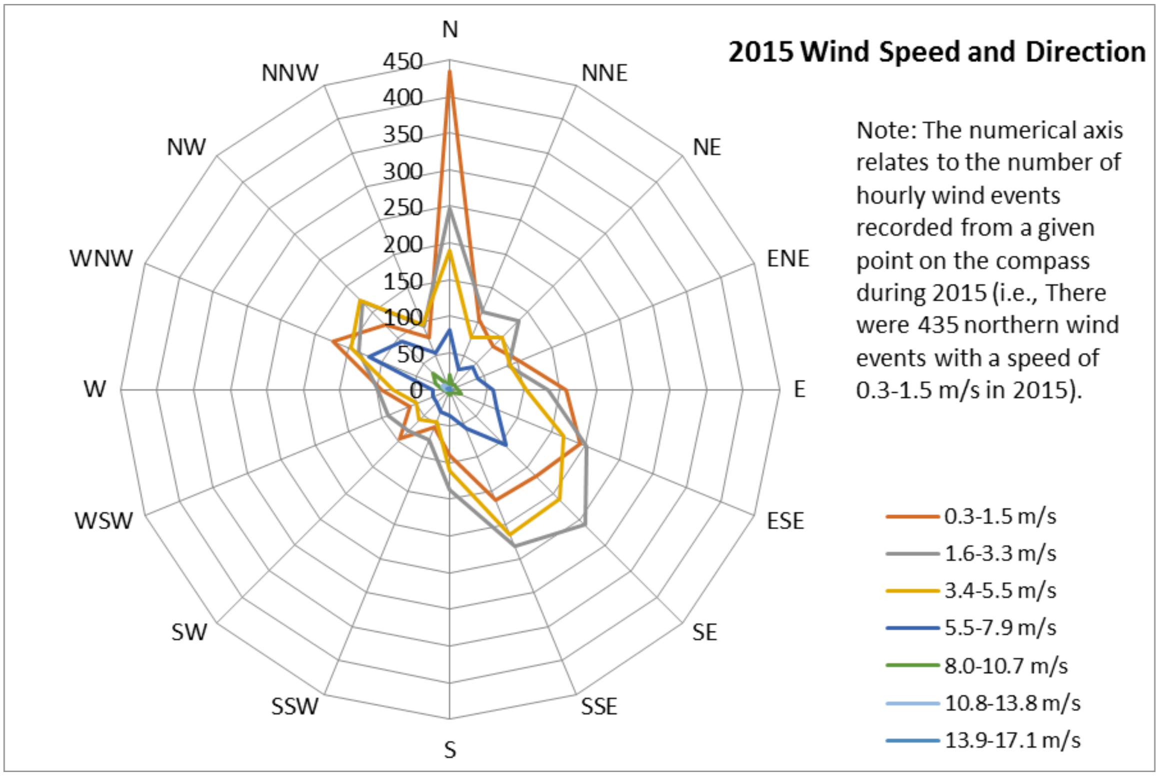


Figure 5-111: Wind Speed and Direction Events (2015)

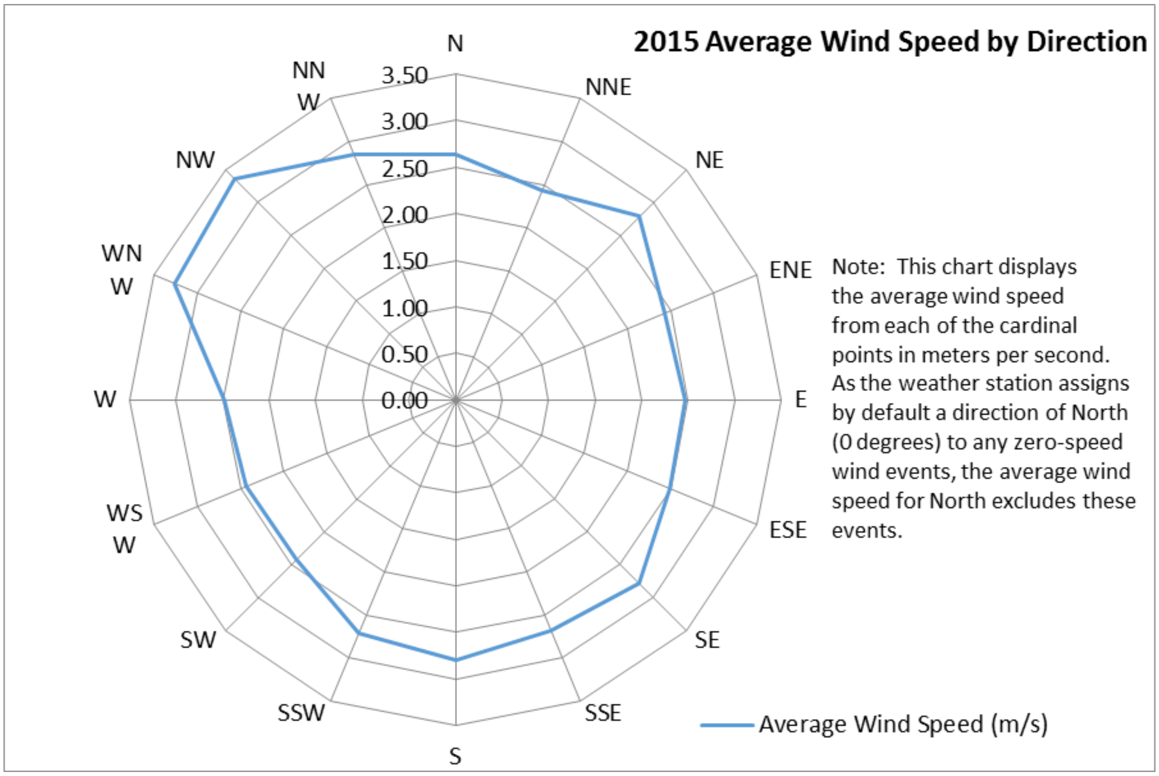


Figure 5-112: Wind Direction (2015)

5.7.2 Snow Survey Program

As required by the WUL Clause 96 and as part of the EMSRP, Minto collects snow data used for calculating the snow water equivalent specifically at the Minto Mine. Snow water equivalents are inputs to the Water Balance model (Section 7.3.3). Three snow courses are surveyed monthly from February through to May (if possible) each year. Snow depth, density and snow water equivalent are measured along three established snow courses, which have north-, east- and south-facing aspects respectively. Multi-year results to 2015 (averaged across the three snow courses) are presented in Appendix H – 2015 Water Balance and Water Quality Model Summary for the Minto Mine Site.

5.8 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 2015 activities under the Wildlife Monitoring Program including the area monitored and frequency of monitoring, are summarized in Table 5-37, below.

Table 5-37: Wildlife Monitoring Activities (2015)

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 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 5-37, 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 I – Wildlife Tracking 2015.

In 2015, 178 wildlife sightings were recorded. The majority of these sightings were comprised of mammals: 68 individual bear sightings, 36 foxes, 16 deer, 12 moose, and 4 wolves, 1 lynx. Other animals observed on site included but were not limited to, hares, grouse, porcupine, water shrew, Sandhill cranes, bald eagles, and peregrine falcons.

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 (involving bear awareness training) and safety flashes concerning the prevention of wildlife habituation on site.

5.9 Operations Adaptive Management Plan

The Operations Adaptive Management Plan has been in use since WUL QZ14-031 became active. Between the months of mid-August to December, no exceedances of the water quality objectives were made at W2 and as such, the Operations Adaptive Management Plan was not triggered.

For the Operations Adaptive Management Plan expected and worst case water quality predictions at W2, Minto's external laboratory was not able to provide a detection limit low to analyze the W2 results against the dissolved chromium standard. All other parameters met the expected case water quality predictions.

The worst case water quality predictions for parameters without a water quality objective were exceeded at times for the parameters of total molybdenum, total arsenic and total zinc. The specific responses as per the Operations Adaptive Management Plan were followed in those cases.

The Canadian Water Quality Guidelines were met during the operational period at W2. The W2 results with the Operations Adaptive Management Plan thresholds can be viewed in Appendix J.

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.

5.10 Invasive Plant Species Monitoring Program

As part of the EMSRP, and in agreement with the *Reclamation and Closure Plan* (RCP), Minto created an *Invasive Species Monitoring Standard Operating Procedure* in 2015. The Invasive Species Monitoring Plan, created in 2014 with the objective to monitor invasive plant species in and around the mine site, was the basis for the SOP. The SOP details how the monitoring program will be conducted.

The 2015 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 5-38). 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 5-39, 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 2016, particularly along invasive species pathways such as roads with high visitor traffic, recently exposed areas and areas that have been recently reclaimed.

Table 5-38: High Priority Invasive Species as determined by the Yukon Invasive Species Council, 2015

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

Table 5-39: Minto Mine Invasive Species Monitoring Program Results, 2015

Invasive Plant Survey Date	Site Location	Site Description	Invasive Plants (Species name or code)
7/15/2015	East Minto Landing		Foxtail Barley
	East Minto Landing		Smooth Brome
	East Minto Landing		White Sweetclover
	East Minto Landing		Narrowleaf Hawksbeard
	East Minto Landing		Narrowleaf Hawksbeard
	East Minto Landing		White Sweetclover
7/15/2015	West Minto Landing		Foxtail Barley
	West Minto Landing		Narrowleaf Hawksbeard
	West Minto Landing		Narrowleaf Hawksbeard
	West Minto Landing		Foxtail Barley
	West Minto Landing		White Sweetclover
	West Minto Landing		Foxtail Barley
	West Minto Landing		Foxtail Barley
	West Minto Landing		White Sweetclover
	West Minto Landing		White Sweetclover
	West Minto Landing		Foxtail Barley
	West Minto Landing		Smooth Brome
	West Minto Landing		Narrowleaf Hawksbeard
	West Minto Landing		White Sweetclover
	West Minto Landing		White Sweetclover
	West Minto Landing		Foxtail Barley

Invasive Plant Survey Date	Site Location	Site Description	Invasive Plants (Species name or code)
	West Minto Landing		White Sweetclover
	West Minto Landing		Pineapple Weed
	West Minto Landing		Narrowleaf Hawksbeard
	West Minto Landing		Narrowleaf Hawksbeard
7/15/2015	Access Road	KM 27.1	Narrowleaf Hawksbeard
	Access Road	KM 27.1	Foxtail Barley
	Access Road	KM 26.2	Narrowleaf Hawksbeard
	Access Road	KM 26.2	Foxtail Barley
	Access Road	KM 25.9	White Sweetclover
	Access Road	KM 25.8	White Sweetclover
	Access Road	KM 23.8 - 24.4	Foxtail Barley
	Access Road	KM 23.8 - 24.4	Narrowleaf Hawksbeard
	Access Road	KM 23.8 - 24.4	White Sweetclover
	Access Road	KM 21.5 - 21.9	Narrowleaf Hawksbeard
	Access Road	KM 20.7	Smooth Brome
	Access Road	KM 20.5	Narrowleaf Hawksbeard
	Access Road	KM 20.5	White Sweetclover
	Access Road	KM 17.7 - 18.7	Narrowleaf Hawksbeard
	Access Road	KM 17.1 - 17.5	Narrowleaf Hawksbeard
	Access Road	KM 16.6 - 16.9	Narrowleaf Hawksbeard
	Access Road	KM 16.5	Narrowleaf Hawksbeard
	Access Road	KM 15 - 16.4	White Sweetclover
	Access Road	KM 12.6 - 12.7	Narrowleaf Hawksbeard
	Access Road	KM 12 - 12.5	Narrowleaf Hawksbeard
	Access Road	KM 11.4 - 11.5	Narrowleaf Hawksbeard
	Access Road	KM 10.7 - 11	Narrowleaf Hawksbeard
	Access Road	KM 10.3	Narrowleaf Hawksbeard
	Access Road	KM 9.5	Foxtail Barley
	Access Road	KM 8.8	Narrowleaf Hawksbeard
	Access Road	KM 6.6	Narrowleaf Hawksbeard
	Access Road	KM 2	White Sweetclover
	Access Road	KM 2	Foxtail Barley

5.11 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 2015, 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 2015 socio-economic data which Minto tracked is summarized in Appendix K.

5.12 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 2015 activities associated with the Erosion and Sedimentation Monitoring Program are identified in Table 5-40, below.

Table 5-40: Erosion and Sedimentation Monitoring Activities (2015)

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, 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 September

5.13 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 (to be submitted December 2017). No updates were made to the Site Characterization Report following its submission in May 2014.

5.14 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 results and interpretations with regards to water quality monitoring, external and on-site laboratory reporting, and environmental programs monitoring.

5.14.1 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 2015, approximately 1,082 water quality samples (surface and groundwater) were collected for the water quality monitoring programs. QC samples represented 10.4% of the total number of samples collected in 2015, and included sixty-nine field duplicates, twenty-one field blanks, seven trip blanks, and sixteen 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 2015.

5.14.2 External Laboratory QA/QC

The 2015 external laboratory water quality analysis were performed by Maxxam Environmental in Burnaby, BC. As described in the EMSRP, all results provided by the external laboratory were accompanied by a Quality Assurance 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.

5.14.3 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. The *Preparation of Dissolved and Total Metals (Cu, Al, Cd)* SOP was updated to reflect a change in the copper calibration standard. Additionally, the *Preparation of Dissolved and Total Selenium SOP* was updated to include a new set of selenium calibration standards. All on-site laboratory equipment was calibrated according to manufacturer's specifications in 2015.

2015 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 2015. Additionally, the on-site laboratory analyzed water from sites W15, W35, and WTP during spring freshet in order to inform day-to-day discharge-related decisions. Samples from W2, W36 and W44 were additionally analyzed.

The 2015 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 2015 QC procedures involved re-analyzing the entire batch of samples.

On-site and external laboratory water quality results for water quality sites W3, W8, 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.

5.14.4 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 2015.

5.14.5 Meteorology QA/QC

Procedures for meteorology monitoring at the Minto Mine are detailed in the Meteorology Station Download 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 reviewed twice monthly by Environmental Department staff and routine visual inspections of the monitoring stations occur on a twice monthly basis.

5.14.6 Hydrogeology QA/QC

Schedules and general procedures for hydrogeology monitoring at the Minto Mine are detailed in the EMSRP. In 2015, ninety-two groundwater samples were taken at the Minto. QC samples represented 16.3% of the total number of samples collected in 2015, and included fourteen field duplicates.

The EMSRP recommends field duplicate sampling be conducted at a frequency of one field duplicate sample per ten groundwater monitoring samples; and a higher rate of field duplicate sampling was achieved in 2015 (16.3%). Additionally the EMSRP states that “one field blank sample will be collected during each Spring/Fall groundwater monitoring event”. The 2015 groundwater sampling program did not obtain the prescribed field blank samples and effort will be made to ensure that field staff collect the appropriate quality control samples as detailed in the EMSRP.

Collection rates for trip blanks are not detailed in the EMSRP and in 2015 there were no trip blanks collected in conjunction with the hydrogeology monitoring.

5.15 Groundwater Monitoring Program

Groundwater monitoring program details are provided in the EMSRP. The primary monitoring objective of the groundwater monitoring program is to identify potential impacts on groundwater from the Minto Mine components including, but 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.

5.15.1 Groundwater Wells

The EMSRP details the groundwater wells at the Minto Mine, including operative and inoperative wells. Figure 5-113 shows a location map of the operative wells.

No new groundwater stations were added during 2015.

Ground water sampling frequency was increased to quarterly while conditions permitted during 2015. Sites were visited once each quarter and sampled as conditions permitted, though sites were often frozen during Q1, preventing any sampling.

Stations that were collected more than three times in 2015 have results presented as follows: Mean, Minimum and Maximum values.

MW12-DP3, MW-DP5, and MW09-01-03 did not produce enough water during 2015 sampling events to complete the analysis required under Minto Groundwater Plan and thus no results are presented.

Table 5-41 lists the operational status and location of the groundwater wells at the Minto Mine for 2015. Complete results for the 2015 Groundwater Monitoring Program groundwater wells are presented in Appendix L.

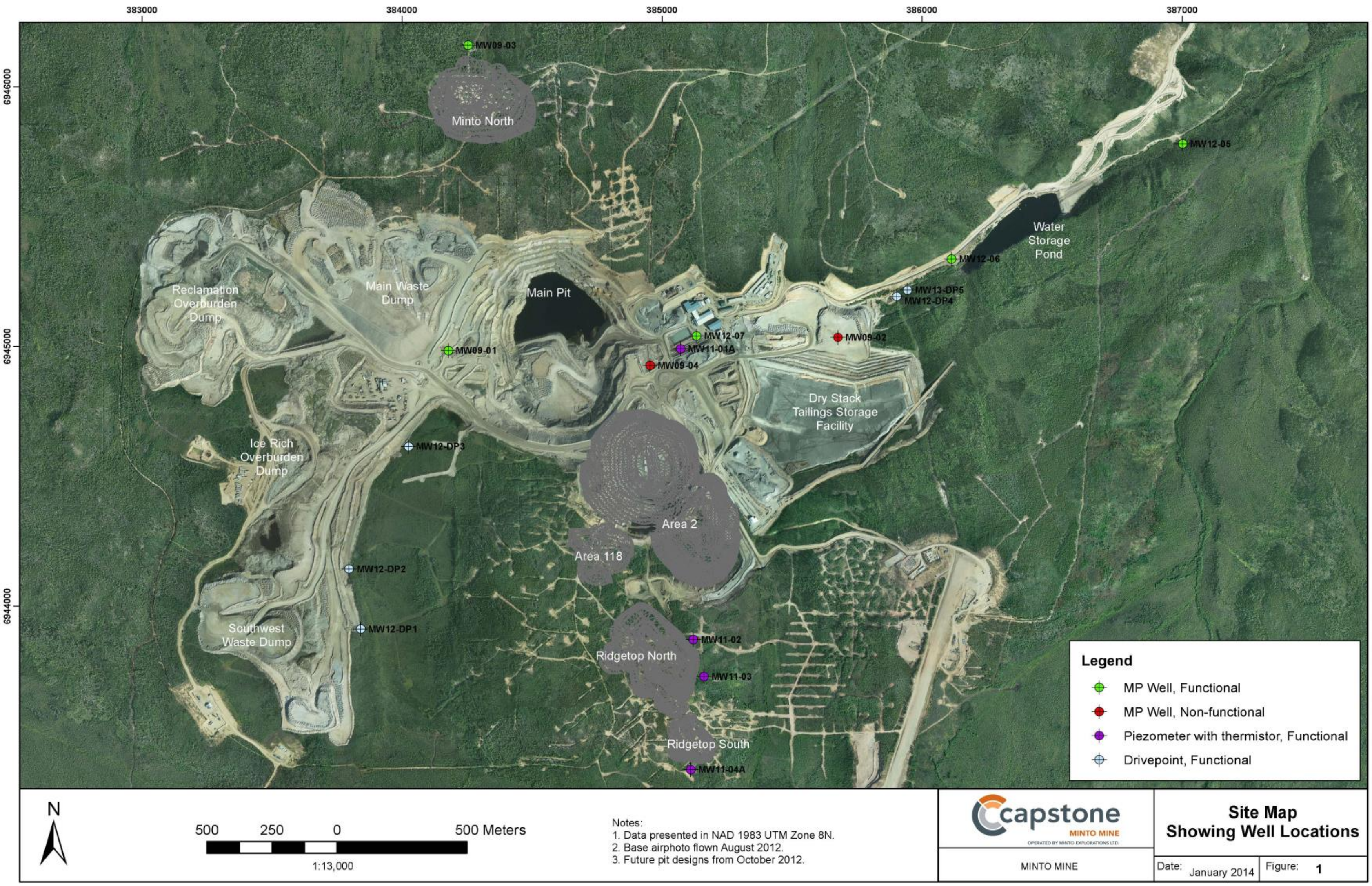


Figure 5-113: Minto Mine Groundwater Well Locations (2015)

