DE BEERS CANADA INC.

SNAP LAKE MINE

SITE WATER QUALITY - 2013 UPDATE

December 2013

EXECUTIVE SUMMARY

This report documents site water quality predictions from the Snap Lake Mine (Mine) in the Northwest Territories (NWT). The purpose of the report is to present the methods used to predict the water quality discharging to Snap Lake from the Mine, and to provide the results of these predictions, which can be used to predict overall Snap Lake and downstream water quality, as required under Type A Water Licence MV2001L2-0002 (renewed to MV2011L2-0004).

The nature of the mining operations, geology of the kimberlite, and host rock, use of explosives, processing and waste management / material handling strategies govern the discharge water quality from the Mine site. The Mine site water quality model incorporates the various factors that influence Mine site water quality and links the modelling results from the hydrogeological (groundwater) model and the hydrodynamic (lake) model, while accounting for treatment and point source loading estimates to the system. Additonal work is underway to develop inputs for modelling post-closure water quatliy based on ongoing measurements on site, as such this report only provides results for the operational mining period through 2028.

Key Site Components

The Mine site consists of five inter-related major components:

1) **Snap Lake** – Snap Lake consists of two main water bodies, the northwest arm and Main Basin, which are connected by a narrow channel. A portion of the Main Basin provides recharge to the Mine workings. As a consequence, water from Snap Lake is continuously recycled during Mine operations; Snap Lake water quality changes dynamically over time.

2) **Mine** – Inflow to the Mine includes seepage from the lake and natural (connate) groundwater, the proportions of which will affect groundwater quality. Additional influencing factors are sediment production or dissolution, backfill placed in Mine openings, and explosives or cement use.

3) **North Pile** – Water quality is influenced by slurry water concentrations (processing), minewater influence, and interactions of the water with solid phase materials in the North Pile. Water migrates through the North Pile towards the perimeter ditches and sumps. From the sumps, water is pumped to the Water Management Pond (WMP). During post-closure, prior to freezing, the pore water of the fines fraction of the processed kimberlite (PK) stored in the North Pile will drain and influence water quality.

4) **Mine Site (and Non-Point Source Discharges)** – Mine site components include flow and chemical loading from site runoff over developed and undeveloped land footprints, process material discharges, and potable water intake. Domestic water discharge is directed to the treatment plant and main site water discharge.

5) **Treatment / Water Management Pond (WMP)** – Flows and chemical loading from the underground Mine, WMP, domestic water waste, and the North Pile (via the WMP) report to the treatment plant with treated water discharged to Snap Lake. The WMP collects runoff from the site and provides backup and upset storage capacity during operations.

A mass and flow balance model (GoldSim) was used to integrate the flow and mass loading from the Mine site components to develop overall estimates of water quality and mass load for the Mine site water quality.

Key Result Summary

Results of the modelling are provided within the main body of the report. Results show that, in terms of site water quality, total dissolved solids (TDS) concentrations during operations will peak and stabilize at approximately 850 milligrams per litre (mg/L) for the Lower Bound Scenario and at approximately 1,800 mg/L for the Upper Bound Scenario. Trends show an increase for most parameters between 2013 and 2018 then more gradual increases or stable concentrations.

Key Conclusions

The two main influences to site water quality are the Mine and North Pile. The proportion of deeper groundwater and the degree of recycling of water between the lake and Mine are the dominant influences on water quality predictions from the Mine. Specifically, deeper, more saline groundwater is the primary influence on the concentrations of major ions in the final discharge water from treatment.

Operations:

- The underground minewater accounts for the majority of loading to treatment and to overall Mine site discharge during operations. The influence of the North Pile and Mine site discharge can be observed in seasonal increases added to the Mine load trend.
- Deeper, saline groundwater (connate water) is the primary source of loading to the Mine for major ions and TDS. Elevated and lower connate water flows have been modelled. Cycling of water from Snap Lake back to the Mine also has an influence on the rate of increase of concentrations in the Mine.
- During operations, loading from non-point sources and seepage to Snap Lake are negligible relative to the discharge and loading reporting from treatment discharge.
- Metal[1] concentrations and loading in the minewater are typically dominated by groundwater inflow characteristics and to a lesser extent by interaction with sediments on the Mine floor or material use.
- Material use is the primary source of nitrate and ammonia due to the explosives use during operations.

[1] Note that in this report the term ‘metal’ includes metalloids and non-metals

TABLE OF CONTENTS

SECTION **PAGE**

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

LIST OF ACRONYMS

ANFO	ammonium nitrate/fuel oil
ASME	American Society of Mechanical Engineers
BSMRP	Bulk Sample Mine Rock Pad
C	concentration
De Beers	De Beers Canada Inc.
EAR	Environmental Assessment Report
Golder	Golder Associates Ltd.
IEE	Institute of Electrical and Electronic Engineers
M	mass
Mine	Snap Lake Mine or Snap Lake Project
MVEIRB	Mackenzie Valley Environmental Impact Review Board
MVLWB	Mackenzie Valley Land and Water Board
N	nitrogen
NaCl	sodium chloride
NH_4	ammonia
NO_3	nitrate
NPS	non-point source
NWT	Northwest Territories
PHREEQC	A computer program for speciation, batch-reaction, one-dimensional transport, and inverse geochemical calculations
PK	processed kimberlite
PR	process flow
SE	seepage flow
TDS	total dissolved solids
TSS	total suspended solids
WMP	water management pond
WTP	water treatment pond
USNRC	U.S. Nuclear Regulatory Commission

UNITS OF MEASURE

%	percent
<	lower than
>	greater than
±	plus or minus
°C	degrees Celsius
d	days
h	hours
ha	hectare
g	grams
g/yr	grams per year
kg	kilograms
kg/d	kilograms per day
mg/L	milligrams per litre
mm	millimetre
mm/yr	millimeters per year
m^3	cubic metre
m^3/d	cubic metres per day
Mm^3	million cubic metres
$mgCO_3$/L	milligrams carbonate per litre
mg/L	milligrams per litre
t	tonnes
t/yr	tonnes per year
µg/L	micrograms per litre
yr	year

1 INTRODUCTION

This report documents site water quality predictions for the Snap Lake Mine (Mine) in the Northwest Territories (NWT). The purpose of this report is to present the methods used to predict the water quality discharging to Snap Lake from the Mine site, and to provide the results of these predictions.

Initial water quality predictions were prepared, and submitted as part of the Environmental Assessment Report (EAR) for the Mine to the Mackenzie Valley Environmental Impact Review Board (MVEIRB) in February 2002 (De Beers 2002a). As part of the Water License Renewal process for Type A Water License MV2001L2-0002, De Beers Canada Inc. (De Beers) is required to provide the Mackenzie Valley Land and Water Board (MVLWB) with updated water quality predictions for Snap Lake and the downstream receiving environment (De Beers 2011, 2013a).

The primary purpose of the site water quality model is to better understand and characterize the quality of site water to inform management and planning decisions for the Mine. The nature of the mining operations, geology of the kimberlite and host rock, use of explosives, processing and waste management, and material handling strategies govern the discharge water quality from the Mine site. The Mine site water quality estimates were developed through assessment of Mine site monitoring data and updated modelling of minewater inflows (Itasca 2013) and geochemical data as developed for the project (De Beers 2002b, 2013b). A chemical mass balance approach was then used to determine sources of chemical loading, and to estimate water quality.

The Mine site water quality model incorporates the various factors that influence Mine site water quality and links the modelling results from the hydrogeological (groundwater) model (Itasca 2013) and the hydrodynamic (lake) model (De Beers 2013a), while accounting for treatment and point source loading estimates to the system.

2 SITE COMPONENTS

2.1 Key Site Components

The Mine site consists of inter-related components. A schematic diagram outlining the main components contributing to flow and/or mass loading at the Mine is presented in Figure 2-1. The Mine site has five major components and several sub-components. The five major components are:

1) **Snap Lake** – Snap Lake consists of two main water bodies, the northwest arm and Main Basin of Snap Lake, which are connected by a narrow channel. A portion of the Main Basin provides recharge to the Mine workings. As a consequence, water from Snap Lake is continuously recycled during Mine operations; Snap Lake water quality changes dynamically over time.

2) **Mine** – Inflow to the Mine includes seepage from the lake and natural (connate) groundwater, the proportions of which will affect groundwater quality. Additional influencing factors in the Mine are sediment production or dissolution, backfill placed in Mine openings, and explosives or cement use.

3) **North Pile** – A thorough review of the North Pile flow and chemistry was undertaken. The primary influencing factors are the material types and structures of the North Pile. The use of coarse-grained internal and perimeter structures interspersed with fines fraction of the processed kimberlite (PK) deposited by slurry influences the routing of water (i.e., from process discharge, water for dust suppression or precipitation) from the North Pile to the sumps. Water on top of the North Pile will either run off along the surface, infiltrate rapidly through the coarse and grits fraction of the PK, or infiltrate more slowly through the fines fraction of the PK. Once water reaches the coarse-grained structures, it will move downward and laterally outward towards the sumps. From the sumps, water is pumped through monitoring location SNP 02-02 to the Water Management Pond (WMP). Water quality is influenced by slurry water concentrations, minewater influence, and interactions of the water with solid phase materials in the North Pile.

4) **Mine Site (and Non-Point Source Discharges)** – Mine site components are flow and chemical loading from site runoff over developed and undeveloped land footprints, process material discharges, and potable water intake. Domestic water discharge is directed to the treatment plant and main site water discharge. Most of the Mine site runoff reports directly to Snap Lake, with a small proportion reporting to the WMP.

5) **Treatment / WMP** – Flows and chemical loading from the underground Mine, WMP, domestic water waste, and the North Pile (via the WMP) report to the treatment plant; treated minewater is discharged to Snap Lake. The WMP collects runoff from the site and provides backup and upset storage capacity during operations.

The Mine site components are detailed further in Sections 5 through 9. A mass and flow balance model (GoldSim) as described in Section 3.2 was used to integrate the flow and mass loading from all of the Mine site components to develop overall estimates of water quality and mass loading for the Mine site water quality.

2.2 Water Balance

The water balance for the Mine site was developed based on available sources of information. Flow from the Mine workings was provided through the hydrogeological modelling completed by Itasca (Itasca 2013). Hydrological data and an effective mixing volume of Snap Lake were used based on the information provided in the lake model (De Beers 2013a). Flows from the North Pile and Mine site were updated in 2013 based on measurements collected primarily in 2011 through 2013, and expected surface areas and deposition rates developed based on the Mine Plan.

The major components contributing to flow at the Mine site are shown in Figure 2-1(a,b,c), summarized in Table 2-1, and are detailed further in Sections 5 through 9. The general flow logic and monitoring station input locations are provided in Figure 2-2.

Figure 2-1 General Site Overview

a) Aerial View of the North Pile and Site

Note: Photograph provided by De Beers Canada Inc., dated July 31, 2010.

Figure 2-1 General Site Overview (continued)

b) Aerial View of Mine Site Looking Southwest

Note: Photograph provided by De Beers Canada Inc., dated July 31, 2010.

c) Aerial View of the North Pile Development

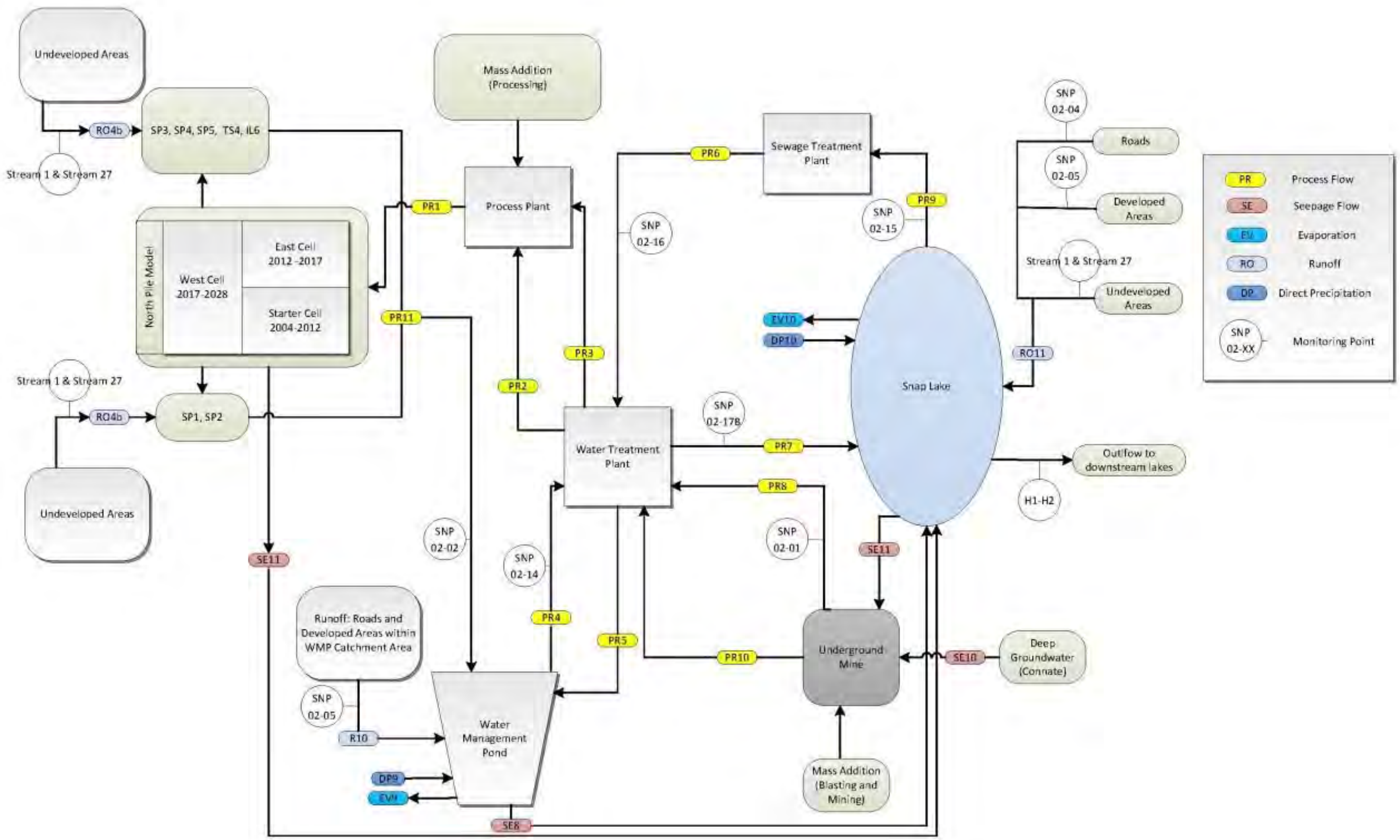
Note: Photograph provided by De Beers Canada Inc., dated July 31, 2010.

Table 2-1 Summary of Major Mine Site Flow Components

Description	Value	Source
SNAP LAKE		
In:		
Seepage / runoff to Snap Lake	Variable	Hydrology Data
- non-point source runoff (airstrip; roads)		
- natural 'clean' runoff		
Discharge from treatment to Snap Lake	Variable	GoldSim Calculations
Out:		
Snap Lake outflow to H1 & H2	Variable	Hydrology Data + Stage Discharge Curves
Snap Lake recharge to Mine workings	Variable	Itasca (2013)
MINE		
In:		
Flow reporting to Mine workings	Variable	Itasca (2013)
– flow from Snap Lake		
– flow from connate water		
Out:		
Flow pumped from Mine workings to water treatment plant (WTP)	Variable	GoldSim Calculations
NORTH PILE		
In:		
Water contribution from slurry in North Pile	Variable	De Beers (Licence Reporting Requirements)
Net runoff from the North Pile reporting to the sumps	Variable	Hydrology Data
Net runoff from undisturbed site areas reporting to the sumps	Variable	Hydrology Data
Out:		
Seepage to Snap Lake	$9.1x10^{-6}$ m^3/s	De Beers (2002a)
Storage released as drainage to sumps	Variable	Appendix II (HGS Model)
Net discharge from North Pile to the WTP	Variable	GoldSim Calculations
SITE		
Seepage / runoff from site to WMP	Variable	Hydrology Data
TREATMENT AND WATER MANAGEMENT POND (WMP)		
In:		
Net discharge from North Pile to the WMP	Variable	GoldSim Calculations
Net discharge from WMP to treatment	Variable	GoldSim Calculations
Out:		
Water from treatment for processing	Variable	GoldSim Calculations
Discharge from treatment to Snap Lake	Variable	GoldSim Calculations

WTP = water treatment plant; WMP= water management pond; m^3 = cubic metre; m^3/s = cubic metres per second.

Figure 2-2 General Flow Logic and Monitoring Stations



2.3 Mass Load Components

The geochemical mass load components are summarized in Table 2-2. The modelled water quality results are tracked in terms of dissolved load. While Snap Lake is accounted for in the GoldSim model, this is only for the purposes of defining the water quality of recharge infiltrating to the Mine workings. The various source terms are calculated and applied as discussed in Sections 5 through 9.

Table 2-2 Summary of Major Mine Site Chemical Loading Components

Description	Value	Source
SNAP LAKE		
In:		
Concentration / mass of seepage / runoff to Snap Lake	Variable	De Beers Snap Lake Environmental Database
- non-point source runoff (airstrip, roads)		
- natural 'clean' runoff		
Concentration / mass from treatment to Snap Lake	Variable	GoldSim Calculations
Out:		
Concentration / mass from Snap Lake outflow to H1 & H2	Variable	GoldSim Calculations
Concentration / mass from Snap Lake recharge to Mine workings	Variable	GoldSim Calculations
MINE		
In:		
Concentration / mass to Mine	Variable	GoldSim Calculations; Explosive Use (Appendix I)
– from Snap Lake		
– from connate water		Itasca (2013)
Out:		
Concentration / mass from Mine workings to WTP	Variable	GoldSim Calculations
NORTH PILE		
In:		
Concentration / mass from slurry in North Pile	Variable	De Beers Snap Lake Environmental Database; GoldSim Calculations
Concentration / mass of runoff from the North Pile reporting to the sumps	Variable	De Beers Snap Lake Environmental Database
Concentration / mass of runoff from undisturbed site areas reporting to the sumps	Variable	De Beers Snap Lake Environmental Database
Out:		
Concentration / mass of seepage to Snap Lake	Variable	GoldSim Calculations
Concentration / mass of storage released as drainage to sumps	Variable	
Concentration / mass of discharge from North Pile to WTP	Variable	
SITE		
Concentration / mass of seepage / runoff from site to WMP	Variable	De Beers Snap Lake Environmental Database
TREATMENT AND WATER MANAGEMENT POND (WMP)		
In:		
Concentration / mass discharge from North Pile to the WMP	Variable	GoldSim Calculations
Concentration / mass discharge from WMP to treatment	Variable	GoldSim Calculations
Out:		
Concentration / mass of water from treatment for processing	Variable	GoldSim Calculations
Concentration / mass discharge from treatment to Snap Lake	Variable	

WTP = water treatment plant; WMP = water management pond; Mine = Snap Lake Mine.

3 METHODS

The estimates of water quality discharge from the Mine site were developed by compiling and assessing available data for the various components contributing to or affecting water quality and mass loading on site:

- site monitoring data;
- laboratory test data;
- measured flow data;
- data provided by hydrology, lake mixing, and groundwater models;
- Mine Plan; and,
- materials and waste management plan.

Water flow through each of the units on-site was calculated based on measured flow data, hydrologic data, or hydrogeological modelling as discussed in Sections 5 through 9. Water quality estimates of various sources were based on on-site monitoring data, laboratory results, and mass loading considerations. Overall water quality estimates for discharges to Snap Lake were developed using these source terms, and adjusted for geochemical controls as discussed below. A schematic diagram showing linkages is provided in Figure 2-2.

3.1 Geochemical Input Methods

Sources of geochemical input were assessed to develop rates of solute mass release or expected concentrations for given areas or materials using information from:

- on-site monitoring data;
- material use;
- laboratory data; and,
- geochemical controls.

Chemical loading estimates were based on a review of site monitoring data (De Beers 2013b) and laboratory test work (De Beers 2002b). The various methods of chemical and mass load applied are summarized below. Detailed methods for assigning chemistry, and loading for each of the main site components are presented in Sections 5 through 9.

3.1.1 On-Site Monitoring Data

Operational site water quality monitoring data have been collected since 2004. Monitoring data were incorporated into the Mine site model to represent initial conditions, and trend and correlation analyses (Appendix III) were conducted to determine which parameters were likely to change over time as operations progress. Where supported by expected geochemical conditions, site water quality monitoring data and trend analyses were used to develop model inputs from the following locations:

- Stream 1 and Stream 27 (combined to develop estimate of clean runoff to Snap Lake);
- SNP 02-01 (underground Mine sump);
- SNP 02-02 (used in part for initial North Pile water quality and process water quality);
- SNP 02-04 (runoff from the airstrip, roads, and laydown areas composed of granite);
- SNP 02-05 (site runoff from developed areas) and,
- SNP 02-17b (treated effluent, calculated treatment efficiency).

As described in Section 6, minewater quality monitoring data were used, where appropriate, to represent chemical source term inputs in the underground Mine:

- major ion and TDS connate water concentrations were based on measured or calculated TDS data at various locations and depths below the dyke as described in Itasca (2013); and,
- metal concentrations were based on monitoring and trend analyses of monitoring results, from minewater discharge at SNP 02-01, in consideration of expected geochemical conditions.

3.1.2 Mining, Processing, and Explosives Use

As a result of mining and processing, material is crushed and ground, which exposes additional surface area and contributes to the mass load to the system. During the 2013 evaluation, water entering the Mine and process plant was compared with the water leaving the Mine and process plant to develop and understand the changes in chemistry due to mining, and those due to processing. Based on the readily observable differences in concentrations between the two waters, an incremental mass load addition was developed and applied to the model to account for the processes that change the water chemistry. Given that the rate of processing and mining is expected to be relatively consistent through the Mine life, this incremental load is a function of the mining rate rather than the volume of flow. Explosives are also used in mining, contributing additional mass (primarily nitrate and ammonia). The measured explosive use rate (De Beers 2013c) was used to update projected mass load rates for ammonia (NH_4), and nitrate (NO_3). In both cases, the mass released was added to the calculated water flow rate to develop estimates of concentration over time for these parameters.

3.1.3 Kinetic Test Data Use in Loading Rates

Laboratory kinetic (repetitive leach) test data (Appendix IV) were used to represent water quality from the North Pile, for estimating the loading rates due to precipitation interacting with rock and PK. Monitoring data for the operating North Pile (available since 2004) were applied to represent pore water quality within the North Pile (De Beers 2013b). These monitoring data essentially represent a long term field kinetic test, the data from which provide useful estimates of potential leachate from processing and deposition within active areas of the North Pile. Initial pore water chemistry of the North Pile is well represented by the monitoring data, and was used, coupled with an understanding of relevant geochemical properties of the material and flow characteristics, to develop appropriate loading estimates from the North Pile.

3.1.4 Geochemical Controls

For treated effluent discharge, measured treatment effectiveness was used to control some parameters in the model as indicated in Section 8. The effectiveness of treatment is not necessarily related only to geochemical controls, flocculation and/or adsorption can also be influencing factors.

3.2 Mass Loading Calculations

To track mass movement and develop estimates of mass load and concentrations at various points in the system, the GoldSim Contaminant Transport model was selected as the main platform for the mass balance calculations. Supplemental calculations were completed using the geochemical speciation code PHREEQC (a computer program for speciation, batch-reaction, one-dimensional transport, and inverse geochemical calculations) and simple spreadsheets to develop the overall estimates of water quality discharging from the Mine site.

GoldSim is a highly graphical, flexible, object-oriented computer program that is designed to provide the user with an understanding of the factors that control the performance of an engineered or natural system defined by a user-specified mathematical model to predict the future behaviour and performance of the defined system. With respect to the Mine site, the GoldSim model was set up as linked elements or cells, with each cell describing an input condition, or process affecting water quality or flow. These cells were subdivided into containers within the model. Each container contained a group of elements linked together by appropriate mathematical relationships describing the pertinent processes. A diagram outlining the relevant linkages associated with the Mine site is provided as Figure 2-2.

The Snap Lake GoldSim model, as constructed, calculates water quality at various points on-site and at the site discharge locations. The inter-relationships and cycling of water between the various site components were incorporated in the GoldSim model through the use of feedback links by which the concentration at the previous model time step was used to calculate, through an iterative process, the concentration at the current time step.

The GoldSim program, as used for the Mine, is fully documented in the Main Users Guide (GoldSim 2013a) and the Contaminant Transport Module Users Guide (GoldSim 2013b). Version 10.50 was used for the predictive calculations completed in this report. Each release of GoldSim including its contaminant transport module is verified using an extensive test suite that includes over 600 individual tests before release. GoldSim code development, testing, and maintenance are compliant with ASME (1994). Code documentation is in general accordance with USNRC (1983). Documentation and configuration management are in general accordance with IEEE (1984).

3.3 Model Limitations

Detailed assumptions that govern the model are presented throughout the text. Key limitations of the modelling approach are:

- **Changes to Mine or site conditions** – The Mine description, and site conditions as identified in both projected and monitored data are the basis for the model. Changes in Mine or site conditions will necessarily result in changes to water quality predictions. The model is limited in its ability to accurately forecast operational conditions due to the dynamic nature of developments in a Mine of this type (e.g., North Pile deposition plans), and potential short-term changes to site conditions.

- **Groundwater inflow data** – Uncertainty related to groundwater inflows (such as heterogeneity in fractures, which control groundwater inflow) results in uncertainty in water quality predictions. Predicted inflow concentrations from connate water recharge also results in prediction uncertainties.
- **System complexity** – For the Mine site, care was taken to incorporate known processes as understood during model development. However, in natural systems and complex man-made systems, observed conditions will almost certainly vary with respect to estimated or predicted conditions.

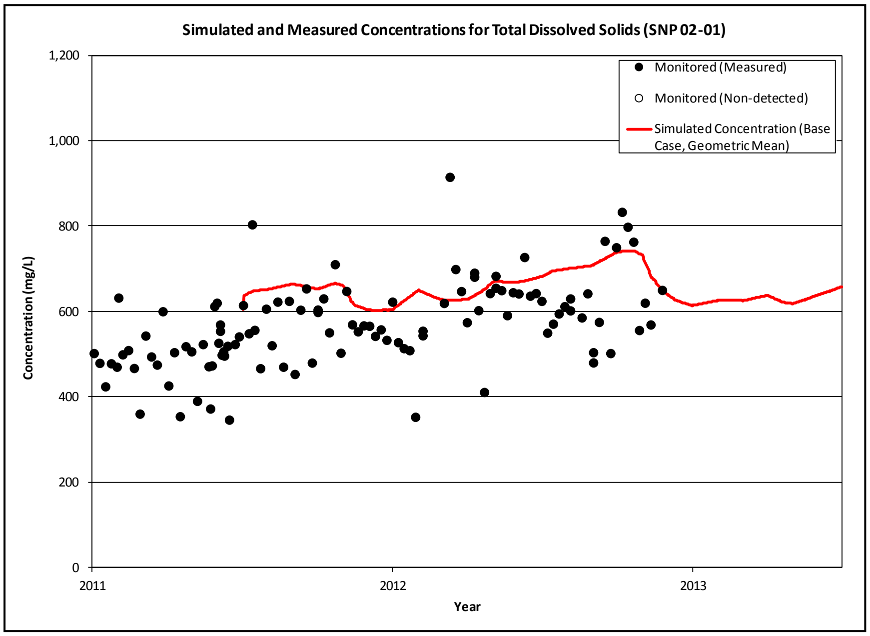
3.4 Model Calibration

For the calibration process, base case flows (Itasca 2013) and geometric mean concentrations for connate water were applied. Calibration for the contaminant transport component of the site-wide GoldSim model was linked to flow estimates of the model's water balance component (De Beers 2013d). However, calibration for contaminant transport was also completed so that the appropriate mass loadings were included within the model.

The calibration targets for the contaminant transport component comprised of 2011 to 2013 measured concentrations at select locations of the site (SNP 02-01, SNP 02-02, and SNP 02-17). Simulated water chemistry was compared to measured water chemistry at those specified locations (Appendix V). Additionally, the calibration process aided in 'refining' the 'additional' mass loadings, which were included to compensate for activities such as mining and processing (Section 3.1.2). Figures 3-1 through 3-3 illustrate the measured and simulated concentrations from the Mine, North Pile, and WMP.

In general, the resulting curves indicated a reasonable match between the simulated and measured concentrations. There was an over-prediction of nitrate/nitrite and of TDS concentrations at SNP 02-17B. Thus, the calibration appears reasonable and conservative.

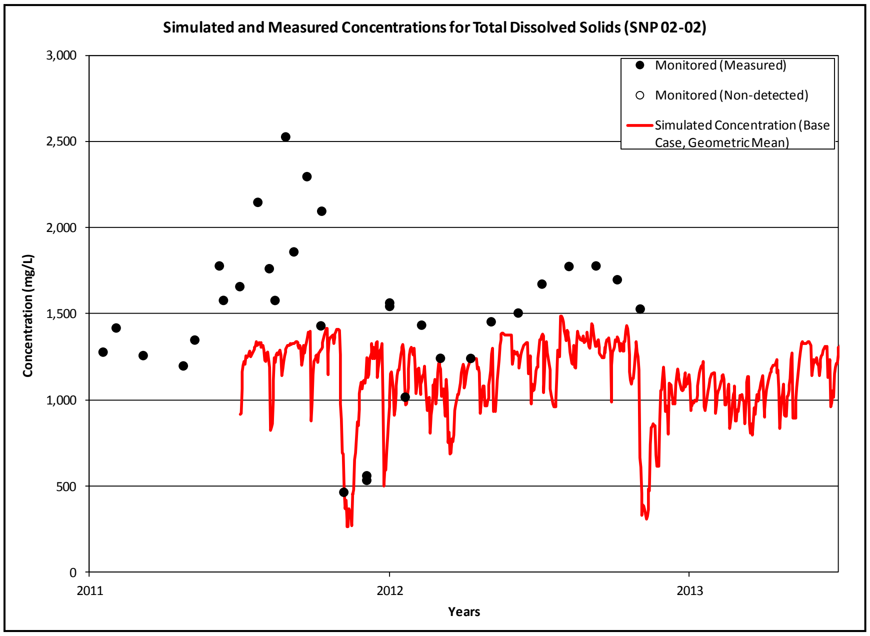
Figure 3-1 Mine Calibration: SNP 02-01 Simulated and Measured Total Dissolved Solids



mg/L= milligrams per litre.

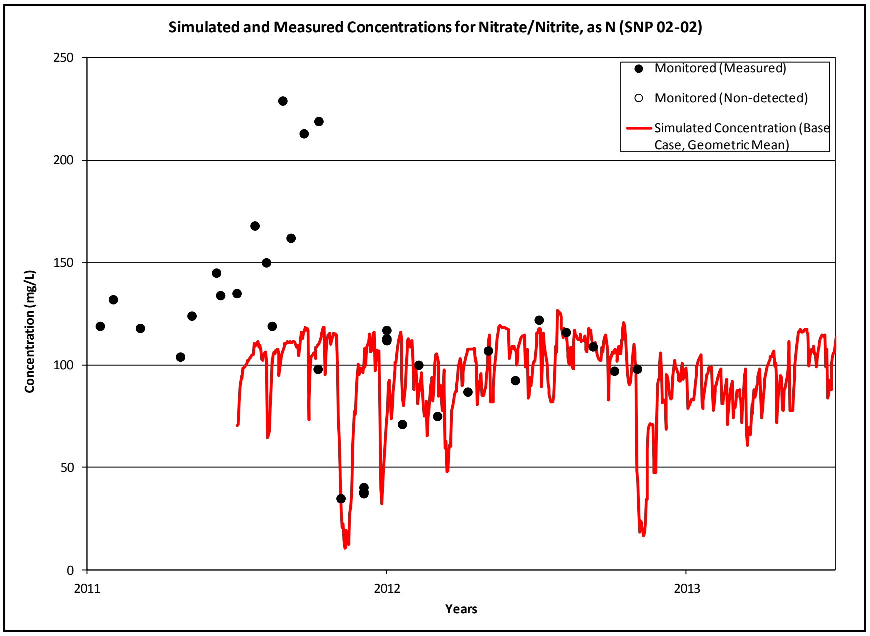
Figure 3-2 North Pile Calibration: SNP 02-2 Simulated and Measured Total Dissolved Solids and Nitrate/Nitrite

a) Simulated and Measured TDS Concentrations



mg/L= milligrams per litre; TDS = total dissolved solids.