Table 5-41: Minto Mine Groundwater Wells Operational Status Summary (2015)

Groundwater Well Name	Location	Status
08SWC270	Southwest Waste Dump area	*Destroyed*
08SWC271	Southwest Waste Dump area	*Destroyed*
08SWC272	Southwest Waste Dump area	*Destroyed (Buried by waste rock)*
08SWC273	Southwest Waste Dump area	*Destroyed*
08SWC274	Southwest Waste Dump area	*Destroyed*
08SWC275	Southwest Waste Dump area	*Destroyed*
08SWC277	Southwest Waste Dump area	*Destroyed*
08SWC278	Southwest Waste Dump area	*Destroyed*
08SWC280	Southwest Waste Dump area	*Destroyed (Buried by waste rock)*
MW09-01	Main Waste Dump area	Operational
MW09-02	DSTSF Area	*Destroyed*
MW09-03	Minto North Pit area	Operational
MW09-04	Main Pit area	*Destroyed*
MW11-01A	Down gradient of Main Pit	Operational (sometimes frozen)
MW11-02	NE of Ridgetop North Pit	Operational (sometimes frozen)
MW11-03	SE of Ridgetop North Pit	Operational (sometimes frozen)
MW11-04A	S of Ridgetop South Pit	Operational
MW12-05	Down gradient of WSP	Operational
MW12-06	Down gradient of MVF/DSTSF	Operational
MW12-07	Down gradient of Main Pit	Operational
MW12-DP1	West of Southwest Waste Dump	Operational
MW12-DP2	West of Southwest Waste Dump	Operational
MW12-DP3	West of Southwest Waste Dump	Operational
MW12-DP4	Down gradient of MVF/DSTSF	*Destroyed during construction*
MW13-DP5	Down gradient of MVF/DSTSF	*Destroyed during construction*
P93-E	Main Pit area	*Destroyed during mining*
P94-20	Main Water Dam area	*Destroyed*
Unnamed auxiliary well near mill	Mill area	Operational
Unnamed camp water well	Camp area	Operational

5.15.1.1 MW09-01

Groundwater well MW09-01 was dry during 2015, thus no results are presented. Historically, this is consistent with sampling data from that well. Between 2013 and 2014, there were two sampling sessions at MW09-01.

Table 5-42: MW09-01-03 Water Quality Results Summary (2013-2015)

MW09-01-03	2013 Results	2014 Results
Parameters	14-Oct	24-Jul
pH	7.69	*
TDS (mg/L)	3220	*
Sulfate-dissolved (mg/L)	*	*
Nutrients (mg/L)		
Ammonia Nitrogen	31	*
Nitrate Nitrogen	124	*
Nitrite Nitrogen	4.99	*
Dissolved Metals (mg/L)		
Calcium	436	444
Cadmium	0.000163	0.000603
Copper	0.0056	0.199
Iron	0.0246	0.0196
Selenium	0.0146	0.0139

*Not available

5.15.1.2 MW09-03

Groundwater well MW09-03 water quality results are summarized in Table 5-43 through Table 5-45 for samples taken from 2009 to 2015. MW09-03 produced results from all sampling zones (01, 02 and 03) during the 2015 monitoring period.

Table 5-43: MW09-03-01 Water Quality Results Summary (2012 - 2015)

Station Name MW09-03-01	2009 - 2014 Summary Statistics			2015 Summary Statistics		
Parameters	Mean	Min	Max	Mean	Min	Max
pH	8.09	7.94	8.23	8.15	8.1	8.21
TDS (mg/L)	251	154	652	161	146	174
Sulfate-dissolved (mg/L)	28.82	0.53	117	22.1	21.2	23.6
Nutrients (mg/L)						
Ammonia Nitrogen	0.068	0.027	0.17	0.037	0.024	0.076
Nitrate Nitrogen	0.111	0.01	0.669	0.114	0.064	0.146
Nitrite Nitrogen	0.2859	0.0742	1.63	0.163	0.119	0.246
Dissolved Metals (mg/L)						
Calcium	53.4	38.8	152	41.2	40	43.3
Cadmium	0.000117	0.000015	0.000683	0.000016	0.000005	0.000026
Copper	0.00282	0.00021	0.019	0.0002	0.0001	0.00025
Iron	1.9687	0.0025	23.5	0.0071	0.0025	0.016
Selenium	0.000733	0.00005	0.008	0.00006	0.00005	0.00012

Table 5-44: MW09-03-02 Water Quality Results Summary (2012 - 2015)

Station Name MW09-03-02	2009 - 2014 Summary Statistics			2015 Summary Statistics		
Parameters	Mean	Min	Max	Mean	Min	Max
pH	8	7.59	8.16	8.02	7.86	8.2
TDS (mg/L)	563	172	716	491	458	520
Sulfate-dissolved (mg/L)	16.49	0.25	110	0.25	0.25	0.25
Nutrients (mg/L)						
Ammonia Nitrogen	0.207	0.031	0.33	0.19	0.18	0.21
Nitrate Nitrogen	0.028	0.01	0.1	0.01	0.01	0.01
Nitrite Nitrogen	0.0939	0.0429	0.171	0.104	0.0464	0.215
Dissolved Metals (mg/L)						
Calcium	128.9	40.5	166	131	120	141
Cadmium	0.000086	0.000005	0.00072	0.000008	0.000005	0.00001
Copper	0.0035	0.0001	0.022	0.00188	0.00122	0.00222
Iron	14.8898	0.005	23.8	14.4	12.8	15.7
Selenium	0.00095	0.00005	0.0067	0.00047	0.00018	0.001

Table 5-45: MW09-03-03 Water Quality Results Summary (2012 - 2015)

Station Name MW09-03-03	2009 - 2014 Summary Statistics			2015 Summary Statistics		
Parameters	Mean	Min	Max	Mean	Min	Max
pH	7.97	7.8	8.1	7.98	7.94	8.03
TDS (mg/L)	115	94	138	110	92	120
Sulfate-dissolved (mg/L)	10.84	9.4	12.8	11.5	9.99	12.6
Nutrients (mg/L)						
Ammonia Nitrogen	0.0171	0.0025	0.063	0.0408	0.0075	0.075
Nitrate Nitrogen	0.41	0.248	0.53	0.51	0.484	0.545
Nitrite Nitrogen	0.0101	0.0025	0.0239	0.0158	0.0073	0.0284
Dissolved Metals (mg/L)						
Calcium	28.2	19.9	33.5	30.9	27.9	33.6
Cadmium	0.000036	0.000005	0.0001	0.000005	0.000005	0.000005
Copper	0.00254	0.00139	0.005	0.0016	0.00139	0.00178
Iron	0.0737	0.0025	0.483	0.0621	0.0363	0.107
Selenium	0.000322	0.00024	0.000414	0.00029	0.00025	0.00031

5.15.1.3 MW11-01A

MW11-01A was dry throughout 2015, therefore water quality results are not available for the 2015 monitoring period. Historical results are not presented as MW11-01A has not produced water in years previous to the reporting year.

5.15.1.4 MW11-02

MW11-02 was dry throughout 2015, therefore water quality results are not available for the 2015 monitoring period. Historical results are not presented as MW11-02 has not produced water in years previous to the reporting year.

5.15.1.5 MW11-03

MW11-03 was dry throughout 2015, therefore water quality results are not available for the 2015 monitoring period. Historical results are not presented as MW11-03 has not produced water in years previous to the reporting year.

5.15.1.6 MW11-04A

Groundwater well MW11-04A water quality results are summarized in Table 5-46 for samples taken in 2012 - 2015. Sampling was attempted at MW11-04A three times in 2015, but only contained enough water for full analysis on one occasion (May 9, 2015).

Table 5-46: MW11-04A Water Quality Results Summary (2012 – 2015)

Station Name MW11-04A	2012 - 2014 Summary Statistics			2015 Summary
Parameters	Mean	Min	Max	5/9/2015
pH	11.2	10.3	11.7	10.9
TDS (mg/L)	211	148	396	154
Sulfate-dissolved (mg/L)	4.77	2.5	7.7	5.74
Nutrients (mg/L)				
Ammonia Nitrogen	0.452	0.058	1.5	0.087
Nitrate Nitrogen	1.26	1	1.64	1.63
Nitrite Nitrogen	0.015	0.0071	0.0234	0.0132
Dissolved Metals (mg/L)				
Calcium	84.3	52.5	170	52
Cadmium	0.000014	0.000005	0.000045	0.000008
Copper	0.0606	0.0119	0.137	0.11
Iron	0.007	0.0025	0.0161	0.0133
Selenium	0.00221	0.00175	0.00334	0.00238

5.15.1.7 MW12-DP1

Drivepoint well MW12-DP1 has not produced water since it was installed in 2012; therefore water quality results are not available for both historic and 2015 site monitoring.

5.15.1.8 MW12-DP2

Drivepoint well MW11-03 was dry and/or frozen throughout 2015, therefore water quality results are not available for the 2015 monitoring period.

5.15.1.9 MW12-DP3

Drivepoint well MW12-DP3 did not produce enough water to analyze during the 2015 samples sessions. Historical results are presented in Table 5-47.

Table 5-47: MW12-DP3 Water Quality Results Summary (2014)

MW12-DP3	2014 Results
Parameters	**1-Jun**
pH	*
TDS (mg/L)	*
Sulfate-dissolved (mg/L)	*
Nutrients (mg/L)	
Ammonia Nitrogen	*
Nitrate Nitrogen	*
Nitrite Nitrogen	*
Dissolved Metals (mg/L)	
Calcium	24.3
Cadmium	0.000161
Copper	0.0153
Iron	1.93
Selenium	0.0001

*Not available

5.15.1.10 MW12-DP4

Drivepoint well MW12-DP4 water quality results are summarized in Table 5-48 for samples taken in 2013 to 2015. While MW12-DP4 produced enough water to analyze during one sampling session (October 10, 2015), it should be noted that after completion of that sample session the well was destroyed during construction of the Mill Valley Fill Extension Stage 2.

Table 5-48: MW12-DP4 Water Quality Results Summary (2013-2015)

Station Name MW12-DP3	2013 - 2014 Summary Statistics			2015 Summary
Parameters	Mean	Min	Max	10-Oct-15
pH	7.97	7.9	8.07	8.11
TDS (mg/L)	581	506	634	638
Sulfate-dissolved (mg/L)	101.3	89.3	121	158
Nutrients (mg/L)				
Ammonia Nitrogen	0.044	0.038	0.052	0.16
Nitrate Nitrogen	2.66	1.12	4.47	5.86
Nitrite Nitrogen	0.0344	0.0093	0.0744	0.1
Dissolved Metals (mg/L)				
Calcium	102	100	104	119
Cadmium	0.000049	0.000046	0.000052	0.000179
Copper	0.00468	0.0044	0.00497	0.00736
Iron	0.0147	0.0095	0.0229	0.0173
Selenium	0.00147	0.00097	0.00224	0.00312

5.15.1.11 MW12-05

Water quality results for groundwater well MW12-05 are summarized in Table 5-49 through Table 5-52 for samples taken in 2012 - 2015. MW12-05 produced results from all sampling zones (01, 03, 05 and 07) during the 2015 monitoring period.

Table 5-49: MW12-05-01 Water Quality Results Summary (2012 - 2015)

Station Name MW12-05-01	2012 - 2014 Summary Statistics			2015 Summary Statistics		
Parameters	Mean	Min	Max	Mean	Min	Max
pH	8.18	8.03	8.31	7.97	7.83	8.14
TDS (mg/L)	1095	706	1280	1379	1250	1540
Sulfate-dissolved (mg/L)	598	350	728	826	757	895
Nutrients (mg/L)						
Ammonia Nitrogen	0.1228	0.0025	0.37	0.108	0.059	0.16
Nitrate Nitrogen	0.062	0.01	0.368	0.013	0.01	0.021
Nitrite Nitrogen	0.101	0.0362	0.195	0.0439	0.0277	0.0608
Dissolved Metals (mg/L)						
Calcium	182	117	221	240	222	254
Cadmium	0.000031	0.000005	0.00014	0.000005	0.000005	0.000005
Copper	0.0011	0.0001	0.00737	0.00015	0.0001	0.00048
Iron	0.022	0.0085	0.0323	0.0326	0.0167	0.0804
Selenium	0.00031	0.00005	0.0009	0.00021	0.00005	0.00058

Table 5-50: MW12-05-03 Water Quality Results Summary (2012 - 2015)

Station Name MW12-05-03	2012 - 2014 Summary Statistics			2015 Summary Statistics		
Parameters	**Mean**	**Min**	**Max**	**Mean**	**Min**	**Max**
pH	8.15	8.06	8.22	8.02	7.81	8.18
TDS (mg/L)	1233	880	1400	1410	1250	1570
Sulfate-dissolved (mg/L)	641	456	754	792	756	812
Nutrients (mg/L)						
Ammonia Nitrogen	0.052	0.015	0.11	0.046	0.033	0.059
Nitrate Nitrogen	0.027	0.01	0.068	0.01	0.01	0.01
Nitrite Nitrogen	0.0766	0.0252	0.132	0.0426	0.0276	0.0687
Dissolved Metals (mg/L)						
Calcium	175	110	209	210	203	215
Cadmium	0.000064	0.000005	0.000324	0.000006	0.000005	0.000011
Copper	0.00067	0.0001	0.00266	0.00049	0.0001	0.00235
Iron	2.1198	0.0981	4.14	1.98	1.43	2.97
Selenium	0.000124	0.00005	0.000364	0.00007	0.00005	0.00012

Table 5-51: MW12-05-05 Water Quality Results Summary (2012 - 2015)

Station Name MW12-05-05	2012 - 2014 Summary Statistics			2015 Summary Statistics		
Parameters	**Mean**	**Min**	**Max**	**Mean**	**Min**	**Max**
pH	8.23	8.08	8.35	8.11	7.89	8.24
TDS (mg/L)	274	252	292	319	302	338
Sulfate-dissolved (mg/L)	39.1	33.3	46.3	58.2	54.9	62.4
Nutrients (mg/L)						
Ammonia Nitrogen	0.019	0.013	0.036	0.037	0.022	0.054
Nitrate Nitrogen	0.436	0.2	0.817	0.489	0.425	0.547
Nitrite Nitrogen	0.1069	0.0305	0.195	0.0421	0.03	0.0503
Dissolved Metals (mg/L)						
Calcium	44.8	41.8	47.2	47.2	46.8	47.6
Cadmium	0.00001	0.000005	0.000016	0.000015	0.000005	0.00003
Copper	0.00101	0.00043	0.00154	0.00071	0.00049	0.00099
Iron	0.0324	0.0152	0.0457	0.023	0.0159	0.0282
Selenium	0.000101	0.00005	0.00017	0.0001	0.00005	0.00014

Table 5-52: MW12-05-07 Water Quality Results Summary (2012 - 2015)

Station Name MW12-05-07	2012 - 2014 Summary Statistics			2015 Summary Statistics		
Parameters	Mean	Min	Max	Mean	Min	Max
pH	8.32	8.22	8.45	8.23	8.06	8.32
TDS (mg/L)	298	260	362	312	288	336
Sulfate-dissolved (mg/L)	24.1	11.4	40.6	43.3	41	45.2
Nutrients (mg/L)						
Ammonia Nitrogen	0.14	0.068	0.24	0.084	0.069	0.1
Nitrate Nitrogen	0.028	0.01	0.1	0.01	0.01	0.01
Nitrite Nitrogen	0.5997	0.0025	2.91	0.0196	0.0107	0.0341
Dissolved Metals (mg/L)						
Calcium	50	47.2	52.4	52.6	51.7	54.6
Cadmium	0.0000073	0.0000025	0.000019	0.000006	0.000005	0.00001
Copper	0.000347	0.0001	0.00065	0.00047	0.0001	0.00158
Iron	0.471	0.0602	0.928	0.177	0.141	0.216
Selenium	0.000222	0.000108	0.00034	0.00008	0.00005	0.00016

5.15.1.12 MW12-06

Groundwater well MW12-06 water quality results are summarized in Table 5-53 through

Table 5-55 for samples taken in 2012 - 2015. MW12-06 produced results from all sampling zones (02, 04 and 06) during the 2015 monitoring period.

Table 5-53: MW12-06-02 Water Quality Results Summary (2012 – 2015)

Station Name MW12-06-02	2012 - 2014 Summary Statistics			2015 Summary Statistics		
Parameters	Mean	Min	Max	Mean	Min	Max
pH	8.1	7.97	8.2	8	7.67	8.19
TDS (mg/L)	643	618	686	640	612	658
Sulfate-dissolved (mg/L)	200	177	227	207	199	218
Nutrients (mg/L)						
Ammonia Nitrogen	0.0381	0.0074	0.072	0.066	0.057	0.075
Nitrate Nitrogen	0.118	0.026	0.25	0.036	0.025	0.051
Nitrite Nitrogen	0.3973	0.0882	0.834	0.13	0.0931	0.183
Dissolved Metals (mg/L)						
Calcium	120.4	97.4	137	135	132	142
Cadmium	0.000018	0.000005	0.000047	0.000008	0.000005	0.000015
Copper	0.000446	0.0001	0.00115	0.0001	0.0001	0.0001
Iron	0.993	0.454	1.67	1.22	1.21	1.23
Selenium	0.000136	0.00005	0.00028	0.00008	0.00005	0.00013

Table 5-54: MW12-06-04 Water Quality Results Summary (2012 – 2015)

Station Name MW12-06-04	2012 - 2014 Summary Statistics			2015 Summary Statistics		
Parameters	**Mean**	**Min**	**Max**	**Mean**	**Min**	**Max**
pH	8.15	8.07	8.23	8.04	7.81	8.21
TDS (mg/L)	619	602	644	616	594	636
Sulfate-dissolved (mg/L)	166	159	178	170	166	182
Nutrients (mg/L)						
Ammonia Nitrogen	0.0171	0.0059	0.023	0.019	0.014	0.028
Nitrate Nitrogen	0.095	0.022	0.324	0.056	0.04	0.074
Nitrite Nitrogen	0.3415	0.0998	1.12	0.182	0.139	0.243
Dissolved Metals (mg/L)						
Calcium	101.3	97	105	100.5	96.8	103
Cadmium	0.000012	0.000005	0.000039	0.000012	0.000005	0.000032
Copper	0.000278	0.0001	0.0007	0.01225	0.0001	0.0722
Iron	0.684	0.531	0.759	0.711	0.651	0.767
Selenium	0.000074	0.00005	0.00014	0.00007	0.00005	0.00014

Table 5-55: MW12-06-06 Water Quality Results Summary (2012 – 2015)

Station Name MW12-06-06	2012 - 2014 Summary Statistics			2015 Summary Statistics		
Parameters	**Mean**	**Min**	**Max**	**Mean**	**Min**	**Max**
pH	8.21	8.1	8.26	8.05	7.87	8.25
TDS (mg/L)	513	472	538	484	478	494
Sulfate-dissolved (mg/L)	156	146	171	145	143	146
Nutrients (mg/L)						
Ammonia Nitrogen	0.0277	0.0093	0.085	0.024	0.013	0.033
Nitrate Nitrogen	0.844	0.45	0.993	1.021	0.893	1.13
Nitrite Nitrogen	0.0808	0.0521	0.102	0.0614	0.0542	0.0672
Dissolved Metals (mg/L)						
Calcium	78.1	73	82.7	76.6	73.9	79.7
Cadmium	0.000027	0.000005	0.000124	0.000012	0.000005	0.000026
Copper	0.00039	0.00022	0.00072	0.00058	0.0001	0.00155
Iron	0.0292	0.0081	0.0833	0.0195	0.0106	0.0334
Selenium	0.000249	0.00018	0.000511	0.0002	0.00015	0.00023

5.15.1.13 MW12-07

Groundwater well MW12-07 water quality results are summarized in Table 5-56 and Table 5-57 for samples taken in 2012 - 2015. MW12-07 produced results from all sampling zones (01 and 02) during the 2015 monitoring period.