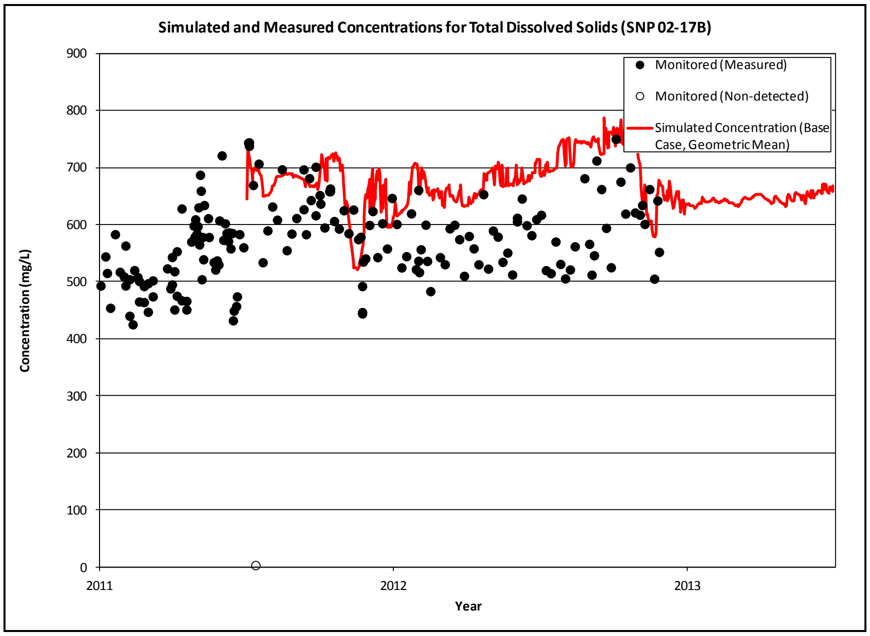
b) Simulated and Measured Nitrate/Nitrite Concentrations



mg/L= milligrams per litre.

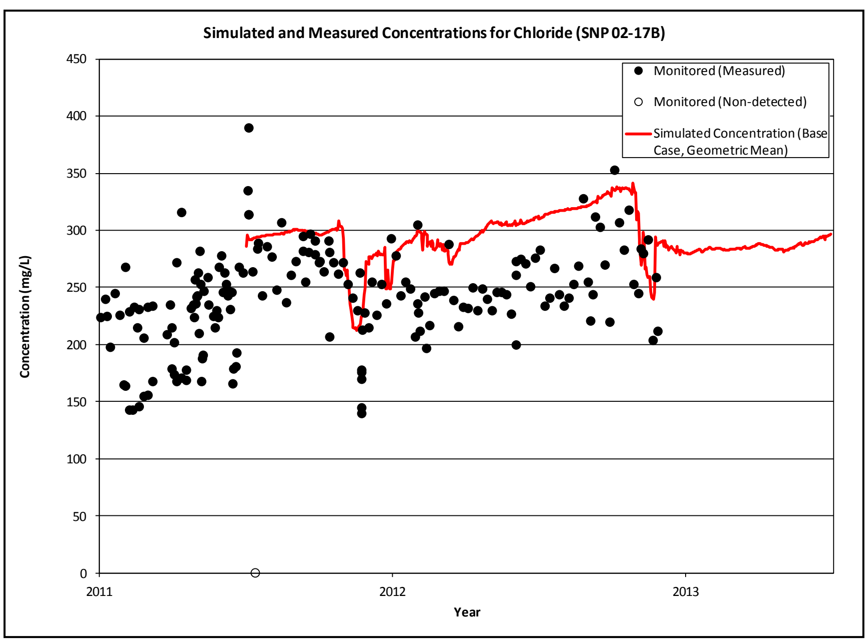
Figure 3-3 Treated Discharge Calibration – SNP 02-17B Simulated and Measured Total Dissolved Solids, Chloride, Nitrate/Nitrite, and Strontium

a) Simulated and Measured TDS Concentrations



mg/L= milligrams per litre; TDS = total dissolved solids.

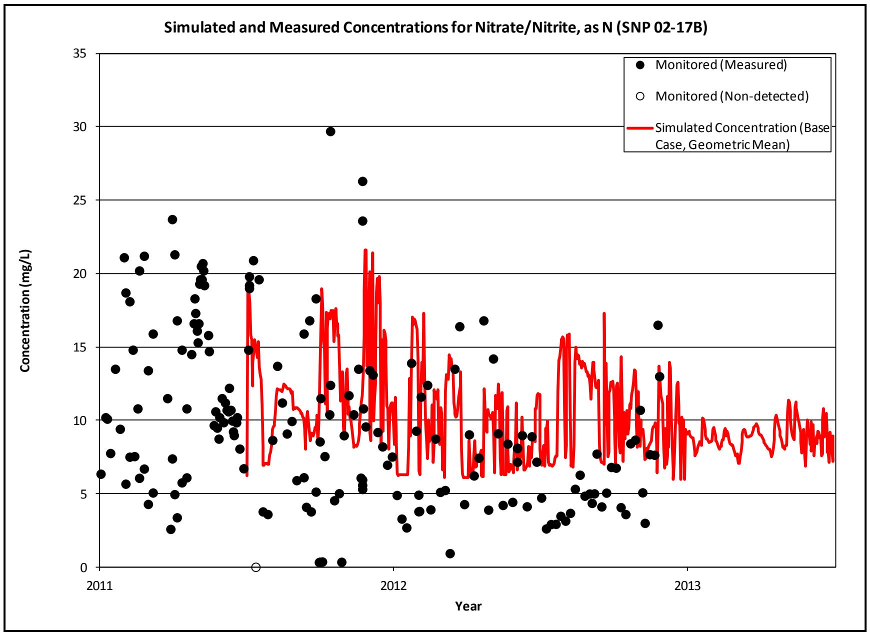
b) Simulated and Measured Chloride Concentrations



mg/L= milligrams per litre.

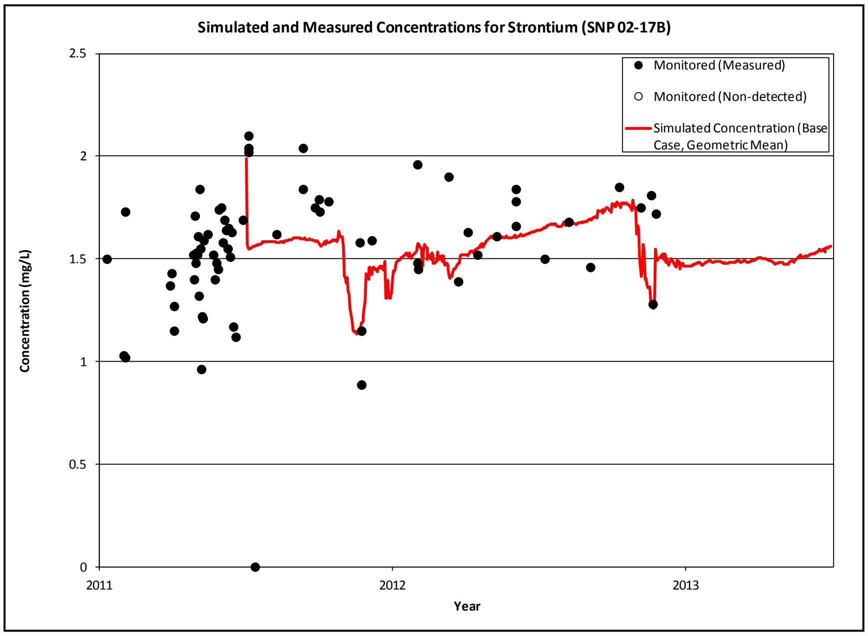
Figure 3-3 Treated Discharge Calibration – SNP 02-17B Simulated and Measured Total Dissolved Solids, Chloride, Nitrate/Nitrite, and Strontium (continued)

c) Simulated and Measured Nitrate/Nitrite Concentrations



mg/L= milligrams per litre.

d) Simulated and Measured Strontium Concentrations



mg/L= milligrams per litre.

4 MODEL SIMULATIONS

The Mine site model results included in this report represent the results of four model simulations:

- Lower Bound Scenario A (Appendix VI): Based on minewater flows from the Base Case of the groundwater model (Itasca 2013) – decreased flows from lake and connate water; arithmetic mean connate water TDS;
- Lower Bound Scenario B (Appendix VII): Based on minewater flows from the Base Case of the groundwater model (Itasca 2013) – decreased flows from lake and connate water; geometric mean connate water TDS;
- Upper Bound Scenario A (Appendix VIII): Based on minewater flows from Scenario 4 of the groundwater model (Itasca 2013) – elevated lake and connate water flows; arithmetic mean connate water TDS concentration; and,
- Upper Bound Scenario B (Appendix IX): Based on minewater flows from Scenario 4 of the groundwater model (Itasca 2013) – elevated lake and connate water flows; geometric mean connate water TDS concentration.

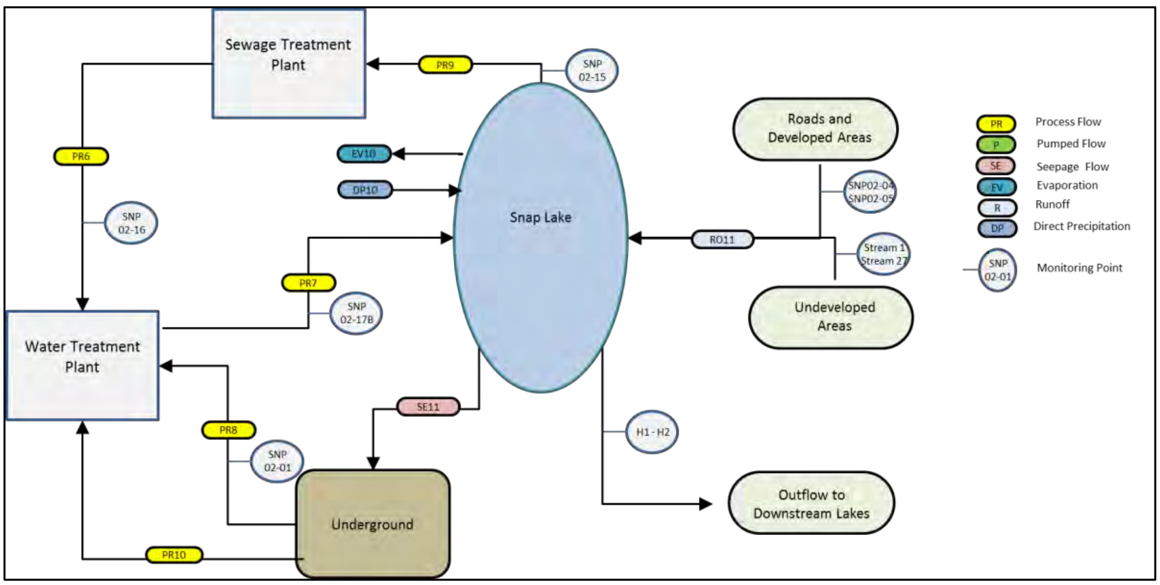
All scenarios were similar with respect to model setup. The primary difference between the models was the flow from the lake and connate water into the Mine, and TDS concentrations assigned to the deeper connate water. Based on results provided by Itasca (2013), the Upper Bound Scenarios were assigned higher Mine inflows, and assigned connate water TDS concentrations of 3,490.2 and 5,727.9 mg/L for the geometric and arithmetic means, respectively. The Lower Bound Scenario flows provided by Itasca (2013) for Mine inflows were lower, and were assigned connate water TDS concentrations of 3,490.2 and 5,727.9 mg/L for the geometric and arithmetic means, respectively.

5 SNAP LAKE

5.1 Background

Snap Lake will receive treated water discharge and non-point source discharge from the Mine site. During development, operation, and post-closure, the waters in Snap Lake consist of a natural runoff component and Mine site discharge components. These components mix in Snap Lake and discharge to the Lockhart River system. During operations, water from Snap Lake will recharge the Mine workings, from where it will be pumped out, treated and discharged back to Snap Lake (Figure 5-1).

Figure 5-1 Simplified Schematic of Snap Lake System and Minewater Cycling



5.2 Flow Summary – Snap Lake

The total volume of water in Snap Lake is approximately 106 million cubic metres (Mm^3). For the purposes of modelling, the Effective Lake Volume of Snap Lake refers to that portion of the lake that mixes with the treated discharge and Mine site discharge before recharging the fractured rock and Mine workings. The Effective Lake Volume is estimated to be approximately 84.8 Mm^3 (or 80 percent [%] of the lake) based on the hydrodynamic mixing model results (De Beers 2013a). The Effective Lake Volume water recharges the lakebed sediments and fracture zones, and ultimately affects the recharge water quality in the Mine. Estimates of recharge to the fracture network were provided by Itasca (2013).

The estimated natural discharge included in the water balance (De Beers 2013d) includes runoff and seepage flows from the Mine site area. For the water quality model, a distinction must be made between natural Mine site runoff unaffected by Mine site activities (undeveloped areas) and Mine site runoff affected by the mining operation (developed areas). For the purposes of estimating runoff, and seepage from the Mine site, the water balance was used as the basis for assigning flows for the Mine site components. The natural precipitation, runoff, and seepage discharge that do not originate from the Mine site are greater than seepage and runoff derived from the Mine site.

In addition to the precipitation, runoff, and seepage components, the model accounts for both flow to the Mine from Snap Lake, and water reporting to Snap Lake due to discharge from the Mine during operations.

5.3 Mass Load – Snap Lake

Natural inflow or runoff concentrations are combined to include all hydrologic processes affecting water quality in Snap Lake under baseline conditions. Baseline concentrations measured prior to mining are provided in Table 5-1 for reference (De Beers 2002b). Initial concentrations in Snap Lake used in the model comprise January to March 2012 measured data (Table 5-2) to be consistent with the measured data at the start of the model simulation. For the purposes of the Mine site water quality modelling, concentrations in Snap Lake are calculated assuming that all discharge from the Mine site will be completely mixed in the Effective Lake Volume (84.8 Mm^3), which is defined as the area of Snap Lake that contributes recharge to the Mine workings. It is further assumed for the purposes of the Mine site water quality model that no attenuation of discharge parameters occurs in the Effective Lake Volume.

Mass load from the Mine site to Snap Lake is evaluated considering each of the following sources, as discussed in the identified sections:

- minewater (Section 6);
- processing Plant and North Pile (Section 7);
- non-point source runoff (Section 8); and,
- treatment discharge (Section 9).

Mass load from natural runoff, and from each of the above Mine site locations was added to the basin volume representing the Effective Lake Volume, which is the portion of Snap Lake that affects recharge to the Mine. All loadings were assumed to be fully mixed for development of water quality estimates in the Effective Lake Volume. The newly calculated basin water quality was then propagated through the lakebed sediments and rock mass, and mixed with the connate water of the fracture system to develop estimates of Mine recharge water quality in future time steps. In this fashion, the continuous cycling of minewater and lake water was accounted for in the GoldSim model.

Table 5-1 Baseline Water Quality in Snap Lake (from De Beers 2002a)

Parameter	Units	Snap Lake 1998 to 2001		
		Minimum	Maximum	Median
Conventional Parameters				
Alkalinity	mg/L	4	10	6
Total Dissolved Solids	mg/L	<10	70	15
Nutrients				
Ammonia	mg/L	0.002	0.086	0.024
Nitrate-N	mg/L	<0.006	<0.038	0.02
Nitrite-N	mg/L	<0.002	0.002	<0.002
Total Phosphorus	mg/L	<0.001	0.026	0.009
Dissolved Phosphorus	mg/L	<0.001	0.012	0.003
Orthophosphate	mg/L	<0.001	0.005	0.002
Total Organic Carbon	mg/L	<1	6.8	3.6
Major Ions				
Bicarbonate	mg CO_3/L	5.2	12	7
Calcium	mg/L	0.93	2.43	1.34
Chloride	mg/L	0.2	<1	<0.2
Fluoride	mg/L	0.04	0.06	<0.05
Magnesium	mg/L	0.48	1.01	0.61
Potassium	mg/L	0.32	0.78	0.44
Sodium	mg/L	0.44	1	0.57
Sulphate	mg/L	1.31	36	3
Dissolved Metals, Metalloids, and Non-Metals[(a)]				
Aluminum	µg/L	1.9	<30	10.3
Antimony	µg/L	<0.03	1.9	0.4
Arsenic	µg/L	<0.03	<0.2	<0.2
Barium	µg/L	1.8	4.5	2.4
Beryllium	µg/L	0.1	<0.2	<0.1
Bismuth	µg/L	<0.03	0.1	<0.1
Boron	µg/L	<1	3	1
Cadmium	µg/L	<0.05	0.1	<0.1
Chromium	µg/L	<0.06	0.8	0.3
Cobalt	µg/L	<0.1	0.2	<0.1
Copper	µg/L	0.4	4.4	0.7
Iron	µg/L	<0.005	0.041	<0.02
Lead	µg/L	<0.05	1.4	<0.2
Manganese	µg/L	<0.1	10	0.5
Mercury	µg/L	<0.01	<0.02	<0.01
Molybdenum	µg/L	<0.06	<1	<0.1
Nickel	µg/L	0.09	3.72	0.3
Selenium	µg/L	<0.01	<10	<1
Silver	µg/L	<0.01	0.1	<0.1
Strontium	µg/L	5.6	12.1	7.4
Thallium	µg/L	<0.03	0.1	<0.1
Titanium	µg/L	<0.1	<0.3	<0.2
Uranium	µg/L	<0.05	0.1	<0.1
Vanadium	µg/L	<0.05	0.1	<0.1
Zinc	µg/L	<0.5	24.2	<10

(a) The term ‘metals’ used in this report includes metalloids such as arsenic and non-metals such as selenium.

< = less than value shown, which is the detection limit; mg/L = milligrams per litre; µg/L = micrograms per litre; mg CO_3/L = milligrams carbonate per litre.

Table 5-2 Concentrations Used for Start of Model Run

Parameter	Units	Snap Lake January, February, March 2012	
		Average	Maximum
Conventional Parameters			
Alkalinity	mg/L	22.9	31.7
Total Dissolved Solids	mg/L	228	279
Total Suspended Solids	mg/L	1.55	3
Nutrients			
Ammonia	mg/L	0.22	0.34
Nitrate-Nitrite-N	mg/L	2.15	3.22
Total Phosphorus	mg/L	0.0014	0.0183
Total Kjeldahl Nitrogen	mg/L	0.57	1.14
Orthophosphate	mg/L	0.007	0.002
Major Ions			
Calcium	mg/L	46.1	62
Chloride	mg/L	100.8	121
Fluoride	mg/L	0.14	0.18
Magnesium	mg/L	5.69	7.5
Potassium	mg/L	2.22	2.85
Sodium	mg/L	24.3	31.4
Sulphate	mg/L	19.7	24.5
Dissolved Metals, Metalloids, and Non-Metals			
Aluminum	µg/L	2.34	9
Antimony	µg/L	0.22	1.11
Arsenic	µg/L	0.1007	0.151
Barium	µg/L	21.8	28.4
Beryllium	µg/L	0.005	0.005
Cadmium	µg/L	0.0078	0.066
Chromium	µg/L	0.0665	0.192
Cobalt	µg/L	0.025	0.263
Copper	µg/L	0.4215	0.72
Iron	µg/L	1.75	11.2
Lead	µg/L	0.0068	0.022
Lithium	µg/L	9.66	10.9
Manganese	µg/L	5.69	7.5
Mercury	µg/L	0.01	0.01
Molybdenum	µg/L	1.16	1.53
Nickel	µg/L	1.45	2.15
Selenium	µg/L	0.02	0.02
Reactive Silica	µg/L	1.28	2.58
Silver	µg/L	0.0025	0.0025
Strontium	µg/L	639	717
Thallium	µg/L	0.005	0.005
Uranium	µg/L	0.143	0.19
Vanadium	µg/L	0.025	0.025
Zinc	µg/L	1	3.97

Notes: Values based on average or maximum values as measured during January, February, and March of 2012 for all SNP Monitoring stations in the main basin of Snap Lake.

Average concentrations as presented used to represent Snap Lake Water Quality at the start of GoldSim Model Run.

< = less than value shown, which is the detection limit; mg/L = milligrams per litre; µg/L = micrograms per litre; mg CO_3/L = milligrams carbonate per litre.

5.4 Model Use – Snap Lake

Mass loading calculations for Snap Lake are only used within the Mine site water quality model to estimate the water quality reporting from Snap Lake to the Mine workings and back to treatment. Detailed hydrodynamic modelling of Snap Lake and discussion of distribution of flow and mass within the lake are reported in detail in De Beers (2013a). The hydrodynamic model was used to adjust the GoldSim calculations in an iterative fashion such that the mixing volume of the lake as used in the Mine site model was reasonably accounted for.

6 THE MINE

6.1 Background

The Mine at Snap Lake is an underground mine that has been developed as a series of drifts and panels from which ore is extracted via two haulage ramps. During operations, the groundwater inflow components to the Mine are connate water and recharge from Snap Lake (Figure 6-1: SE10 and 11, respectively). Recharge water from Snap Lake passes through lakebed sediments and fractured bedrock before reporting to the Mine workings. Water from the Mine is collected in sumps and pumped to the surface for treatment via two separate lines, one directly to the water treatment plant (Figure 6-1: PR8), and the other to the water treatment plant (WTP) via the WMP (Figure 2-2: PR3). When the treatment system cannot operate, or has insufficient capacity, the minewater is pumped to the WMP for interim storage before treatment and discharge. In post-closure, the Mine will be flooded, and the only discharge from the Mine will be via regional groundwater flow. An overview of the various inputs and their expected values for the Mine component is provided in Table 6-1.

Figure 6-1 Schematic of Minewater System

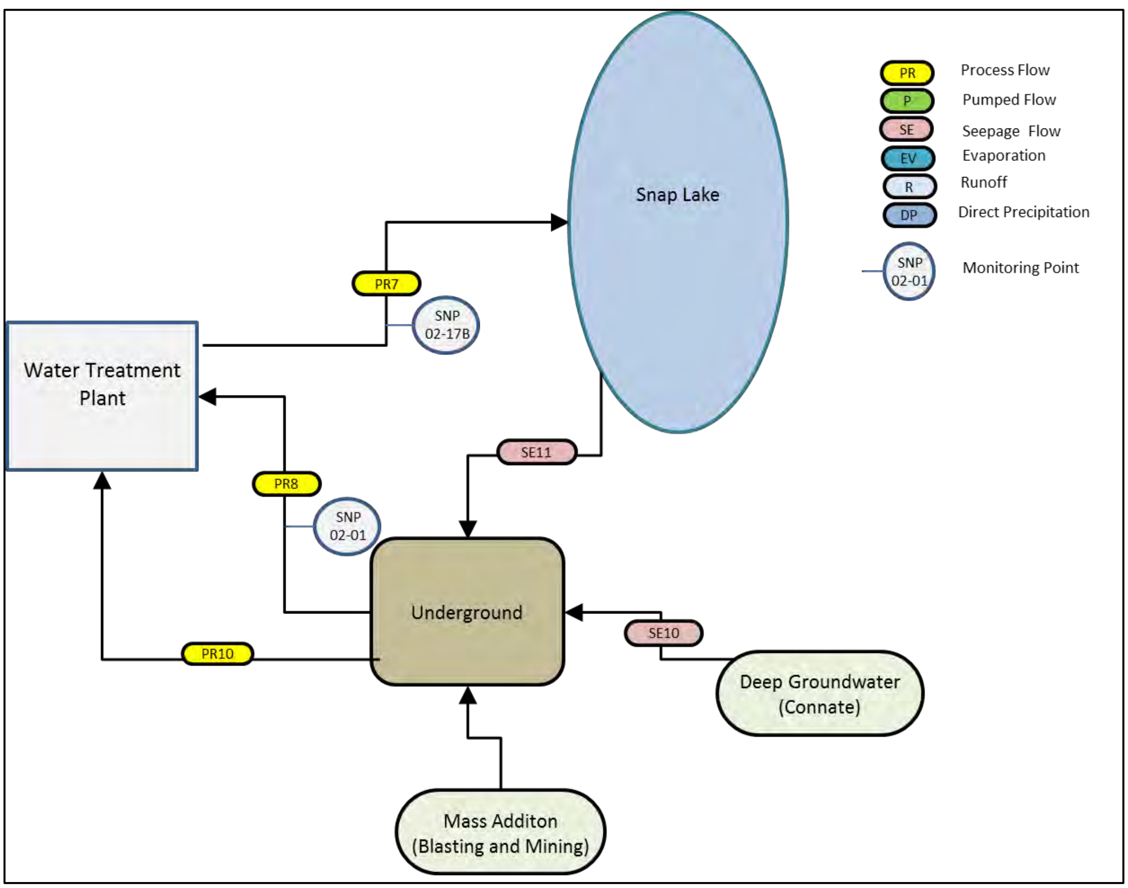


Table 6-1 Summary of Expected Case – Mine

ID	Description	Value	Source
FLOWS			
SE11 +SE10	Total inflow to Mine workings	(SE11 +SE10) Figure 6-2	Itasca (2013)
SE11	Snap Lake recharge to Mine workings	Figure 6-2	Itasca (2013)
SE10	Connate water recharge to Mine workings	Figure 6-2	Itasca (2013)
PR12	Underground storage of North Pile water	0 m^3/day – only used for upset conditions	N/A
PR8	Total water pumped from Mine workings	SE11 +SE10	Itasca (2013)
CHEMISTRY			
C(minewater)	Mass to Mine from lake and connate recharge	(SE11 x CSE11) + (SE10 x CSE10)	Calculated
C(SE11)	Concentration of lake recharge	Initial in Table 5-1, then calculated	Calculated in GoldSim
C(SE10)	Concentration of connate water	Geometric mean: 3,740.9 mg/l; or Arithmetic mean: 5,727.9 mg/L	Itasca (2013)
M(SE11)a	Incremental concentration addition as a result of mining	Table 6-4 (based on correlation and trend analyses of monitoring data)	De Beers (2013b)
M(SE11)b	Mass load due to explosives use	Appendix I	De Beers (2013c)
M(PR8)	Mass reporting to treatment or WMP	(Cminewater) x PR8 + M(SE11)a + M(SE11)b	GoldSim Calculations
C(PR8)	Concentration reporting to treatment or WMP	M(PR8) / PR8	GoldSim Calculations

WMP = Water management pond; % = percent; tonnes/yr = tonnes per year; m^3/day = cubic metres per day; mg/L = milligrams per litre; PR = Process Flow; SE = Seepage flow; C = Concentration; M = Mass.

6.2 Minewater Inflow and Discharge

Water inflow to the Mine originates from two primary sources:

- recharge water from Snap Lake; and,
- recharge of connate water.

The minewater discharge calculated during operations is the sum of the two primary sources. The groundwater inflow estimates are based on the Itasca (2013) groundwater model, as summarized in Table 6-2.

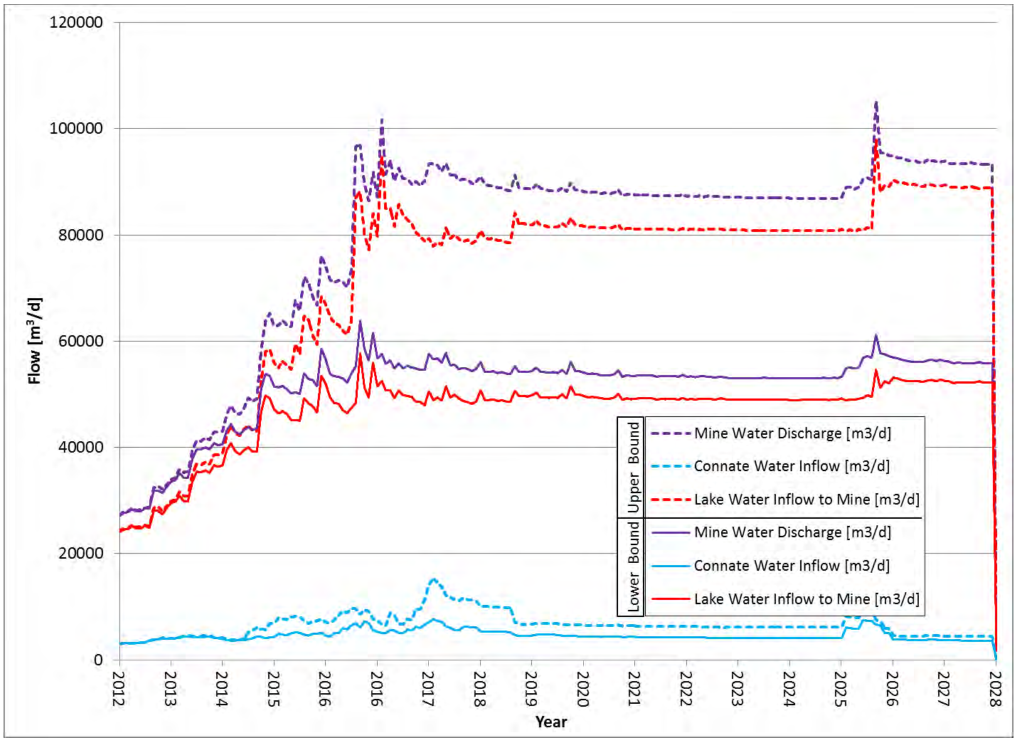
Table 6-2 Mine Inflow Summary

Year Represented	Inflow [m^3/d]	Minewater Outflow [m^3/d]	Notes
2012 to end of 2028	Snap Lake recharge + connate water recharge to Mine workings as per Itasca (2013)	Snap Lake recharge + connate water recharge to Mine workings as per Itasca (2013)	Mine Operations
>2028	0	0	Mine Closed

> = greater than; m^3/d = cubic metres per day.

The volumes of Snap Lake water, and connate water that enter the Mine were estimated based on hydrogeological information provided by Itasca (2013). The ultimate proportion of lake water to connate water recharging the Mine used in the GoldSim model was approximately 84% to 95% in the Upper Bound model, and 86% to 94% in the Lower Bound model (Itasca 2013). The total Mine inflow from groundwater recharge, and the relative proportions of inflow from the connate water and from Snap Lake used in the GoldSim model are provided in Figure 6-2.

Figure 6-2 Groundwater Inflows and Minewater Discharge Used in GoldSim



m^3/d = cubic metres per day.

6.3 Mass Load – Mine

Solid phase and dissolved phase mass load will result from activities within the Mine: drilling; blasting; grouting; and, haulage of rock and ore. The mass load reporting to the Mine is further complicated by the interaction of connate water with recharge from Snap Lake. The combined Mine recharge occurs in both operating and worked-out areas of the Mine.

Monitoring data from the Mine discharge from 2004 through to the end of 2012 (De Beers 2013b) were reviewed to determine implications, and trends with respect to concentrations released. Analyses included development of correlation matrices to understand relationships of the various components (Appendix III). Initial minewater concentrations were set based on the median concentrations observed in the monitoring data from the minewater discharge at SNP02-01 as shown in Table 6-3, following which the concentrations were calculated by GoldSim based on the factors expected to influence a given parameter. To make optimal use of current monitoring and laboratory data, the individual contributions to mass load were divided into the following integrated components:

- mass load due to recharge from Snap Lake;
- mass load due to connate water addition (for TDS and related parameters);
- mass load as a function of mining; and,
- mass load as a function of explosives use in the Mine.

Each of these components is accounted for in the water quality estimates as discussed in the following sections.

Table 6-3 Minewater Initial Input Values

	Units	Minewater Initial Input
Conventional Parameters		
Alkalinity (as $CaCO_3$)	mg/L	57.1
Total Dissolved Solids	mg/L	605
Total Suspended Solids	mg/L	695
Nutrients		
Ammonia (NH_4 as N)	mg/L	1.54
Nitrate-Nitrite-N (NO_3 + NO_2 as N)	mg/L	3.505
Total Phosphorus	mg/L	1.02
Total Kjeldahl Nitrogen	mg/L	1.88
Ortho-phosphate	mg/L	0.001
Major Ions		
Calcium	mg/L	126
Chloride	mg/L	292
Fluoride	mg/L	0.4205
Magnesium	mg/L	11.4
Potassium	mg/L	3.63
Sodium	mg/L	64.2
Sulphate	mg/L	39.4
Dissolved Metals, Metalloids, and Non-Metals		
Aluminum	µg/L	10
Antimony	µg/L	0.4
Arsenic	µg/L	0.47
Barium	µg/L	33.15
Beryllium	µg/L	0.25
Cadmium	µg/L	0.01
Chromium	µg/L	0.8
Cobalt	µg/L	0.19
Copper	µg/L	2.1
Iron	µg/L	8
Lead	µg/L	0.05
Lithium	µg/L	26.75
Manganese	µg/L	32.2
Mercury	µg/L	0.01
Molybdenum	µg/L	3.98
Nickel	µg/L	7.97
Selenium	µg/L	0.2
Reactive Silica	mg/L	10.5
Silver	µg/L	0.05
Strontium	µg/L	1.83
Thallium	µg/L	0.025
Uranium	µg/L	0.7
Vanadium	µg/L	0.885
Zinc	µg/L	3.2

Note: Initial concentrations are set at the median concentration from observed data between July 4, 2004 and June 19, 2013, at location SNP 02-01 (Data as available and vetted in the database).
mg/L = milligrams per litre; µg/L = micrograms per litre; mg-CO_3/L = milligrams carbonate per litre.

6.3.1 Mass Load Due to Recharge (Concentrations Dependent on Minewater Inflow)

Water recharging from Snap Lake (hanging wall water) will mix with deeper recharge water (footwall water or connate water) reporting to the Mine workings; relative proportions are provided in Section 6.2. The resulting groundwater recharge concentrations were based on the relative contributions from these two sources.

The initial recharge water from Snap Lake hanging wall and all footwall inflow water were assigned the median concentrations as observed from the Snap Lake water quality monitoring data (Table 5-2). Thereafter, the hanging wall recharge concentrations reflected the calculated concentrations in the Effective Lake Volume of Snap Lake, as determined from the previous time step in the GoldSim modelling (Section 5). For the footwall recharge concentrations, adjustments to assigned concentrations were made for parameters associated with TDS.

The hydrogeological minewater inflow model developed by Itasca (2013) provided the basis for assigning flow and TDS concentrations to the deeper component of groundwater flow. The TDS concentrations assigned to footwall water inflows for the four model iterations were as follows:

- Upper Bound Scenario A – High Flows: 5,727.9 mg/L TDS (arithmetic mean);
- Upper Bound Scenario B – High Flows: 3,490.2 mg/L TDS (geometric mean);
- Lower Bound Scenario A - Low Flows: 5,727.9 mg/L TDS (arithmetic mean); and,
- Lower Bound Scenario B – Low Flow: 3,490.2 mg/L TDS (geometric mean).

The concentrations of calcium, chloride, sodium, sulphate, lithium, and strontium are strongly correlated with TDS based on monitoring data results (Table 6-4; Appendix III), whereas alkalinity and potassium have some association with TDS but may not be influenced by changing TDS concentrations. The proportions of each of these parameters that comprised the TDS measured in the minewater were developed based on the ratios as observed in monitoring data collected in 2012 from location SNP 02-01 (De Beers 2013b). In the model predictions, these parameters were calculated as a relative proportion of the predicted TDS concentrations provided by Itasca (2013) (Table 6-4), exemplified in the case of chloride as:

$$C_{(HW\ Cl)(t)} = C_{(HW\ TDS)(t)} \times P_{(Cl)HW}$$

where,

$C_{(HW\ Cl)(t)}$ = Hanging Wall Chloride Concentration at a given time step

$C_{(HW\ TDS)(t)}$ = Hanging Wall TDS Concentration at given time step

$P_{(Cl)HW}$ = The proportion of TDS from chloride in Hanging Wall water (in this case $P_{(Cl)HW}$ = 0.37) and

$$C_{(FW\ Cl)(t)} = C_{(FW\ TDS)(t)} \times P_{(Cl)FW}$$

where,

$C_{(FW\ Cl)(t)}$ = Foot Wall Chloride Concentration at a given time step

$C_{(FW\ TDS)(t)}$ = Foot Wall TDS Concentration at given time step

$P_{(Cl)FW}$ = The proportion of TDS from chloride in Foot Wall water (in this case $P_{(Cl)FW}$ = 0.53).

Table 6-4 Correlation and Proportion of Parameters Relative to Total Dissolved Solids

Parameter	Snap Lake Mine 2004 to 2013		
	Correlation Coefficient [a] (relative to TDS)	Proportion of TDS Comprised of Parameter [b] (Hanging Wall)	Proportion of TDS Comprised of Parameter [c] (Footwall)
Alkalinity (as $CaCO_3$)	N/A	0.32	0.056
Calcium	0.99	0.21	0.21
Chloride	0.99	0.47	0.47
Potassium	0.1	-	0.0015
Sodium	0.99	0.12	0.12
Sulphate	0.91	0.066	0.061
Lithium	0.89	9.43E-05	5.25E-05
Strontium	0.96	0.002	0.003

(a) Data based on measurements taken from SNP 02-01.
(b) Applied as a function of TDS for mass entering the Mine via the hanging wall.
(c) Applied as a function of TDS for mass entering the Mine via the footwall.
$CaCO_3$ = calcium carbonate; - = less than detection limit; TDS = total dissolved solids; .

6.3.2 Concentrations Independent of Minewater Inflows or Mining Rate

Fresh surface area will be exposed as fine-grained particulate matter is generated during drilling, blasting, and hauling of mined rock. Dissolution of certain metals and major ions will be enhanced in the working areas of the Mine due to the presence of these fine-grained materials. In addition, footwall connate water is expected to occur at a relatively constant rate, and most associated parameters (other than those associated with TDS) are not expected to change substantially over time based on monitoring data trends (De Beers 2013b).

Monitoring of minewater discharge concentrations has been undertaken since 2004 and trend analyses are completed each year as part of the Annual Water Licence Reporting (De Beers 2013b). A trend analysis and correlation evaluation (Appendix III) of the monitoring data indicated which parameters tend to change as a result of mining or connate water addition (excluding TDS associated parameters), and the amount of associated mass that added to the minewater. For these parameters an "incremental mass" was added to the minewater in the model. The incremental mass for parameters not associated with TDS was calculated based on 2012 data for parameters which showed a substantial change between expected inflow mass versus measured minewater discharge mass as follows:

Incremental mass = Mass Discharged at SNP 02-01 – Mass from assigned to recharge water

The mass is added to the minewater prior to discharge as a daily incremental mass that does not change over time, or with volume of water, since it is considered to be a function of the amount of rock blasted or mined (the mining rate). These values, while variable over the short term, are reasonably constant over the life of Mine. Table 6-5 provides the mass added by each parameter.

Table 6-5 Incremental Mass Load

Element	Cumulative Mass 2012 [kg]	Daily Incremental Mass [kg/d][(a)]
Barium	109	0.3
Copper	43	0.12
Potassium	16,277	44
Magnesium	75,960	208
Manganese	543	1.5
Molybdenum	33	0.089
Nickel	109	0.3
Silica	92,237	252
Uranium	8	0.021
Total Phosphorus	16,277	44
Fluoride	2,170	5.9
Nitrite	33,163	91
Ammonia	26,131	71

(a) Mass is added to the minewater prior to discharge from the Mine and concentrations are re-calculated.
kg = kilograms; kg/d = kilograms per day.

6.3.3 Mass Load Due to Explosives Use

The primary type of explosive used during operations is an emulsion type explosive (emulsion), with ammonia nitrate/fuel oil (ANFO) used for quarry activities on surface. A relatively minor amount of packaged explosive and detonator cord is also used. The bulk compositions of the emulsion and ANFO are provided in Table 6-5. For the purposes of the mass loading estimates, all types of packaged explosives and other explosive products (excluding emulsion) were conservatively assigned the chemical composition of ANFO, since ANFO has a higher proportion of ammonia and nitrate relative to emulsion.

The GoldSim model assumes that explosives use in the Mine will contribute to loading of nitrate and ammonia. The rate of this mass loading addition is a function of the rate of explosives used in the Mine and is independent of the rate of groundwater inflow. Estimates of mass load due to explosives were calculated by considering the following factors:

- the type and amount of explosives used;
- the monitored mass of nitrogen leaving the Mine via minewater discharge at SNP 02-01 (measured water quality and flow); and,
- the monitored mass of nitrogen reporting to the North Pile in process water.

For the purpose of calculating the rate of nitrogen released from site as a function of mining, explosives data from 2012 were used. Data from 2012 were used since 2012, it can be considered a full operating year (typical of production rates in the future) and since sufficient monitoring data were available during 2012 to calculate the relative contribution of explosive use on nitrogen release from site.

Metal and other contributions from explosives were not explicitly incorporated. However, they were implicitly included in the mass and/or concentration assigned to the minewater and North Pile water since they will influence the incremental mass added as a result of the trend and correlation analyses (Sections 6.3.1 and 6.3.2; Appendix III).

Geochemical reactions and attenuation mechanisms for the nitrogen species were not included in the model although they have the potential to reduce observed concentrations along the flow system. It is considered doubtful that biologically mediated reactions, which play an important role in the natural nitrogen cycle, occur to any significant degree in the underground workings. Consequently, these reactions were not included.

The amount of explosive that will dissolve and enter the flow system varies depending on the total explosives used, handling practices of the Mine, and blasting efficiency. Approximately 25% of the nitrogen from explosives produced on site currently dissolves and is discharged or stored in the porewater of the North Pile based on measured flow, nitrate, and ammonia concentrations at monitoring station SNP 02-01 together with the measured flow (makeup water) and concentrations of nitrate and ammonia discharged to the North Pile (Table 6-6). The anticipated total emulsion and ANFO use as incorporated in the model calculations are shown in Table 6-7.

Table 6-6 Explosive Composition

Components	ANFO	Emulsion (non-aluminized)
NH_4NO_3	94%	63%
$NaNO_3$	0%	18%
H_2O	0%	9%
Fuel Oil	6%	6%
Micro balloons (glass)	0%	4%
Aluminum	0%	0%

Note: Compositions are based on data from manufacturers.
% = percent; ANFO = ammonium nitrate/fuel oil; NH_4NO_3 = ammonium nitrate; $NaNO_3$ = sodium nitrate; H_2O = water.

Table 6-7 Summary of Nitrogen (N) Species Concentrations Due to Explosives Use on Site for 2012

Parameter	Value (unit)		Obtained By	Source/Based on
Underground				
Total annual discharge from underground	10,845,756.00	m^3	Measured	Monitored data at SNP 02-01
Concentration of water leaving underground	5.46	mg-N/L	Calculated	Cumulative loading and cumulative flow for 2012
Total annual mass of explosives in minewater	236.92	t/yr	Calculated	Total annual mass of emulsion explosives released to minewater in 2012
Total annual mass of N species	180.37	t/yr	Calculated	Total annual mass of N species in tonnes of N, converted based on gram formula weights and emulsion composition
Total annual mass of N species as N	59.26	t/yr as N	Measured	Monitored data at SNP 02-01
North Pile				
Total annual mass of N in North Pile	204.09	t	Calculated	Total annual mass of N species (t) in the North Pile from emulsion and ANFO, calculated based on measured data
Mass from emulsion	60.08	t		
Mass from ANFO	144.02	t		
Total annual mass of N species	166.57	t	Calculated	Total annual mass of N species in t of N, converted based on gram formula weights and emulsion composition
Total annual mass of N species as N	55.94	Total N	Calculated	Concentration of field cell first flush results, cumulative flow of makeup water
Total annual water reporting to North Pile	346,061.00	m^3	Measured	Cumulative flow from makeup water for 2012
Concentration in pore water in the North Pile	161.21	mg-N/L	Measured	Average of field cell first flush results

Notes: calculations based on the amount of explosives being used on site and concentrations of NH_4 and NO_3 in water leaving the underground Mine and contained in the pore water of solids being deposited in the North Pile tailings facility.
m^3 = cubic metres; mg-N/L = milligrams nitrogen per litre; t =tonnes; t/yr = tonnes per year; N = nitrogen; ANFO = ammonium nitrate/fuel oil.

6.3.4 Mass Load Due to Grout and Cement Use

Grout and cement are used in the Mine, are contributing to loadings of calcium, chloride, and alkalinity, and will serve to raise the pH of the minewater. The resulting mass loads are implicitly included in the mass and/or concentration assigned to the minewater and North Pile water as an incremental addition based on past water quality monitoring data.

6.4 Results and Discussion – Minewater

The minewater discharge concentrations and loading for selected dissolved parameters are summarized in Table 6-8, and Figures 6-3 through 6-8. The relative contribution of mass loading from the Mine with respect to the Mine site as a whole is discussed in Section 10.

Table 6-8 Summary of Minewater Concentrations

Parameter	Units	Average Annual Mine Water[a] Concentrations					
		Lower Bound			Upper Bound		
		2014	2019	2028	2014	2019	2028
Conventional Parameters							
pH[b]	pH	6 - 9	6 - 9	6 - 9	6 - 9	6 - 9	6 - 9
Alkalinity	mg/L	167	260	279	278	524	538
Total Dissolved Solids	mg/L	611	846	873	949	1648	1661
Total Suspended Solids	mg/L	64	69	51	70	74	39
Nutrients							
Ammonia	mg/L	2.8	3.7	4.8	2.6	3.2	4.3
Nitrate + Nitrite	mg/L	6.5	8.6	11	6.3	8.0	10
Total Phosphorus	mg/L	1.1	0.93	0.90	0.98	0.62	0.56
Total Kjeldahl Nitrogen	mg/L	1.2	1.3	1.4	1.2	1.4	1.5
Orthophosphate (PO_4)	mg/L	0.002	0.002	0.002	0.002	0.002	0.002
Major Ions							
Calcium	mg/L	130	177	179	202	348	347
Chloride	mg/L	276	382	390	435	760	761
Fluoride	mg/L	0.36	0.43	0.50	0.35	0.41	0.47
Magnesium	mg/L	13.4	15.6	18.2	12.9	14.5	17.1
Potassium	mg/L	4.0	4.6	5.3	3.9	4.4	5.1
Silica	mg/L	9.5	13.1	16.8	9.0	11.7	15.5
Sodium	mg/L	70	96	99	108	189	190
Sulphate	mg/L	45	60	61	67	113	113
Dissolved Metals							
Aluminum	µg/L	19.5	33.6	48.5	19.4	33.1	48.4
Antimony	ug/L	0.72	0.50	0.29	0.72	0.50	0.30
Arsenic[c]	µg/L	0.18	0.21	0.22	0.18	0.23	0.24
Barium	µg/L	32.4	33.3	34.3	31.8	32.4	33.5
Beryllium[c]	µg/L	0.06	0.12	0.16	0.07	0.13	0.17
Cadmium[c]	µg/L	0.05	0.04	0.04	0.05	0.04	0.04
Chromium	µg/L	0.25	0.31	0.33	0.26	0.35	0.37
Cobalt	µg/L	0.26	0.29	0.33	0.25	0.30	0.34
Copper	µg/L	2.7	3.1	3.2	2.6	2.7	2.8
Iron	µg/L	41.8	80.7	122	41.4	78.4	121
Lead[c]	µg/L	0.03	0.05	0.06	0.03	0.05	0.06
Lithium	ug/L	47.4	72.1	76.6	79.3	148	151
Manganese	µg/L	60.6	76.0	94.9	57.2	66.1	85.3
Mercury[c]	µg/L	0.01	0.02	0.02	0.01	0.02	0.02
Molybdenum	µg/L	4.7	6.1	7.6	4.5	5.6	7.2
Nickel	µg/L	12.0	15.5	19.5	11.3	13.6	17.6
Selenium[c]	µg/L	0.09	0.18	0.25	0.10	0.18	0.26
Silver[c]	µg/L	0.02	0.04	0.06	0.02	0.04	0.06
Strontium	µg/L	1452	1958	1973	2249	3855	3837
Thallium	µg/L	0.01	0.02	0.03	0.01	0.02	0.03
Uranium[c]	µg/L	0.89	1.1	1.4	0.85	1.0	1.3
Vanadium	µg/L	0.17	0.30	0.39	0.18	0.35	0.43
Zinc	µg/L	3.5	3.7	3.9	3.5	3.8	4.0

(a) Estimates of minewater reporting to treatment, values based on flow weighted average annual values of daily data model results.

(b) The pH range is not modelled; however it is expected to be consistent with currently measured range of values and meet efluent quality criteria requirements, set by 2012 Snap Lake Mine Water Licence (MV2011L2-0004, De Beers Canada Inc.).

(c) GoldSim input data based on one half of typical lower detection limits (where values were below detection). Elevated detection limits were not included in average detection limit values, therefore the resulting calculated values may be biased upwards.

mg/L = milligrams per litre; µg/L = micrograms per litre.

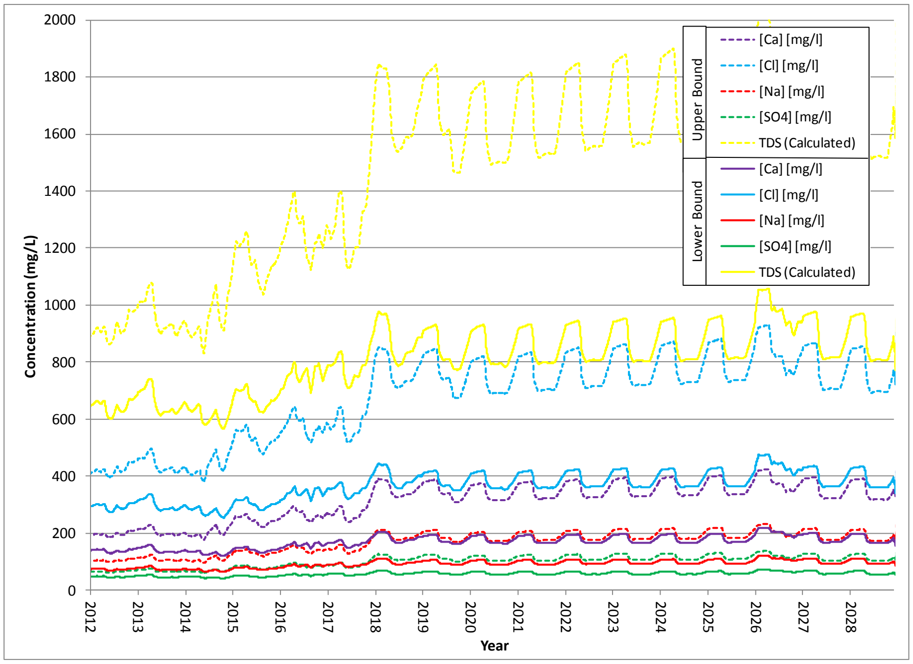
6.4.1 Concentrations – Minewater

Based on monitoring data and predictions, the greatest TDS concentrations in minewater occurred in early 2006 at approximately 1,300 mg/L TDS, and then decreased between 2006 and 2010 to approximately 500 mg/L TDS (De Beers 2013b). Model predictions begin in 2012 and show that from 2013 onwards, average annual concentrations gradually increase until 2018 as the volume and proportion of lake water recharging the Mine increase. The predicted values level off at approximately 1,800 mg/L in the Upper Bound Scenario and 850 mg/L in the Lower Bound Scenario. The concentrations of calcium, magnesium, sulphate, chlorine, and sodium follow a similar trend although at lower concentrations. In the Upper Bound Scenario, TDS and major ion concentrations are elevated in comparison to the Lower Bound concentrations due to the increase in connate water flows to the Mine in the Upper Bound Scenario and the increased re-circulation between the Mine and Snap Lake. The trend is consistent for all major ions (Figure 6-3).

In the monitoring data from SNP 02-01 (De Beers 2013b) the concentrations of ammonia and nitrate are variable, ranging from peaks near 30 mg/L to below the detection limit; this variability is observed in the monitoring data as a function of blast timing and locations. Nitrate and ammonia concentrations gradually increase over time at a more constant, cyclical rate over the duration of modelling, due primarily to recirculation of the lake water though the Mine. It is expected that the actual monitoring data will continue to be variable, but averages will be maintained below the predicted values.

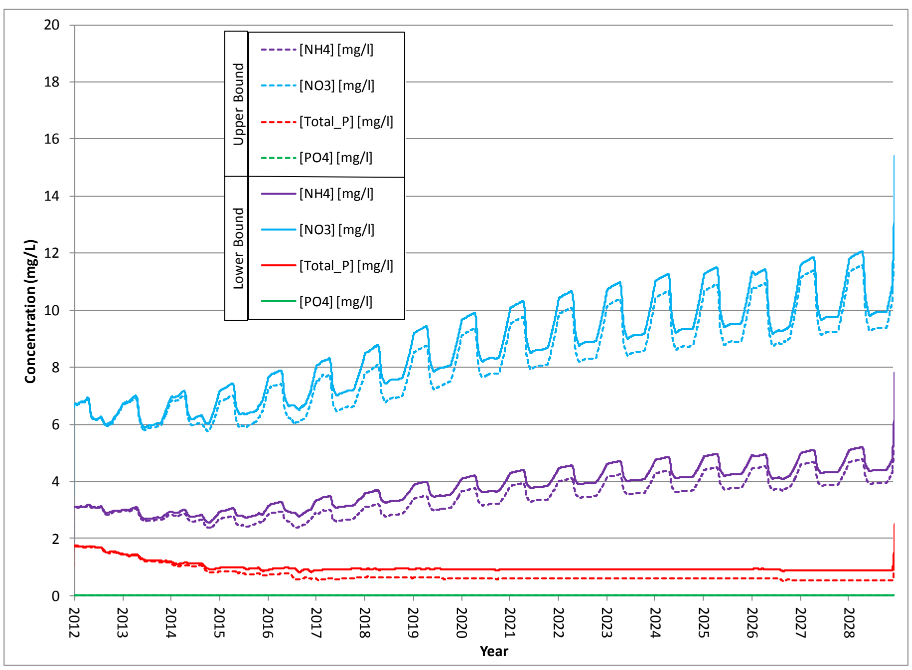
Metal concentrations (Figure 6-5a, b) varied over the monitoring period (from 2004 to 2013), likely due to analytical variability as well as varying degrees of Mine activity during the sampling periods (De Beers 2013b). Predicted data from 2012 onwards show a gradual increase, or near steady concentration. There is an initial decline in concentration for parameters influenced by incremental addition due to mining, followed by a gradual increase, likely due to lake water re-circulation into the Mine. It is expected that the actual monitoring data will continue to be variable; however, averages are expected to trend towards the predicted data.

Figure 6-3 Major Ion Concentrations – Minewater



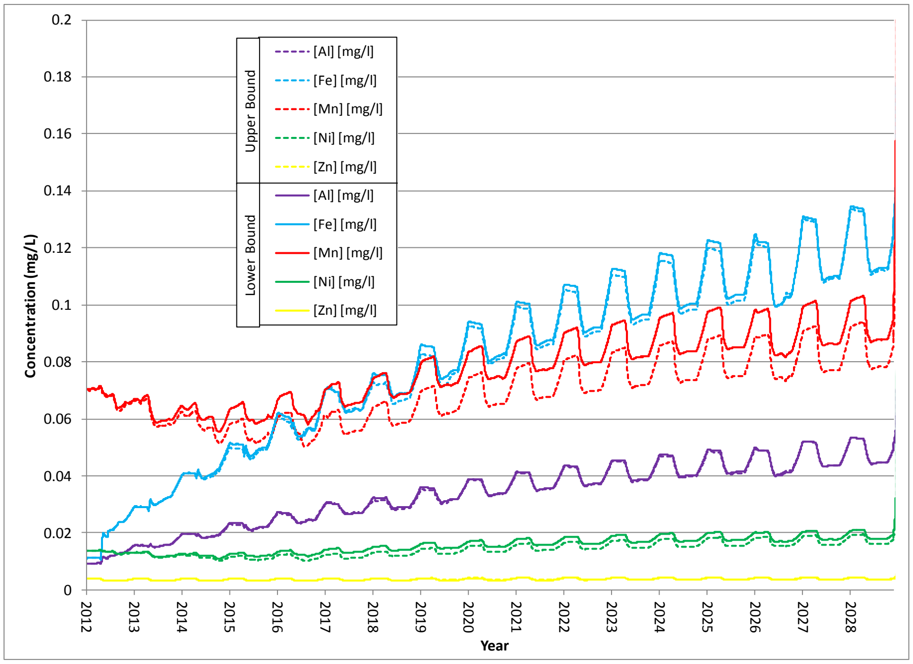
mg/L = milligrams per litre.

Figure 6-4 Nutrient Concentrations – Minewater



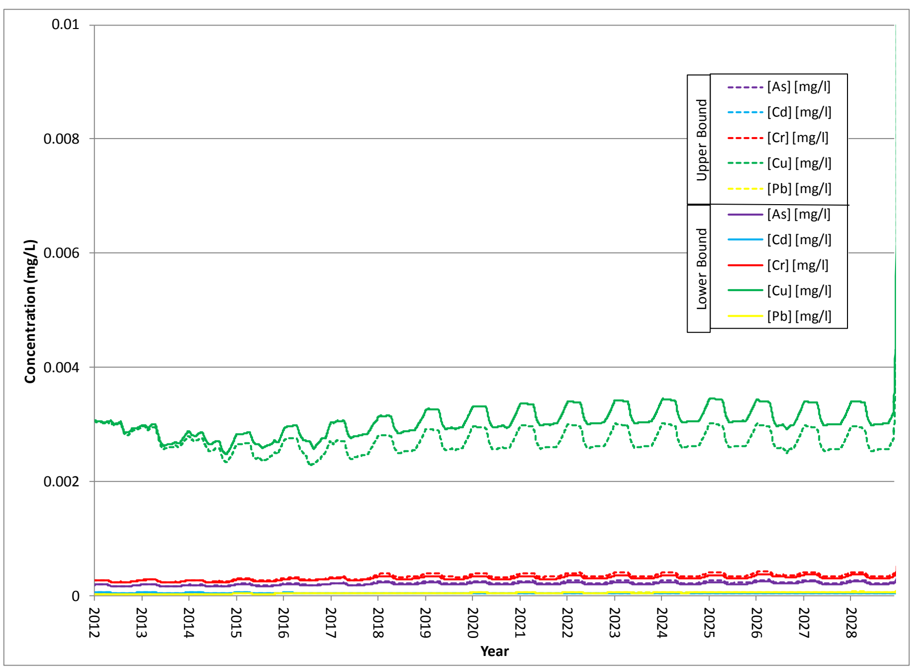
mg/L = milligrams per litre.

Figure 6-5a Selected Metal Concentrations – Minewater



mg/L = milligrams per litre.

Figure 6-5b Selected Metal Concentrations – Minewater



mg/L = milligrams per litre.

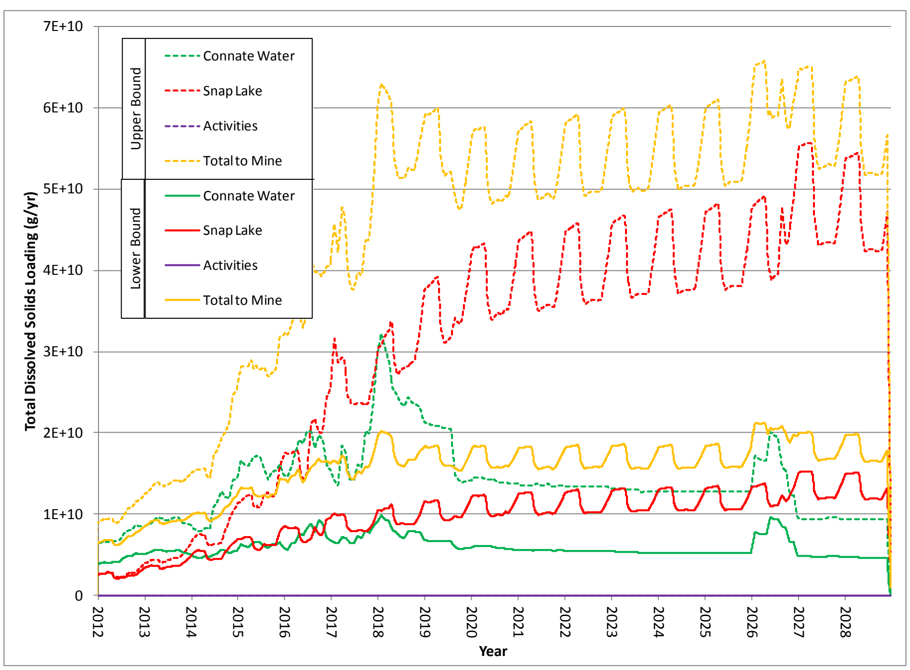
6.4.2 Distribution of Mass Load – Minewater

To illustrate loading trends, the total mass load discharged from the Mine for TDS, ammonia (NH_4), and dissolved chromium, as well as the individual contributions from the various components that make up the overall load from the Mine are presented in Figures 6-6, 6-7, and 6-8. Results for all parameters are included in Appendices VI through IX. During the modelled period, loadings generally increase over the life of the Mine, as the underground surface area increases, as a result of increasing amounts of water pumped from the Mine and re-circulated from the lake. Typical mass loading trends are illustrated by the TDS load distribution (Figure 6-6).

For the parameters NH_4, and nitrate (NO_3), variability is governed not only by groundwater inflow, but also by material use. The NH_4 loading shown in Figure 6-7 illustrates the relative influence of explosives use on the total load for constituents derived from explosives. For these parameters, explosives use contributes the majority of the total minewater load, with the recharge of lake water to the Mine contributing the remainder. Chromium loading rates are provided in Figure 6-8 to illustrate loading trends for a typical metal; trends are similar to those of TDS, as a result of the influence of the recharge from connate water and lake water recycling.

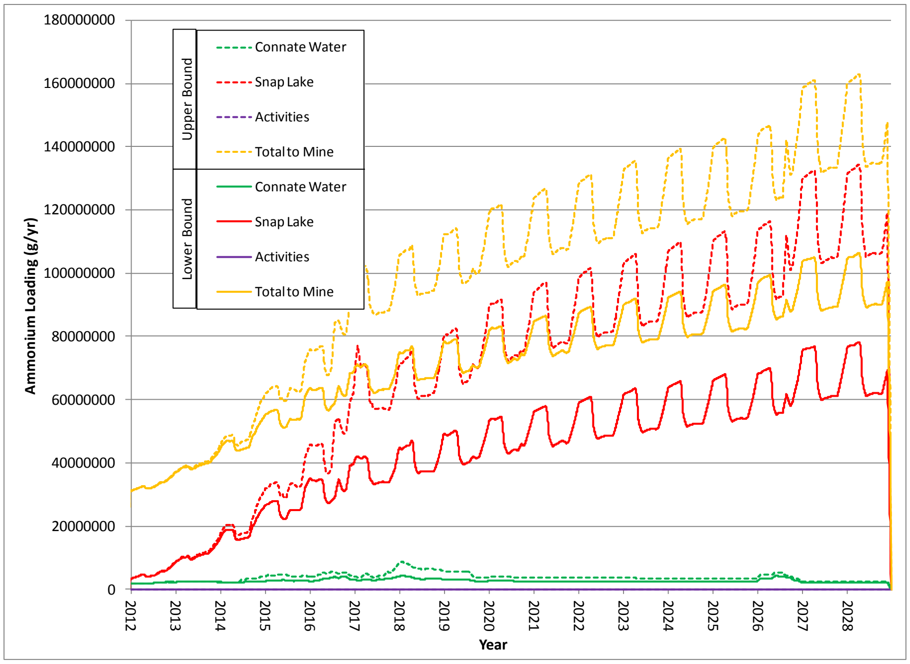
The results from the Upper and Lower Bound scenarios generally show similar concentration and loading trends; however, the increases in concentrations are more pronounced in the Upper Bound case due to the increased influence of re-circulated lake water, and an increase in the flow rate of connate water to the Mine.

Figure 6-6 Total Dissolved Solids Load From Mine Sources



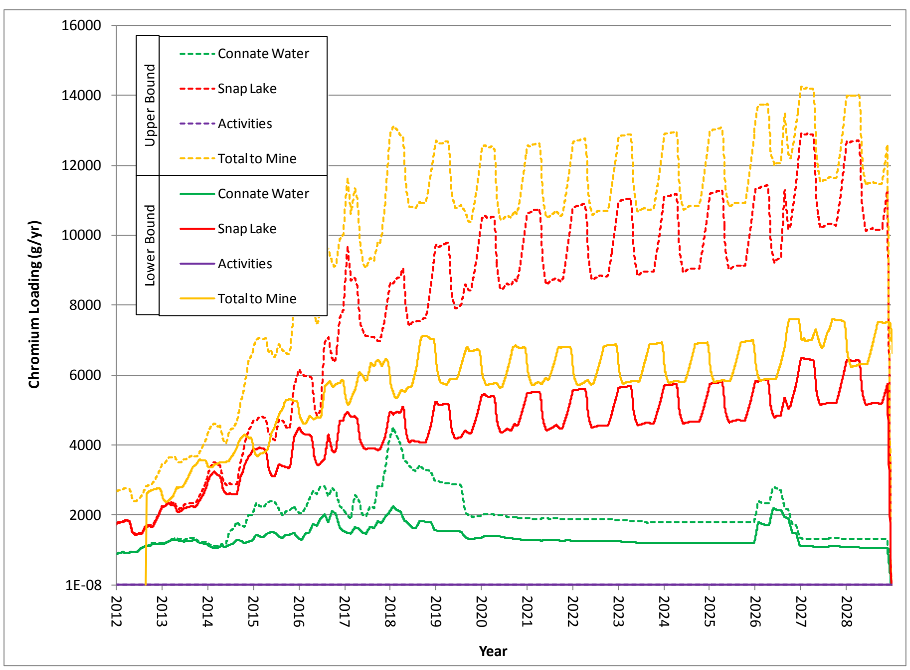
g/yr = grams per year.

Figure 6-7 Ammonia Load From Mine Sources



g/yr = grams per year.

Figure 6-8 Chromium Load From Mine Sources



g/yr = grams per year.

6.4.3 Concentrations and Mass Load following Mine Closure

Following Mine closure, there will be no direct discharge to Snap Lake from pumping of the Mine workings. Regional groundwater flows and chemistry are not expected to change relative to data presented in De Beers (2002c).

6.4.4 Key Results

Based on the model results, the following processes, trends, and influences are considered most relevant with respect to the quality of minewater discharge:

- The results of site monitoring between 2004 and 2012 (DeBeers 2013b) were variable, with generally decreasing trends in concentrations over time between 2004 and 2010 followed by slight increasing trends in 2011 and 2012.
- Predicted concentrations show continued increasing trends throughout the life of Mine, which are more pronounced for TDS, nutrients, and some metals between 2013 and 2018.
- Minewater concentrations and loading are typically dominated by groundwater inflow characteristics and, to a lesser extent, by interaction with sediments on the Mine floor or material use.