Table 5-56: MW12-07-01 Water Quality Results Summary (2012 – 2015)

Station Name MW12-07-01	2012 - 2014 Summary Statistics			2015 Summary Statistics		
Parameters	Mean	Min	Max	Mean	Min	Max
pH	8.14	7.66	8.38	7.76	7.38	8.18
TDS (mg/L)	881	774	1080	1231	1090	1400
Sulfate-dissolved (mg/L)	300	185	640	421	371	624
Nutrients (mg/L)						
Ammonia Nitrogen	0.3353	0.0025	0.96	0.57	0.16	1.6
Nitrate Nitrogen	13.644	0.318	53.5	0.185	0.109	0.306
Nitrite Nitrogen	2.344	0.025	4.96	0.387	0.235	0.68
Dissolved Metals (mg/L)						
Calcium	173	154	192	244	195	266
Cadmium	0.000088	0.000005	0.000633	0.000046	0.000005	0.000403
Copper	0.0127	0.00042	0.077	0.00056	0.0001	0.00319
Iron	0.293	0.111	0.705	0.3284	0.0699	0.698
Selenium	0.00874	0.00005	0.0347	0.00088	0.00005	0.00208

Table 5-57: MW12-07-02 Water Quality Results Summary (2012 – 2015)

Station Name MW12-07-02	2012 - 2014 Summary Statistics			2015 Summary Statistics		
Parameters	Mean	Min	Max	Mean	Min	Max
pH	7.96	7.81	8.08	7.94	7.68	8.11
TDS (mg/L)	1064	782	1160	1100	952	1160
Sulfate-dissolved (mg/L)	612	283	658	656	397	702
Nutrients (mg/L)						
Ammonia Nitrogen	0.2158	0.0025	0.61	0.108	0.039	0.54
Nitrate Nitrogen	1.664	0.158	21.3	0.105	0.075	0.172
Nitrite Nitrogen	0.816	0.148	1.47	0.231	0.151	0.325
Dissolved Metals (mg/L)						
Calcium	188	140	207	209	191	232
Cadmium	0.000023	0.000005	0.000269	0.000005	0.000005	0.000005
Copper	0.00198	0.0001	0.0217	0.00062	0.0001	0.00231
Iron	0.3266	0.0069	1.3	0.259	0.193	0.762
Selenium	0.0011	0.00005	0.0148	0.00019	0.00005	0.00151

5.15.1.14 MW13-DP5

Drivepoint well MW13-DP5 produced water on three sampling events during 2015. The data from 2014 and 2015 are presented below in Table 5-58. It should be noted that, while the well did produce water during 2015, the well was destroyed during the construction of the MVFES2 after sampling had been completed.

Table 5-58: MW13-DP5 Water Quality Summary (2014 - 2015)

Station Name MW13-DP5	2014 Summary Statistics			2015 Summary Statistics		
Parameters	**Mean**	**Min**	**Max**	**Mean**	**Min**	**Max**
pH	8.36	8.36	8.36	8.14	8.04	8.24
TDS (mg/L)	548	548	548	666	656	676
Sulfate-dissolved (mg/L)	119	119	119	150	129	172
Nutrients (mg/L)						
Ammonia Nitrogen	0.023	0.023	0.023	0.046	0.012	0.08
Nitrate Nitrogen	7.88	7.88	7.88	7.97	5.34	10.6
Nitrite Nitrogen	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025
Dissolved Metals (mg/L)						
Calcium	94	94	94	114	105	123
Cadmium	0.000018	0.000018	0.000018	0.000032	0.000018	0.000047
Copper	0.00538	0.00538	0.00538	0.00788	0.00772	0.00803
Iron	0.0053	0.0053	0.0053	0.0126	0.0104	0.0148
Selenium	0.00342	0.00342	0.00342	0.00372	0.00197	0.00547

5.15.2 Vibrating Wire Piezometers

There are currently 22 operating vibrating wire piezometers installed on site, listed in Table 5-59. Four new piezometers were installed to monitor the DSTSF and the Mill Valley Fill Extension (MVFE) Stage 2. There were no changes to the operational status of any piezometers in 2015. Summaries of data collected from each piezometer are provided in the following sections.

Table 5-59: Vibrating Wire Piezometer Summary (2015)

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	Operational
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

5.15.2.1 DSTSF Piezometers

Data collected from DSTSF vibrating wire piezometers are presented in Figure 5-114. Sensor DSP-6A is reading negative pressures and has not been included in the figure. Data are collected monthly. Due to the limited data in 2015 from DSP-07 to DSP-10 (installed in December, 2015), the graphs were not included.

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 factor of safety values (factor of safety>2) even without consideration of the planned MVFE2. With the construction of the MVFE2 beginning in fall 2015, these FOS values are predicted to increase significantly.

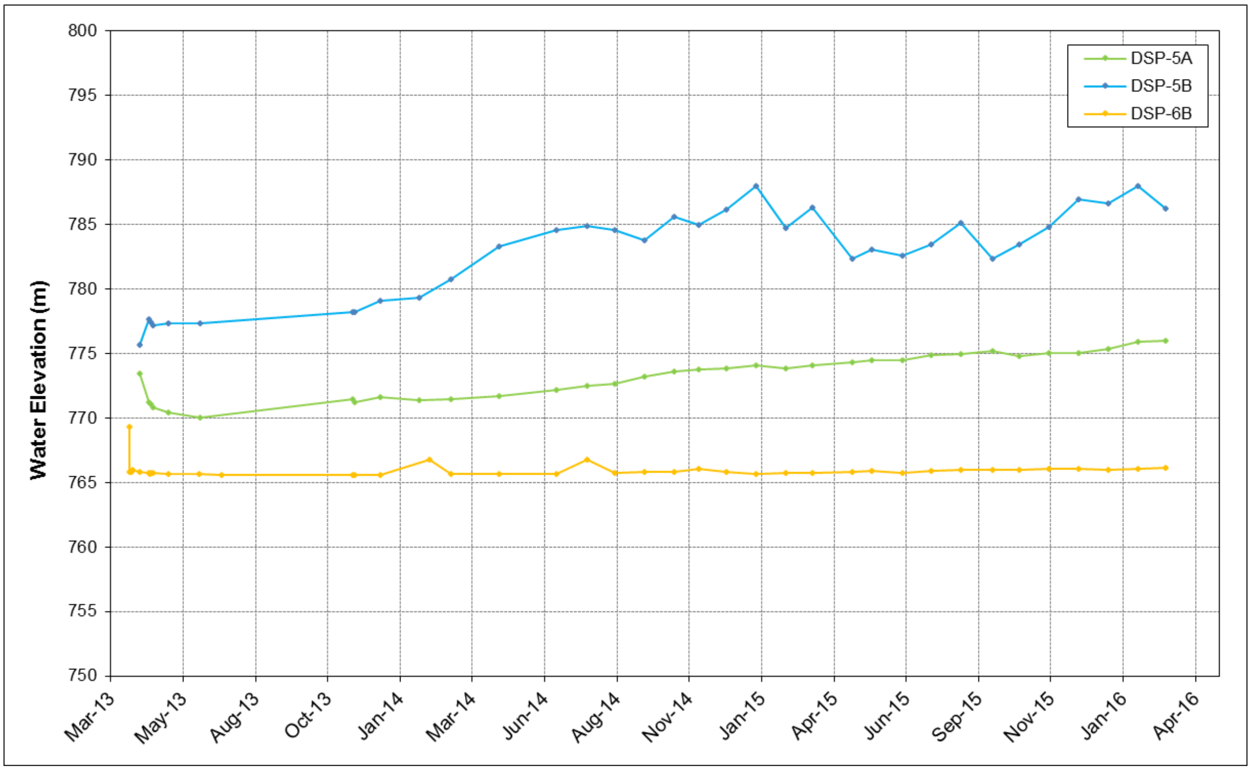


Figure 5-114: DSTSF Piezometer Data – DSP-05 and DSP-06 (2013-2015)

5.15.2.2 Southwest Dump Piezometers

Data collected from Southwest Dump vibrating wire piezometers are presented in Figure 5-115. 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 2015. Work on the dump in 2015 consisted primarily of resloping for closure.

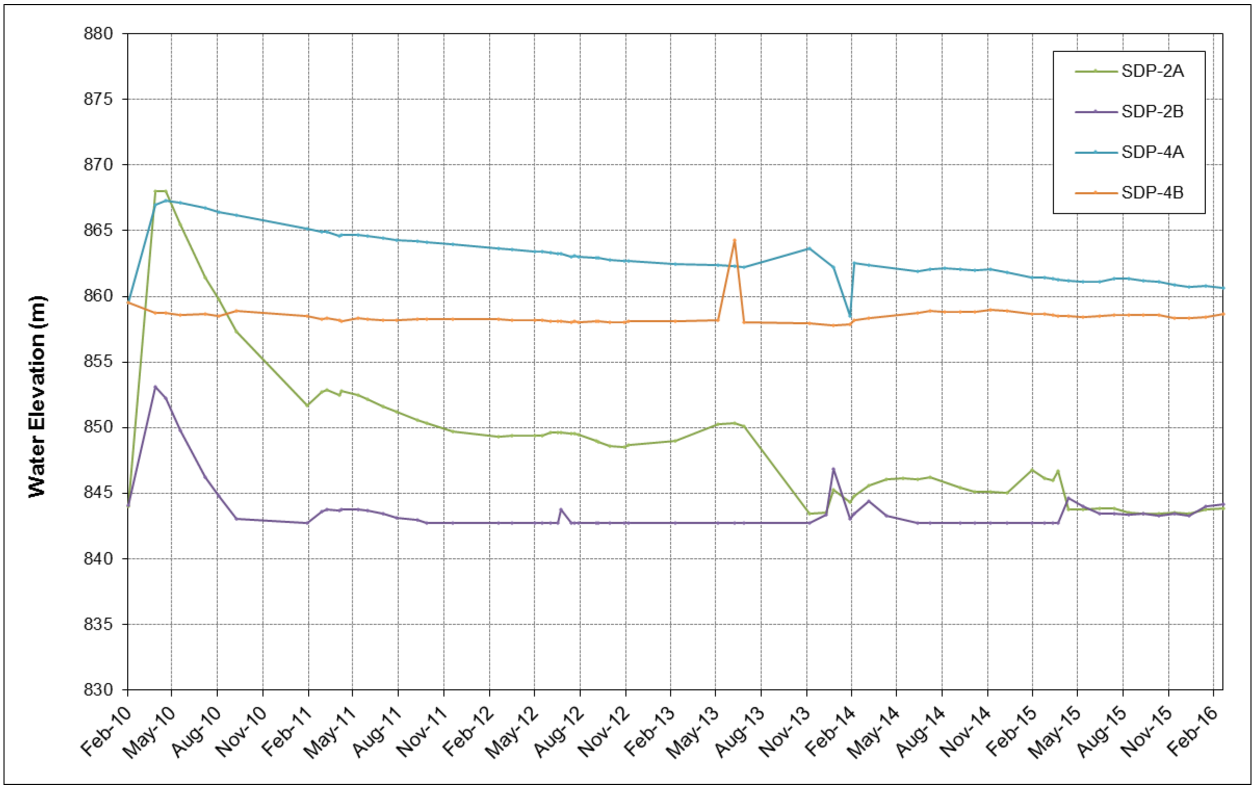


Figure 5-115: Southwest Dump Piezometer Data (2010-2015)

5.15.2.3 Water Storage Pond Dam Piezometers

Data collected from WSP Dam vibrating wire piezometers are presented in Figure 5-116. 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 2015 generally followed the trend of the water level in the water storage pond as in previous years.

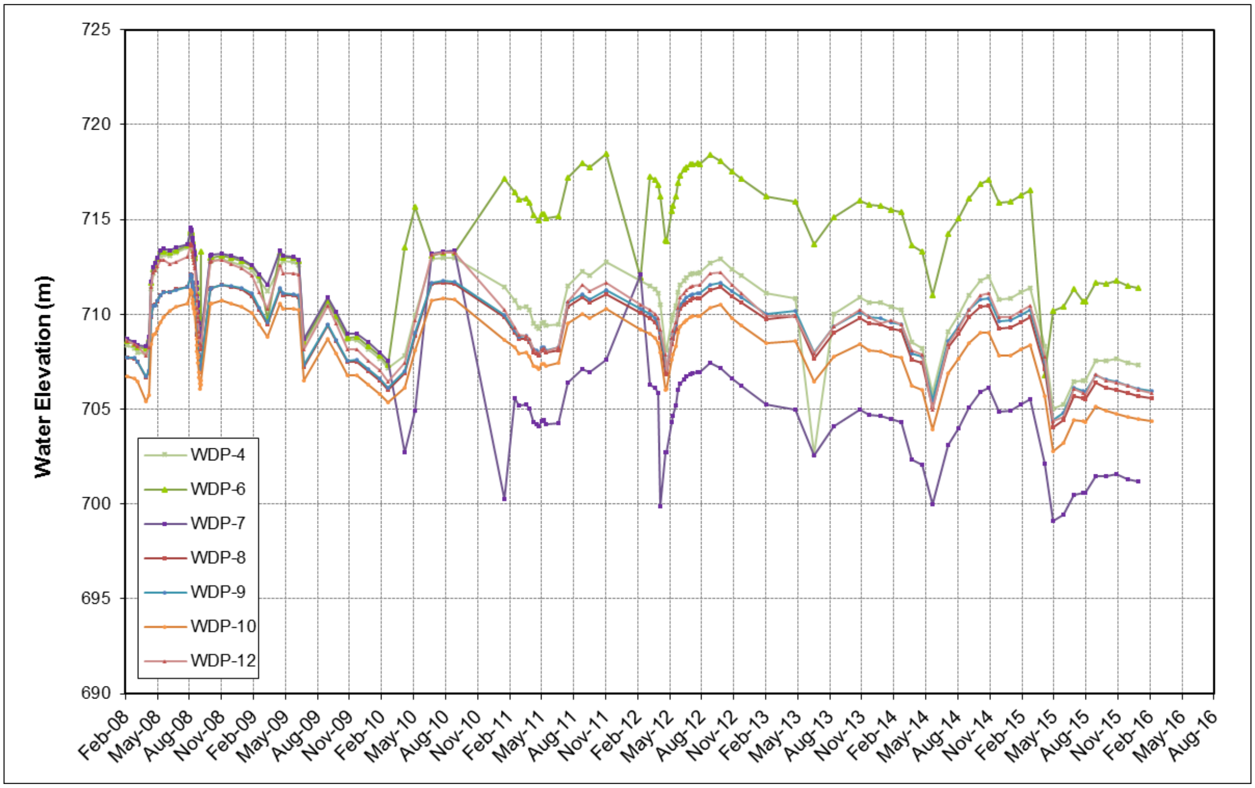


Figure 5-116: WSP Dam Piezometer Data (2007-2015)

5.15.3 Ground Temperature Cables

There are currently twenty-five operating thermistors (ground temperature cables) installed on site, listed in Table 5-60

Table 5-60. There were no changes to the operational status of any of the existing thermistors in 2015. Summaries of data collected from each thermistor are contained in the following sections.

Table 5-60: Thermistor Summary (2015)

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	Operational
MWPT2	Mill Water Pond	Operational
MW11-01A	Mill Water Pond	Operational
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)
08SWC278	Southwest Dump	Destroyed (2008)

Thermistor	Location	Operational Status
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

5.15.3.1 DSTSF Thermistors

Data collected from DSTSF thermistors are presented in Figure 5-117 through Figure 5-122. Data are collected monthly (only quarterly data are shown in the figures for clarity). No major changes to ground temperatures at the DSTSF were observed in 2015.

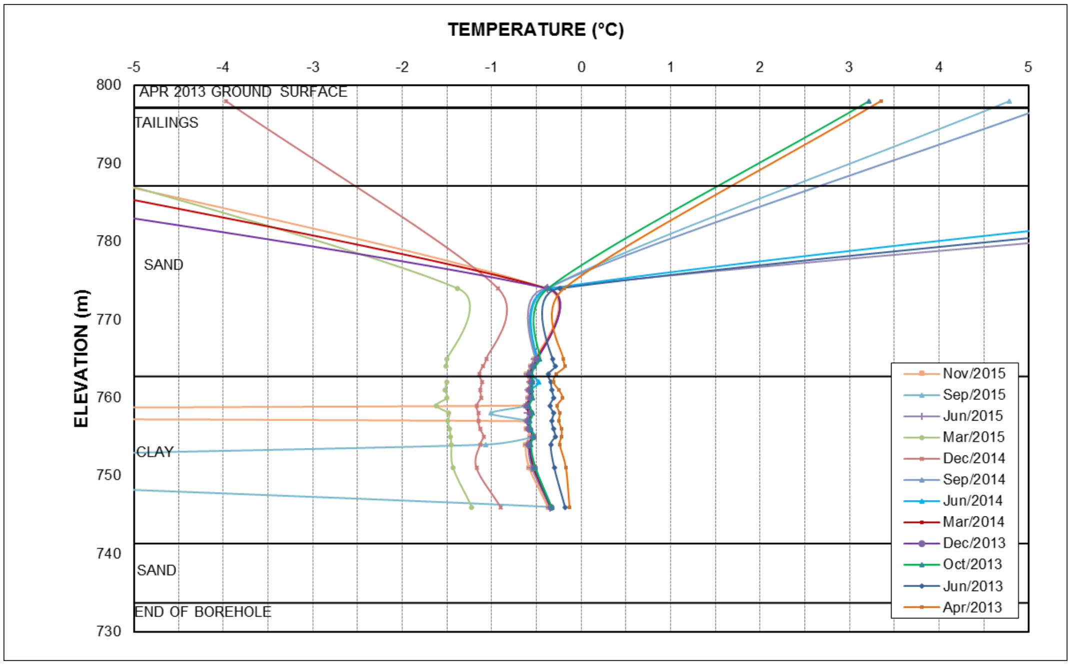


Figure 5-117: Thermistor DST-10 (2013-2015)

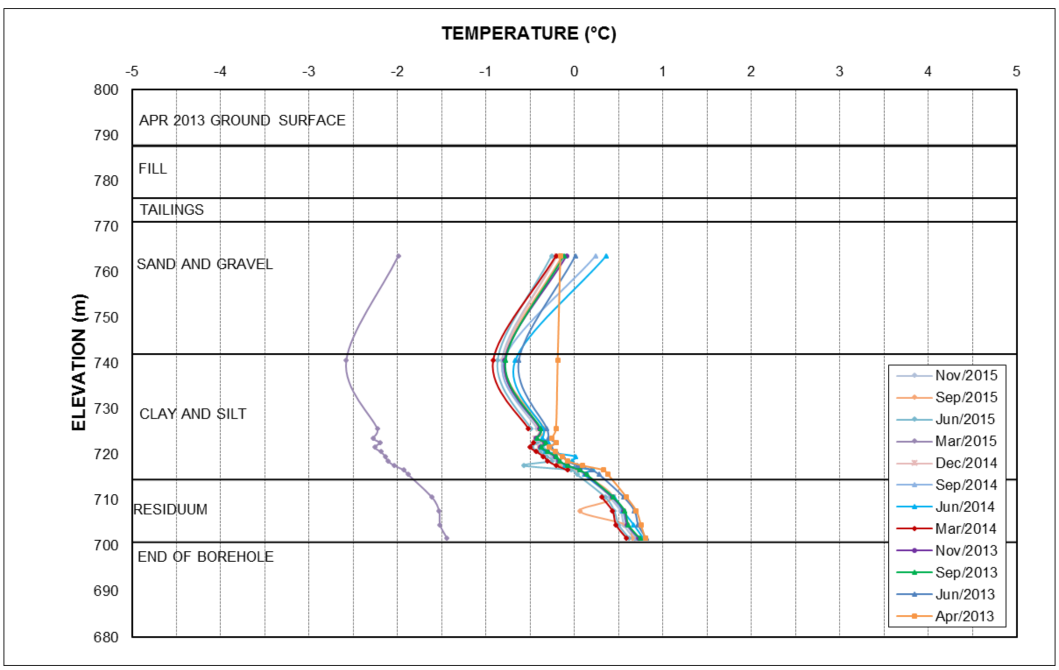


Figure 5-118: Thermistor DST-11 (2013-2015)

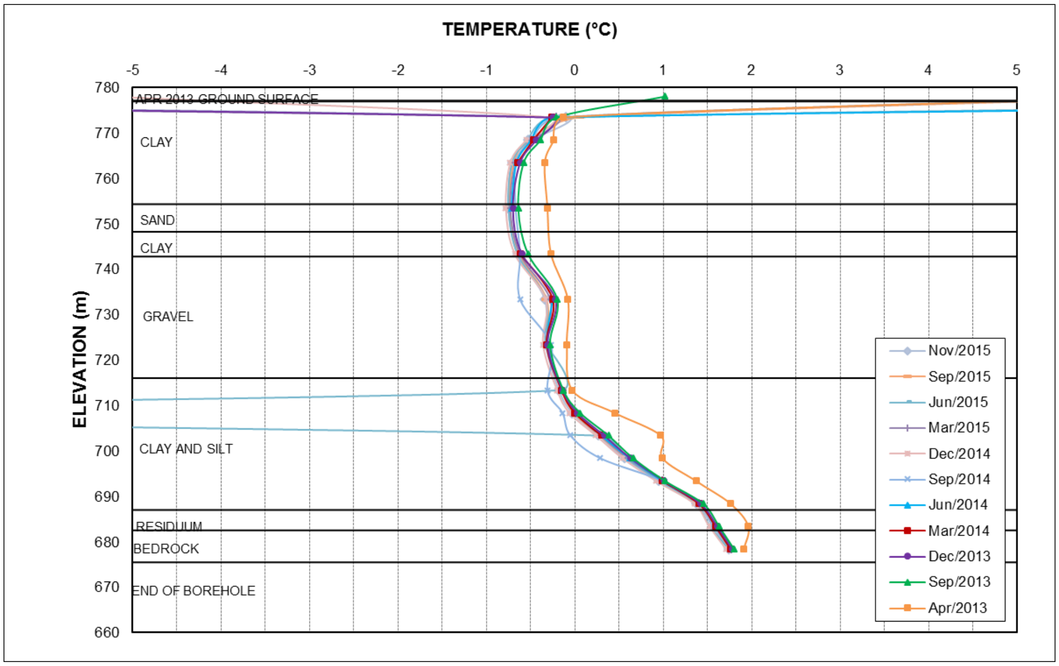


Figure 5-119: Thermistor DST-13 (2013-2015)

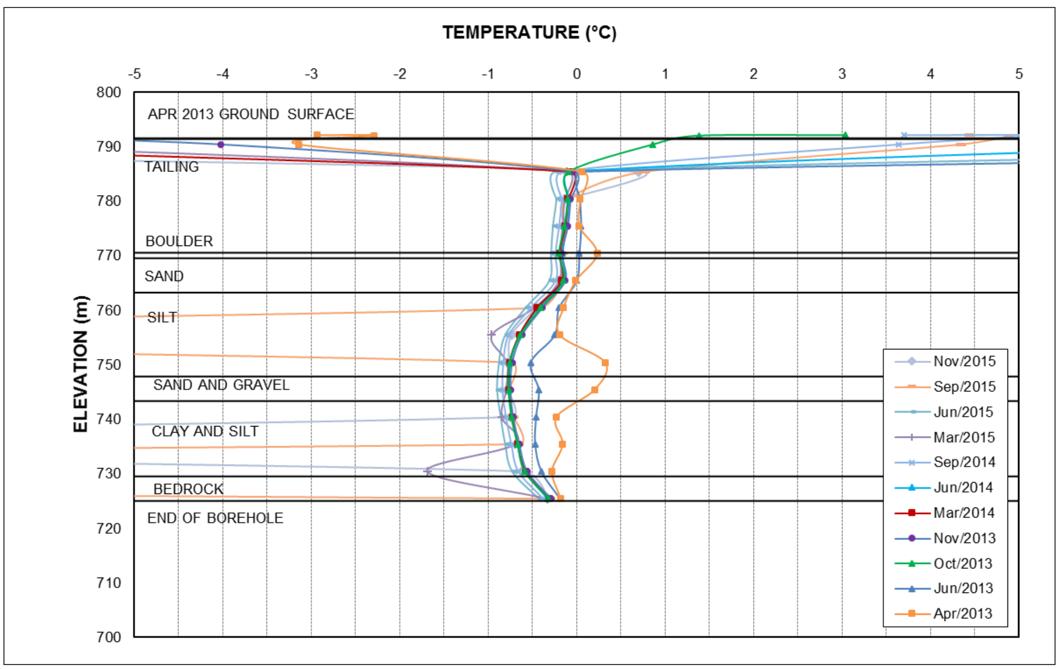


Figure 5-120: Thermistor DST-14 (2013-2015)

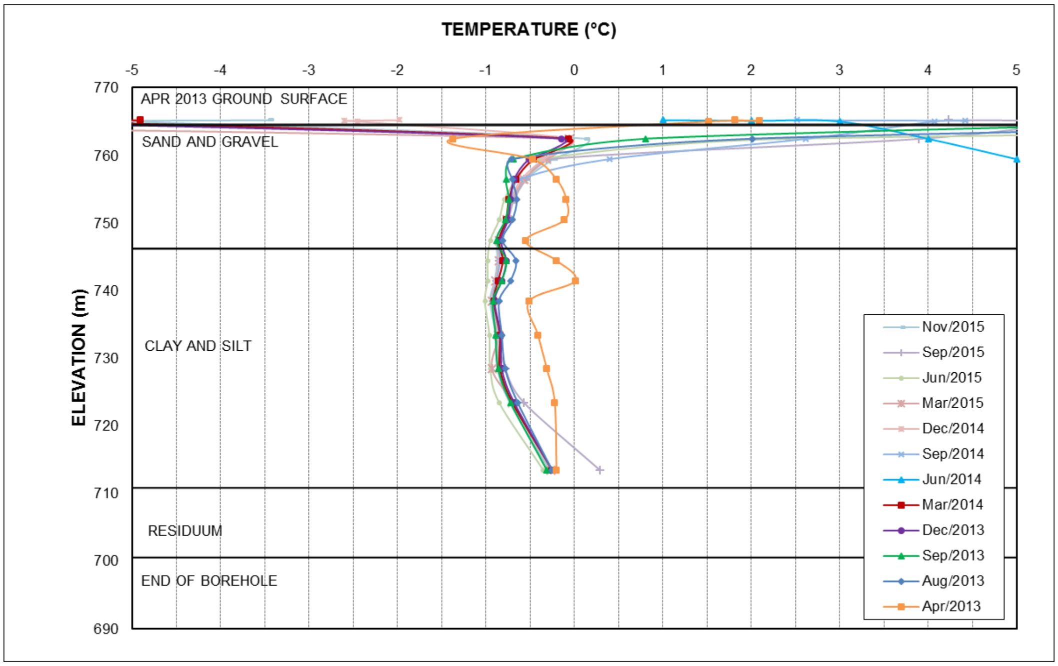


Figure 5-121: Thermistor DST-15 (2013-2015)

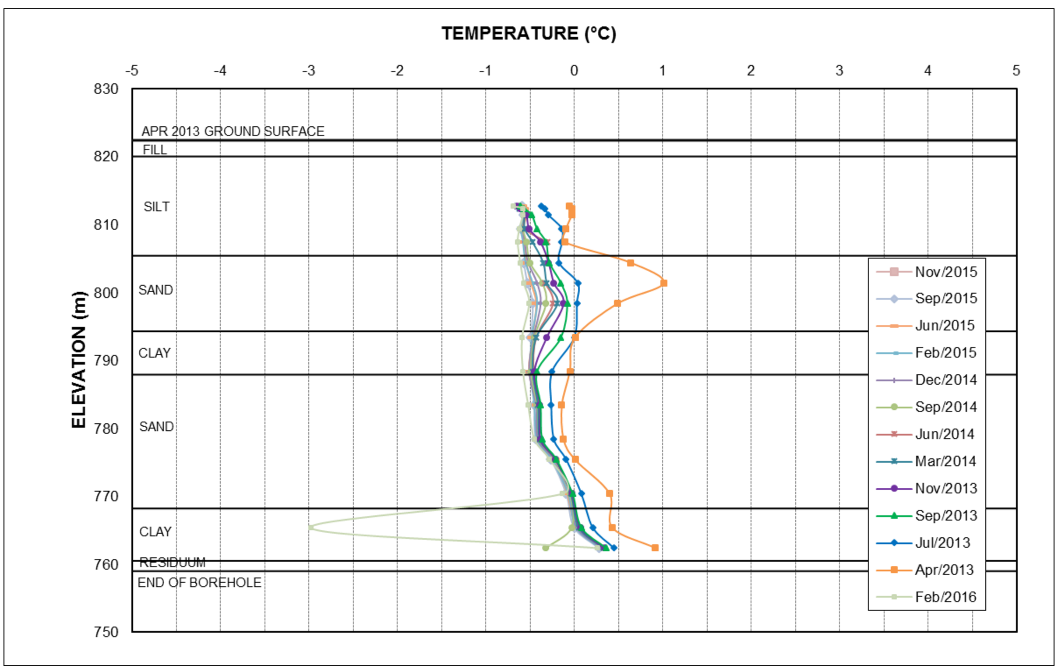


Figure 5-122: Thermistor AT2-1 (2013-2015)

5.15.3.2 Mill Water Pond Thermistors

Data collected from Mill Water Pond thermistors are presented in Figure 5-123 and Figure 5-124. Data are collected quarterly. No major changes to ground temperatures at the Mill Water Pond were observed in 2015.

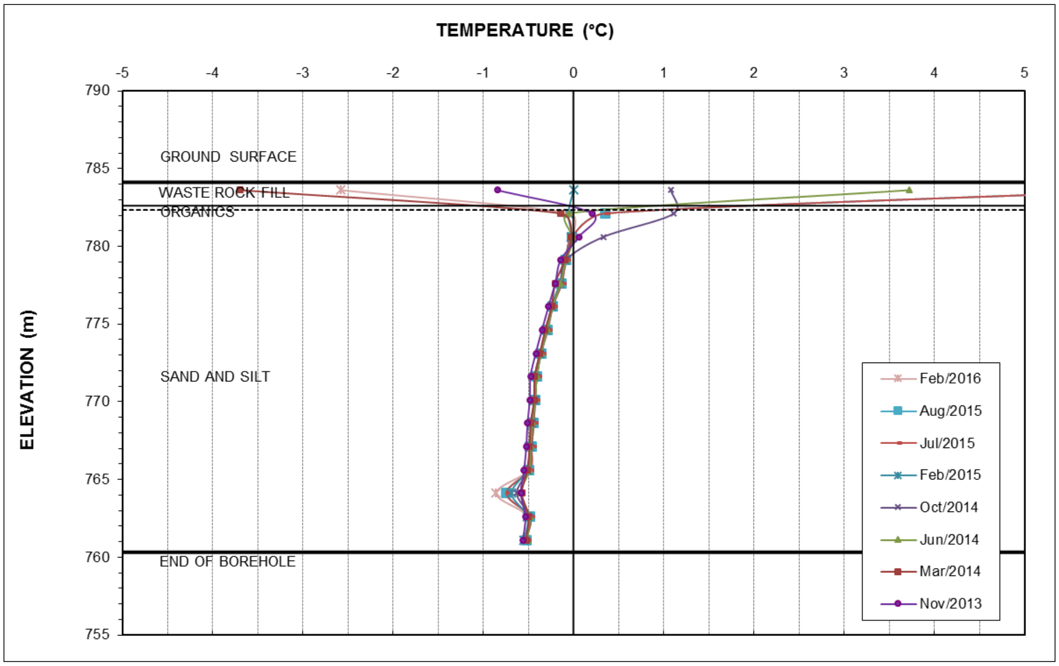


Figure 5-123: Thermistor MWPT-1 (2013-2015)

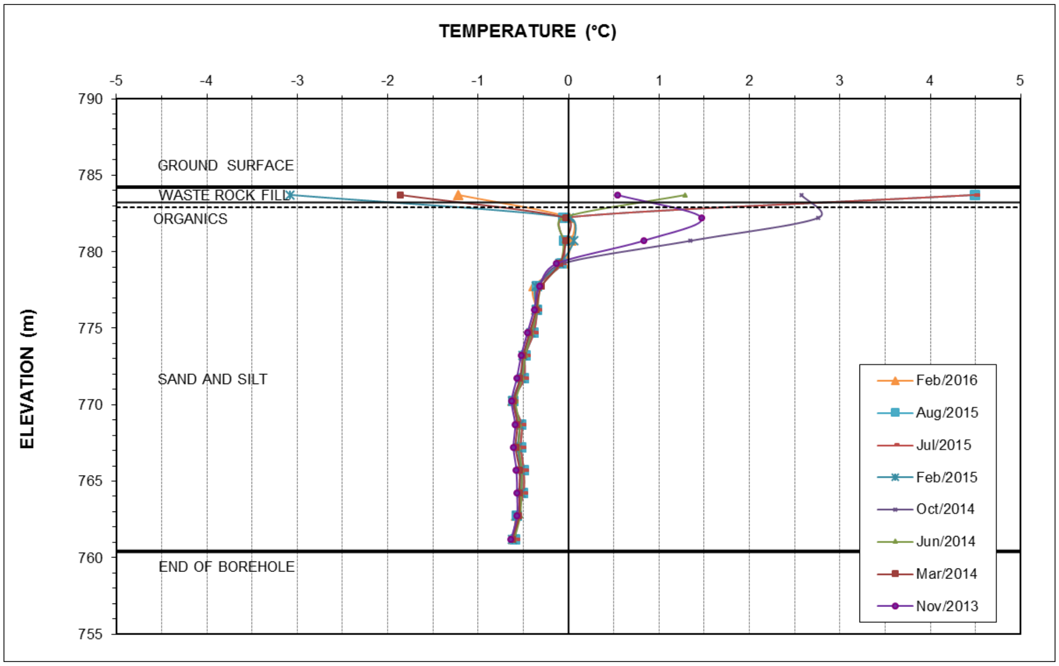


Figure 5-124: Thermistor MWPT-2 (2013-2015)

5.15.3.3 Main Pit Dam Thermistors

Data collected from the Main Pit Dam thermistors are presented in Figure 5-125 and Figure 5-126. Data are collected quarterly. No major changes to ground temperatures at these locations were observed in 2015.