7 NORTH PILE

7.1 Background

The site selected for PK and waste rock containment is to the west of the Mine and is referred to as the North Pile (see Figure 2-1c). The original ground surface consists of granite outcrop with thin, discontinuous cover of organic and mineral soil over the granite bedrock. The North Pile comprises three phases of development: the Starter Cell, the East Cell, and the West Cell. The Starter Cell and East Cell are currently in development. The West Cell will be developed in due course. The Starter Cell and East Cell are discretized by a series of internal cells, to facilitate deposition and development. The embankments of the facility are constructed of the combined course (6.0 mm [millimetres] to 1.2 mm) and grits (1.5 mm to 0.125 mm) fractions of the PK and waste rock (typically less than 0.6 m). To date, the majority of the PK deposited into the facility is the fines fraction (<0.125 mm) as a slurry. Predictive water quality modelling is complicated by the multiple cells, multiple material sizes and ongoing changes to deposition locations, which result from typical mining operations.

Surface runoff and seepage to surface within (or near the base of) the North Pile are collected through a series of ditches and sumps (Figure 2-2) and pumped to the WTP via the WMP during operations; this will also be the case when closure is implemented. A detailed water balance for the North Pile is provided in De Beers (2013d). The expected final configuration of the North Pile has not changed substantially from that described by De Beers (2002a); however, there are changes in governing properties of the North Pile due to the deposition of slurry in the North Pile and less PK material being placed underground. At Mine closure, the North Pile will be capped by coarse granite to reduce potential for erosion. Post-closure surface water flow will report directly to the northwest arm of Snap Lake, when acceptable water quality criteria are met. The model assumes that water quality is not influenced by the coarse granite layer.

7.2 Flow Summary and Water Release – North Pile

Water from the North Pile originates from precipitation (approximately 350 millimetres per year [mm/yr]) and process water from the processing plant (approximately1,300 m^3/d). Evaporation will affect the amount of water that infiltrates into the North Pile and discharges as direct runoff. The surface area of the North Pile contributing to runoff will change over time as additional cells are added as indicated in Table 7-1. The timing and quantity of runoff versus infiltration that report from the North Pile will depend to a large degree on temperature conditions, with a substantial proportion of runoff reporting during the spring freshet (Table 7-2). During deposition within a cell, process water flows from the slurry deposition point, and is either incorporated into the pore space of the PK or runs off to the more permeable berm material, after which water moves (in comparison to flow through the fines fraction of the PK) relatively quickly into a sump. Water is also pumped from the facility into the sumps, however for the purposes of modelling it is assumed that this water reports first to the sumps.

Water incorporated into the pore space of the PK is expected to remain at saturation until filling of the cell is completed. Once placement of PK ceases, water levels in the North Pile are expected to drop, eventually reaching a state of equilibrium with respect to long term average infiltration. During this period of time, water is expected to drain through the fines fraction of the PK downward and laterally outward from the cells to the coarser berm materials over time, and discharge as seepage at the toe of the coarse berm material near one of the collection ditches or sumps. The overall amount of water released from storage depends on the North Pile design, hydraulic conductivity, and saturation of the materials within the North Pile as well as the amount of precipitation infiltrating into the fine-grained materials. Appendix IV provides calculations on release rates and timing for the pore water of the North Pile based on laboratory kinetic test data. The release rates (monthly flow plus discharge from storage) applied in the GoldSim water quality model are based on those from the North Pile water balance and determined through modelling (Appendix V). The drain-down time for a generalized section through a single cell is provided in Figure 7-1. The overall discharge from the North Pile, including process flows and seepage, is provided in Figure 7-2.

The original water flow estimates (De Beers 2002a) indicate that approximately 8,300 m^3/yr (at full North Pile dimensions) will flow directly from the North Pile to Snap Lake through deeper groundwater flow assuming the original ground surface remains unfrozen; however, freezing conditions should limit this potential input over time. As modelled, most of this deep potential seepage water reports to the sumps, and is therefore implicitly incorporated into the GoldSim model.

Table 7-1 North Pile Surface Area for Purpose of Water Quality Estimates

Year	Total Area	Area Closed (Capped)
	(ha)	(ha)
2004 to 2012	~ 22[(a)]	0
2012 to 2017	~ 43[(b)]	~ 22
2017 to 2028	~ 76[(c)]	~ 43
>2028	~ 76	~ 76

(a) Approximated area for Starter Cells

(b) Approximated area for Starter + East Cells

(c) Approximated area for Starter + East + West Cells

Areas are approximated for purposes of mass load addition thus are focused on footprint of materials contributing to mass load as measured from air photos and De Beers 2002a and may be different than the areas used for the water balance (De Beers 2013) ; ~ = approximately; > = greater than; ha = hectare.

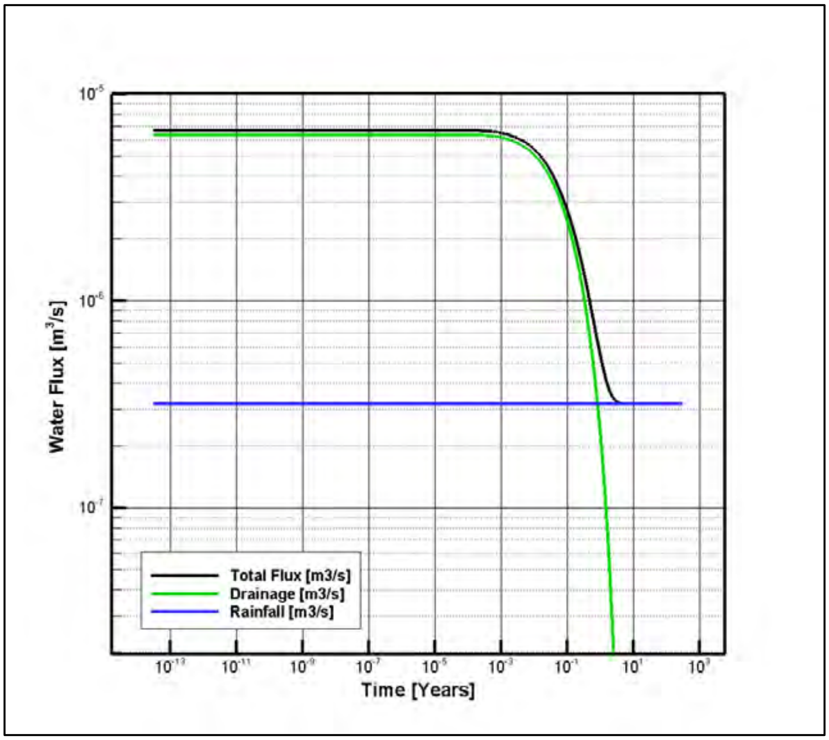
Table 7-2 Monthly Proportion of Annual Flow Release

Description	Precipitation [(a)]	Runoff [(a)]	Process Plant Water	Sump Evaporation	Process Plant Seepage
	Proportional by Month	Proportional by Month	Proportional by Month[(a)]	Proportional by Month	Proportional by Month
	(%)	(%)	(%)	(%)	(%)
Annual	100	100	100	100	100
January	0	0	9.7	0	9.7
February	0	0	8.3	0	8.3
March	0.03	0.03	7.5	0	7.5
April	0.6	0.6	8.2	0	8.2
May	58.5	61.6	9.7	7.3	9.7
June	6.4	5.9	9.2	26.5	9.2
July	10.5	9.7	8	35.6	8
August	11.9	11	8	20.6	8
September	8	7.4	7.8	7.4	7.8
October	3.9	3.6	8	2.6	8
November	0.2	0.2	7.8	0	7.8
December	0.03	0.03	8	0	8

(a) Water accumulated in the snowpack is released during freshet.

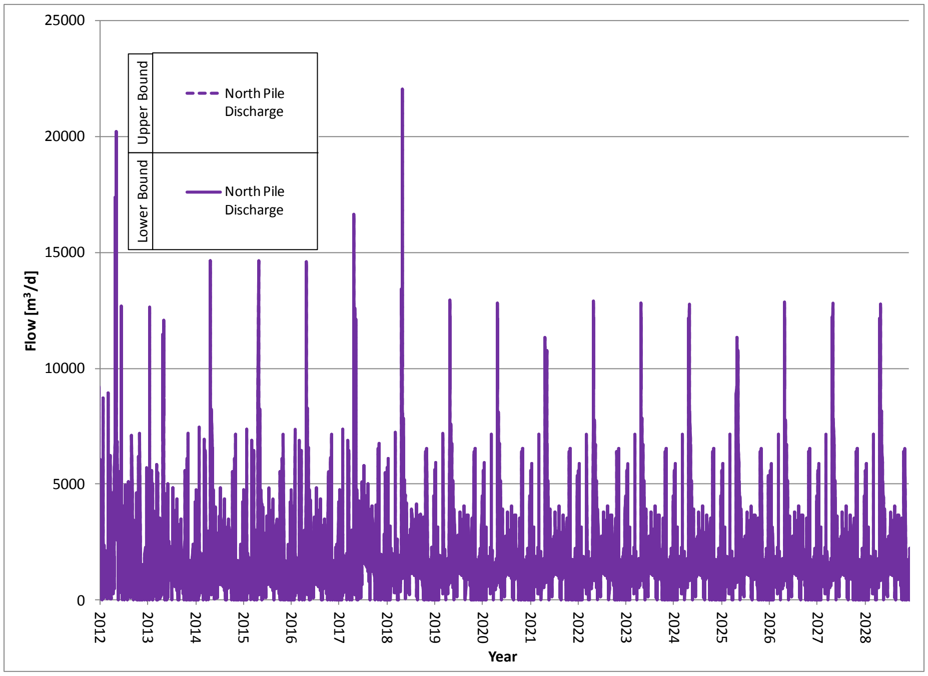
% = percent.

Figure 7-1 Generalized Transient Water Release Rate for Flux during Drain-Down of Fine Processed Kimberlite



Notes: Flux for generalized two-dimensional cross section (100 m long x 20 m thick) through a cell from centerline to toe of dam (see Appendix I for application to overall pile).
m^3/s = cubic metres per second; m = metres.

Figure 7-2 Overall North Pile Discharge – Flow



m^3/d= cubic metres per day.

7.3 Mass Load – North Pile

Mass load and concentrations within and from the North Pile are a function of the discharged process water quality, infiltration and runoff rates, and storage and release of water in the fines fraction of the PK pore space. Mass load and/or concentrations were assigned to the North Pile water as follows:

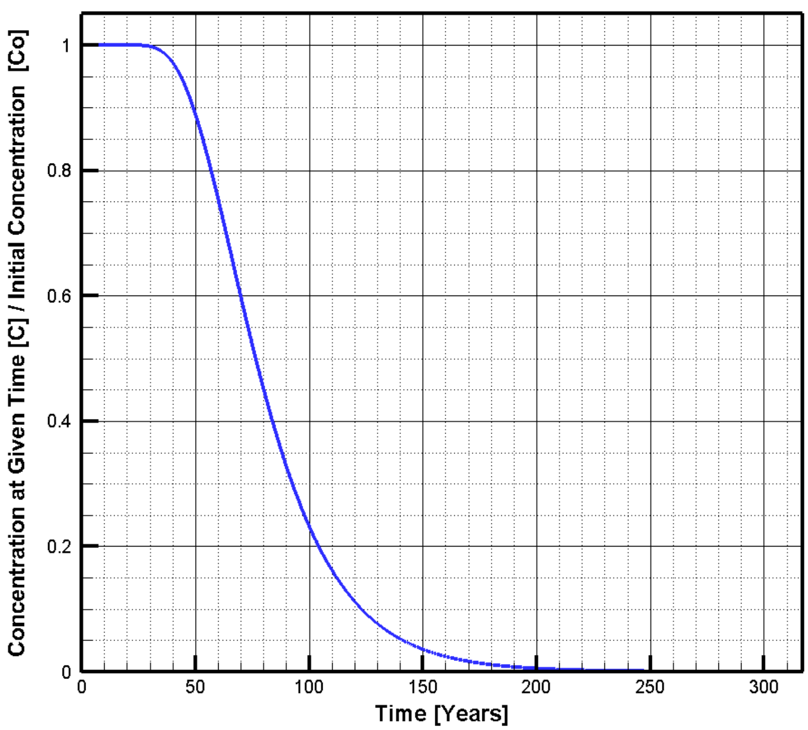
- Initial mass load of the North Pile was based on the volume of process water in the North Pile (i.e., pore water), which was assigned a concentration equivalent to the median concentrations in the monitoring data between 2007 and 2012 from location SNP 02-02 (Table 7-3).
- Mass associated with infiltration was based on the (GoldSim) calculated concentration of the pore water within the North Pile.
- Mass associated with runoff (as precipitation interacted with the North Pile) was based on long term kinetic test data (Appendix IV).
- Parameters related to TDS were assigned water quality based on the relative proportion (calculated in GoldSim) of minewater and makeup water used in processing.
- Concentrations for all parameters as calculated by the relative proportion of minewater and makeup water used in processing were compared with available data from the process plant and monitoring data from SNP 02-02. An "incremental" mass addition was applied for specific parameters depending on observed differences to account for mass release due to processing and geochemical changes as a result of processing and deposition within the North Pile.

Mass was allowed to leave the North Pile as follows:

- Mass associated with excess process water and runoff based on the mass assignments as indicated.
- Mass associated with drain-down of fines fraction of the PK in closed cells was allowed to discharge at the drain-down rates as indicated in Section 7-2. This was developed as a relative proportion of the fines fraction of the PK initial pore water reporting to the sumps (Figure 7-3).

The calculated resulting water quality was assigned to the quantity of water discharged from the North Pile to the WMP from where it would report to treatment.

Figure 7-3 Relative Concentration at Edge of Fine Processed Kimberlite



C = Concentration at given time; Co = Initial Concentration.

Table 7-3 Concentrations Applied to North Pile Process Plant Water

Parameter	Units	Process Plant[a]			
		2007 - 2012			
		Minimum [b]	Maximum [b]	Median [b]	Incremental Mass Addition [c]
Conventional Parameters					
Alkalinity (as $CaCO_3$)	mg/L	7.0	218.0	44.2	-
Total Dissolved Solids	mg/L	74.0	4440.0	1270.0	728.2
Total Suspended Solids	mg/L	1.5	378000.0	12.1	-
Nutrients					
Ammonia (NH_4 as N)	mg/L	0.05	46.9	16.9	-
Nitrate-Nitrite-N (NO_3 + NO_2 as N)	mg/L	3.75	392.0	97.1	120.1
Total Phosphorus	mg/L	0.005	39.3	0.03	-
Total Kjeldahl Nitrogen	mg/L	0.05	42.2	13.60	-
Ortho-phosphate	mg/L	0.001	0.03	0.001	-
Major Ions					
Calcium	mg/L	13.2	482.0	142.0	-
Chloride	mg/L	6.0	858.0	313.5	48.7
Fluoride	mg/L	0.1	1.7	0.7	1.1
Magnesium	mg/L	2.9	289.0	68.0	-
Potassium	mg/L	2.1	81.5	29.4	-
Sodium	mg/L	6.0	325.0	112.0	87.3
Sulphate	mg/L	9.5	1050.0	157.0	25.3
Dissolved Metals, Metalloids, and Non-Metals					
Aluminum	µg/L	0.0021	0.251	0.02	-
Antimony	µg/L	0.00004	0.0029	0.00062	-
Arsenic	µg/L	0.0001	0.0092	0.000265	-
Barium	µg/L	0.00713	0.224	0.104	-
Beryllium	µg/L	0.000005	0.005	0.00025	-
Cadmium	µg/L	0.000016	0.0002	0.000064	-
Chromium	µg/L	0.00003	0.0078	0.0002	-
Cobalt	µg/L	0.0002	0.012	0.00186	-
Copper	µg/L	0.00039	0.0137	0.00203	-
Iron	µg/L	0.0025	1.93	0.018	-
Lead	µg/L	0.000025	0.001	0.00005	-
Lithium	µg/L	0.001	0.0459	0.0223	-
Manganese	µg/L	0.006	0.857	0.129	-
Mercury	µg/L	0.000005	0.0003	0.00001	-
Molybdenum	µg/L	0.0009	0.154	0.03975	-
Nickel	µg/L	0.00109	0.503	0.0281	-
Selenium	µg/L	0.00005	0.0013	0.0002	-
Reactive Silica	mg/L	1.7	23	9.515	-
Silver	µg/L	0.0000025	0.0053	0.00005	-
Strontium	µg/L	0.0455	4.84	1.57	-
Thallium	µg/L	0.000015	0.0005	0.0000985	-
Uranium	µg/L	0.00007	0.0257	0.002205	-
Vanadium	µg/L	0.000025	0.005	0.00033	-
Zinc	µg/L	0.0004	0.483	0.009175	-

(a) Data based on measurements taken from SNP 02-02.

(b) If measurement was a non-detect, half the detection limit was applied.

(c) Incremental mass was estimated by comparing field cell flushing (September 2012; Appendix IV) to measurements at SNP 02-02.

- = values are below the detection limit; mg/L = milligrams per litre; µg/L = micrograms per litre; $CaCO_3$ = calcium carbonate.

7.4 Results and Discussion – North Pile

During operations, the mass load from the North Pile primarily reports to Snap Lake via the treatment discharge, although a small amount of water will report via seepage to the northwest arm of Snap Lake. When acceptable discharge criteria have been met, post-closure, surface runoff from the North Pile will no longer be directed to treatment but will report directly to the northwest arm of Snap Lake. Results are provided for the operational period and reflect the assumptions governing the various minewater contributions as applied in the GoldSim model. Additonal work is underway to develop post closure water quality estimates. Simulated flows from the North Pile were compared to measured data between 2012 and 2013. When reasonable calibration was achieved, confidence was gained pertaining to the applied assumptions.

Average annual concentrations for North Pile seepage for selected years are summarized in Table 7-4, and general trends over time for selected dissolved major ions, nutrients and metal concentrations are illustrated in Figures 7-4, 7-5, and 7-6. The TDS and major ion concentrations for the North Pile are variable seasonally (Figure 7-4). Long-term trends show a slight increase from 2018 through 2028 while the West Cell is being operated. Peak TDS concentrations are higher in the Upper Bound Scenario, than those reported in the Lower Bound Scenario due to the influence of minewater in the treated water used as part of the process makeup water.

Concentrations of nitrate are provided in Figure 7-5 and those of select metals are provided in Figure 7-6. In both instances, similar to the major ions, the values show significant seasonal variability, due to drain-down of the fines fraction of the PK material over a protracted period of time.

Table 7-4 Summary of Estimated Concentrations for North Pile Seepage Water

Parameter	Units	Average Annual North Pile Water[a] Concentrations					
		Lower Bound			Upper Bound		
		2014	2019	2028	2014	2019	2028
Conventional Parameters							
pH[b]	pH	6 - 9	6 - 9	6 - 9	6 - 9	6 - 9	6 - 9
Alkalinity	mg/L	146	212	224	214	386	397
Total Dissolved Solids	mg/L	998	1168	1186	1207	1693	1708
Total Suspended Solids	mg/L	9.3	9.4	9.5	9.3	9.4	9.5
Nutrients							
Ammonia	mg/L	12.1	12.2	12.2	12.1	12.2	12.2
Nitrate + Nitrite	mg/L	85.7	86.9	87.0	85.7	86.8	87.0
Total Phosphorus	mg/L	0.03	0.03	0.03	0.03	0.03	0.03
Total Kjeldahl Nitrogen	mg/L	9.9	10.0	10.0	9.9	10.0	10.0
Orthophosphate (PO_4)	mg/L	0.003	0.003	0.003	0.003	0.003	0.003
Major Ions							
Calcium	mg/L	95	127	129	140	240	241
Chloride	mg/L	230	301	306	329	550	553
Fluoride	mg/L	0.88	0.91	0.91	0.88	0.91	0.91
Magnesium	mg/L	51.0	51.9	52.0	51.0	51.9	52.0
Potassium	mg/L	22.0	22.5	22.5	22.0	22.5	22.5
Silica	mg/L	7.3	7.5	7.5	7.3	7.5	7.5
Sodium	mg/L	111	130	132	135	191	192
Sulphate	mg/L	57.3	66.8	67.6	71.2	102	102
Dissolved Metals							
Aluminum	µg/L	18.4	18.4	18.5	18.4	18.4	18.5
Antimony	ug/L	0.57	0.60	0.60	0.57	0.60	0.60
Arsenic[c]	µg/L	0.30	0.33	0.33	0.30	0.33	0.33
Barium	µg/L	76.3	77.3	77.5	76.3	77.3	77.5
Beryllium[c]	µg/L	0.23	0.24	0.24	0.23	0.24	0.24
Cadmium[c]	µg/L	0.06	0.06	0.06	0.06	0.06	0.06
Chromium	µg/L	0.29	0.32	0.31	0.29	0.32	0.31
Cobalt	µg/L	1.4	1.4	1.4	1.4	1.4	1.4
Copper	µg/L	1.7	1.7	1.7	1.7	1.7	1.7
Iron	µg/L	23.2	22.7	22.7	23.2	22.7	22.7
Lead[c]	µg/L	0.27	0.33	0.32	0.27	0.33	0.32
Lithium	ug/L	32.7	49.5	52.4	52.6	100	102
Manganese	µg/L	93.1	94.1	94.3	93.1	94.1	94.3
Mercury[c]	µg/L	0.09	0.11	0.11	0.09	0.11	0.11
Molybdenum	µg/L	29.7	30.3	30.3	29.7	30.3	30.3
Nickel	µg/L	23.3	24.1	24.1	23.3	24.1	24.1
Selenium[c]	µg/L	0.32	0.35	0.35	0.32	0.35	0.35
Silver[c]	µg/L	0.04	0.04	0.04	0.04	0.04	0.04
Strontium	µg/L	1045	1385	1397	1543	2638	2640
Thallium	µg/L	0.09	0.09	0.09	0.09	0.09	0.09
Uranium[c]	µg/L	2.5	2.7	2.7	2.5	2.7	2.7
Vanadium	µg/L	1.5	1.7	1.7	1.5	1.7	1.7
Zinc	µg/L	6.9	7.0	7.0	6.9	7.0	7.0

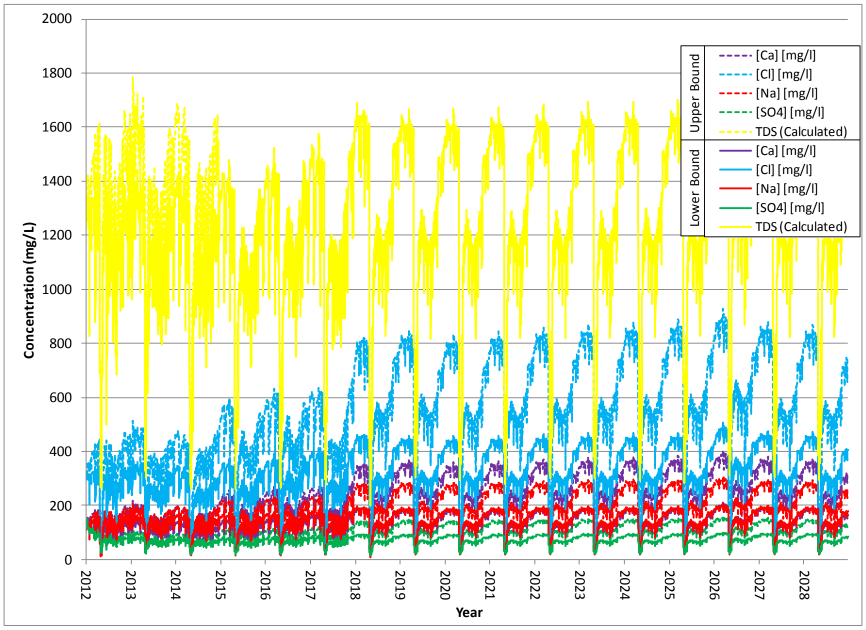
(a) Estimates of water being discharged from the North Pile to the Water Management Pond; values based on flow weighted average annual values of daily data model results.

(b) The pH range is not modelled; however it is expected to be consistent with currently measured range of values and meet efluent quality criteria requirements, set by 2012 Snap Lake Mine Water Licence (MV2011L2-0004, De Beers Canada Inc.).

(c) GoldSim input data based on one half of typical lower detection limits (where values were below detection). Elevated detection limits were not included in average detection limit values, therefore the resulting calculated values may be biased upwards.

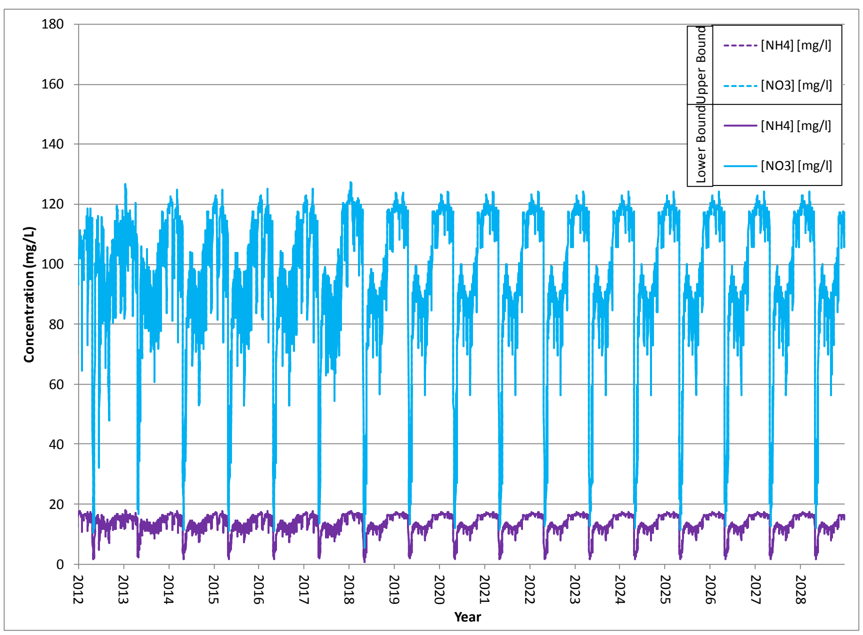
mg/L = milligrams per litre; µg/L = micrograms per litre.

Figure 7-4 Major Ion Concentrations – North Pile Discharge



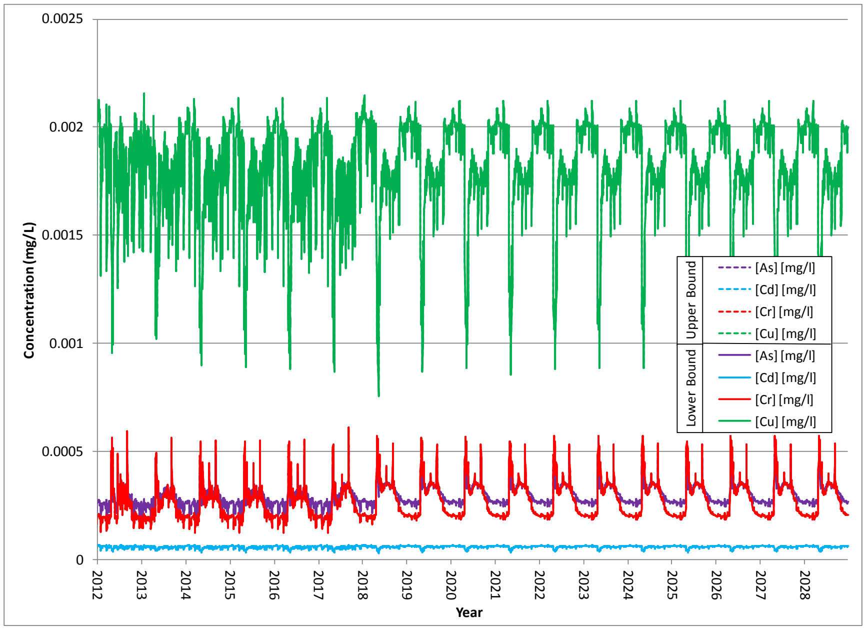
mg/L = milligrams per litre

Figure 7-5 Selected Nutrient Concentrations – North Pile Discharge



mg/L = milligrams per litre

Figure 7-6 Selected Metal Concentrations – North Pile Discharge



mg/L = milligrams per litre

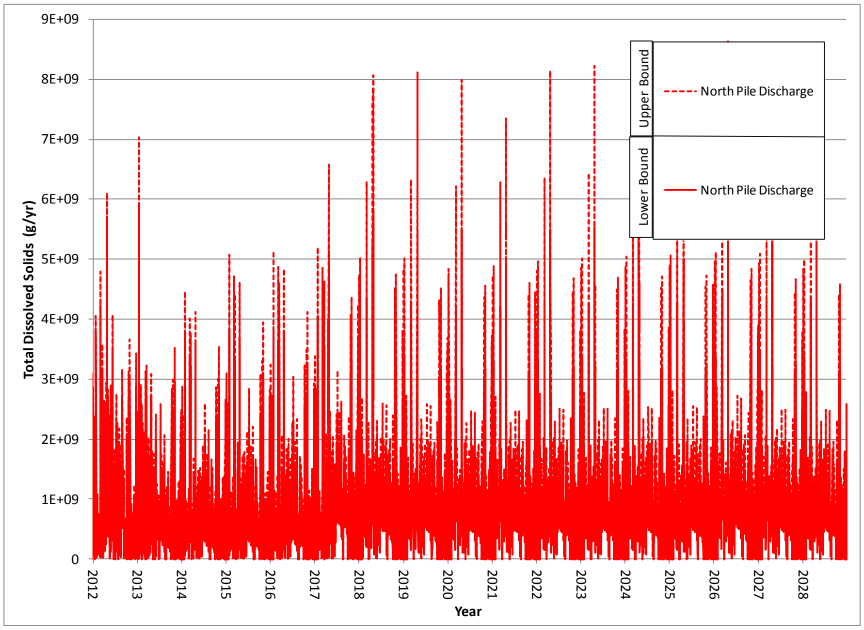
Dissolved mass load from the North Pile is a mixture of stored mass, mass due to dissolution of PK and dilution rock (from precipitation interacting with the North Pile), and mass contained in process water. Mass release is influenced strongly by the spring freshet and the release of dissolved mass from drain-down of the fines fraction of the PK material. The dissolved contributions from the various sources for major ions are provided in Figure 7-7. With respect to nutrient and metal release, the large majority of mass release from the North Pile similarly occurs during the spring freshet, as is illustrated for nitrate and chromium in Figures 7-8 and 7-9.

Based on the model results, the following processes, trends, and influences are considered most relevant with respect to the North Pile discharge:

- With respect to the dissolved phase load, the calculated concentrations are predominantly influenced by production factors, surface area of the North Pile, infiltration, and drain-down of the fines fraction of the PK. The major ion concentrations during operations are mainly associated with the slurry mixture.
- The Upper Bound Scenario reports elevated concentrations of major ions in the North Pile discharge compared to those reported in the Lower Bound Scenario due to the use of treated water used for processing, which incorporates some of the TDS from the minewater at different concentrations.

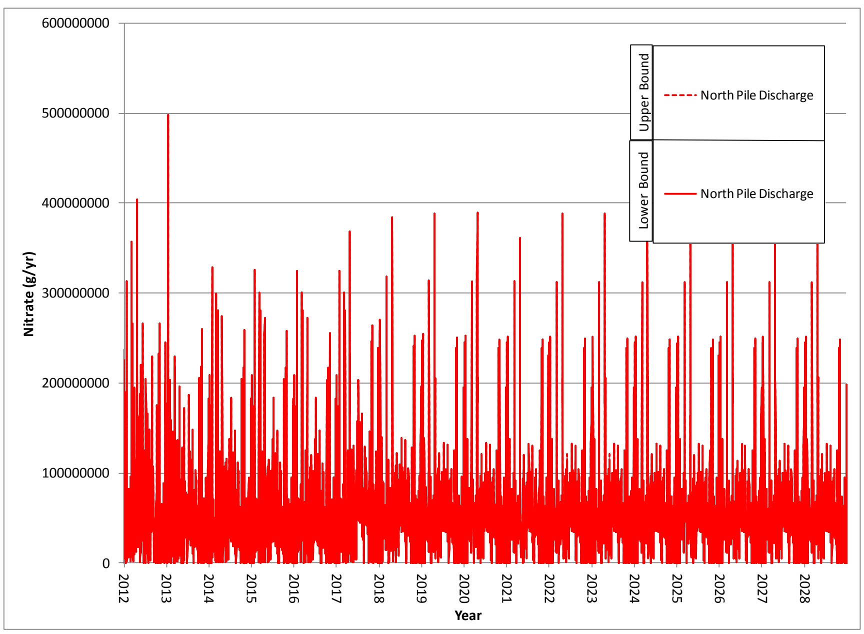
Relative to other areas of the Mine site, the North Pile mass load is the most difficult to predict. The key factors that can affect the North Pile water quality include pile design, mass distribution, deposition schedule, freezing, and material properties. In addition the thickness of active layer, cover material, retention pond volumes and runoff volumes all affect the North Pile water quality. The pile design and characteristics were based on site observations and the available information at the time of modelling (De Beers 2013b). The North Pile as modelled is thought to be a reasonable representation of expected conditions during operations. As the design of the North Pile is refined and/or monitoring data become available, particularly with respect to temperature within the North Pile, the estimates of water quality should be adjusted accordingly and the long term post-closure water quality estimates should be updated.