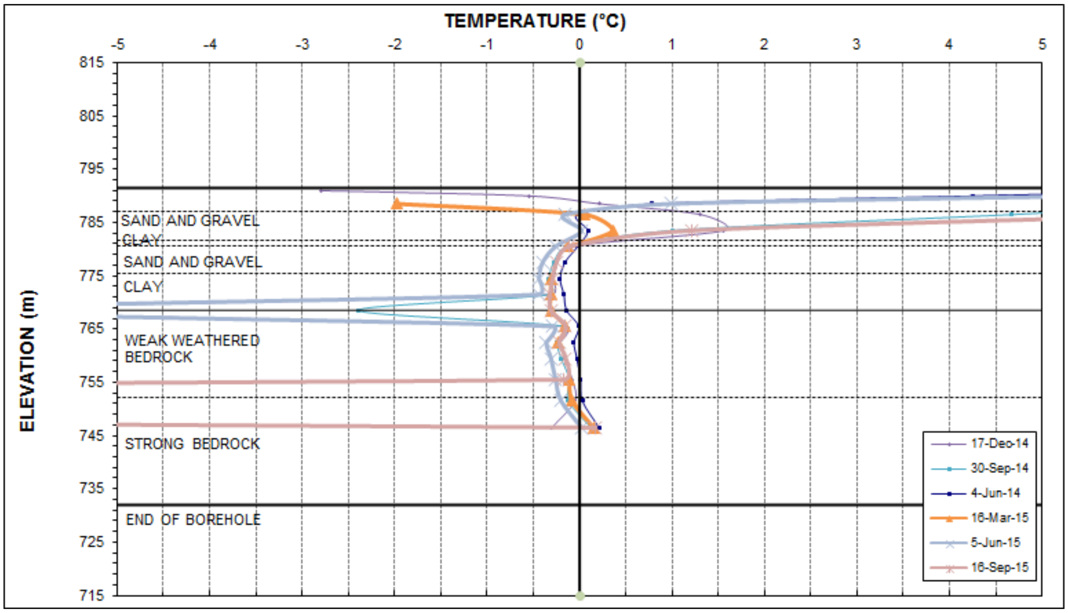


Figure 5-125: Thermistor MPD-1 (2014-2015)

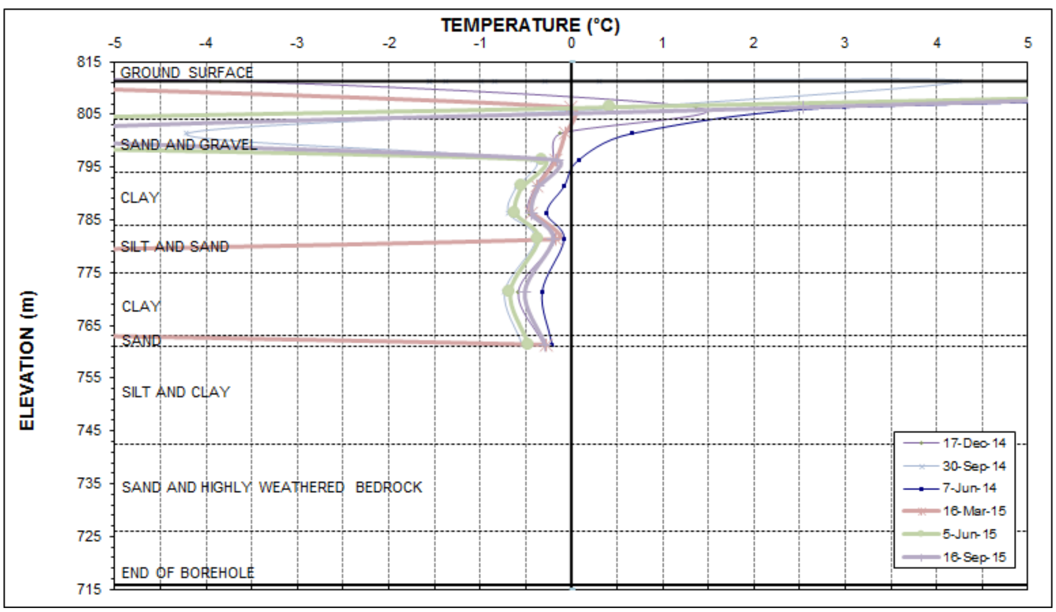


Figure 5-126: Thermistor MPD-2 (2014-2015)

5.15.3.4 Ridgetop Thermistors

Data are collected quarterly from both Ridgetop thermistors. No major changes to ground temperatures at the Ridgetop were observed in 2015.

5.15.3.5 Southwest Dump Thermistors

Data collected from SWD thermistors are presented in Figure 5-127 through Figure 5-130. Data are collected monthly (only quarterly data are shown in the figures for clarity). No major changes to ground temperatures at the SWD were observed in 2015.

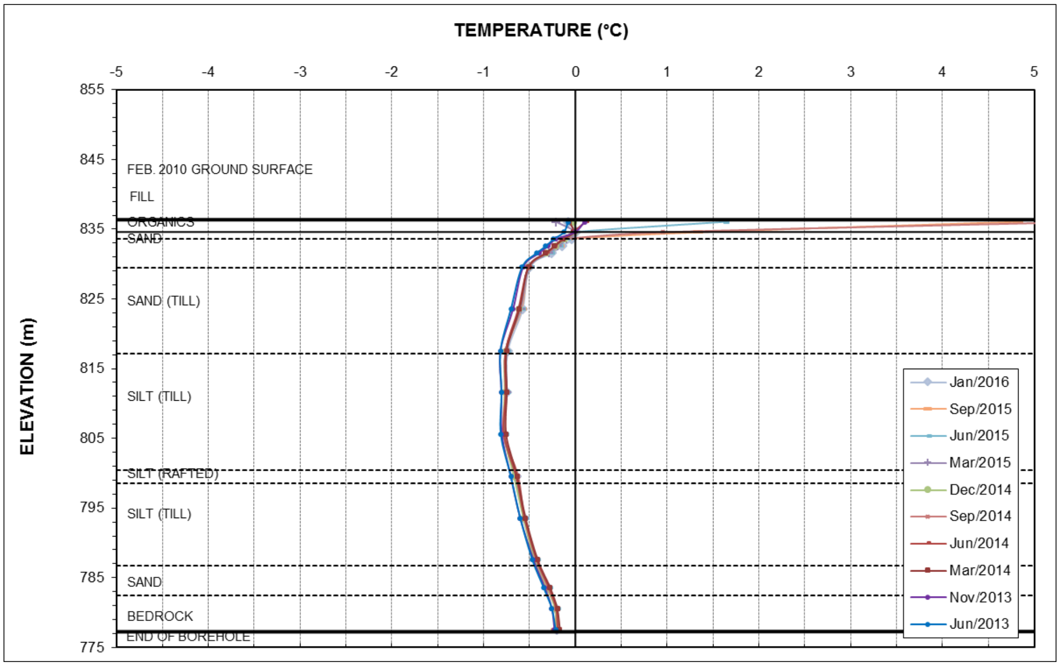


Figure 5-127: Thermistor SDT-1 (2013-2015)

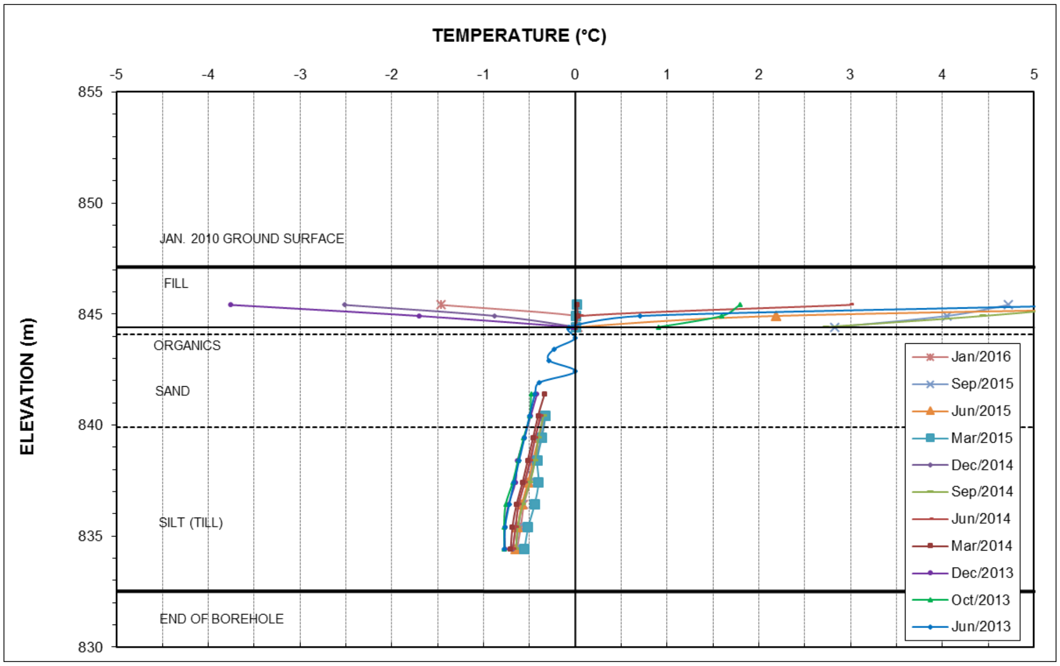


Figure 5-128: Thermistor SDT-2 (2013-2015)

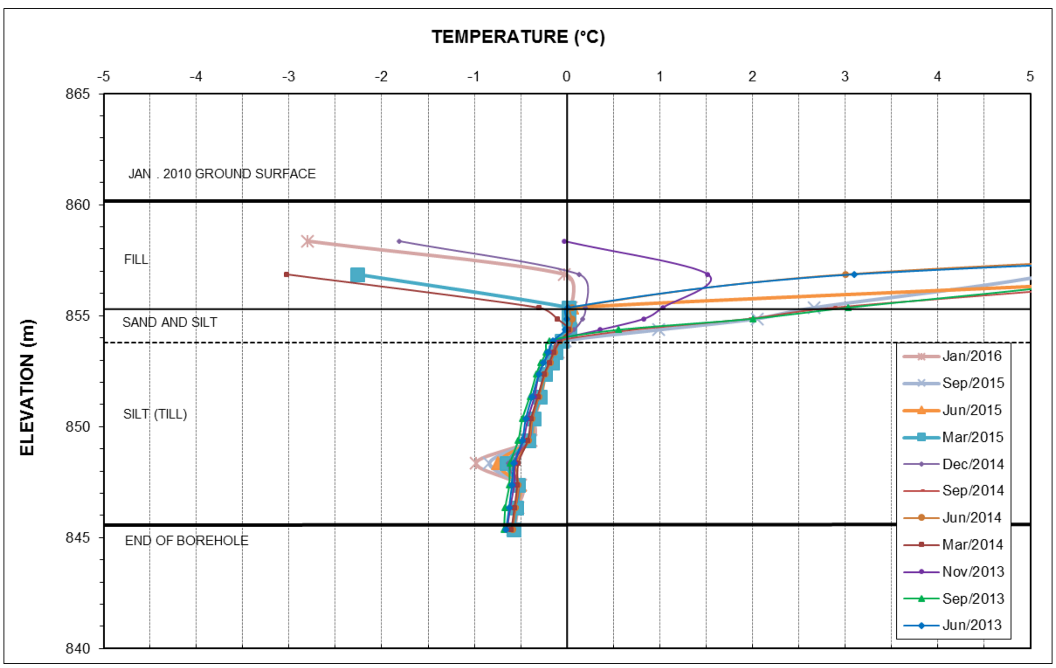


Figure 5-129: Thermistor SDT-3 (2013-2015)

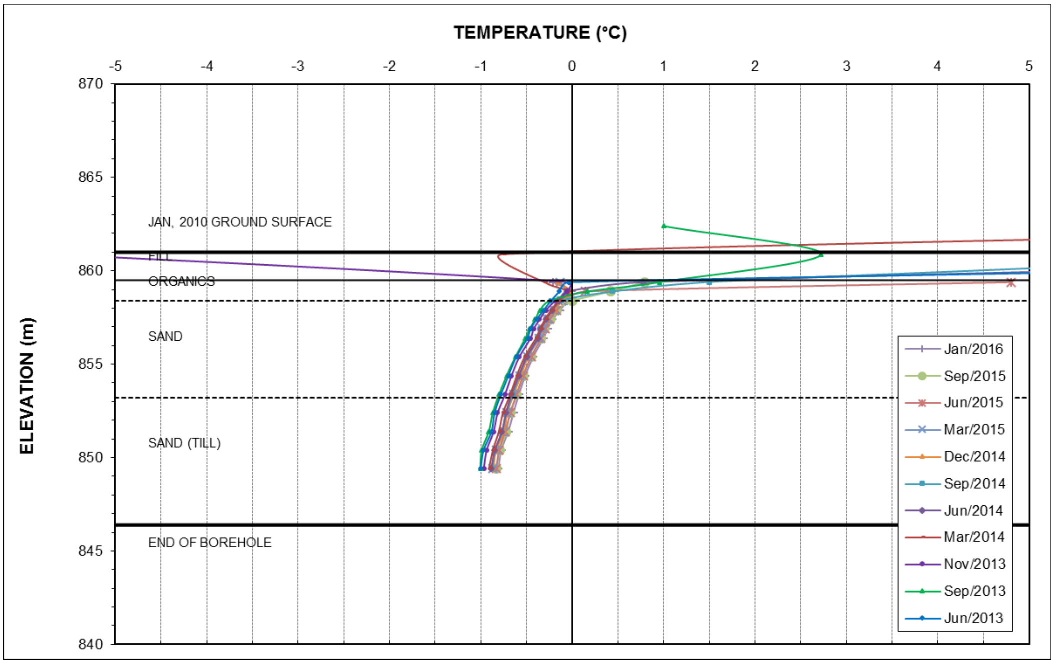


Figure 5-130: Thermistor SDT-4 (2013-2015)

5.15.3.6 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.

5.16 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 is a component of the EMSRP, 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 August and December of 2015, sixty-two grab samples of waste (WST) were collected from the Main Waste Dump Extension (MWDE) and six waste 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 sixty-eight samples taken from the two destinations, sixty-seven met the pass criteria based on the NP/AP segregation criteria. As the one failure was determined to be an isolated event, no further sampling was required. The average monthly values of the Acid-Base Accounting (ABA) parameters for each dump location are summarized in Table 5-61, below. For a complete summary of the sample results, please refer to Appendix M.

Table 5-61: Waste Rock Management Verification Program Summary (2015)

Average ABA Parameter Values: Month By Location								
Location	Month	Waste Type	Cu%	C% (Tot)	S% (Tot)	NP	AP	NP/AP
MWDE	Aug	WST	0.190	0.132	0.004	11.00	0.13	88
	Sep	WST	0.012	0.083	0.002	6.92	0.07	102
	Oct	WST	0.018	0.385	0.018	32.09	0.57	56
	Nov	WST	0.014	0.373	0.003	31.07	0.10	312
	Dec	WST	0.051	0.298	0.030	24.84	0.95	26
MFVE 2	Dec	WST	0.173	0.414	0.132	34.44	4.11	8

5.17 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 2015.

A total of 156 samples were collected from the Area 2 Pit, Minot North Pit and the Area 118 Underground deposit and sent to the accredited laboratory (SGS CEMI Ltd.) during the 2015 monitoring period. The samples were analyzed according to the MEND Modified NP Method as noted in the EMSRP. The mean NPR results for waste rock samples was 5.1 for the duration of the monitoring period.

20 samples during the 2015 monitoring period were below the NPR threshold of 3 for construction grade waste rock. The mean paste pH values for all samples tested in 2015 were 8.70. The mean sulphide sulphur (SS) content for waste rock samples during the 2015 monitoring period was 0.09%. In 2015, 12 samples were above the SS content for construction grade waste (waste grading Cu <0.1%, NPR>3, SS<0.3%).

Tailings samples analyzed in this period had a mean NPR of 11.96. All tailings samples were well above a NPR of 4. All twelve samples of tailings were also below 0.30% SS content and had a paste pH between 8.27 and 8.71.

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

5.18 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 – monthly;
- Main Pit and Area 2 Pit tailings storage facilities – monthly;
- WSP dam – weekly (seepage), monthly (stability); and
- Mill water pond – weekly (seepage).

Deformation monitoring instrumentation includes survey hubs and borehole inclinometers, described in the following sections. A layout of physical monitoring instrumentation is provided in Figure 5-131, below.

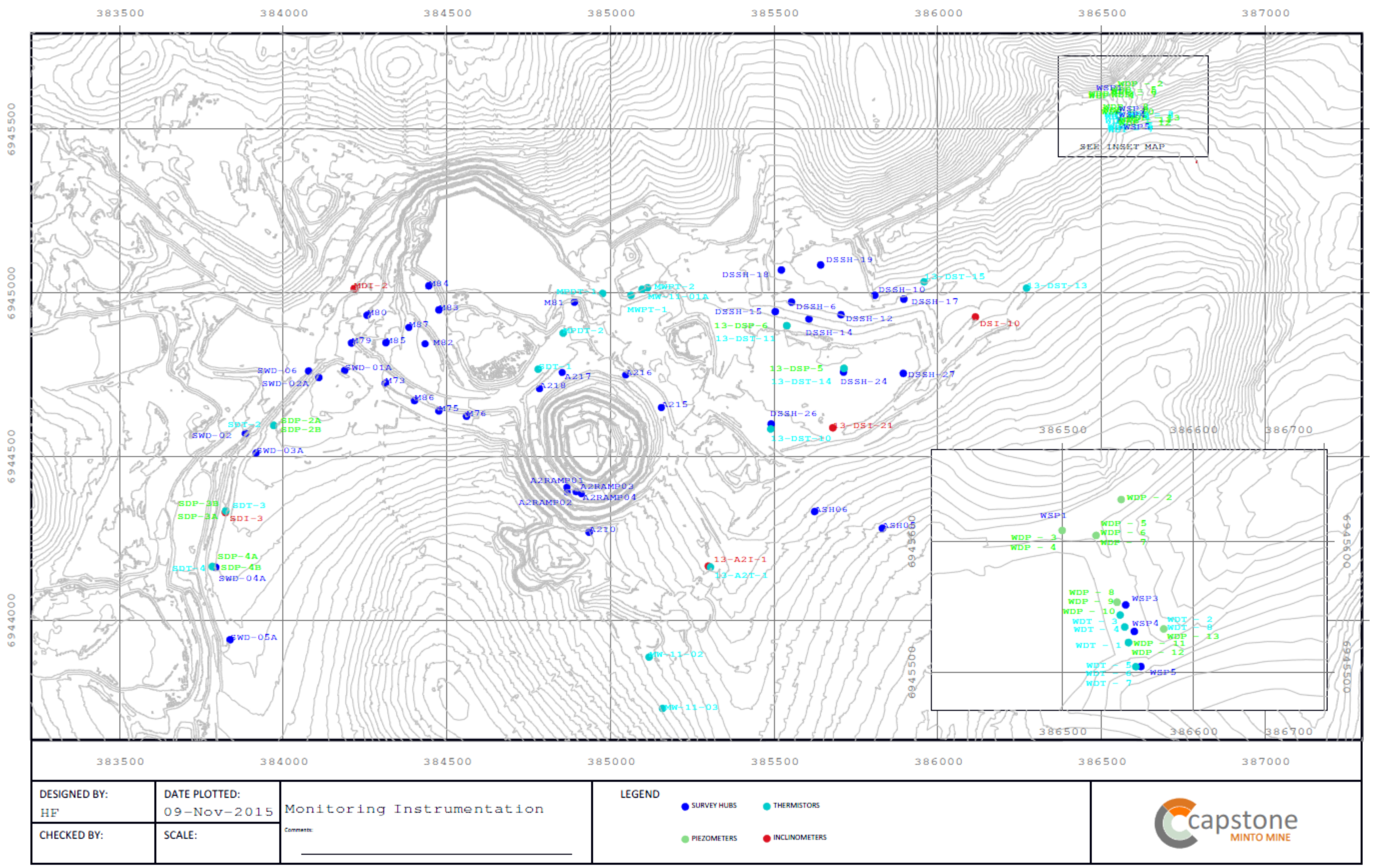


Figure 5-131: Physical Monitoring Program Installation (2015)

5.19 Physical Deformation Monitoring Instrumentation

5.19.1 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.

5.19.1.1 Main Pit/South Wall Buttress Survey Hubs

There are currently fifteen operating survey hubs on the Main Pit south wall buttress. M69 and M74 were replaced with cement-block survey hubs (as M85 and M86) and decommissioned. Data collected are presented in Figure 5-132. Data was collected bi-weekly.

In general the movement rates continued a gradual decrease in 2015, with rates now nearing zero movement in some of the hubs. The in-pit survey hubs indicated relatively consistent movement rates in 2015 as presented in Figure 5-133. 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.