Figure 7-7 Total Dissolved Solids Loading – North Pile to Water Management Pond



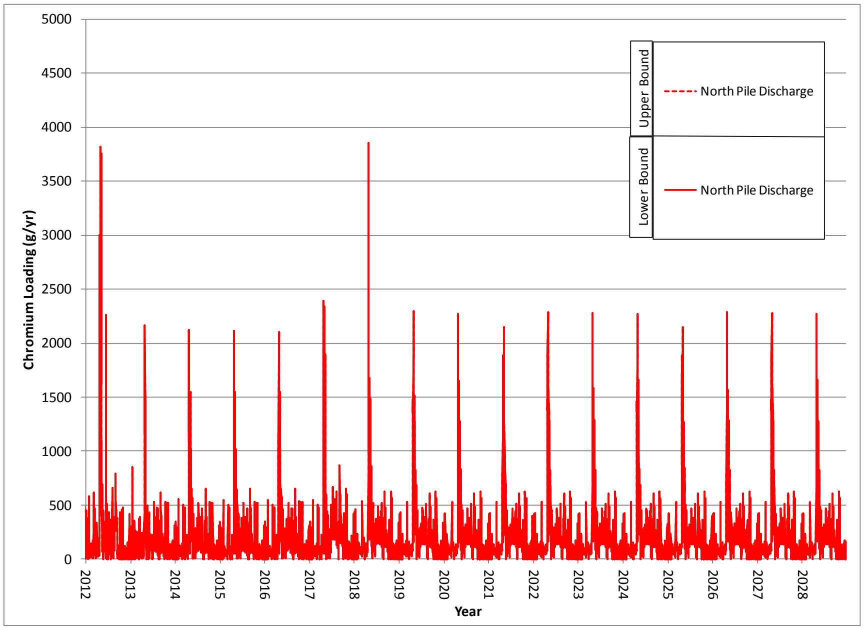
g/yr = grams per year.

Figure 7-8 Nitrate Loading – North Pile to Water Management Pond



g/yr = grams per year.

Figure 7-9 Dissolved Chromium Load – North Pile



g/yr = grams per year.

8 MINE SITE AND NON-POINT SOURCE DISCHARGES

Approximately 16% of the overall Mine site runoff (developed and undeveloped) reports to the WMP. In the developed area (excluding the North Pile), most of the water is contained within the catchment of the WMP; the remaining runoff from both these undeveloped and developed areas reports directly to Snap Lake as non-point source discharges.

Non-point sources reporting to Snap Lake are:

- undeveloped areas;
- North Pile seepage through fractured granite bedrock (Section 7);
- Mine site runoff;
- runoff from the airstrip;
- runoff from the explosives storage area; and,
- seepage from the WMP.

8.1 Flow Summary

Flow and chemical loading from most of the above non-point sources will report to Snap Lake in areas not tracked as independent components by the GoldSim model. Mass load applied to developed Mine site runoff locations, including the airstrip and explosives plant, is based on observed water quality results from operational site monitoring data between July 2004 and June 2013 from the Snap Lake Environmental Database (Table 8-1).

The Bulk Sample Rock Pad (BSMRP) receives runoff from the waste rock pad created through bulk sample activities. This runoff has been monitored since 2004 at station SNP 02-05. The waste rock pad has historically been composed of approximately 90% metavolcanic material and 10% granite material with trace amounts of kimberlite. Laboratory test work and site monitoring results from SNP 02-05 confirm that the sulphide concentrations observed in the rock of the BSMRP are not expected to result in acid-generating conditions (De Beers 2013b). Since these rocks appear to be chemically stable with respect to acid generation and no long-term changes in environmental behaviour are anticipated, it is reasonable to conclude that the results from the monitoring data at SNP 02-05 are representative of potential Mine site runoff water quality. These monitoring data are collected under ambient field conditions, and are therefore considered more reliable than laboratory results.

The loading estimates based on the runoff data are considered conservative from an environmental perspective since the proportion of metavolcanic rock at the BSMRP sampling location is higher than observed at other developed Mine site areas (De Beers 2011). Laboratory testing has demonstrated that leachates from metavolcanic rock samples generally have higher concentrations of dissolved metals than leachates from granitic samples (De Beers 2002b). Granite free of sulphide minerals, which is less reactive than metavolcanic rock, has been used for construction purposes throughout the Mine site.

Mass load applied to runoff from undeveloped portions of the Mine site is based on water quality measured from Streams 1 and 27; these measurements are considered to be representative of background conditions. Loading from the explosives plant may be associated with washing of explosives. However, wash water from the explosives plant is expected to be collected and discharged via the treatment plant. As the approach used to determine the mass loading from explosives accounts for all explosives brought to the Mine site, the loading from the explosives plant is implicitly accounted for.

The water quality of the seepage below the WMP dam will be predominantly influenced by the dissolved phase water quality in the WMP. Water quality is calculated based on relative contributions from the Mine (Section 6), North Pile (Section 7), and Mine site runoff reporting to the WMP.

8.2 Results

8.2.1 Mine Site Runoff and Non-Point Source Discharge

Concentrations and mass loading applied to the Mine site runoff and non-point source discharge are provided in Tables 8-1 and 8-2. Given that the Mine site footprint is not expected to change over the course of operations, now that facilities are in place, the mass loading as calculated should not change over time.

Relative to the loadings to Snap Lake from the Mine and North Pile, the non-point source loadings are small as illustrated and discussed in Section 10.

Table 8-1 Mine Site Runoff Concentrations

Parameter	Units	Site Runoff from Developed Areas to Snap Lake/WMP [(a)]	Site Runoff from Airstrip/Roads to Snap Lake [(b)]
Conventional Parameters			
Alkalinity	mg/L	27.90	5.10
Total Dissolved Solids	mg/L	212	12.25
Total Suspended Solids	mg/L	3	4.25
Nutrients			
Ammonia (NH_4 – N)	mg/L	0.04	0.03
Nitrate (NO_3 – N)	mg/L	2.04	0.04
Total Phosphorous	mg/L	0.02	0.02
Total Kjeldahl Nitrogen	-	0.52	0.75
Ortho-phosphate	µg/L	0.50	0.50
Major Ions			
Calcium	mg/L	32.20	1.95
Chloride	mg/L	7.00	1.00
Fluoride	µg/L	124.00	51.50
Magnesium	mg/L	18.45	1.10
Potassium	mg/L	3.32	0.90
Silica	mg/L	2.60	1.50
Sodium	mg/L	4.25	1.10
Sulphate	mg/L	110.00	1.53
Dissolved Metals, Metalloids, and Non-Metals			
Aluminum	µg/L	41.80	149.00
Antimony	µg/L	0.21	0.02
Arsenic	µg/L	0.13	0.14
Barium	µg/L	22.20	5.50
Beryllium	µg/L	0.10	0.10
Cadmium	µg/L	0.06	0.03
Chromium	µg/L	0.22	0.20
Cobalt	µg/L	3.81	0.50
Copper	µg/L	10.20	3.90
Iron	µg/L	49.25	416.50
Lead	µg/L	0.07	0.10
Lithium	µg/L	2.20	1.80
Manganese	µg/L	57.90	10.90
Mercury	µg/L	0.01	0.01
Molybdenum	µg/L	5.93	0.61
Nickel	µg/L	11.80	0.79
Selenium	µg/L	0.20	0.20
Silver	µg/L	0.05	0.05
Strontium	µg/L	112.00	10.30
Thallium	µg/L	0.02	0.02
Uranium	µg/L	0.36	0.10
Vanadium	µg/L	0.24	0.21
Zinc	µg/L	11.05	6.00

(a) Based on average data from monitoring point SNP 02-05.
(b) Based on average data from monitoring point SNP 02-04.
Concentrations based on median values from July 2004 through May 2013.
- = not applicable/ unitless; mg/L = milligrams per litre; µg/L = micrograms per litre; WMP = water management pond.

Table 8-2 Average Annual Loading From Site Runoff

Parameter	Units	Loadings from Site Runoff (Developed Areas) to WMP[(a), (d)]	Loadings from Site Runoff (Developed Areas) to Snap Lake[(b), (d)]	Loadings from Site Runoff (Airstrip/Roads) to Snap Lake[(c), (d)]
Conventional Parameters				
Alkalinity	kg/d	3.99E+00	1.45E+01	7.75E-01
Total Dissolved Solids	kg/d	3.03E+01	1.10E+02	1.86E+00
Total Suspended Solids	kg/d	4.29E-01	1.56E+00	6.46E-01
Nutrients				
Ammonia (NH_4 – N)	kg/d	5.72E-03	2.08E-02	4.56E-03
Nitrate (NO_3 – N)	kg/d	2.92E-01	1.06E+00	6.08E-03
Total Phosphorous	kg/d	2.86E-03	1.04E-02	3.04E-03
Total Kjeldahl Nitrogen		7.44E-02	2.70E-01	1.14E-01
Ortho-phosphate	kg/d	7.15E-05	2.60E-04	7.60E-05
Major Ions				
Calcium	kg/d	4.60E+00	1.67E+01	2.96E-01
Chloride	kg/d	1.00E+00	3.63E+00	1.52E-01
Fluoride	kg/d	1.77E-02	6.44E-02	7.83E-03
Magnesium	kg/d	2.64E+00	9.58E+00	1.67E-01
Potassium	kg/d	4.75E-01	1.72E+00	1.37E-01
Silica	kg/d	3.72E-01	1.35E+00	2.28E-01
Sodium	kg/d	6.08E-01	2.21E+00	1.67E-01
Sulphate	kg/d	1.57E+01	5.71E+01	2.33E-01
Dissolved Metals, Metalloids, and Non-Metals				
Aluminum	kg/d	5.98E-03	2.17E-02	2.26E-02
Antimony	kg/d	3.00E-05	1.09E-04	2.28E-06
Arsenic	kg/d	1.87E-05	6.80E-05	2.13E-05
Barium	kg/d	3.17E-03	1.15E-02	8.36E-04
Beryllium	kg/d	1.43E-05	5.19E-05	1.52E-05
Cadmium	kg/d	8.58E-06	3.11E-05	3.80E-06
Chromium	kg/d	3.15E-05	1.14E-04	3.04E-05
Cobalt	kg/d	5.45E-04	1.98E-03	7.60E-05
Copper	kg/d	1.46E-03	5.29E-03	5.93E-04
Iron	kg/d	7.04E-03	2.56E-02	6.33E-02
Lead	kg/d	1.00E-05	3.63E-05	1.52E-05
Lithium	kg/d	3.15E-04	1.14E-03	2.74E-04
Manganese	kg/d	8.28E-03	3.01E-02	1.66E-03
Mercury	kg/d	1.43E-06	5.19E-06	1.52E-06
Molybdenum	kg/d	8.48E-04	3.08E-03	9.24E-05
Nickel	kg/d	1.69E-03	6.12E-03	1.19E-04
Selenium	kg/d	2.86E-05	1.04E-04	3.04E-05
Silver	kg/d	7.15E-06	2.60E-05	7.60E-06
Strontium	kg/d	1.60E-02	5.81E-02	1.57E-03
Thallium	kg/d	2.15E-06	7.79E-06	2.28E-06
Uranium	kg/d	5.12E-05	1.86E-04	1.52E-05
Vanadium	kg/d	3.43E-05	1.25E-04	3.19E-05
Zinc	kg/d	1.58E-03	5.73E-03	9.12E-04

(a) Average annual flow rates based on De Beers (2013d) water balance; 143 m^3/d.
(b) Average annual flow rates based on De Beers (2013d) water balance; 519 m^3/d.
(c) Average annual flow rates based on De Beers (2013d) water balance; 152 m^3/d.
(d) Calculated values based on site runoff concentrations as provided in Table 8-1 and average annual flows.
m^3/yr = cubic metres per year; kg/d = kilograms per day; WMP = Water management pond; NPS = Non-point source.

8.2.2 Water Management Pond Water Quality

Seepage from the WMP migrates below Dam 1 and reports to Snap Lake just south of the northwest peninsula. Seepage volume is estimated to be 12,000 m^3/yr (33 m^3/d) and is released during periods where the ground is thawed (De Beers 2002c). The water quality of the seepage immediately down gradient from the WMP is expected to be similar to that of the WMP, which is estimated in GoldSim, based on relative contributions from the North Pile, the Mine site, and the underground Mine (via the WTP) reporting to the WMP. Further down gradient of the WMP the seepage is expected to mix with other groundwater and infiltration; however, this was not considered in the current modelling, therefore the model results are conservative relative to expected conditions.

Average annual expected concentrations in the WMP for selected years are summarized in Table 8-3. General trends over time for selected major ion and metal concentrations in the WMP are illustrated in Figures 8-1 and 8-2. Concentrations in the WMP are highly variably over the course of a given year due to the variable inputs originating from the North Pile. Concentrations trend upwards between 2012 and 2018, and then are relatively consistent, although seasonally variable through to Mine closure in 2028.

Table 8-3 Summary of Estimated Concentrations for Water Management Pond Water

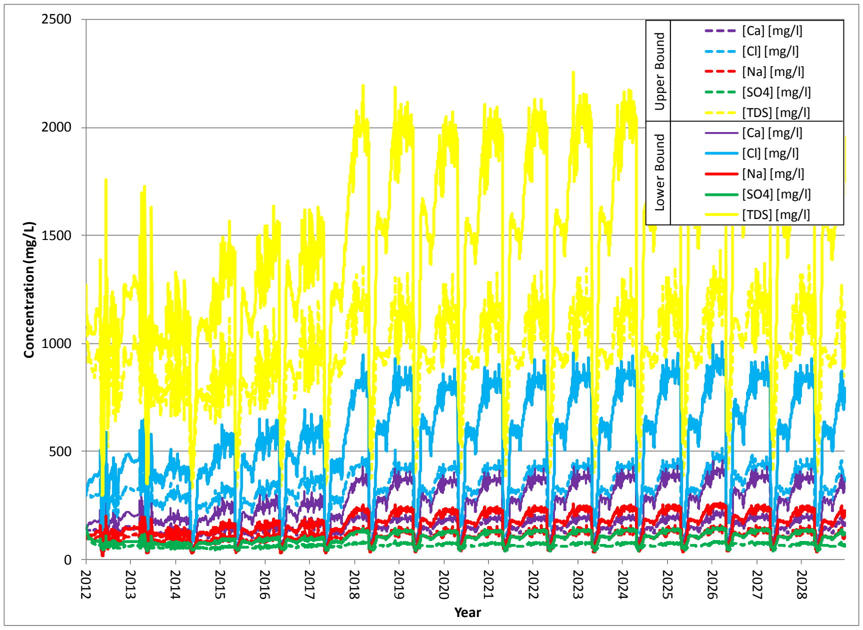
Parameter	Units	Average Annual Water Management Pond Water[a] Concentrations					
		Lower Bound			Upper Bound		
		2014	2019	2028	2014	2019	2028
Conventional Parameters							
pH[b]	pH	6 - 9	6 - 9	6 - 9	6 - 9	6 - 9	6 - 9
Alkalinity	mg/L	152	232	248	242	448	464
Total Dissolved Solids	mg/L	747	971	994	1018	1624	1646
Total Suspended Solids	mg/L	7.6	7.9	7.9	7.6	7.9	7.9
Nutrients							
Ammonia	mg/L	6.4	7.4	8.0	6.3	7.1	7.7
Nitrate + Nitrite	mg/L	37.8	43.2	44.2	37.5	42.4	43.4
Total Phosphorus	mg/L	0.02	0.02	0.02	0.02	0.02	0.02
Total Kjeldahl Nitrogen	mg/L	4.6	5.2	5.2	4.6	5.2	5.2
Orthophosphate (PO_4)	mg/L	0.002	0.002	0.002	0.002	0.002	0.002
Major Ions							
Calcium	mg/L	112	151	153	170	291	294
Chloride	mg/L	246	335	342	375	644	651
Fluoride	mg/L	0.56	0.64	0.68	0.55	0.62	0.66
Magnesium	mg/L	28.4	32.0	33.4	28.1	31.2	32.6
Potassium	mg/L	11.1	12.6	12.9	11.1	12.3	12.7
Silica	mg/L	8.3	10.3	12.7	8.0	9.6	11.9
Sodium	mg/L	83.4	109	111	115	184	186
Sulphate	mg/L	51.9	64.8	65.8	69.9	108	109
Dissolved Metals							
Aluminum	µg/L	19.7	27.4	35.7	19.7	27.2	35.8
Antimony	ug/L	0.65	0.54	0.43	0.64	0.54	0.43
Arsenic[c]	µg/L	0.22	0.26	0.27	0.23	0.27	0.28
Barium	µg/L	49.4	52.7	53.5	49.0	52.0	52.7
Beryllium[c]	µg/L	0.13	0.17	0.19	0.13	0.18	0.20
Cadmium[c]	µg/L	0.05	0.05	0.05	0.05	0.05	0.05
Chromium	µg/L	0.26	0.31	0.32	0.27	0.33	0.34
Cobalt	µg/L	0.84	0.92	0.93	0.83	0.91	0.93
Copper	µg/L	2.1	2.2	2.2	2.1	2.2	2.2
Iron	µg/L	34.2	54.5	77.6	34.0	53.5	77.7
Lead[c]	µg/L	0.13	0.17	0.18	0.13	0.17	0.18
Lithium	ug/L	39.6	60.0	63.9	65.4	122	126
Manganese	µg/L	73.0	84.0	95.7	71.1	78.5	90.0
Mercury[c]	µg/L	0.04	0.06	0.06	0.04	0.06	0.06
Molybdenum	µg/L	14.6	16.9	17.7	14.5	16.5	17.3
Nickel	µg/L	16.4	19.3	21.7	16.0	18.2	20.6
Selenium[c]	µg/L	0.19	0.26	0.30	0.19	0.26	0.30
Silver[c]	µg/L	0.03	0.04	0.05	0.03	0.04	0.05
Strontium	µg/L	1235	1650	1670	1879	3206	3223
Thallium	µg/L	0.04	0.05	0.05	0.04	0.05	0.05
Uranium[c]	µg/L	1.5	1.8	2.0	1.5	1.8	1.9
Vanadium	µg/L	0.68	0.93	0.97	0.68	0.95	0.99
Zinc	µg/L	5.2	5.5	5.6	5.2	5.5	5.6

(a) Estimates of water seepage from the Water Management Pond to Snap Lake, values based on flow weighted average annual values of daily data model results.

(b) The pH range is not modelled; however it is expected to be consistent with currently measured range of values and meet efluent quality criteria requirements, set by 2012 Snap Lake Mine Water Licence (MV2011L2-0004, De Beers Canada Inc.).

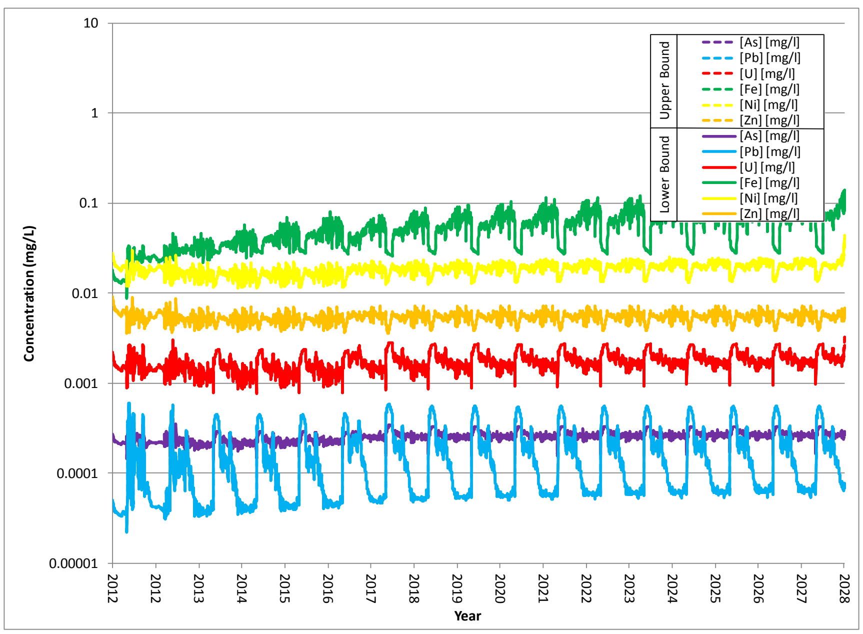
(c) GoldSim input data based on one half of typical lower detection limits (where values were below detection). Elevated detection limits were not included in average detection limit values, therefore the resulting calculated values may be biased upwards.mg/L = milligrams per litre; µg/L = micrograms per litre.

Figure 8-1 Major Ion Concentration – Water Management Pond



mg/L = milligrams per litre

Figure 8-2 Selected Metal Concentrations – Water Management Pond



mg/L = milligrams per litre

9 TREATMENT AND WATER MANAGEMENT POND

9.1 Overview

For the purposes of estimating discharge water quality it is assumed that current levels of treatment will continue during the operational phase of the Mine and into post-closure (i.e., end of 2028). In post-closure, at such a time as concentrations in water originating from the North Pile and Mine site meet acceptable discharge criteria without active treatment, these waters will be discharged directly to Snap Lake, and the WMP and WTP will be decommissioned.

During operations, flows and chemical loading from the Mine, the Mine site, and the North Pile report either to the WMP or to the WTP. Other than a small amount of seepage through Dam 1, water from the WMP is directed through the WTP. Water is then either discharged to Snap Lake via twin diffusers located offshore (underwater), or used in processing and discharged with the PK to the North Pile. Treated domestic waste water is included in the discharge from the WTP.

Treatment currently consists of removal of total suspended sediments (TSS) to concentrations below 7 mg/L as required under the Water Licence. Some other parameters are incidentally removed with the TSS, and there is the ability within the treatment plant to adjust pH. Treatment discharge flows and quality have been measured since 2004 and continue to be measured as required under the Water Licence. The available monitoring data were used to represent the initial concentrations within the WMP and WTP, and to evaluate the effective removal of incidental parameters during treatment. Where relevant and appropriate to do so, discharge concentrations have been adjusted for observed treatment efficiency (Table 9-1).

9.2 Flow and Mass Load Components

Total flow reporting to, and discharging from the WTP was initially represented by measured data. When measured data do not exist, total inflows (flow from the Mine and WMP; Figure 9-1), and total outflows (water used for the process plant and overflows to the WTP) were calculated using the water balance model component of the GoldSim model. Mass load components were accounted for in the underground Mine, North Pile, and Mine site as discussed in Sections 6, 7, and 8, respectively. The mass reporting to treatment was based on the summation of the mass load from these sources.

For TSS, a maximum allowable concentration of 7 mg/L was set for discharge from the WTP as per the Mine's Water Licence. For dissolved silver, arsenic, copper, and phosphorus, concentrations were adjusted based on observed treated concentrations at the final discharge location (between 2004 and 2013); rationale for each parameter adjustment is identified in Table 9-1. For these parameters, concentrations measured in the discharge do not trend upwards, but rather are consistently near or below detection limits, and their removal can be enhanced if necessary in the treatment process to maintain low concentrations. The remaining parameter concentrations were not adjusted as a function of treatment (i.e., no dissolved mass was removed), since this was not relevant to the model results.

Table 9-1 Constraints Applied to Treatment

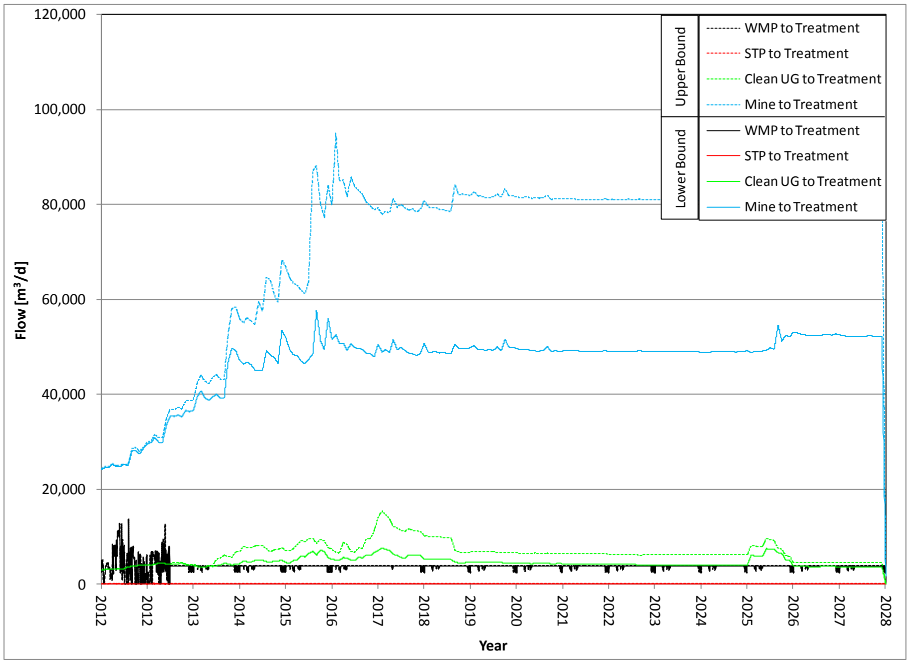
Parameter	Units	Current Constraints (Limits)[a,b]	Rationale
Conventional Parameters			
Alkalinity	mg/L	unlimited	Not relevant
Total Dissolved Solids	mg/L	unlimited	Not relevant
Total Suspended Solids	mg/L	7	treatment limit from Water Licence
Nutrients			
Ammonia (NH4-N)	mg/L	unlimited	Not relevant
Nitrate + nitrite as Nitrogen (NO_3-N)	mg/L	unlimited	Not relevant
Total Phosphorous	mg/L	0.02	observation
Total Kjeldahl Nitrogen	mg/L	unlimited	Not relevant
Ortho-phosphate	mg/L	0.02	Set at 95th percentile of monitoring data from 2009 to 2013
Major Ions			
Calcium	mg/L	unlimited	Not relevant
Chloride	mg/L	unlimited	Not relevant
Fluoride	mg/L	unlimited	Not relevant
Magnesium	mg/L	unlimited	Not relevant
Potassium	mg/L	unlimited	Not relevant
Silica	mg/L	unlimited	Not relevant
Sodium	mg/L	unlimited	Not relevant
Sulphate	mg/L	unlimited	Not relevant
Dissolved Metals, Metalloids, and Non-Metals			
Aluminum	µg/L	unlimited	Not relevant
Antimony	µg/L	unlimited	Not relevant
Arsenic	µg/L	4	Most monitoring data 1 order of magnitude lower
Barium	µg/L	unlimited	Not relevant
Beryllium	µg/L	unlimited	Not relevant
Cadmium	µg/L	unlimited	Not relevant
Chromium	µg/L	unlimited	Not relevant
Cobalt	µg/L	unlimited	Not relevant
Copper	µg/L	2	2/3 of license limit, (conservatively set slightly higher than 75th percentile value of the monitoring data between 2009 and 2013)
Iron	µg/L	unlimited	Not relevant
Lead	µg/L	unlimited	Not relevant
Lithium	µg/L	unlimited	Not relevant
Manganese	µg/L	unlimited	Not relevant
Mercury	µg/L	unlimited	Not relevant
Molybdenum	µg/L	unlimited	Not relevant
Nickel	µg/L	unlimited	Not relevant
Selenium	µg/L	unlimited	Not relevant
Silver	µg/L	0.2	almost all values below detection limit of 0.05
Strontium	µg/L	unlimited	Not relevant
Thallium	µg/L	unlimited	Not relevant
Uranium	µg/L	unlimited	Not relevant
Vanadium	µg/L	unlimited	Not relevant
Zinc	µg/L	unlimited	Not relevant

(a) Constraints are based on observed treatment reductions and/or maximum concentrations observed between 2004 and 2013 at final discharge station SNP 02-17b.

(b) Where the observed values were in agreement with modelled results without imposing a constraint due to treatment, or where treatment was not expected to influence the resulting concentrations, the upper limit from the treatment plan was set as "unlimited" as treatment was not relevant for these cases.

mg/L = milligrams per litre; µg/L = micrograms per litre.

Figure 9-1 Flow Reporting to Treatment



m^3/d = cubic meters per day

9.3 Results – Treatment

For all parameters there are significant seasonal cycles influencing both concentration and loading trends. These seasonal cycles are driven by temperature conditions, including solute rejection as a function of ice formation. These seasonal trends are more pronounced for parameters more strongly influenced by the North Pile than for those associated primarily with minewater inflows. Discussion of concentrations and loadings below focuses on general overall year-to-year trends rather than seasonal cycles.

9.3.1 Concentrations – Treatment

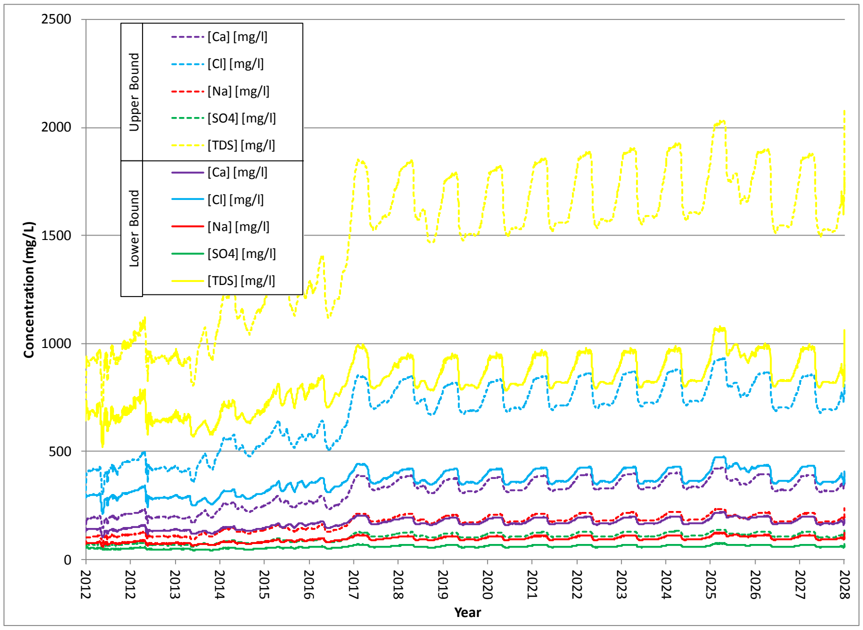
Concentrations of major ions, nutrients, and metals in the treatment discharge are shown in Figures 9-2 through 9-4. Average annual flow-weighted concentrations in the treated discharge are summarized in Table 9-2 for selected years representing water quality at different points in the Mine life (early, mid, late).

Concentration trends for TDS show a substantial increase in concentrations between 2015 and 2018, following which the overall upward trend is gradual until closure in 2028 with peak values of approximately 1,000 mg/L in the Lower Bound Scenario and between 1,800 mg/L and 2,000 mg/L for the Upper Bound Scenario. The primary influences on TDS concentrations are the deeper connate water mass load and the cycling of water between Snap Lake and the Mine. The influence of connate water is evident from the difference between the Upper Bound Scenario and the Lower Bound Scenario. The Upper Bound Scenario reports significantly higher concentrations of major parameters and TDS due to the increase in connate water flow.

Nutrients concentrations for nitrate and ammonia have a much more gradual trend since they are primarily influenced by the explosive use rate. The slight increase for nitrate and ammonia is the result of lake water recycling through the Mine. Metal concentrations vary depending on the influencing factors. Where metal concentrations are elevated as a result of mining interaction or connate water inflow, they show an increasing trend during operations. Where the input values for the metals concentrations are low in each of the Mine, site, and North Pile, the resulting trend in discharge water quality is somewhat flatter, and does not change appreciably over time.

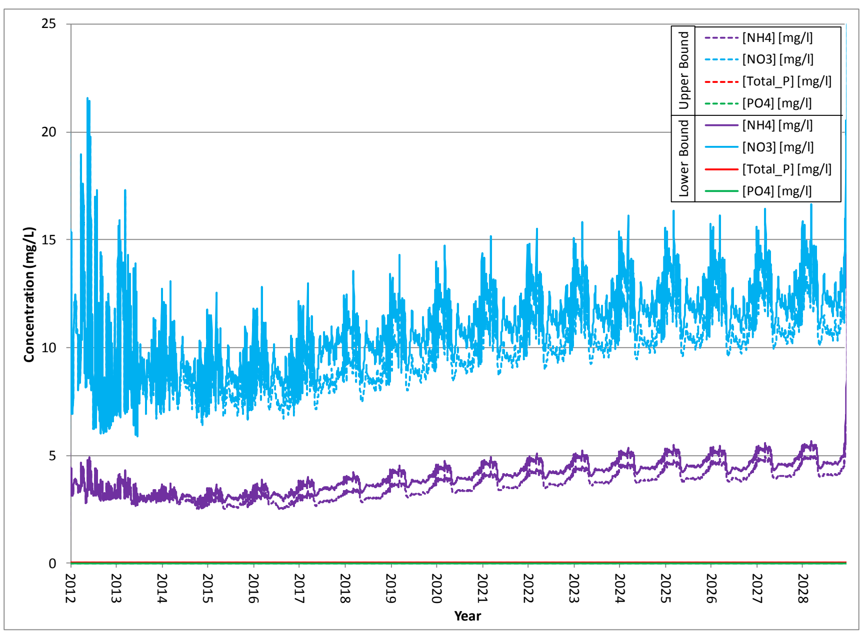
The concentration of copper is notable as input concentrations suggest that the values should be higher than observed in the measured discharge concentrations at SNP 02-17B. Given the observed effectiveness of treatment, copper values have an upper limit of 0.002 mg/L as set in the model treatment efficiency.