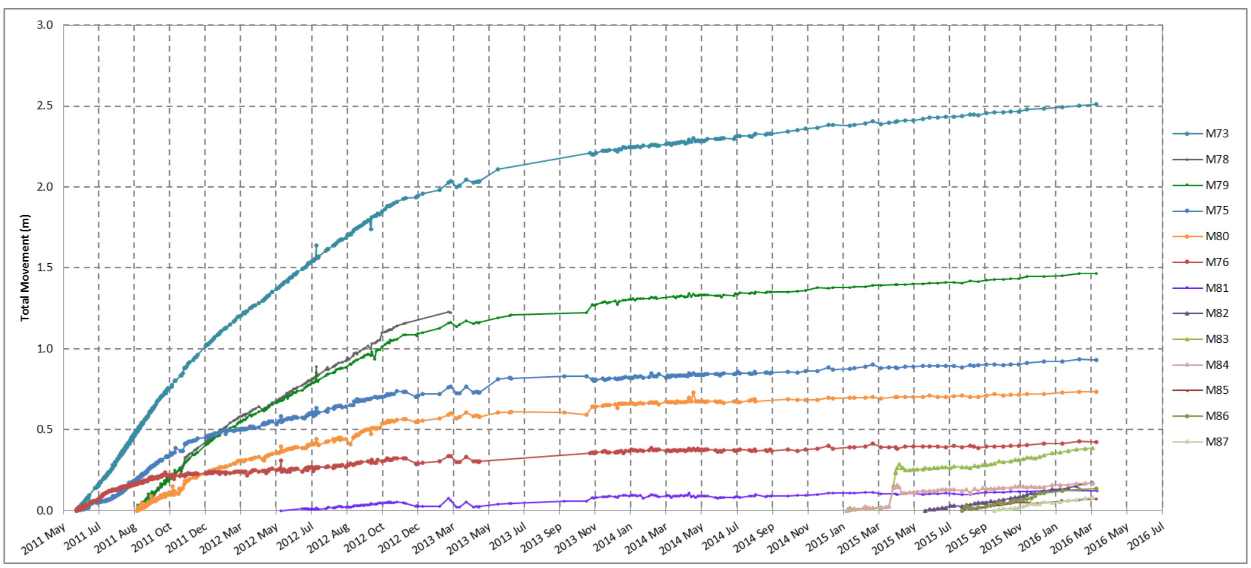


Figure 5-132: Main Pit/South Wall Buttress Survey Hub Data (2011-2015)

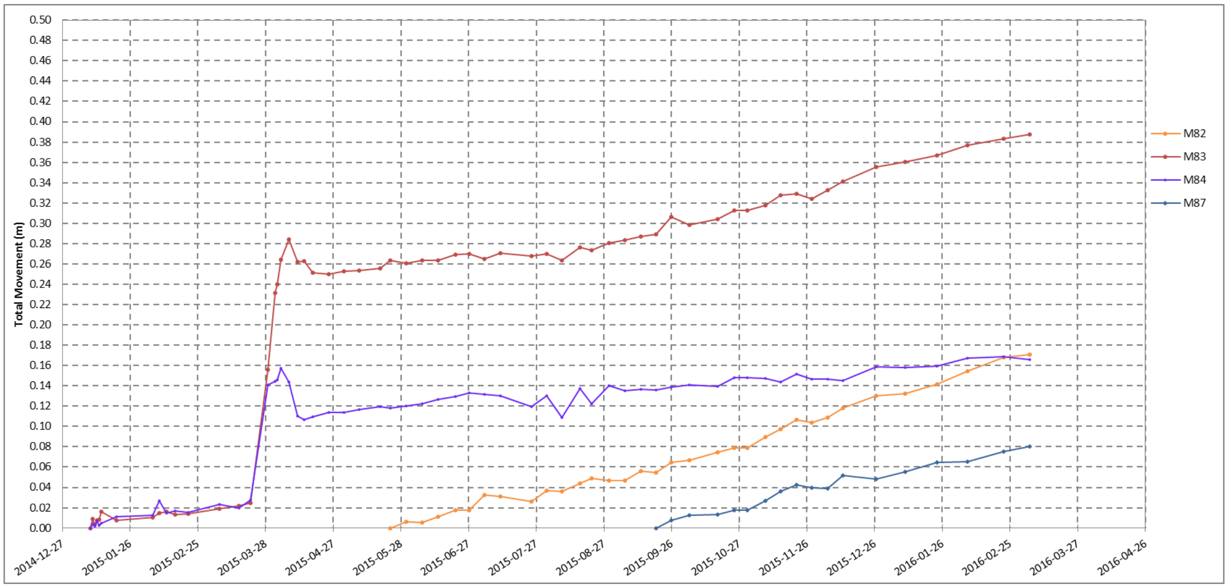


Figure 5-133: Main Pit/South Wall Buttress Survey Hub Data (2014-2015)

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

There are were sixteen operating survey hubs on the DSTSF and MVF during 2015. The construction of the Mill Valley Fill Extension (MVFE) Stage 2 has destroyed ten of the DSTSF survey hubs, which will be reinstalled upon completion of the structure. DSSH-23 and DSSH-25 were replaced with cement-block survey hubs, as DSSH-26 and DSSH-27, and decommissioned. Data collected are presented in Figure 5-134. Data are collected weekly. All hubs indicated a continued gradual decrease in movement rates in 2015. Most hubs have shown a significant decrease in movement rate already since the start of the MVFE2 construction in fall, 2015.

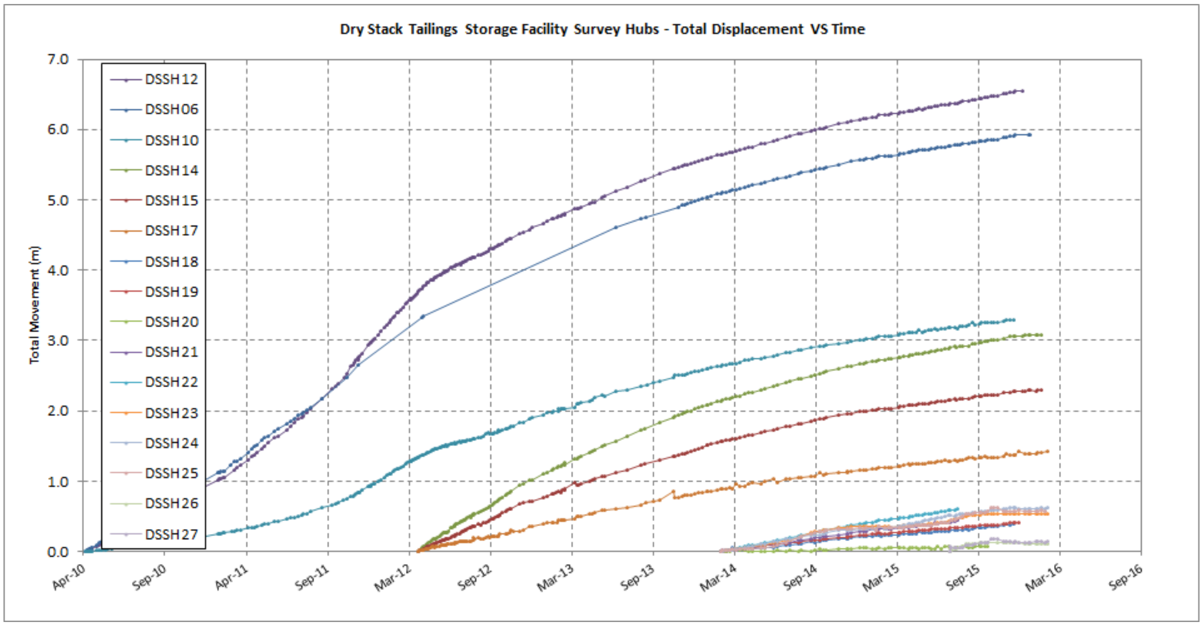


Figure 5-134: DSTSF Survey Hub Data (2010-2015)

5.19.1.3 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-01A has been replaced with a cement-block survey hub as SWD-06. Data collected are presented in

Figure 5-135. Data are collected monthly. Hubs indicated relatively consistent movement rates in 2015, with the exception of SWD-04A nearing zero movement.

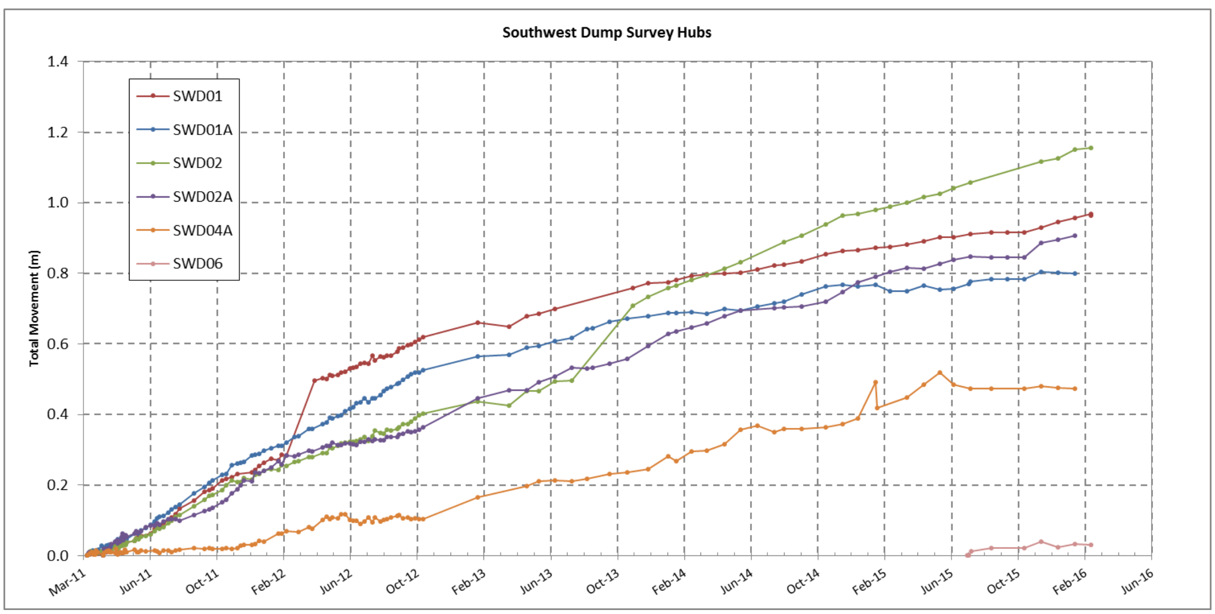


Figure 5-135: SWD Survey Hub Data (2011-2015)

5.19.1.4 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 2015. Data collected are presented in Figure 5-136. Data are collected monthly. Data continue to indicate no movement.

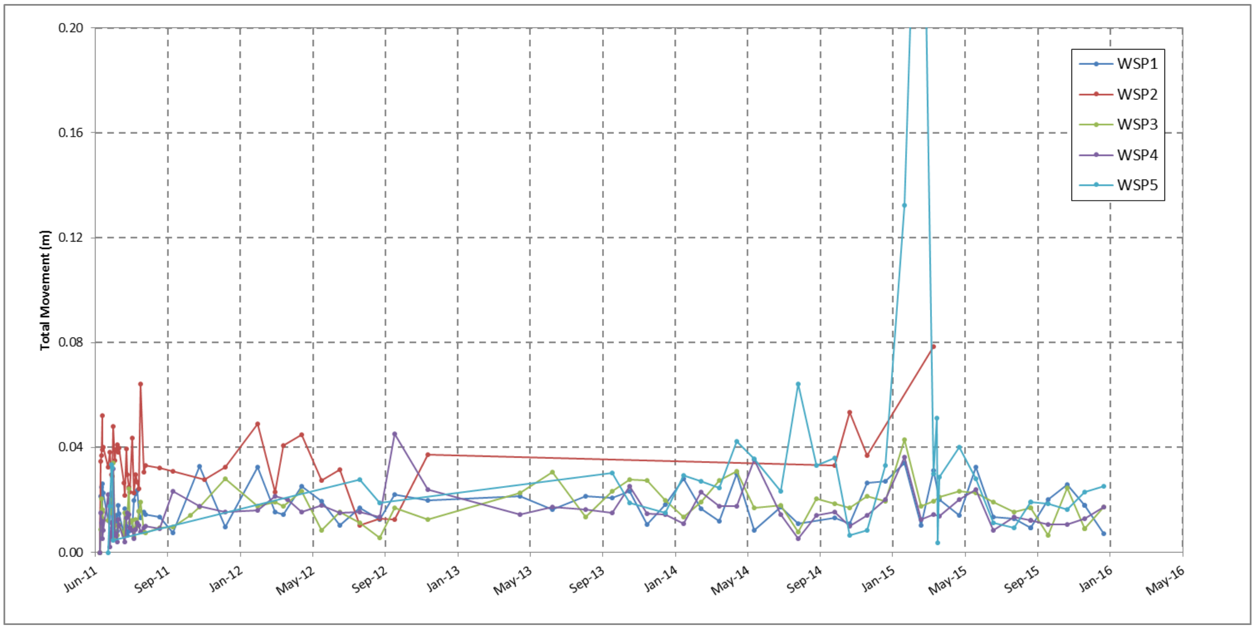


Figure 5-136: Water Retention Dam Survey Hub Data (2011-2015)

5.19.2 Inclinometers

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

5.19.2.1 DSTSF Inclinometers

There are currently two operating inclinometers in the DSTSF area. DSI-14 and DSI-21 sheared off in September and October respectively. Data collected for the most recent surveys in 2015 relative to the original surveys are presented in Figure 5-137 through Figure 5-140. DSI-10 and A2I-1 are monitored quarterly.

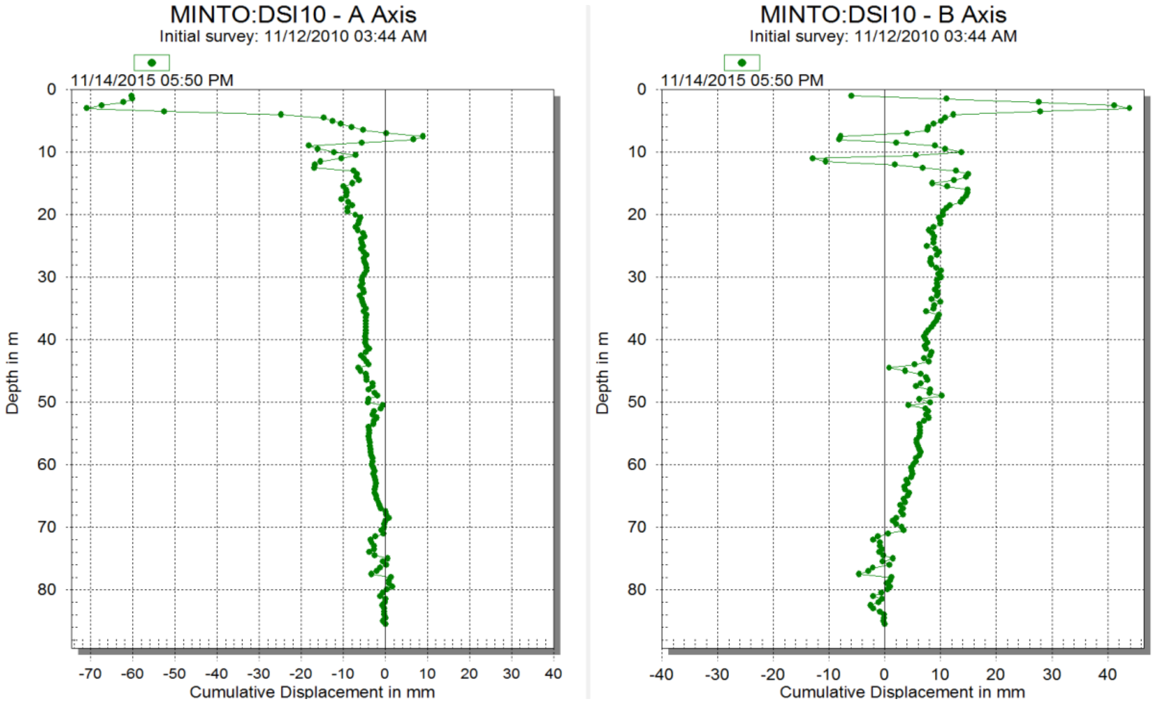


Figure 5-137: DSTSF Inclinometer DSI-10 (2015)

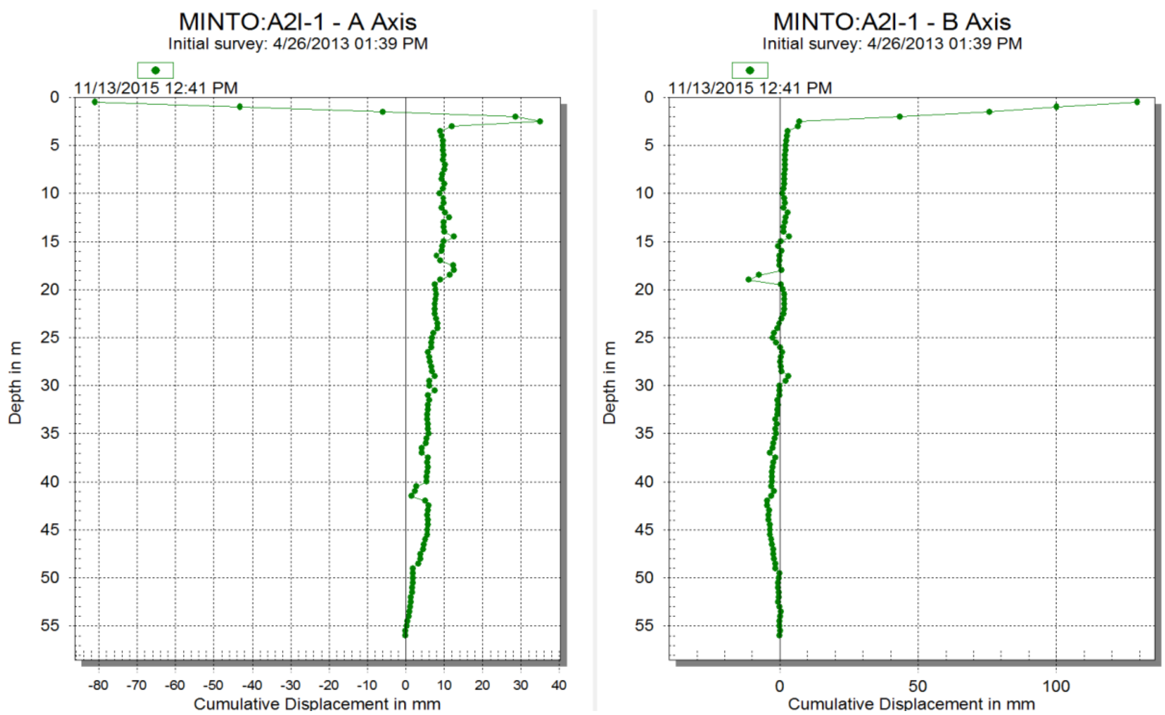


Figure 5-138: DSTSF Inclinometer A2I-1 (2015)

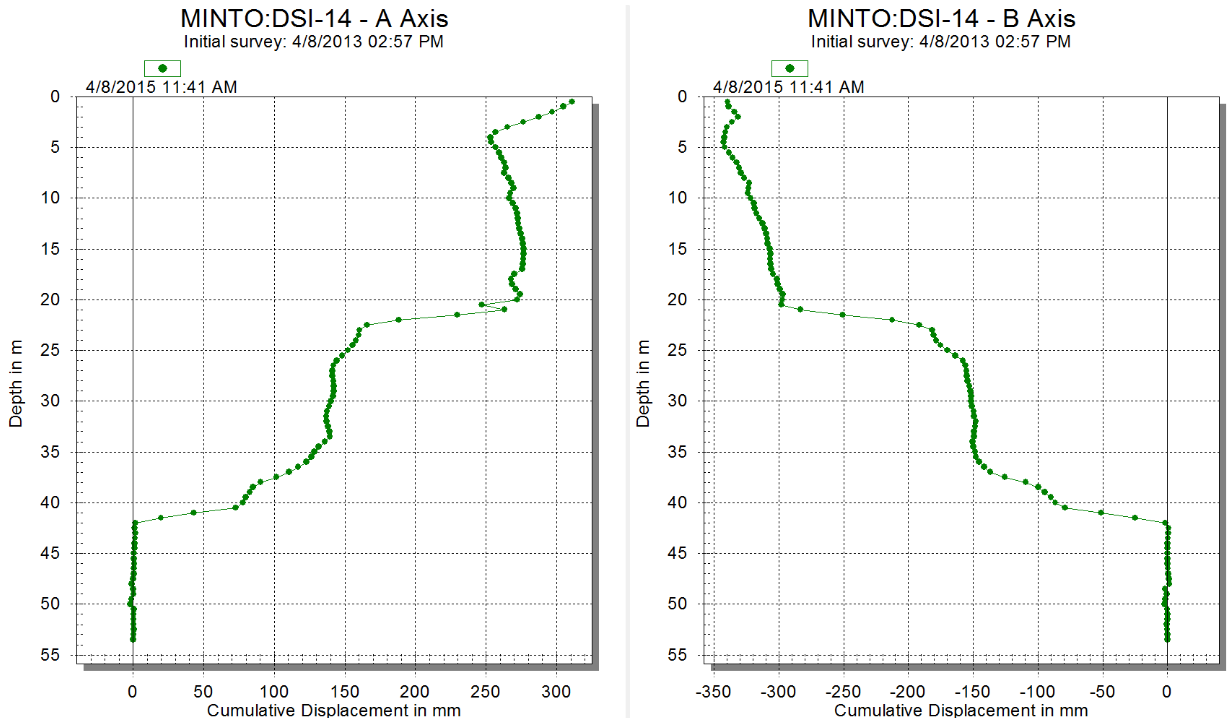


Figure 5-139: DSTSF Inclinometer DSI-14 (2015)

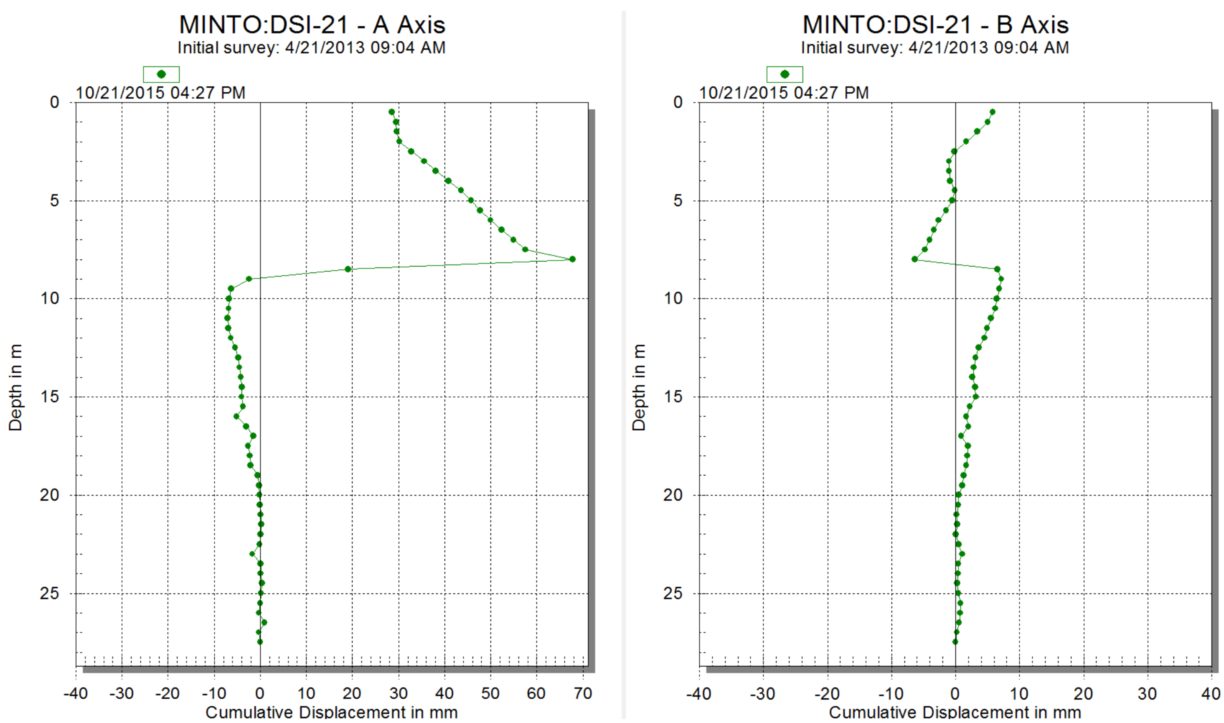


Figure 5-140: DSTSF Inclinometer DSI-21 (2015)

5.19.2.2 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 5-141.

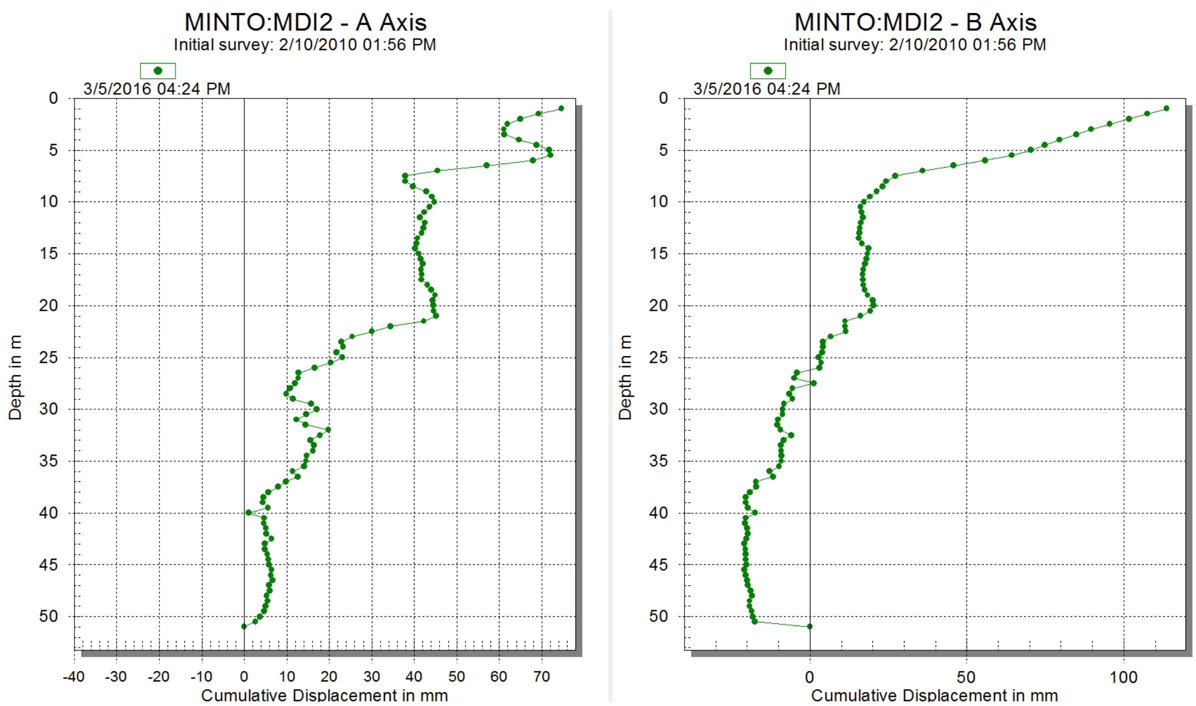


Figure 5-141: Main Pit Inclinometer MDI-2 (2015)

5.20 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;
- DSTSF;
- Fuel Containment Facility;
- MWD;
- MCDS;
- Mill Water Pond;
- ROD;
- SDD;
- SWD; and
- WSP Dam.

Table 5-62 summarizes the recommendations from the most recent external inspection in August 2015 and the associated planned actions.

Table 5-62: Annual Physical Inspection Report Summary (2015)

Area	Recommendation	Action
General	The condition of all survey hubs on site should be reviewed. Hubs experiencing frost heave should be noted and replaced with hubs that are not susceptible to frost heave. Alternate installation methods could include grouting a hub mount to a large boulder, using a deeper post, and/or welding a base plate (1 m x 1 m) to the base of the post and placing in a deep pit excavation backfilled with compacted, non-frost susceptible materials.	Survey hubs were inspected and photographed in June, 2015. Replacement hubs for those deemed unreliable were replaced in summer of 2015. All new survey hubs installed were a grouted hub into either a large boulder or cement block.
DSTSF & MVFE	Re-grade the DSTSF overburden surface to promote runoff once the final cover design has been determined and cover the remaining areas of exposed tailings on the south edge of the facility.	Currently a temporary 1 m thick nominal overburden cover has been installed on the DSTSF, meeting the requirements of the Phase IV water licence. The area is relatively large and though the initial design had grade to it, it was insufficient to be achieved in practice and has resulted in spots that pond water. Final cover construction and re-grading will be completed as part of the reclamation and closure plan.

Area	Recommendation	Action
	Continue to monitor the 2013 crack and settlement area in the MVFE.	Visual inspections were carried out as part of the semi-annual geotechnical site inspections. This area is now covered by the MVFE2.
	Cover the historical instrumentation to prevent preferential flow paths, and develop a plan for decommissioning instrumentation that is no longer used.	Historical instrumentation within mine structures are backfilled with bentonite prior to being covered.
	Continue to monitor the 2014 crack and install two survey nails/pins (one on each side of the crack) to measure the relative displacement using a tape measure.	Two survey nails are installed and measured monthly as part of the DSTSF Inspection.
	The slopes at the outlet for the tailings diversion ditch should be monitored for signs of instability and erosion.	Semi-annual monitoring is carried out as part of the site geotechnical inspections.
MWD	None	None
SWD	Complete reading of the survey hub and slope inclinometers on at least a monthly and bi-monthly basis, respectively, and continue monitoring ground movement rates. Notify SRK Consulting of any other observations or increases in movement that indicate a significant change in dump performance or dump stability.	Survey hubs are currently read monthly and inclinometers are read quarterly. Frequencies were reduced once the dump was closed and in consultation with SRK. Geotechnical inspections are carried out semi-annually.
	The survey hubs at the toe of the dumps were not inspected, and the condition should be reviewed to determine if there is ongoing susceptibility to frost heave (similar to previous inspections).	Replacements for unstable survey hubs were installed in summer, 2015.
	Monitor the large linear crack noted near the crest at the south-east corner of the dump.	Monitoring, including photographs, is carried out semi-annually as part of the site geotechnical inspections. No major changes have been observed.
ROD	Continue to monitor the slope failure area for further signs of movement or instability.	Monitoring, including photographs, is carried out semi-annually as part of the site geotechnical inspections. No major changes have been observed.
Mill and Camp Site	Continue to monitor the retaining wall near the mill's apron feeder tunnel and maintain a photographic record of its condition.	Monitoring, including photographs, is carried out semi-annually as part of the site geotechnical inspections. No major changes have been observed.

Area	Recommendation	Action
	Western corner of slope appears undercut and regular monitoring of the slope should occur to identify signs of instability.	Monitoring, including photographs, is carried out semi-annually as part of the site geotechnical inspections. The toe of this slope has been buttressed with coarse rock on the ore stockpile pad.
	Re-grade the area above the erosion channels on the camp pad to promote runoff away from these areas.	Completed in summer, 2015 for the main erosion channels.
	In addition to the surface regrading, develop and implement measures to mitigate the erosion.	Completed in summer, 2015 for the main erosion channels. Mitigation included construction of a sump and pipe system to collect water and convey it to the bottom of the slope.
	Monitor the erosion gully and the seepage noted along the hillside east of the water treatment plant. Install erosion protection along the slope to limit further erosion of the pile.	Completed in summer, 2015.
	Shallow the slopes of the diversion ditch or complete routine maintenance of the ditch to maintain appropriate drainage at the north end of the camp terrace.	Routine maintenance will be performed as required. This is a small ditch with limited flow and easy access for maintenance purposes.
Mill Water Pond	Due to the tears in the geomembrane, the pond is not considered functional. Repairs are required if the pond is to be brought back into service.	The Mill Water Pond is no longer in use and decommissioning is in progress.
	Repair fencing around the pond such that it is continuous.	The Mill Water Pond is no longer in use and decommissioning is in progress.
	If the Mill Water Pond is to be brought back into service the following actions are recommended: • Patch tears in the liner system. • Fill the voids under the tears before patching. • Clean out sediments accumulated in the surface runoff ponds and culverts	The Mill Water Pond is no longer in use and decommissioning is in progress.
SDD	Remove vegetation and perform routine maintenance along ditch alignment.	Will be reassessed in the spring.
	Along the airport ditch, cover the exposed geotextile, and confirm the ditching profile through the access road drains correctly.	Will be reassessed in the spring.

Area	Recommendation	Action
MCDS	Continue annual monitoring for further signs of instability or seepage on the downstream slope of the MCDS.	MCDS was decommissioned and replaced by MVFE2 collection sump.
	Repair the crest and exposed geotextile, or move towards replacing the pond as planned.	MCDS was decommissioned and replaced by MVFE2 collection sump.
WSP Dam	Continue regular monitoring of the dam, noting specifically the clarity of the seepage and flow exiting the stilling basin and the seepage rate through the weir.	Monitored during monthly inspections.
	Significant erosion on the left abutment. Plans for repair should be made in conjunction with the Engineer of Record.	Completed in July, 2015 after consultation with EBA.
Big Creek Bridge	Continue regular annual monitoring of sediment accumulation in the culverts. If sediments continue to accumulate, clean them out. Exposed geotextile around culverts should be repaired.	Semi-annual monitoring is carried out as part of the site geotechnical inspections. Geotextile will be reassessed in the spring and repaired if required.
South Wall Buttress	The tension crack area in the In-Pit Dump should continue to be monitored. A photographic record should be maintained to inspect for changes in condition. Following completion of the buttress, additional survey hubs should be installed along the crest to monitor movement.	Note this recommendation refers to the in-pit dump which is not part of the designed and built south wall buttress. Three survey hubs, M82, M83 and M84 were installed along the crest referred to in January 2015. Monitoring, including photographs, is carried out quarterly as part of the site geotechnical inspections.
	Tensions cracks were observed on Level 821. Recommend adding survey monuments, and painting cracks, and adding these to the	Cracks painted and documented. Additional survey hub, M87, installed to monitor this area. Monitoring, including photographs, is carried out quarterly as part of the site geotechnical inspections.

6 Reclamation

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

- SWD Recontouring;
- Construction of the Mill Valley Fill Stage 2 (MVFES2); and
- Reclamation Research;

6.1 Southwest Dump Recontouring

In late 2014 (November), SRK Consulting was able to develop a closure landform design for the Southwest Dump (SWD) incorporating the following goals: ensure slopes are geotechnically stable while avoiding large uniform slopes; and ensure slopes are hydrotechnically stable by reducing or impeding concentrated flow of water and reducing erosion pathways for both water and wind. The preliminary design had slope angles ranging from 3:1 to 13:1 with built in flexibility to allow operations to produce slopes that would vary in slope angle while still meeting design criteria.

In early 2015, Pelly Construction completed the recontouring on the low grade area of the SWD. After completion of the low grade area, the primary focus of the recontouring effort shifted to the medium grade waste area of the SWD starting at the south west corner. Over 1500 hrs of dozer time was put into the recontouring effort on the SWD in 2015. Slope angles ranging from 3:1 to 13:1 were achieved over the entire dump faces. The high grade waste area was the only area not worked on, as Minto has not decided the fate of that material in regards to closure. During 2015, recontouring work on the SWD carried out from January through July. Figure 6-1, below, shows as-built images for the SWD both before and after the recontouring was completed. Photograph 6-1, below, shows a detailed photo of the sloping of the medium grade waste area. Photograph 6-2, below, show the overall SWD after recontouring was completed in 2015.