Figure 9-2 Total Dissolved Solids and Major Ion Concentrations – Treated Discharge



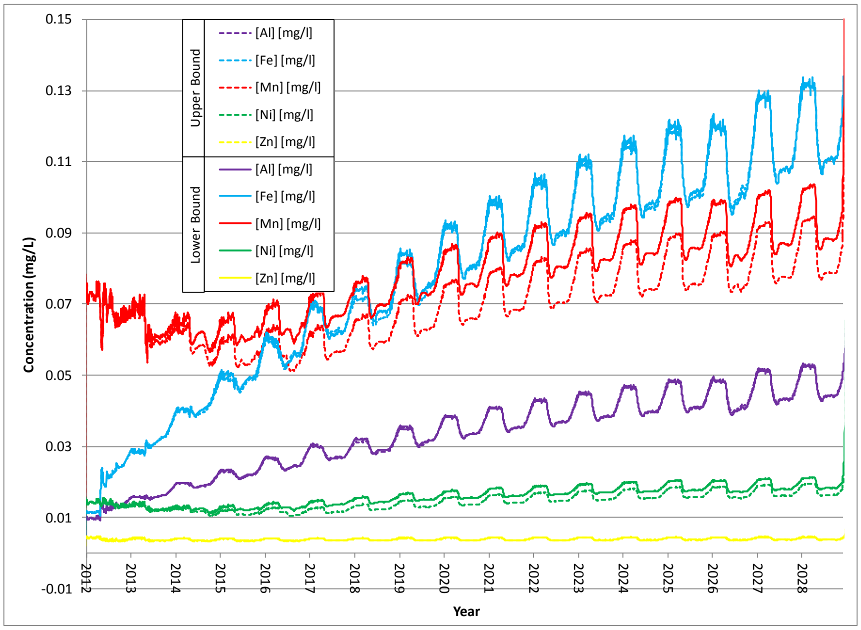
mg/L = milligrams per litre

Figure 9-3 Nutrient Concentrations – Treated Discharge



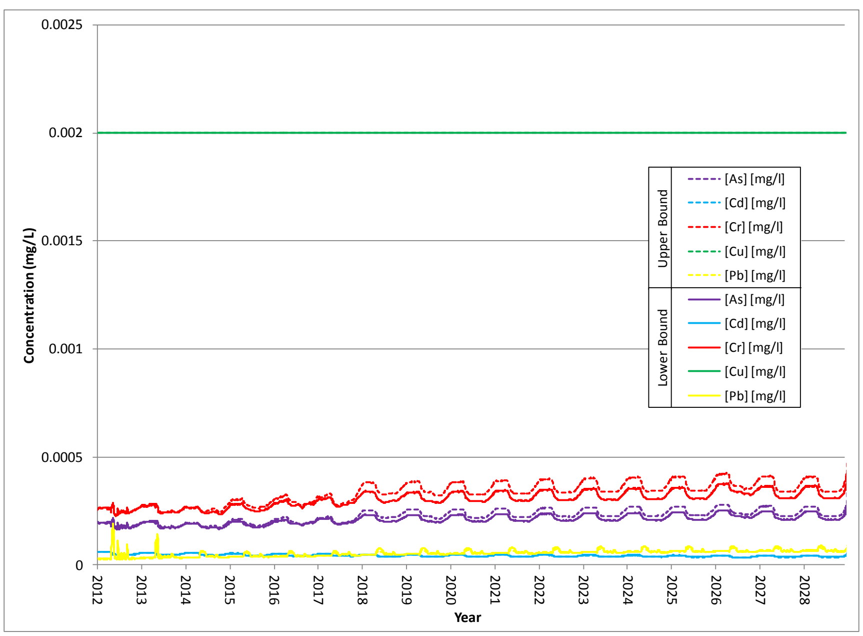
mg/L = milligrams per litre.

Figure 9-4a Metal Concentrations – Treated Discharge



mg/L = milligrams per litre.

Figure 9-4b Selected Metal Concentrations – Treated Discharge



mg/L = milligrams per litre.

Table 9-2 Summary of Treated Discharge Concentrations

Parameter	Units	Effluent Quality Criteria Requirements[b]	Average Annual Treated Discharge Water[a] Concentrations					
			Lower Bound			Upper Bound		
			2014	2019	2028	2014	2019	2028
Conventional Parameters								
pH[c]	pH	6 - 9	6 - 9	6 - 9	6 - 9	6 - 9	6 - 9	6 - 9
Alkalinity	mg/L		166	258	277	276	522	535
Total Dissolved Solids	mg/L		622	855	881	954	1650	1661
Total Suspended Solids	mg/L	7	7.0	7.0	7.0	7.0	7.0	7.0
Nutrients								
Ammonia	mg/L	10	3.1	4.0	5.0	2.9	3.4	4.4
Nitrate + Nitrite	mg/L	22.5[e,f] (4.5[g,h])	8.9	10.9	13.0	8.5	9.4	11.7
Total Phosphorus	mg/L	-	0.020	0.020	0.020	0.020	0.020	0.020
Total Kjeldahl Nitrogen	mg/L	-	1.4	1.6	1.7	1.4	1.6	1.7
Orthophosphate (PO_4)	mg/L	-	0.002	0.002	0.002	0.002	0.002	0.002
Major Ions								
Calcium	mg/L	-	129	175	178	200	346	345
Chloride	mg/L	310[e] (160[g])	274	379	387	431	756	756
Fluoride	mg/L	(0.15[g])	0.38	0.44	0.51	0.36	0.41	0.48
Magnesium	mg/L	3	14.6	16.7	19.2	14.0	15.2	17.8
Potassium	mg/L	-	4.6	5.2	5.8	4.4	4.8	5.4
Silica	mg/L	-	9.4	12.9	16.5	8.9	11.6	15.3
Sodium	mg/L	-	70.7	97.3	100	109	189	190
Sulphate	mg/L	75	45.5	60.0	61.1	67.5	113	113
Dissolved Metals								
Aluminum	µg/L	100	19.6	33.3	47.6	19.5	32.9	47.9
Antimony	ug/L	-	0.72	0.50	0.30	0.72	0.50	0.31
Arsenic[d]	µg/L	7	0.18	0.21	0.23	0.18	0.23	0.24
Barium	µg/L	-	33.7	34.6	35.6	33.0	33.2	34.2
Beryllium[d]	µg/L	-	0.07	0.12	0.16	0.07	0.13	0.17
Cadmium[d]	µg/L	-	0.05	0.04	0.04	0.05	0.04	0.04
Chromium	µg/L	10	0.25	0.31	0.33	0.26	0.35	0.37
Cobalt	µg/L	-	0.30	0.33	0.37	0.30	0.32	0.36
Copper	µg/L	3	2.0	2.0	2.0	2.0	2.0	2.0
Iron	µg/L	-	41.3	79.0	119	41.0	77.4	120
Lead[d]	µg/L	5	0.04	0.05	0.07	0.04	0.05	0.07
Lithium	ug/L	-	46.8	71.4	75.8	78.5	147	150
Manganese	µg/L	-	61.7	76.6	94.8	58.2	66.6	85.4
Mercury[d]	µg/L	-	0.01	0.02	0.02	0.01	0.02	0.02
Molybdenum	µg/L	-	5.5	6.8	8.3	5.2	6.1	7.6
Nickel	µg/L	50	12.4	15.7	19.6	11.7	13.8	17.8
Selenium[d]	µg/L	-	0.10	0.18	0.25	0.10	0.19	0.26
Silver[d]	µg/L	-	0.02	0.04	0.06	0.02	0.04	0.06
Strontium	µg/L	-	1436	1939	1954	2226	3833	3812
Thallium	µg/L	-	0.01	0.02	0.03	0.01	0.02	0.03
Uranium[d]	µg/L	-	0.94	1.2	1.5	0.89	1.1	1.3
Vanadium	µg/L	-	0.21	0.34	0.43	0.22	0.37	0.45
Zinc	µg/L	10	3.7	3.9	4.1	3.7	3.9	4.1

(a) Estimates of treated water reporting to Snap Lake, values based on flow weighted average annual values of daily data model results.

(b) Effluent Quality Criteria set by 2012 Snap Lake Mine Water Licence (MV2011L2-0004, De Beers Canada Inc.).

(c) The pH range is not modelled; however it is expected to be consistent with currently measured range of values and meet efluent quality criteria requirements, set by 2012 Snap Lake Mine Water Licence (MV2011L2-0004, De Beers Canada Inc.).

(d) GoldSim input data based on one half of typical lower detection limits (where values were below detection). Elevated detection limits were not included in average detection limit values, therefore the resulting calculated values may be biased upwards.

(e) Criteria valid up to December 31, 2014.

(f) Value includes 0.5 mg/L of nitrite as N, and 22 mg/L of nitrate as N.

(g) Criteria valid from January 1, 2015.

(h) Value includes 0.5 mg/L of nitrite as N, and 4 mg/L of nitrate as N.

mg/L = milligrams per litre; µg/L = micrograms per litre.

9.3.2 Mass Load Distribution – Treatment

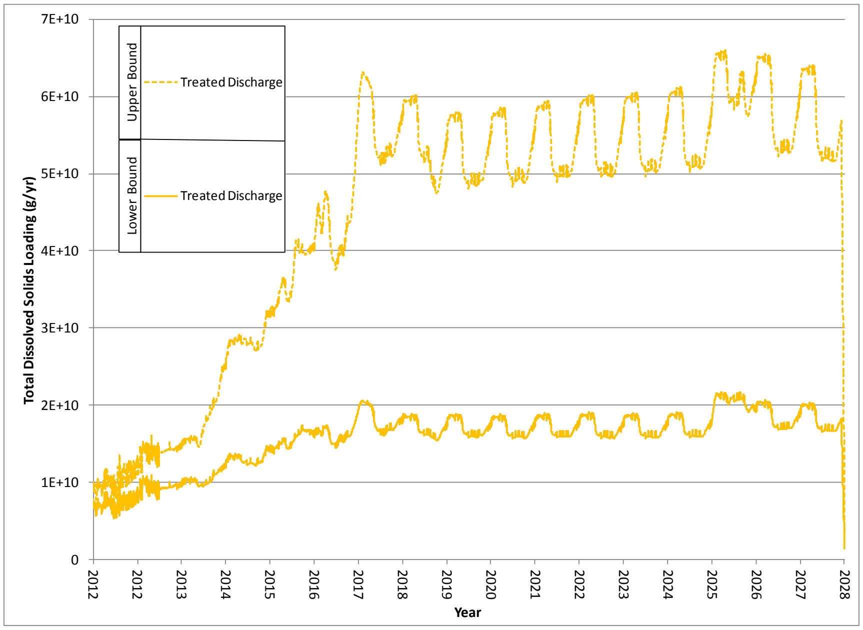
Mass loading plots for three example parameters (TDS, nickel, and chromium) are provided in Figures 9-5 through 9-7. Trends to note are the substantial increase in loading due to increased minewater inflow between 2013 and 2018, which levels out or becomes more gradual between 2018 and the end of mining in 2028. Once pumping from the Mine stops, the loading for all parameters drops substantially as can be observed in the example plots due to the much smaller rate of water discharge from the site.

9.3.3 Summary of Key Results and Discussion

Based on the model results, the following processes, trends, and influences are considered most relevant with respect to treatment feed and treated discharge:

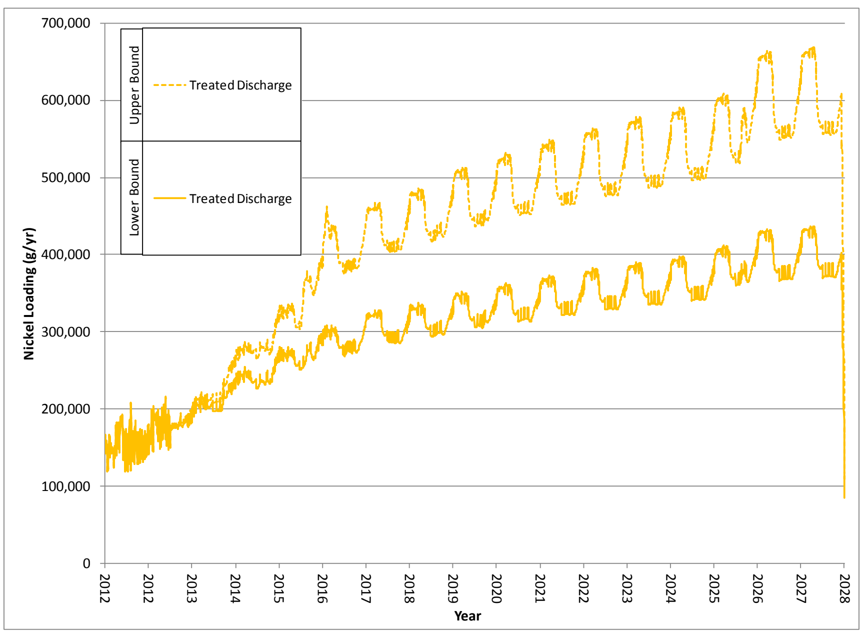
- typical major ion trends show concentrations and loadings consistent with those of the minewater, and that connate water is the primary driver for TDS concentrations at the final discharge point, as shown by the difference between the Upper Bound and Lower Bound Scenarios;
- parameters with very low concentrations in the minewater, and elevated concentrations in the North Pile discharge show the more pronounced seasonal variability in concentration and load typical of the North Pile discharge trends; and
- there is a substantial increase in loading due to increased minewater inflow between 2013 and 2018, which levels out or becomes more gradual between 2018, and the end of mining in 2028.

Figure 9-5 Total Dissolved Solids Mass Load Treated Discharge



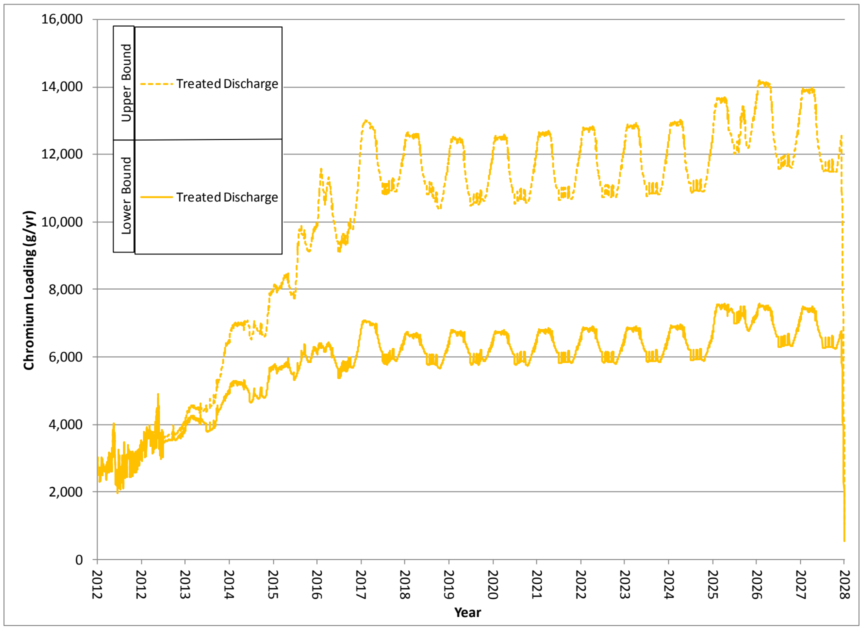
g/yr = grams per year

Figure 9-6 Nickel Mass Load from Treatment



g/yr = grams per year

Figure 9-7 Chromium Load from Treatment



g/yr = grams per year

10 RELATIVE CONTRIBUTION OF MINE SITE DISCHARGE COMPONENTS

GoldSim modelling results from the underground Mine, North Pile, Mine site, and treatment are provided for operational time period, and discussed individually in Sections 6 through 9, respectively. To assess the relative contributions of these components to the overall discharge and loading to Snap Lake, this section presents a comparison of model results from the following discharge locations:

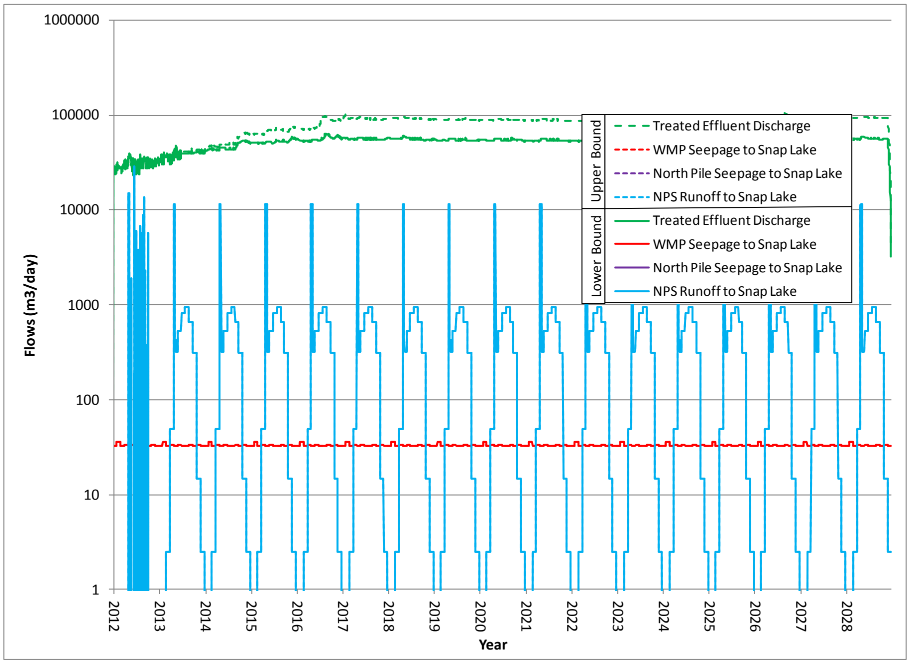
- WTP discharge to Snap Lake;
- WMP concentrations and potential loading to Snap Lake;
- North Pile discharge; and,
- Non-point source discharge from the Mine site.

The minewater, North Pile discharge, and WMP contribution all report to the WTP during operations; their potential impact on Snap Lake is largely controlled by treatment plant operation. However, the contributions of these sources are provided to illustrate the relative importance of these components in the overall discharge during operations.

10.1 Flow Distribution

Mine site discharges during operations are shown in Figure 10-1 as calculated between 2012 and 2028, with the flow plotted on a logarithmic scale. The flow from the WTP discharge is largely governed by the expected inflows to the Mine; seasonal increases result from spring freshet runoff from the North Pile, and Mine site as discussed in Section 9. Relative to the treatment discharge during operations, which ranges from 50,000 m^3/d (Lower Bound) to 80,000 m^3/d (Upper Bound), discharge from the remainder of the Mine site is minor overall; however, peak flows (up to about 10,000 m^3/d) can be significant during freshet (Figure 10-1).

Figure 10-1 Site Discharge – Operations



m^3/day = cubic metres per day.

10.2 Mass Load Distribution of Project Discharges

General trends in relative mass load distribution from the various Mine site discharge locations are illustrated in Figures 10-2 through 10-6. Relative mass loads for TDS, chloride, nitrate, and strontium are provided for illustrative purposes, with loadings along the y-axis plotted on a logarithmic scale. The general trends for TDS load follow the patterns of the flow discharges from the Mine site, with the load from the treated discharge dominating the overall load to Snap Lake during operations. Trends for the metal load during operations are similar to TDS, with the treated discharge providing the majority of the loading during operations. At closure loading will occur primarily from the North Pile, however additional monitoring results and modelling are required prior to updating the estimates of post-closure water quality.

10.3 Principal Results and Discussion – Overall Discharge

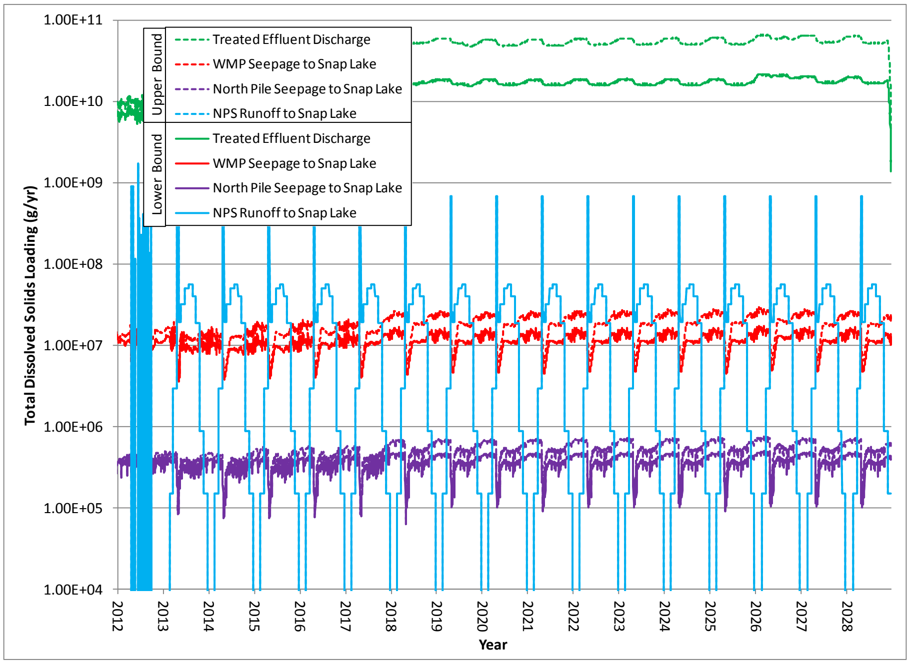
Based on the model results, the following processes, trends, and influences are considered the most relevant with respect to the overall discharge from the Mine site:

- During operations, discharge and loading from the Mine site and North Pile directly to Snap Lake are insignificant relative to the discharge and loading originating from treatment;
- At closure loading will occur primarily from the North Pile, however additional monitoring results and modelling are required to better understand the implications of pile freezing prior to updating the estimates of post-closure water quality; and,

- Typical major ions show concentrations and loading trends consistent with those of the minewater. The influence of the North Pile and Mine site discharge can be observed in seasonal increases in loading added to the Mine load trend.

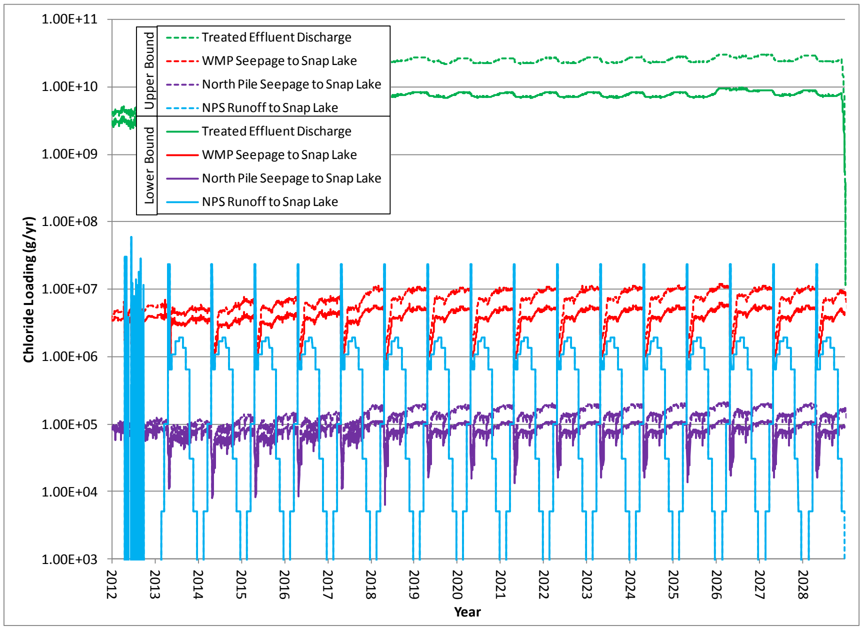
Additional discussion on factors affecting loading trends for individual Mine site components is provided in Sections 6 through 9.

Figure 10-2 Total Dissolved Solids Mass Load Distribution of Site Discharges – Operating Conditions from 2012 to 2028



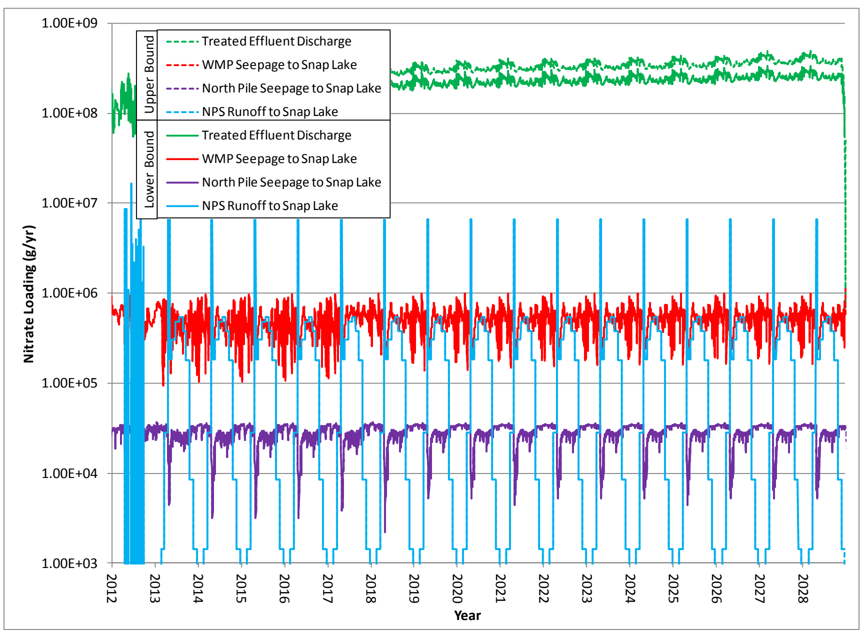
g/yr = grams per year

Figure 10-3 Chloride Mass Load Distribution of Site Discharges



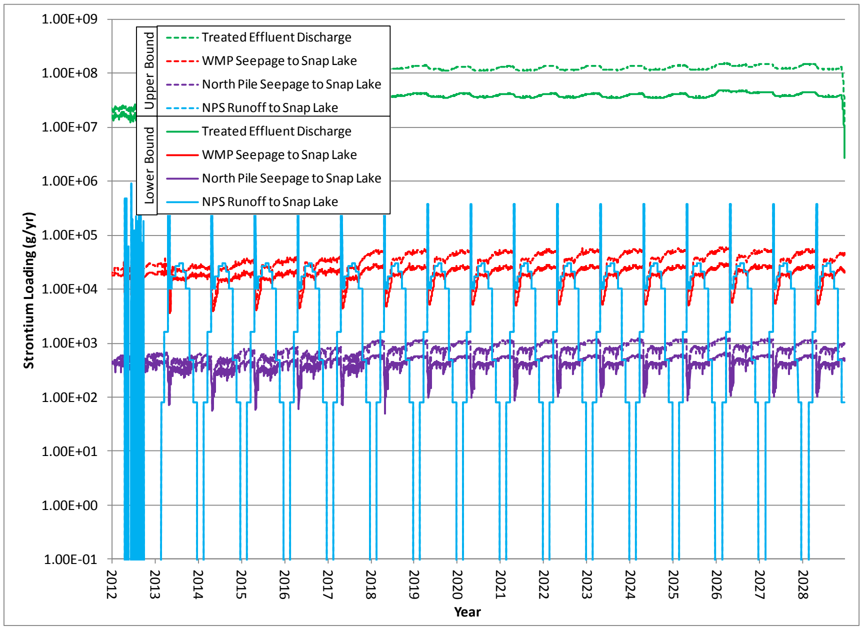
g/yr = grams per year

Figure 10-4 Nitrate Mass Load Distribution of Site Discharges



g/yr = grams per year

Figure 10-5 Strontium Mass Load Distribution of Site Discharges



g/yr = grams per year

11 SUMMARY OF KEY CONCLUSIONS

Based on the above assessment and predictions of Mine site water quality, conclusions resulting from the model calculations are provided for the operational period of the Mine (Section 11.1).

11.1 Operations

- The underground minewater accounts for the majority of loading to treatment and to overall Mine site discharge during operations. The influence of the North Pile and Mine site discharge can be observed in seasonal increases added to the Mine load trend.
- Connate water is the primary source of loading to the Mine for major ions and TDS. The Upper Bound and Lower Bound Scenarios represent elevated, and lower connate water flows. Cycling of water from Snap Lake back to the Mine also has an influence on the rate of increase of concentrations in the Mine.
- During operations, loading from non-point sources and seepage to Snap Lake are negligible relative to the discharge, and loading reporting from treatment discharge.
- Dissolved metal concentrations and loading in the minewater are typically dominated by groundwater inflow characteristics, and to a lesser extent, by interaction with sediments on the Mine floor or material use.
- Material use is the primary source of nitrate and ammonia due to the explosives use during operations.
- Loading to Snap Lake is associated with groundwater inflows: as more water enters the Mine, more load to Snap Lake results.

11.2 General

The two main contributors to water quality are the Mine and North Pile. The proportion of connate water, and the degree of recycling water between Snap Lake and the Mine are the dominant influences on water quality predictions from the Mine during the operationaly period. Specifically, connate water is the primary influence on the concentrations of major ions in the final discharge water from treatment. De Beers is currently in the process of further investigating the conditions of the North Pile and will update the model as further information is developed.

12 REFERENCES

ASME (American Society of Mechanical Engineers). 1994. Quality Assurance Requirements for Nuclear Facility Applications. ASME NQA-1-1994. New York, NY, USA..

De Beers (De Beers Canada Mining Ltd.) 2002a. Snap Lake Diamond Project Environmental Assessment. Submitted to Mackenzie Valley Impact Review Board. Yellowknife, NWT, Canada.

De Beers Canada Mining Ltd. 2002b. Snap Lake Diamond Project Environmental Assessment. Appendix III.2: Geochemistry Report. Submitted to Mackenzie Valley Impact Review Board. Yellowknife, NWT, Canada.

De Beers Canada Mining Ltd. 2002c. Snap Lake Diamond Project Environmental Assessment. Appendix IX: Mine Water Quality. Submitted to Mackenzie Valley Impact Review Board. Yellowknife, NWT, Canada.

De Beers (De Beers Canada Inc.). 2011. Supplemental Document 6. Snap Lake Mine Site Water Quality. Type A Water License MV2001L2-0002 Licence Renewal Supporting Document. Prepared for the Mackenzie Valley Land and Water Board. Yellowknife, NWT, Canada.

De Beers. 2013a. Snap Lake Hydrodynamic and Lake Model Report. Prepared for the Mackenzie Valley Land and Water Board. Yellowknife, NWT, Canada.

De Beers. 2013b. 2012 Annual Report, Type A Water License MV2001L2-0002. Prepared for the Mackenzie Valley Land and Water Board. Yellowknife, NWT, Canada.

De Beers. 2013c. Explosives use at Snap lake Site. Email correspondence to Golder Associates Ltd. September 2013. Yellowknife, NWT, Canada.

De Beers. 2013d. 2012 Annual Report, Type A Water License MV2001L2-0002, Snap Lake Site Water Balance Model. Prepared for the Mackenzie Valley Land and Water Board. Yellowknife, NWT, Canada.

GoldSim (GoldSim Consulting Group). 2013a. GoldSim Users Guide. Redmond, WA, USA.

GoldSim. 2013b. GoldSim Contaminant Transport Module Users Guide. Redmond, WA, USA.

IEEE (Institute of Electrical and Electronic Engineers). 1984. Standard for Software Quality Assurance Plans. ANSI/IEEE 730-1984. New York, NY, USA.

Itasca. 2013. Predicted TDS Concentration in Mine Water Discharge Based on Calculated TDS Values. Technical Memorandum, October 3, 2013, Denver, CO, USA.

USNRC (United States Nuclear Regulatory Commission). 1983. Final Technical Position on Documentation of Computer Codes for High-Level Waste Management. NUREG-0856, Office of Nuclear Material Safety and Safeguards, Washington, DC, USA.

APPENDIX I

NITROGEN SPECIES CONCENTRATIONS DUE TO EXPLOSIVES USE ON SITE FOR 2012

December 2013

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ACRONYMS

Term	Definition
ANFO	ammonium nitrate/fuel oil
Al	aluminium
C	daily concentration
C_{FC}	concentration of N in the first flush of the field cells (mg/L)
E	total emulsion use on site (t)
N	nitrogen
Na	sodium
$NaNO_3$	sodium nitrate
NH_4	ammonia
NH_4NO_3	ammonium nitrate
NO_2	nitrite
NO_3	nitrate
Q	daily flow
Q_{MK}	2012 Cumulative flow of makeup water ($m^{3/}$yr)
t	tonne
W_{MW}	total annual mass of waste in mine water (calculated) (t)
WR	waste rate

UNITS OF MEASURE

Term	Definition
%	percent
m^3	cubic metre
m^3/yr	cubic metres per year
mg/L	milligrams per litre
kg	kilogram
Kg N/d	kilograms of nitrogen per day

I.1 UNDERGROUND

For the site water quality model predictions, it is important to understand the movement of the mass load of nitrogen from underground through the water treatment system. Table I-1 presents a summary of key nitrogen loading variables from both underground and the North Pile, and their values for 2012. Sections I.1 and I.2 provide a summary of the calculations upon which these values are based.