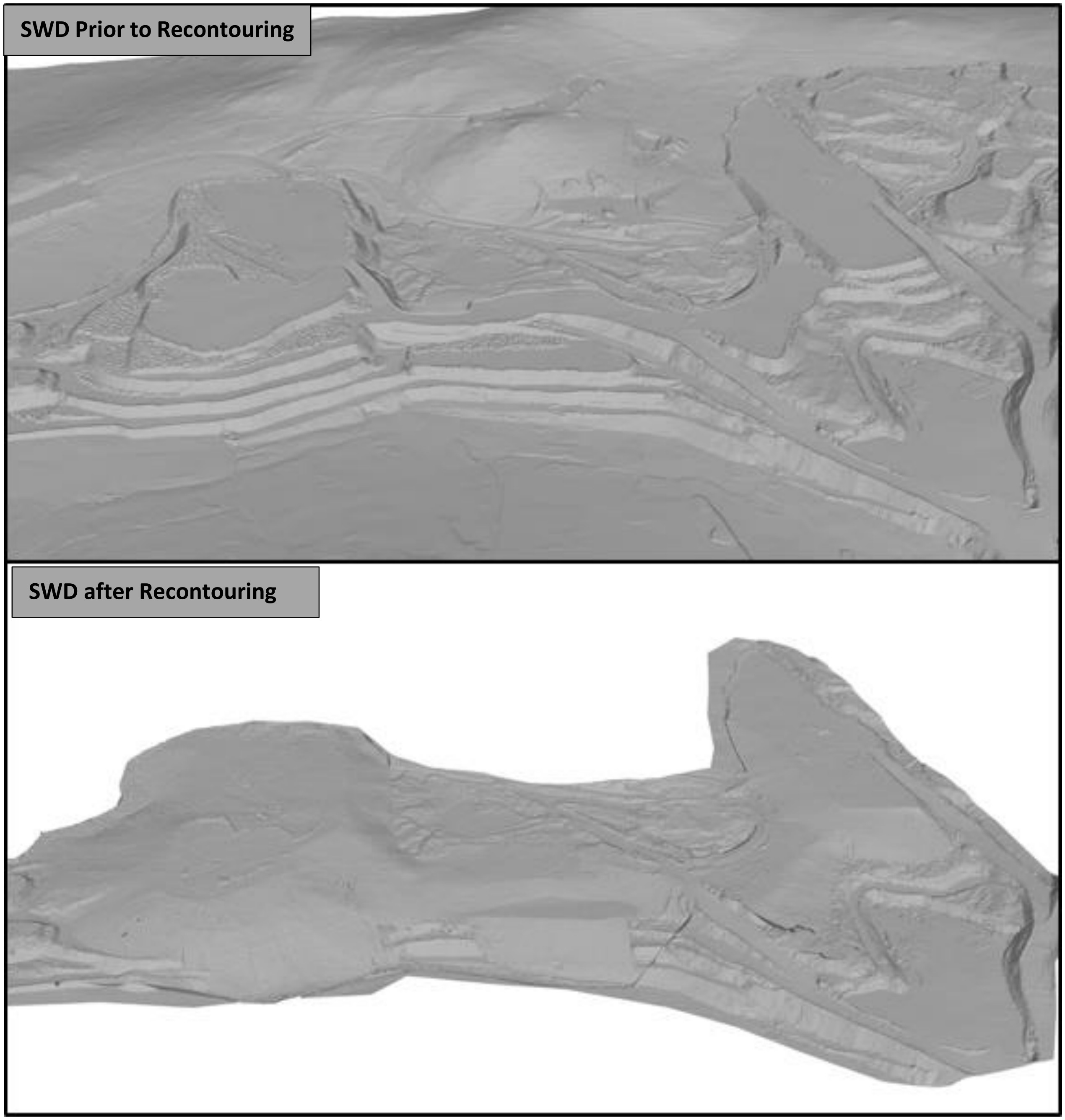
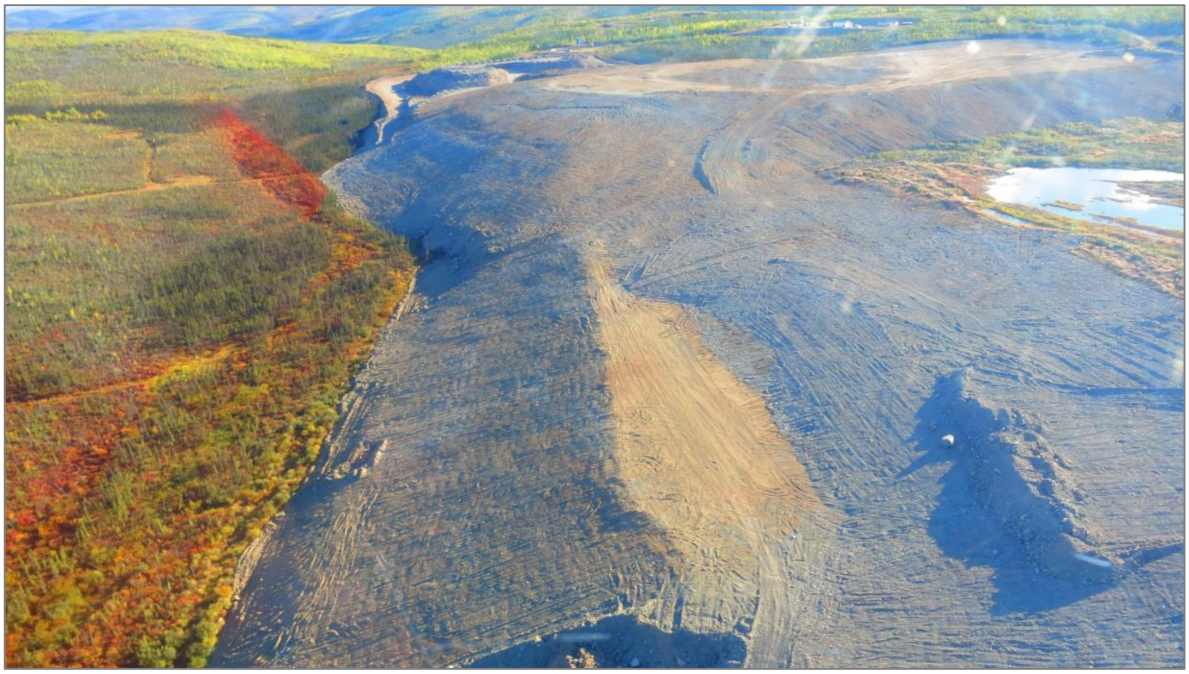


Figure 6-1: SWD As Built Images Before and After Recontouring



Photograph 6-1: Sloping of the Medium Grade Waste Area

Photograph 6-2: SWD After Recontouring Completion in 2015

6.2 Mill Valley Fill Stage 2

In late 2015, 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. Minto submitted final design drawings on September 16, 2015 and notification of construction on November 7, 2015 to the YWB and EMR. Pelly Construction began construction by stripping the organic layer off of the foot print of the Mill Valley Fill Extension Stage 2. A total of 86,561 BCM was hauled to the Mill Valley Fill Extension Stage 2 by the end of 2015. Photograph 6-3 shows material being dumped on the 764 lift on top of the original Mill Valley Fill Extension.

Photograph 6-3: Dumping of Material on Top of the Original Mill Valley Fill Extension (764 lift)

6.3 2015 Reclamation Research

Reclamation research in 2015, focused primarily on carryover on research started in 2014. Large scale reclamation research included passive water treatment and a Dry Stack Tailings Storage Facility cover assessment.

6.3.1 Passive Water Treatment

The primary focus of the passive water treatment research in 2015, was the continual operation of the demonstration scale wetland. Table 6-1, below, summarizes the work completed in relation to the demonstration scale constructed wetland. Table 6-2, below, summarizes all of the key findings of the research that was completed in 2015. All full detailed report can be found in Appendix O.

Table 6-1: Demonstration Scale Constructed Wetland 2015 Work Summary

Event	Key Activity	Flow Rate Setting m^3/day (gal/min)		Calendar Date	Day of Operation
		CWTS Series 1	CWTS Series 2		
CWTS constructed and planted	First sampling, water started.	-	-	August 27 – 31, 2014	0-4
Freeze up for winter	Feed water pumps turned off.	-	-	September 19, 2014	23
Start up for 2015	Feed water pumps turned on.	14.17 (2.60)	11.61 (2.13)	May 16, 2015	24
Contango Site Visit #1	Microbiology, soils, water tested. *Carex* stem counts. Added more aquatic moss. Put black wrap on water tank to prevent algal growth. Water depth adjusted with sandbags.			June 18, 2015	57
Flow rate increased	Flow rates increased.	17.44 (3.20)	15.81 (2.90)	July 13, 2015	82
Contango Site Visit #2	Microbiology, soils, water tested. Added more aquatic moss.			August 16, 2015	116
Contango Site Visit #3	Water tested. Started Fe-EDTA test on System 2.			September 17, 2015	148
	Microbiology, soils, plants, water tested.			September 18, 2015	149
Fe-EDTA Testing	Daily total and dissolved copper analysis conducted at Minto.			September 19 – 26, 2015	150-157
Freeze up for Winter	Feed water pumps turned off.	-	-	September 29, 2015	160

Table 6-2: Passive Water Treatment Research Key Findings (2015)

Objective	Purpose	Key Findings
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 -Increased slope on sides, and riprap or sandbags added at shores would prevent water short circuiting and deter wildlife access
		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** -Copper treatment improving through commissioning period; wetland achieving better treatment than suggested by inflow and outflow concentrations of system, as soils are leaching copper -Cadmium and selenium are also being removed from water -Wetland is maturing as expected and is performing beyond anticipated from the design -Tracer study recommended for 2016 to assess hydrology and pore volume of CWTS and determine HRT and removal rate coefficients for full-scale sizing
		Soils -Soil redox has decreased as expected, reaching targeted ranges in Series 1 by the end of 2015, while Series 2 continues to establish -Significant amounts of metals are leaching from soil substrate into water, putting additional treatment demands on system
		Microbes -Sulphide-producing bacteria needed for copper and other metals removal have increased over time as soil redox achieved target ranges. Proportions are comparable to those in pilot system at similar point in commissioning -Abundance of selenium- and nitrate-reducing organisms are similar to those in pilot testing, indicating maturation as expected -Selenium treatment performance expected to increase as mosses continue to grow, as they can

Objective	Purpose	Key Findings
		sorb dissolved selenium and harbour highest abundance of selenate-reducing microorganisms to render the selenium insoluble
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)
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

6.4 Proposed Reclamation for 2016

Proposed reclamation for 2016 includes the following:

- Completion of the MVFES2;
- Continuation of the Passive Treatment Water Research;
- Minor recontouring work.

7 Water Management and Water Balance

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.

7.1 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 W36 MCDS 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.

7.1.1 Operations Overview

The water treatment system operated for 77 days in 2015, from January 1 to July 27, and treated 357,211 m^3 of water. The RO units operated for 1,903 hours producing 120,568 m^3 of permeate water which was discharged to WSP. RO removal efficiency decreased throughout the operating season as a result of low water temperatures, and calcium and other contaminant build up in the RO membranes. This resulted in several hours of down time in order to wash the membranes. Table 7-1 and Table 7-2 summarize the 2015 water treatment operations statistics, reagent consumption and contaminant removal efficiency.

Table 7-1: WTP Operating Statistics (2015)

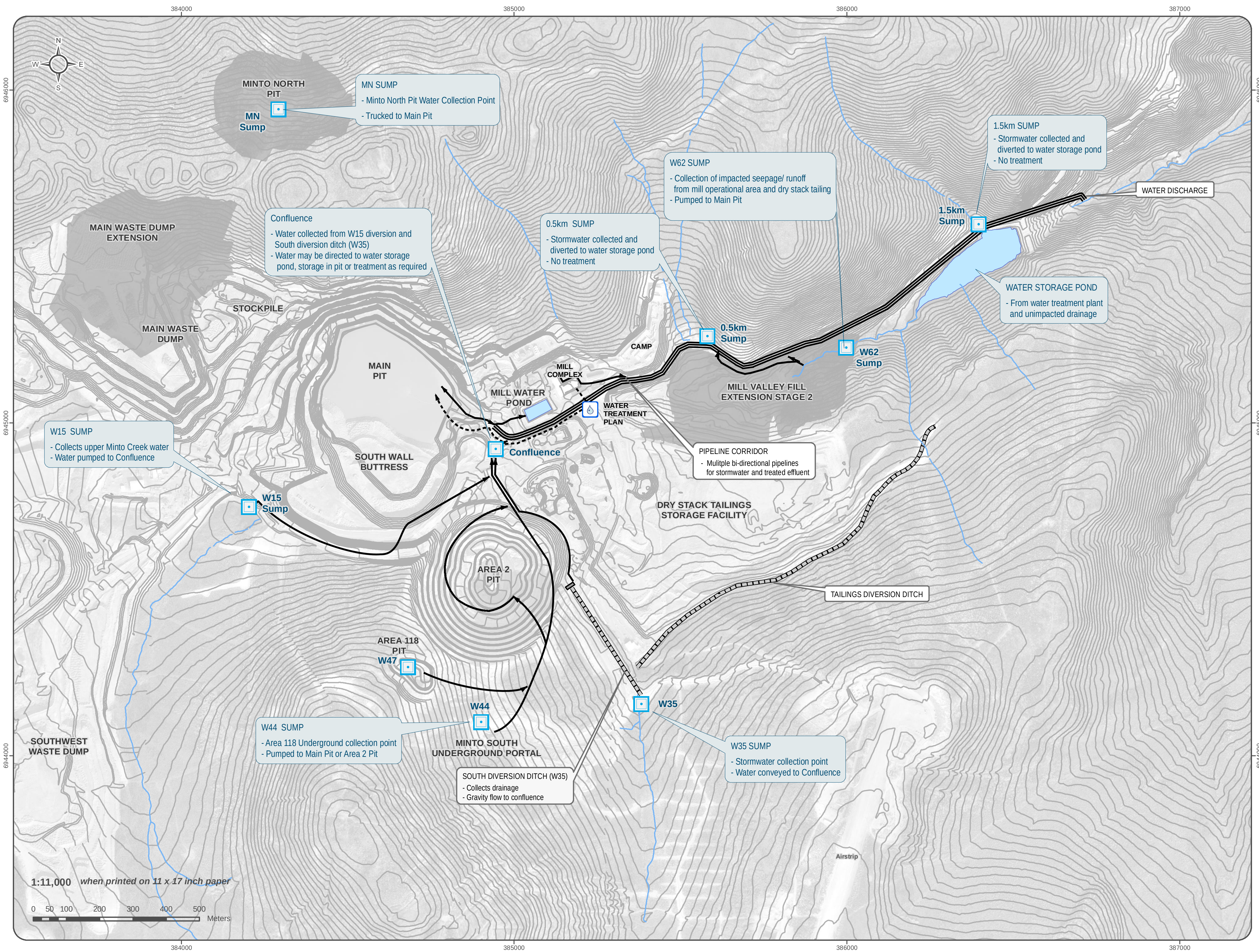
WTP Statistics 2015	
Plant Feed (m^3)	357,211
RO Treated (m^3)	120,568
Discharged to WSP (including blending) (m^3)	120,568
Runtime (hour) (Discharge hours)	1903
Recovery (%)	66
Yardney psi	35
Reagent Consumption	
Polyclear 2528 (floc) bags	8
Flowrate floc (average ml/min)	1,686
Hydrex (totes)	25
Average Flowrate Hydrex (average ml/min)	170.2
TMT liters	0
Flowrate TMT (average ml/min)	0
Actisand (85 micron sand) kg	2,974
Sodium Bicarbonate bags	76
Antiscalant liters	1,248
1 micron filters each	1,134
RO	65
CUNO	255

Table 7-2: WTP Constituent Removal Summary (2015)

Parameter	Units	Average WTP Feed	Average WTP Product
pH-L	pH units	8.2	7.7
Cond-L	µS/cm	939	337
TDS	mg/L	638	218
TSS	mg/L	8.3	1.8
Ammonia	mg/L	1.39	0.58
N-NO2	mg/L	0.20	0.13
N-NO3	mg/L	13.53	5.33
Al-T	mg/L	0.2	0.1
Cd-T	mg/L	0.000023	0.000011
Cr-T	mg/L	0.001	0.001
Cu-T	mg/L	0.017	0.002
Fe-T	mg/L	0.2	0.1
Pb-T	mg/L	0.00020	0.00020
Mo-T	mg/L	0.059	0.019
Ni-T	mg/L	0.0025	0.0012
Se-T	mg/L	0.0056	0.0019
Zn-T	mg/L	0.0061	0.0085

7.2 Water Storage and Conveyance Network

There were no major changes to the management of water storage or conveyance structures in 2015. The strategy for managing the mine water inventory was unchanged in 2015, and the water conveyance network is illustrated in Figure 7-1. 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.



MINTO MINE

WATER LICENCE
QZ14-031/QML-0001
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FIGURE 7-1

OPERATIONAL WATER MANAGEMENT

capstone MINTO MINE

- Collection Point
- Pipe Alignment
- Piping Corridor
- Tailings Slury Discharge
- Mine Feature Footprints

AEG

Aerial imagery obtained from Challenger Geomatics. Imagery acquired Sept 9th 2014.
Site contours derived from 2012 aerial imagery obtained from Challenger Geomatics.

Hydrology data provided by Minto Explorations Ltd, May 2009.

Datum: NAD 83 Projection: UTM Zone 8N

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(*Last edited by: amatlashevska;3/29/2016/11:27 AM*)

7.3 Water Storage Volumes Movement and Tracking

The main water balance components are summarized in Table 7-3 and include the volumes of water stored at the Minto Mine, and the volume discharge to Minto Creek in 2015. Table 7-4 provides a summary of water volumes moved by conveyance structure but is not reconciled against the water balance.

Table 7-3: Minto Mine Water Balance Summary (2015)

	Units	Main Pit Tailings Management Facility	Area 2 Pit Tailings Management Facility	WSP
Volume Change 2015 (water + tailings)	m^3	-106,337	1,024,087	-97,406
Tailings Deposited, total	BCM	149,779	344,556	-
Water Volume Change 2015	m^3	-256,116	679,531	-97,406
Estimated Groundwater Inflow	m^3	0	60,000	0
Total Water Inventory Increase in 2015	**m^3**	386,000		
Total Water Discharged to Minto Creek	m^3	328,526		
Total Site-Wide Yield in 2015	**m^3**	**714,534**		

Table 7-4: Volume of Water Moved by Conveyance Structure (2015)

Description	W15 to Main Pit	W17 to WSP	W35 to Main Pit	W35 to WSP	W36 to Main Pit	W44 to Main Pit	W44 to 118 Pit	W44 to Area 2 Pit
Annual Conveyance Volume (m^3)	103,161	49,374	1,155	30,215	44,484	28,594	13,030	3,673
Description	**Main Pit to WTP**	**Main Pit to Mill**	**Mill to Main Pit**	**Mill to Area 2 Pit**	**Main Pit to Area 2 Pit**	**Area 2 Pit to Main Pit**	**WTP to WSP**	**Camp Well**
Annual Conveyance Volume (m^3)	333,225	1,569,475	355,351	1,270,644	151,000	298,336	120,568	9,989

Please note that approximately 76, 500 m^3 reports directly to the Main Pit and is not captured by flow monitoring devices above. Additionally, approximately 140, 850 m^3 reports directly to the WSP and is not captured by flow monitoring devices above. The reported volumes are approximates only.

7.3.1 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 30,215 m^3 moved through this structure in 2015 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 103,161 m^3 was conveyed through the W15 conveyance structure in 2015. 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 44,484 m^3 was conveyed through this structure in 2015. The flow volumes were measured and recorded using a Seametrics® mag flow meter with digital head relay module. The 2015 flow volume from the MCDS was lower than predicted based on previous seasons; possible causes for the discrepancy include the winter glaciation at the MCDS which resulted in overflow conditions and water not reaching the conveyance structure.

7.3.2 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 831,081 m^3 of water was conveyed to the Main Pit in 2015 (note that this volume includes water from conveyed from the mill to the Main Pit; Table 7-4).

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 1,425,317 m^3 was conveyed to the Area 2 Pit in 2015.

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 200,157 m^3 of water was conveyed to the WSP in 2015 (Table 7-4).

7.3.3 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 2015 site water balance and water quality prediction model update, provided in Appendix H.

7.3.4 Water Conveyance Construction

Maintenance activities on water conveyance structures included repair of a slope in the water storage pond due to erosion. Otherwise routine maintenance on water conveyance structures took place.

8 Closure

Minto trusts this document fulfills the 2015 annual reporting requirements of Minto Mine's WUL and QML.

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Appendix A – Minto Mine Spill Contingency Plan

Appendix B – MMER Effluent Monitoring and Environmental Effects Monitoring Water Quality 2015 Submissions

Appendix C – Minto Mine Phase 4 Study Design Report

Appendix D – Minto and McGinty Creek 2015 Surface Hydrology Update

Appendix E – Seepage Monitoring Program Laboratory Results

Appendix F – Minto Creek Sediment, Periphyton and Benthic Invertebrate Community Assessment - 2015

Appendix G – Fisheries Monitoring Program, Minto Creek, 2015 Summary Report

Appendix H – 2015 Water Balance and Water Quality Model Summary for the Minto Mine Site

Appendix I – Wildlife Tracking 2015

Appendix J – 2015 Operations Adaptive Management Plan Thresholds

Appendix K – 2015 Annual Socio-Economic Monitoring Report

Appendix L – Groundwater Quality Monitoring Program Laboratory Results

Appendix M – Waste Rock Management Verification Program Results 2015

Appendix N – ABA Report

Appendix O – Minto Mine Constructed Wetland Treatment Research Program