Total annual mass of N species and the total annual waste in mine water in tonnes were calculated using measured concentration and flow rates at SNP 02-01. Although daily concentrations were not available, the concentration on each day was assumed to be the same as the last measured data until a new measurement was taken. The daily load was calculated as follows:

Daily Mass Load (kg N/day) = C x Q x 0.001

where C = the daily concentration (mg/L)

Q = the daily flow (cubic metre [m^3])

N = nitrogen from nitrate (NO_3) + nitrite (NO_2) species, and ammonia (NH_4) expressed as nitrogen (N)

kg = kilograms

mg/L = milligrams per litre

The NO_3/NO_2 and NH_4 (daily loads) were then summed to provide a daily total N load. Following this, the daily total N loads were summed to provide a cumulative nitrogen load for 2012. This load (in kg N) was then converted to total mass of the compounds of N species (in kg), based on the known composition of emulsion, seen in Table I-2.

Table I-1 Summary of Nitrogen Species Concentrations Due to Explosives Use on Site for 2012

Parameter	Value	Unit	Obtained By	Source/Based on
Underground				
Annual Mass of Explosives Used	946.92		Measured	Szybunka (2013)
Total annual mass of waste in mine water	237.03	t	Calculated	Cumulative mass of N species in t of N, flow rates at SNP 02-01 for 2012, emulsion composition, converted to total mass using gram formula weights and emulsion composition
Total annual mass of N species	180.46	t	Calculated	Total annual mass of N species in t, converted based on gram formula weights and emulsion composition
Total annual mass of N species as N	59.29	t of N	Measured	Monitored data at SNP02-01
Total annual discharge from underground	10,851,392.00	m^3	Measured	Monitored data at SNP02-01and Procon Line

Table I-1 Summary of Nitrogen Species Concentrations Due to Explosives Use on Site for 2012

Parameter	Value	Unit	Obtained By	Source/Based on
Concentration of water leaving underground	5.46	mg/L of N	Calculated	Cumulative loading and cumulative flow for 2012
North Pile				
Annual Mass of Explosives Used	814.86	t	Measured	Szybunka (2013)
Total annual mass of waste in North Pile	203.98	t	Calculated	Total useage of emulsion and ANFO ending up in North Pile for 2012
Mass from ANFO	60.08	t	Calculated	ANFO use for 2012, waste rate
Mass from Emulsion	143.90	t	Calculated	Emulsion use for 2012, waste rate
Total annual mass of N species	166.48	t	Calculated	Total annual mass of N species in t of N, converted to total mass based on gram formula weights
Total annual mass of N species as N	55.79	t of N	Calculated	Concentration of Field Cell first flush results, cumulative flow of makeup water
Total annual discharge from North Pile	346,061.00	m^3	Measured	Cumulative flow from Makeup Water for 2012
Concentration in pore water in the North Pile	161.21	mg/L of N	Measured	Average Concentration of Field Cell first flush results

t = tonne; mg/L = milligrams per litre; m^3= cubic metre; N = nitrogen; ANFO = ammonium nitrate/fuel oil.

The flow-weighted average concentration of nitrogen leaving underground was calculated based on the cumulative loading and cumulative flow for 2012, as follows:

Flow-weighted average concentration = Cumulative N Loading / Cumulative Flow

I.2 NORTH PILE

The mass of waste from emulsion entering the North Pile was calculated based off the calculated values of mass of waste in underground, the known amount of emulsion used on site, and the waste rate of 25.032 percent (%) as follows:

Mass of waste from emulsion = (WR x E) - W_{MW}

where WR = waste rate (25.032%)

E = Total emulsion use on site (tonne [t])

W_{MW} = Total annual mass of waste in mine water (calculated) (t)

The mass of waste from ammonium nitrate/fuel oil (ANFO) was calculated based on the known use of ANFO on site, and the waste rate of 25.032%. Waste from the ANFO was assumed to go only to the North Pile, as it was not used underground.

Mass of waste from ANFO (t) = Total use of ANFO (t) x 25.032%

The mass of waste from ANFO and emulsion were then summed to provide a total annual mass of waste going to the North Pile.

The total annual mass of N species (t of N) going to the north pile was checked by calculating measured concentrations of N in the first flush of the Field Cells and the cumulative flow of makeup water circulating through the Process Plant.

Total annual mass of N species (t of N) = (Q_{MK} * C_{FC}) / 1e106

where Q_{MK} = 2012 Cumulative flow of makeup water ($m^{3/}$yr)

C_{FC} = Concentration of N in the first flush of the field cells (mg/L)

The total annual mass of N species in the North Pile was calculated based on the percentage of N species (Table I-2) in the total annual mass of waste in the North Pile (calculated above).

The check confirmed that a waste rate of approximately 25% was consistent with measured data for all nitrogen mass both from the underground discharge and reporting to the North Pile in the pore water.

Table I-2 Composition of Emulsion and Ammonium Nitrate Fuel Oil Explosives

Components		Gram Formula Weight	ANFO		Waste Explosives	Waste Explosives	Emulsion (no Al)		Waste Explosives	Waste Explosives
			%	% of total Mass	kg/t explosives	kg/t (expressed as N)	%	% of total Mass	kg/tonne explosives	kg/t (NO_3 + NO_2 expressed as N)
NH_4NO_3			94%		235.3		63.0%		157.7016	
	NH_4	18.0383		23%	53.0	41.2		23%	35.5	28
	NO_3	62.0049		77%	182.3	41.2		77%	122.2	28
NaNO3							18.0%		45.0576	
	Na	22.9898						27%	12.2	
	NO_3	62.0049						73%	32.9	7
H_2O							9.0%		22.5288	
Fuel Oil			6%		15.0192		6%		15.0192	
Microballoons (glass)							4%		10.0128	
Aluminum	Assuming Al	26.981					0%		0	

% = percent; kg/t = kilograms per tonne; NH_4 = ammonia; Na = sodium; $NaNO_3$ = sodium nitrate; NH_4NO_3 = ammonium nitrate; NO_3 = nitrate; NO_2 = nitrite; Al = aluminium.

I.3 REFERENCES

Szybunka N. 2013. Orica Mining Services, Site Operators. Email. September 13, 2013.

Email from Snap Lake Orica to Ken De Vos

De Vos, Ken

From:	snap.lake@orica.com
Sent:	Friday, September 13, 2013 3:06 PM
To:	De Vos, Ken
Subject:	Re: Explosives use rate on site
Attachments:	Useage.xlsx; ATT00003.txt

Ken ,

As requested here is a three year history of use-age with bulk product break down . In the last couple years production has increased a fair amount , as well there was the surface blasting program during the summer of 2012 .

Emulsion (Handibulk) From September 13 2010 - September 13 2013

4,565,539 KG , when this is amount is broken down into raw materials this would approximately be

2,864,876 KG of Ammonium Nitrate Prill
318,565 KG of DN10M mineral oil
98,882 KG of 3m Microballoons
602,195 KG of Sodium Nitrate
684,831 KG of water.

We recorded 564 manufacture dates for that amount which works to a mean average of 8095 KG / Mix and if broke down to a daily amount it is 4169 Kg . As with any operation , demands and usage had high and low points .

I made a quick chart so you can see the frequency over that period not the best but at least it gives a linear representation .

ANFO used in surface blasting From April 18 2011 - Current

255475 kg , When this is broken down into raw materials this would approximately be

241, 294 KG of Ammonium Nitrate prill
15,116 kg diesel

The majority of the AMEX used and consumed was between April and September of 2012 in the Quarry

As this is a bulk site these numbers can be close approximate but are actual within reason . We follow quality control procedures that keep our product within close specifications . This ensures that we in fact are using correct percentages and amounts which gives us accurate useage amounts which is reflected upon when considering winter road requirements .

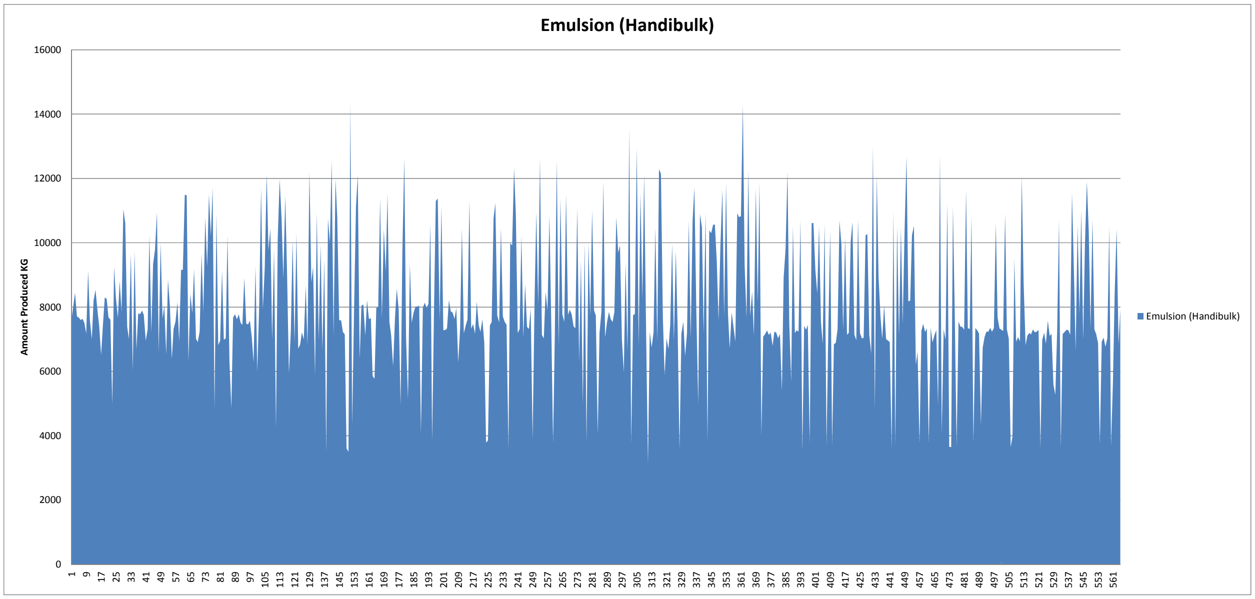
Let me know if you need anything else

Neil Szybunka

Site Operators | Tlicho Blasting Services Inc. - An Orica Partnership (De Beers Snap Lake Mine)

1

Figure I-1 Emulsion Handibulk from September 13, 2010 to September 13, 2013



APPENDIX II

SNAP LAKE SITE WATER MODEL REPORT – NORTH PILE LONG TERM WATER STORAGE AND RELEASE

December 2013

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ACRONYMS

Term	Definition
1D	one-dimensional
2D	two-dimensional
C	concentration at a given time
CGPK	combined coarse and grits fraction of the processed kimberlite
Co	initial concentration
FPK	fines fraction of the processed kimberlite
GPK	grits fraction of the processed kimberlite
HGS	HydroGeoSphere model
K	hydraulic conductivity
Kd	distribution coefficient
Mine	Snap Lake Mine
PK	processed kimberlite
PPK	full mix processed kimberlite
Q	flow
Q(t)	flow at time (t)
t	time
x	horizontal direction
y	horizontal direction perpendicular to the x direction
z	vertical direction

UNITS OF MEASURE

Term	Definition
%	percent
cm	centimetre
kg	kilogram
kg/m^3	kilograms per cubic metre
m	metre
m/s	metres per second
m^2	square metre
m^3/d	cubic metres per day
m^3/kg	cubic metres per kilogram
m^3/s	cubic metres per second
m^3/yr	cubic metres per year
mg/L	milligrams per litre
mm	millimetre
mm/yr	millimetres per year

II.1 INTRODUCTION

Nitrate and ammonia, derived from explosive material used in the mining process, are found within the emplaced materials of the processed kimberlite (PK) in the North Pile at the De Beers Canada Inc. Snap Lake Mine (Mine) in the Northwest Territories. Process and infiltration waters that discharge from the North Pile to the surrounding sumps currently have a concentration of about 100 milligrams per litre (mg/L) of nitrate (as N) and 30 mg\/L of ammonia (as N). It is expected that over time the nitrate and ammonia will be flushed from the PK pore space, and concentrations in the discharge waters will decline. While the nitrate and ammonia in the sump waters are presently mixed with minewaters, facilitating discharge at acceptable (overall) water quality conditions, the long term concentrations and significance of the long term discharge concentrations are not well understood.

Provided herein is an initial assessment of the long-term water storage, release rate, and water quality conditions (in particular with respect to nitrate and ammonia) within, and discharging from, the North Pile. The assessment was completed through a review of available hydrogeological and site design information related to this issue. This review was conducted in combination with numerical simulations (using the computer program HydroGeoSphere [HGS]), to forecast future concentrations of these parameters through the operational and closure periods.

II.2 DATA REVIEW, COMPILATION AND SYNTHESIS

The hydraulic properties used in this assessment for the various material types associated with the fines-fraction of the PK as well as the coarse fractions of the PK used in the construction of the embankments are presented in Table II-1.

Table II-1 Hydraulic Parameters for Processed Materials

Material	Saturated Hydraulic Conductivity (m/s)	Porosity (fraction)	Specific Storage (1/m)	Bulk Density (kg/m^3)
Full mix PK	5×10^{-7}	0.45	1×10^{-4}	1400
Fine fraction of the PK	1×10^{-6}	0.45	1×10^{-4}	1540
Grits fraction of the PK	1×10^{-5}	0.35	1×10^{-4}	1680
Combined Coarse and Grits fraction of the PK	5×10^{-4}	0.325	1×10^{-4}	1700
Coarse fraction of the PK PK	1×10^{-4}	0.3	1×10^{-4}	1800

m/s = metres per second; m=metre; kg/m^3 = kilograms per cubic metre; PK = processed kimberlite.

Full mix PK was not included in any of the one-dimensional (1D) or two-dimensional (2D) model scenarios at this time.

Hydraulic properties, thicknesses, etc. for the geological units underlying the North Pile (e.g., peat, overburden, fractured bedrock, etc.) are not included here as it is assumed that the ground below the North Pile facility will be in a frozen state, thus (for practical purposes) will not contribute to under draining.

Soil retention relations which define the hydraulic conductivity of the porous medium under variably-saturated conditions are required by the HGS model. Soil retention relationship estimates for the fines fraction of the PK material were obtained from Sun and Stianson (2013). For the combined coarse and grits fraction of the PK soil retention properties for Borden Sand (Abdul 1985) were assumed. Soil retention curves are shown in Figure II-1.

Initial estimates of nitrogen in the form of nitrate, nitrite, and ammonia are shown in Table II-2. These data are from an analysis of water drained from fresh, processed material that was sampled on September 18, 2012.

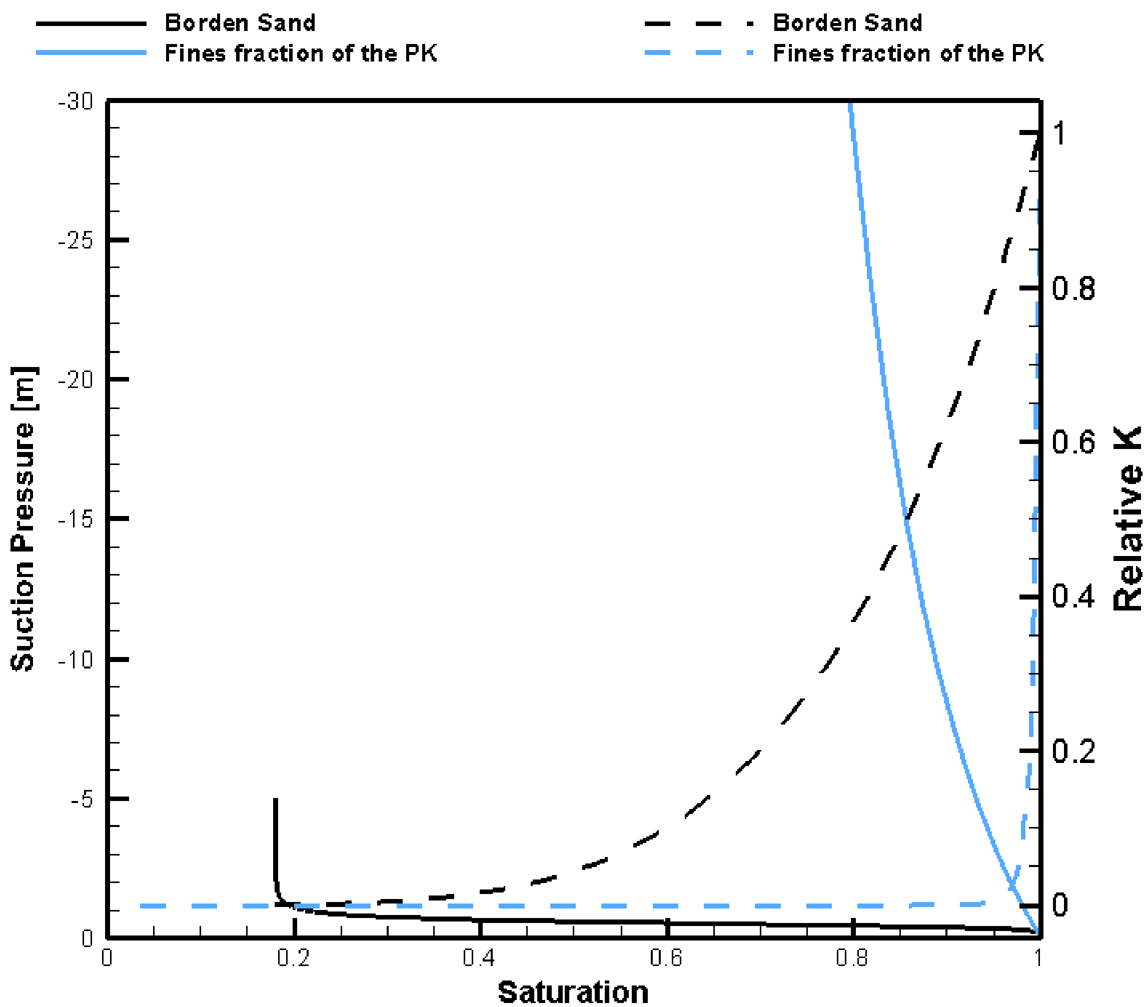
Table II-2 Initial Values for Nitrate, Nitrite and Ammonia in Processed Materials

	Unit	**CGPK1** (Combined Coarse and grits fraction of the processed kimberlite)	**FPK1** (fine fraction of the processed kimberlite)	**GPK1** (Grits fraction of the PK)	**PPK1** (Full mix PK)	Average
Ammonia-N	mg/L	29.5	30.6	24.1	25.3	27.375
Nitrate-N	mg/L	132	122	137	130	130.25
Nitrite-N	mg/L	3.54	4.04	2.98	3.78	3.585
Total-N	mg/L	165.04	156.64	164.08	159.08	161.21

CGPK = Combined Coarse and Grits Processed Kimberlite; FPK = Fine Fraction of the Processed Kimberlite; GPK = Grits fraction of the Processed Kimberlite PPK = Full mix Processed Kimberlite; mg/L = milligrams per litre.

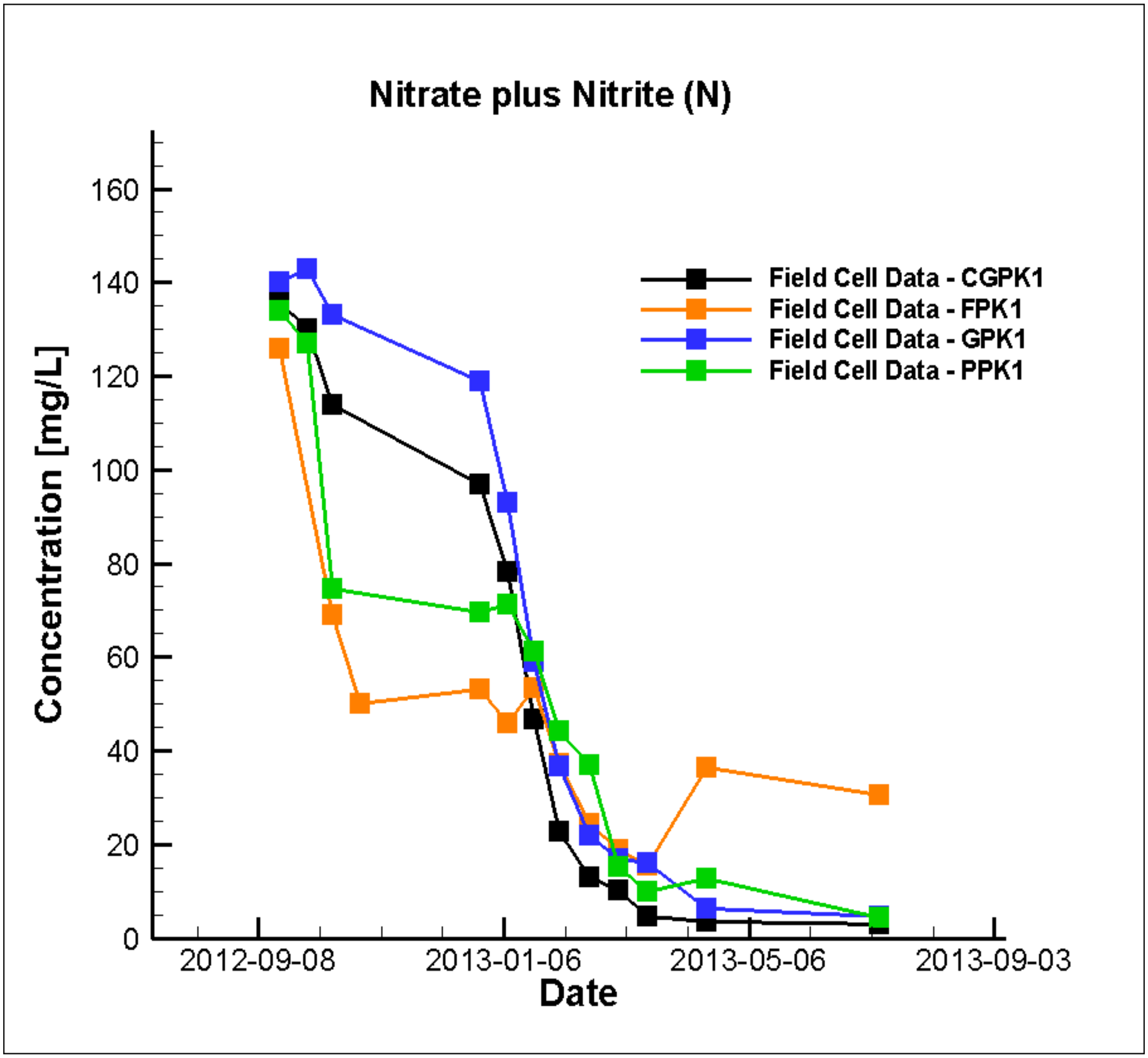
Nitrate plus nitrite concentrations measured in the treated effluent during the four indoor barrel experiments (Section II.3) are shown in Figure II-2. Data were not available from the outdoor barrel experiments.

Figure II-1 Soil Retention Properties.



PK = Processed Kimberlite; m = metre; K = Hydraulic Conductivity.

Figure II-2 Nitrate + Nitrite Concentrations (mg/L) Versus Time in "Barrel" Experiment Treated Effluent



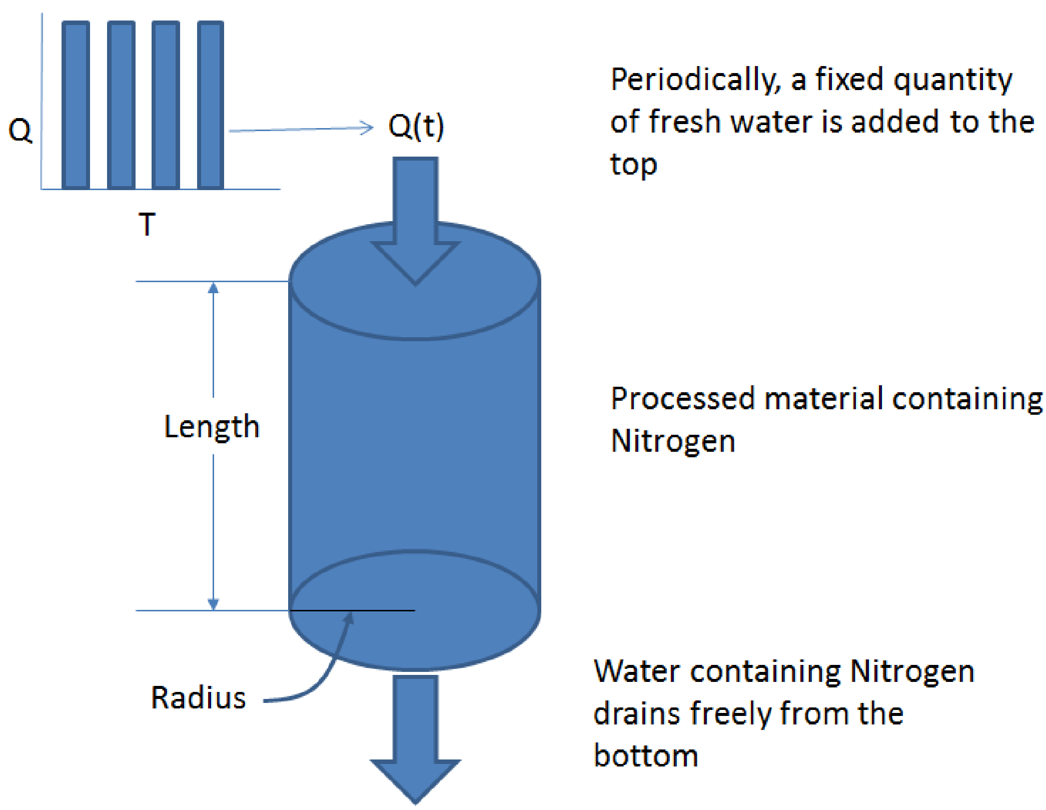
mg/L = milligrams per litre; CGPK = Combined Coarse and Grits Processed Kimberlite; FPK = Fines Fraction of the Processed Kimberlite; GPK = Grits Fraction of the Processed Kimberlite; PPK = Full Mix Processed Kimberlite.

II.3 ONE DIMENSIONAL NUMERICAL SIMULATION OF FIELD CELL EXPERIMENTS

A total of eight barrels (i.e., field cells) were partially filled with representative samples from the various mine waste streams fines, grits, and coarse fraction PK used in the construction of the berms and internal dykes), each of which would contain nitrate and ammonia. Periodically, water would enter the top of the barrel, either under conditions of natural precipitation (outdoor experiments) or by the direct addition of water at regular intervals (indoor experiments), and be allowed to drain freely from the bottom. The concentration of nitrate and ammonia in the treated effluent was measured. Data from the outdoor experiments were not available and so they were not included in this assessment. Paste PK was not included in any of the 2D model scenarios so field cell PPK1 was not included in this assessment. Results from field cells CGPK1 and GPK1 were similar and so only field cell GPK1 was analysed.

A schematic of a barrel experiment is shown in Figure II-3. The barrels used had a radius of 30 centimetre (cm) and were filled with 20 cm of processed material. At the times indicated by the data points in Figure II-2, 60 millimetre (mm) of water was added over a period of 10 minutes.

Figure II-3 Field (Barrel) Cell Experimental Setup.



Q = Flow, t =Time; Q(t) = Flow at time (t).

In the model (HGS), it was assumed that the processed material was both homogeneous and isotropic and that flow was uniform and vertical from top to bottom through the domain. The barrel was represented as a rectangular block 0.532 metre (m) by 0.532 m by 0.2 m in the x-, y-, and z-directions respectively, and had the same cross-sectional area perpendicular to flow as a circle of radius 0.3 m. The domain was subdivided vertically into 50 elements each with a thickness of 0.004 m. The initial condition of the processed material is unknown, but for these simulations an initial hydraulic head of zero was assumed. The top boundary condition consisted of an assigned flux of 1 x 10^{-5} metres per second (m/s) for 600 seconds (i.e., 60 mm over 10 minutes) at times corresponding to the data points shown on Figure II-2. On the bottom boundary, a fixed head equal to the elevation of the base was assigned, which allows water to drain freely from the domain.

For the nitrogen transport simulation, only nitrate plus nitrite were considered, since they are the largest constituent of total nitrogen and are more stable than ammonia, which degrades relatively quickly into other forms. Two source conditions were tested for nitrate plus nitrite:

1) An initial porewater concentration of nitrate plus nitrite of 130 mg/L; and,
2) An initial solid mass which dissolved at a solubility of 130 mg/L until the mass was exhausted.

An initial dispersivity value of 0.1 m was used. Best-fit simulated nitrate plus nitrite breakthrough curves are shown for the field cell FPK1 initial concentration case in Figure II-4 and for the solid source case in Figure II-5.

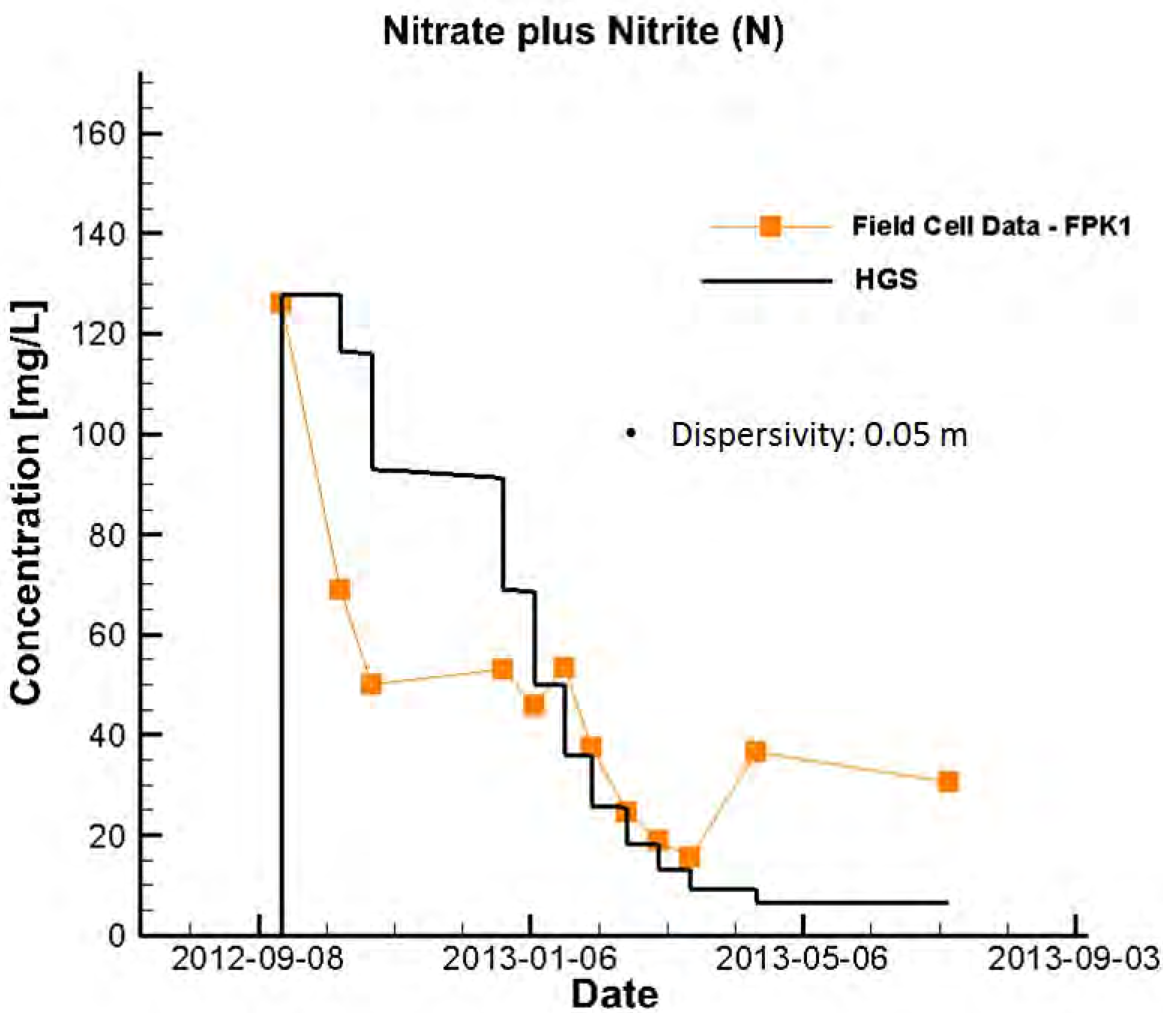
The results are similar for both source types, except at early time, when the dissolution of the solid source causes elevated solute levels to persist for longer than was observed. In the case of the initial concentration source, a smaller dispersivity value of 0.05 m gave a better fit. In both cases, a small Kd value of 1x 10^{-3} cubic metres per kilogram (m^3/kg), equivalent to a retardation factor of about 5, improved the fit. The initial mass shown in Figure II-5 was computed from the observed breakthrough concentrations by summing over the sampling events and by assuming that:

1) The volume of treated effluent collected was equal to the amount of water added; and,
2) Solute was completely mixed in the treated effluent.

Best-fit simulated nitrate plus nitrite breakthrough curves are shown for the field cell GPK1 initial concentration case in Figure II-6 and for the solid source case in Figure II-7. Similar results were seen regarding dispersivity and Kd values and, again, the solid source appears to cause the nitrate plus nitrite concentrations to remain at high levels in the model for longer than was observed in the test data.

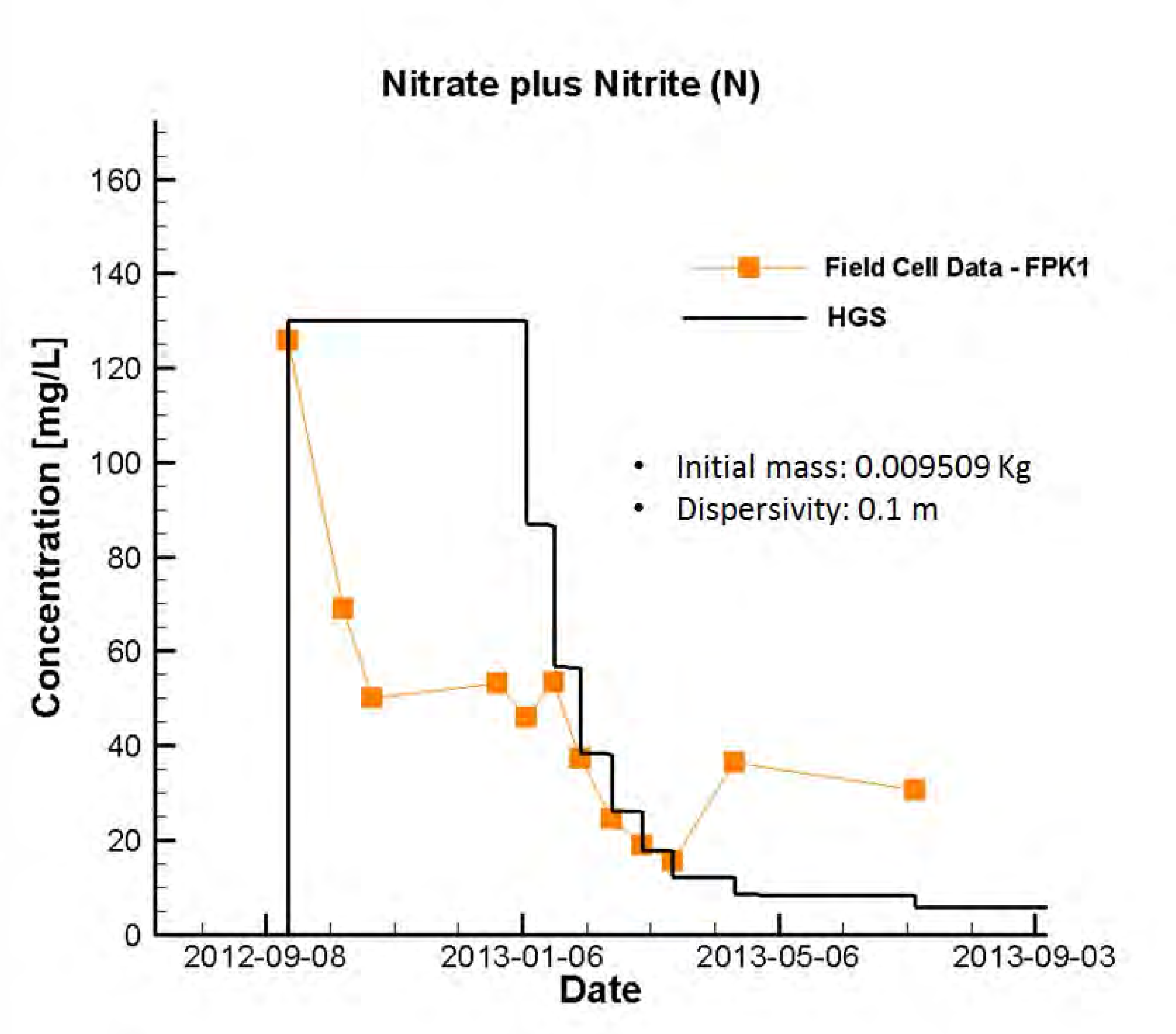
Based on these initial 1D model runs, an initial concentration of nitrate plus nitrite of 130 to 140 mg/L in the porewater produces the most reasonable simulated results compared to the observed breakthrough.

Figure II-4 Concentration Versus Time for Field Cell FPK1 Initial Concentration Case



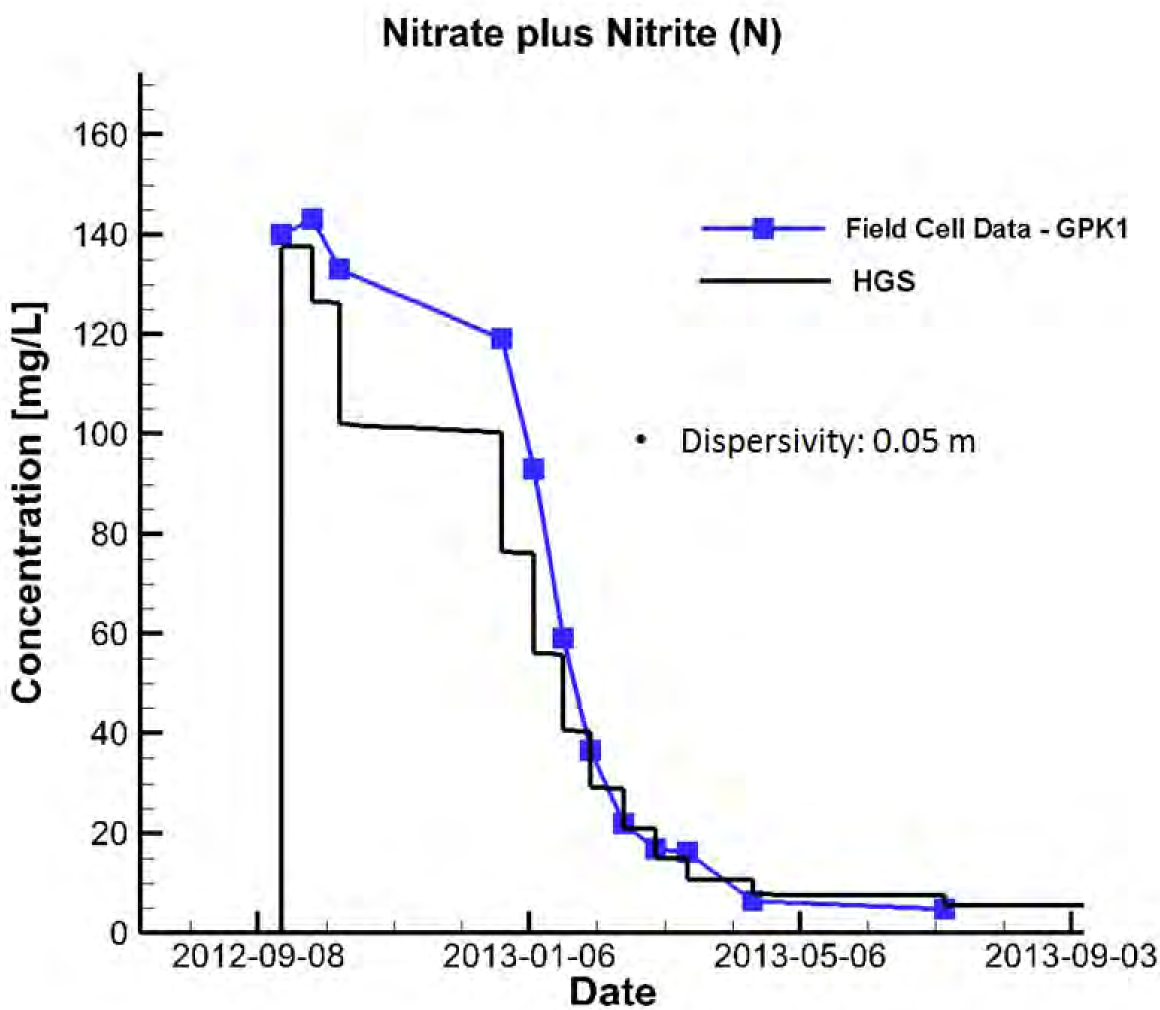
mg/L = milligrams per litre; m = metre; HGS = HydroGeoSphere model, FPK = Fines Fraction of the Processed Kimberlite.

Figure II-5 Concentration Versus Time for Field Cell FPK1 Solid Source Case



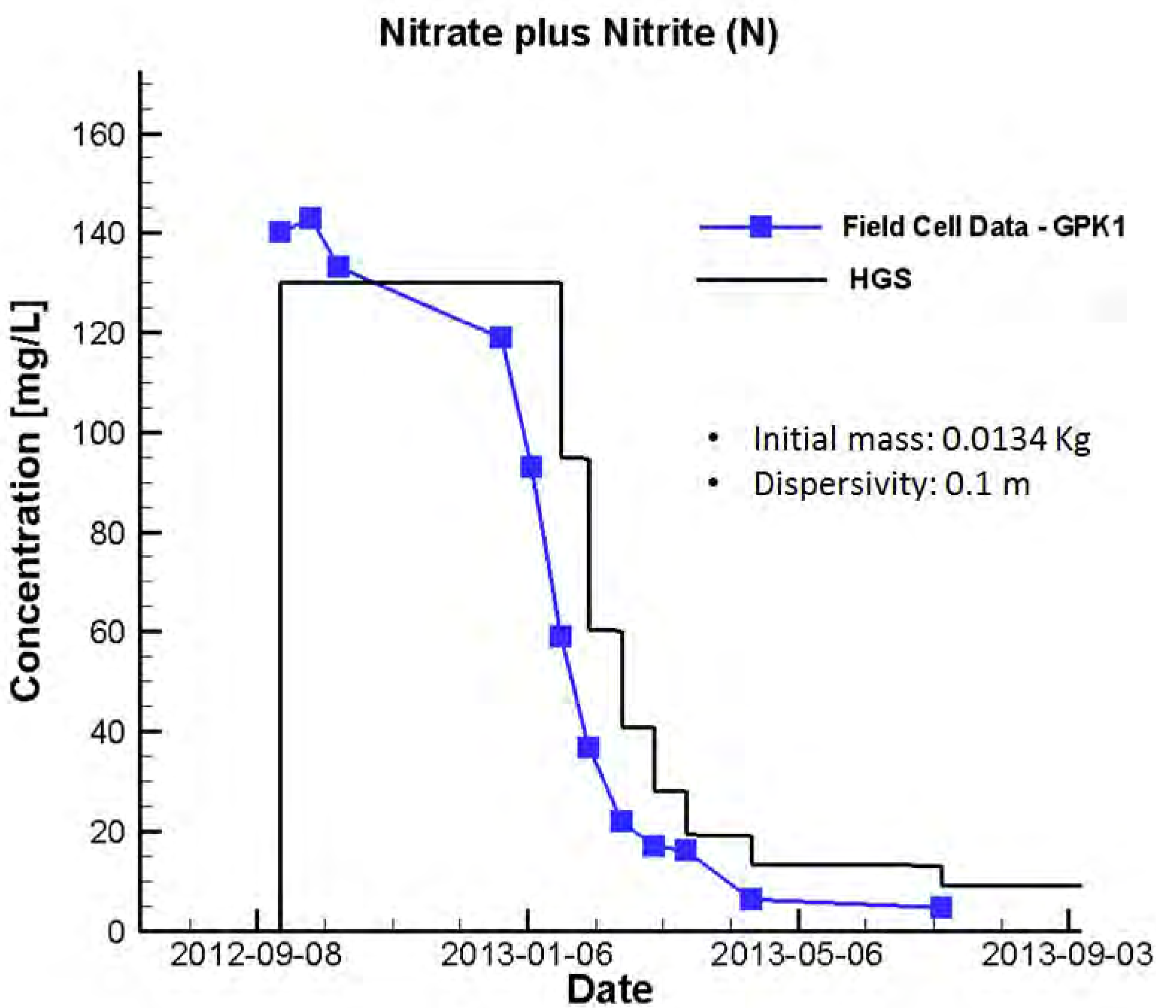
mg/L = milligrams per litre; m = metre; kg = kilogram; HGS = HydroGeoSphere model, FPK = Fines Fraction of the Processed Kimberlite.

Figure II-6 Concentration Versus Time for Field Cell GPK1 Initial Concentration Case.



mg/L = milligrams per litre; m = metre; HGS = HydroGeoSphere model, GPK = Grits Fraction of the Processed Kimberlite (Grits).

Figure II-7 Concentration Versus Time for Field Cell GPK1 Solid Source Case.



mg/L = milligrams per litre; m = metre; kg = kilogram; HGS = HydroGeoSphere model, GPK = Grits Fraction of the Processed Kimberlite Grits

II.4 2D CROSS-SECTIONAL PARAMETRIC SIMULATIONS

The Mine's North Pile facility has a relatively complex geometry, with multiple cells of the fines fraction of the PK separated by berms of coarser material, and variable underlying topology and geological conditions. However, the main drainage mechanism and an understanding of the critical processes can be reasonably captured through 2D cross-sectional flow paths from the centre of a PK cell to the more permeable berm, after which water would move (in comparison to flow through the fines fraction of the PK) relatively quickly to a sump. Recent monitoring indicates that permafrost conditions exist immediately beneath the North Pile and so the underlying strata can be considered to be impermeable with respect to water flow.

It was assumed that during operations the cells were continuously flooded with process water and maintained in a fully saturated condition. Once the emplacement of PK ceased, water levels in the North Pile are expected to drop, eventually reaching a state of equilibrium with respect to the long term average infiltration.

For the purpose of simplifying the modelling effort, a cross-sectional thickness of 20 m was chosen as representative of the North Pile. It is understood that this will certainly vary; however, it is considered a reasonable average case.

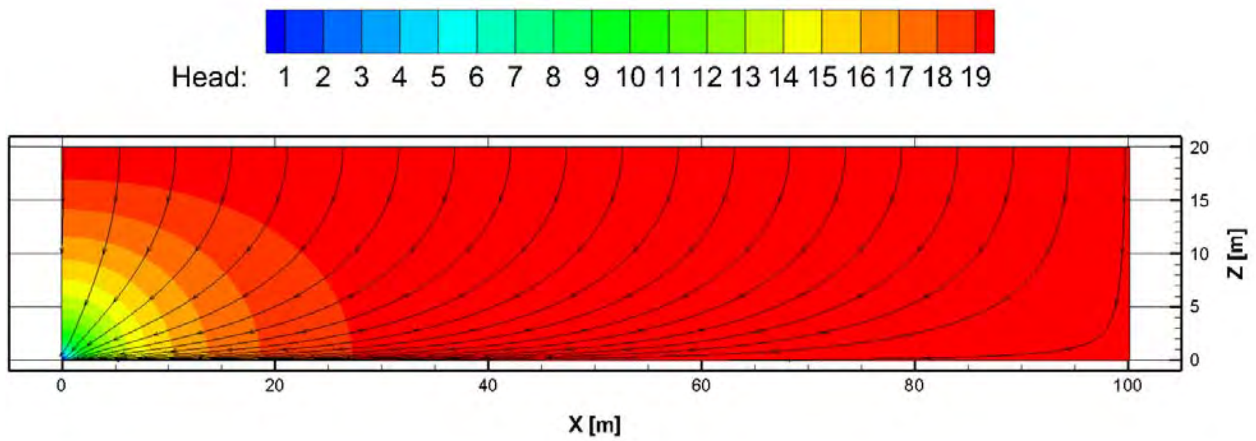
A cross-section length (centre of PK to berm) was estimated by taking the average of the surface area of all cells in the North Pile (approximately 31,000 square metre [m^2]) and computing the radius of a circle of equivalent area (approximately 100 m). To compute overall mass loadings, water and mass fluxes obtained from the 2D cross-sectional model were scaled up to represent the whole North Pile by multiplying by a factor of 2,190, which is the ratio of the total surface area of the North Pile (approximately 219,000 m^2) to the cross-sectional surface area (100 m^2).

A finite element mesh was constructed with element lengths of 1.0 m in the horizontal "x" direction, and 0.2 m in the vertical "z" direction, for a total of 10,000 8-node block elements and 20,402 nodes. The 2D cross-section represents a "per unit width" flow rate and mass flux estimate.

A long term average infiltration rate of 100 millimetres per year (mm/yr), or about 22 percent (%) of the total average annual precipitation of approximately 450 mm/yr, was assumed. Although the berms were not included explicitly in the domain, they were represented by specifying a hydraulic head of 0.2 m at the two lowermost nodes on the left side of the domain. This allowed water to flow freely from the domain at this point and approximates the effect of a relatively permeable berm of the combined coarse and grits PK.

The initial flow condition for the coupled draindown and transport simulation was generated by fixing the hydraulic head on top of the domain to be equal to the top of fines fraction of the PK elevation and running the model to equilibrium. The resulting head solution is shown in Figure II-8.

Figure II-8 Initial Head Solution.



m = metre; x = horizontal direction; z = vertical direction.

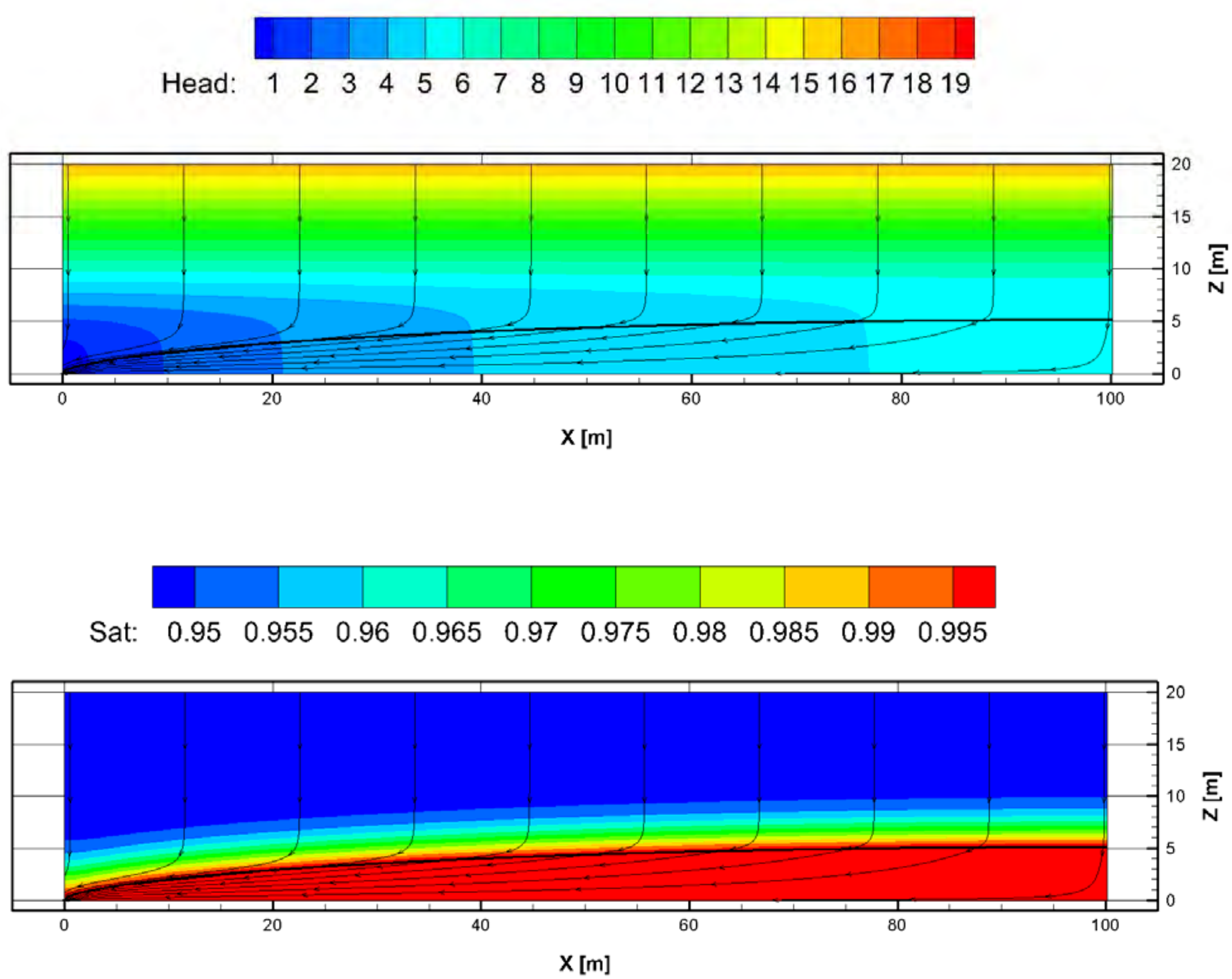
Streamlines illustrate that water enters the domain along the top boundary and exits at the constant head nodes at the lower left corner. The total flux of water moving through the domain is 6.6 x 10^{-6} cubic metres per second (m^3/s) or 0.57 cubic metres per day (m^3/d) (per metre cross-section). When scaled up to a typical cell area (~31,000 m^2), this is equivalent to approximately 177 m^3/d (0.57 m^3/d times a scaling factor of 310), which is reflective of the relatively low hydraulic conductivity of the fines fraction of the PK. Rough estimates of actual process water production rates as applied to the fines fraction of the PK are around 1,000 m^3/d, and it is assumed that in the real system excess process waters move laterally as overland flow to the more permeable berms, and then infiltrate and flow relatively quickly to the sumps.

The steady-state initial head solution provides the initial condition for the transient draindown and transport solution. In this case, we replace the fixed head boundary condition on the top of the domain with a specified flux boundary condition of 100 mm/yr, or 3.17 x 10^{-9} m/s, which represents the (assumed) long-term average infiltration rate. This gives a total long term flux of 3.17 x 10^{-7} m^3/s or 10 cubic metres per year (m^3/yr) moving through the cross-section.

Initially, the domain is filled with process water, which is represented in the model by specifying an initial solute concentration of 1.0 in the porewater. Along the top boundary, a specified concentration of 0.0 is applied, which, when combined with the applied infiltration, represents the inflow of fresh rain water to the domain, which eventually flushes the solute from the fines fraction of the PK. It is understood that the actual concentrations will be different; however the purpose of this particular exercise is to develop a “breakthrough curve” of a conservative solute. Using values of 1 and 0 for the initial and inflow waters allows us to develop a proportional representation of discharge, and hence a breakthrough curve, which can be applied to any conservative parameter at a later stage of modelling, within the GoldSim model.

The transient solution was run for an elapsed time of 10^{10} seconds (317 years); however, equilibrium conditions were achieved prior to that. The equilibrium hydraulic heads and saturations are shown in Figure II-9. The heavy black line indicates the position of the water table. The domain is no longer at full saturation, and a water table “mound” is evident, with the highest water table elevation located at the groundwater divide at the right end of the cross-section. Streamlines indicate that water flows vertically downwards and then laterally through the saturated zone to the discharge point. A relatively high degree of saturation (i.e., greater than 0.95) is maintained due to the nature of the fines fraction of the PK soil retention curves.

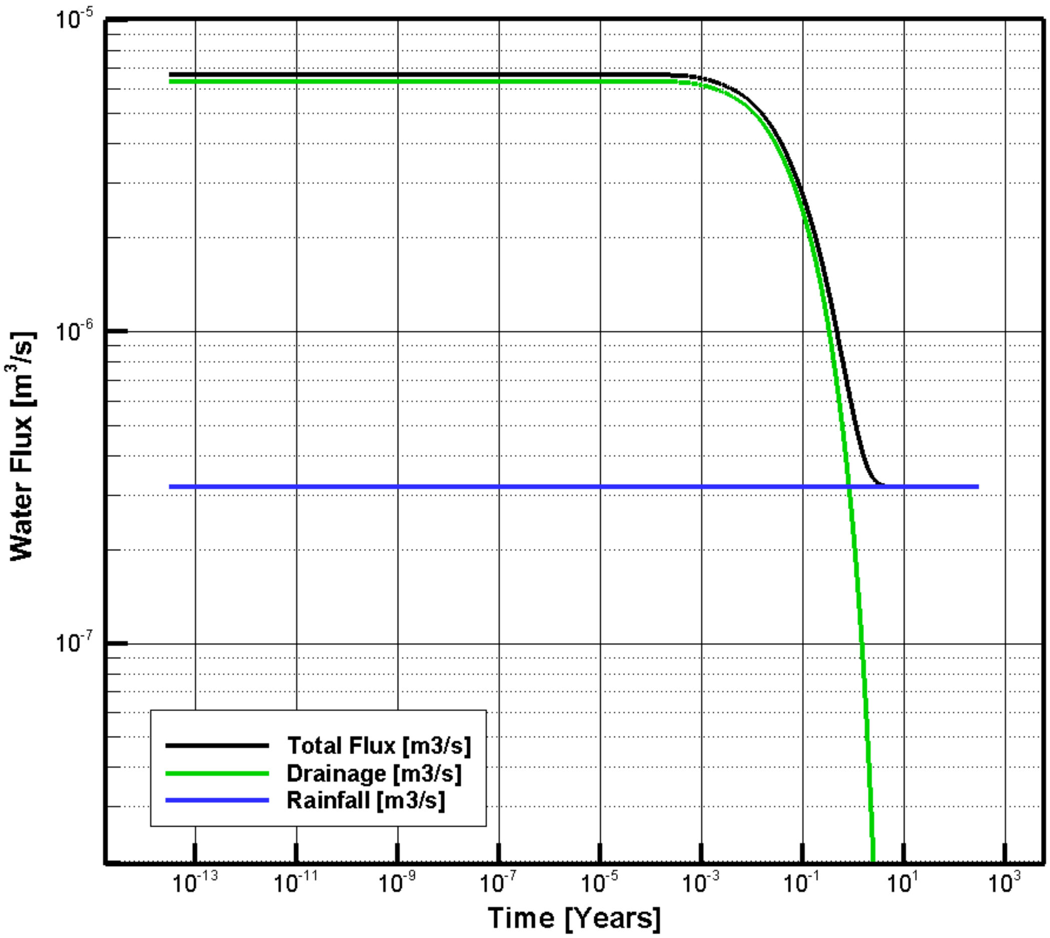
Figure II-9 Hydraulic Head and Saturation After Draindown.



m = metre; x = horizontal direction; z = vertical direction.

The components of the transient water flux at the ouflow point of the cross-section are shown in Figure II-10. Initially, the total flux (black line) is composed almost entirely of drainage water (green line) derived from dewatering of the fines fraction of the PK material in the cross-section. After 10 years, the total flux is composed entirely of rainfall (blue line).

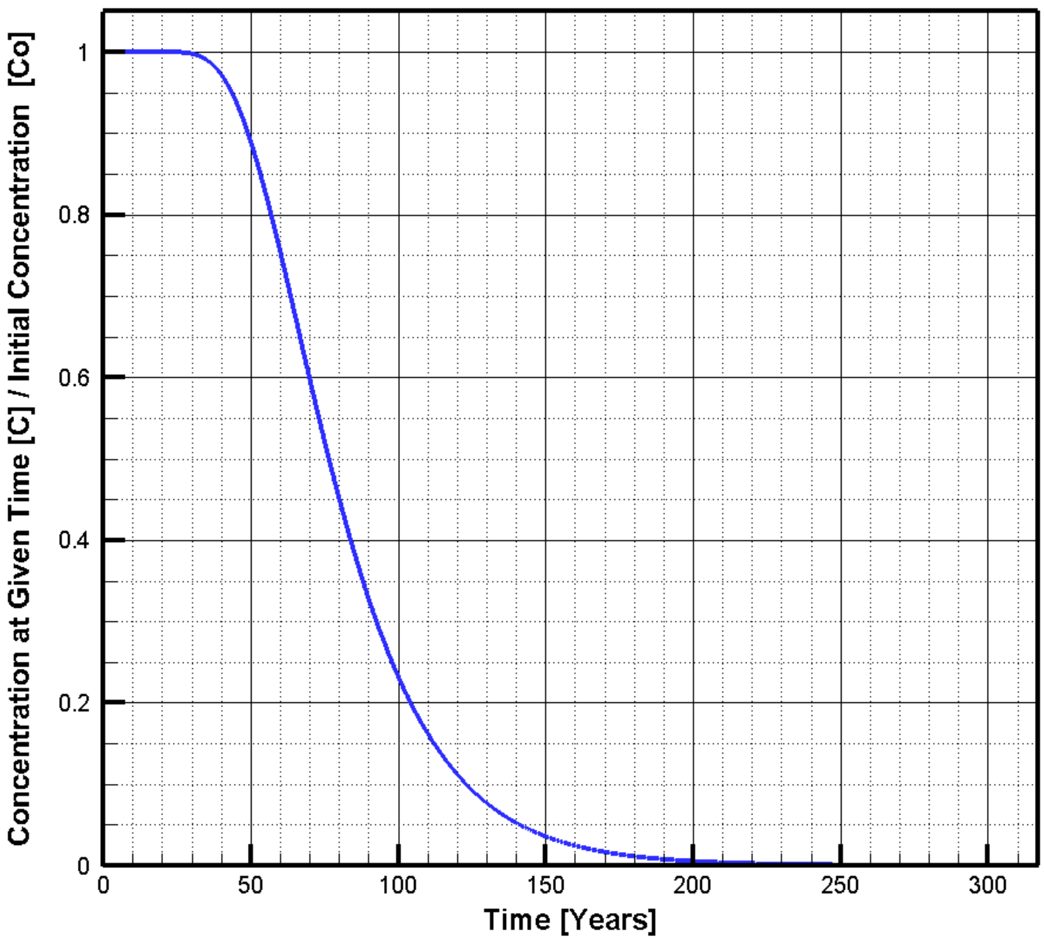
Figure II-10 Transient Water Flux During Draindown.



m^3/s = cubic metres per second.

The reference solute concentration breakthrough curve at the outlet point is shown in Figure II-11. The relative concentration remains at full strength for about 30 years and then declines to 5% of the initial source concentration by about 140 years.

Figure II-11 Reference Solute Breakthrough Curve



C = Concentration at a given time; Co = Initial Concentration.

Current model results are conservative in that they assume an unfrozen condition persists within the North Pile. It is expected that permafrost will eventually aggrade into the North Pile; however, at this time there are insufficient data with which to include and account for potential freezing of the North Pile. The results shown in Figure II-11 (in combination with the seepage rates presented in Figure II-10 and porewater / process water concentrations in the North Pile) are considered reasonable in reflecting the (incremental) longer term release of solute mass from porewater within the fines fraction of the PK of the North Pile once particular cells (or sub-cells) are no longer used for active emplacement of fines fraction of the PK . These results were used as inputs in the GoldSim Contaminant Transport model to define long-term water release (Section 7.2) and mass loading (Section 7.3) from the North Pile.

II.5 REFERENCES

Abdul AS. 1985. Experimental and numerical studies of the effect of the capillary fringe on streamflow. Ph.D. Thesis, University of Waterloo, Waterloo, ON, Canada.

Sun J., Stianson J. 2013. Junior Engineer and Geotechnical Engineer, Golder Associates Ltd., Saskatoon, SK, Canada. E-mails. September 17 and 18, 2013.

APPENDIX III

CORRELATION MATRICES

December 2013

Table III-1 SNP 02-01 Correlation Matrix (Underground)

	[Ag][ug/l]	[Al][ug/l]	[Alk][mg/l]	[As][ug/l]	[Ba][ug/l]	[Be][ug/l]	[Ca][mg/l]	[Cd][ug/l]	[Cl][mg/l]	[Co][ug/l]	[Cr][ug/l]
[Ag][ug/l]	1										
[Al][ug/l]	0.025464628	1									
[Alk][mg/l]	-0.140494057	-0.018985626	1								
[As][ug/l]	0.54637353	0.303752524	-0.499783168	1							
[Ba][ug/l]	-0.2343496	0.065684263	-0.166456348	0.171090475	1						
[Be][ug/l]	0.882155301	0.089257132	0.019509369	0.285498509	-0.28112307	1					
[Ca][mg/l]	-0.117328774	0.295834057	-0.323023395	0.368338241	0.234301833	-0.162662372	1				
[Cd][ug/l]	0.776656232	-0.189920412	-0.52383479	0.600663881	0.371711502	-0.433715589	0.55654832	1			
[Cl][mg/l]	-0.1051276	0.270220705	-0.354371246	0.352594657	0.238480198	-0.17533539	0.974421419	0.624348523	1		
[Co][ug/l]	0.046453257	0.875207998	0.062063135	0.329334855	0.201956173	0.105743499	0.307357994	0.20173881	0.254808772	1	
[Cr][ug/l]	0.201429491	0.727651818	-0.329098115	0.53546402	0.097339079	0.163641784	0.408785715	0.202194101	0.381356798	0.610519351	1
[Cu][ug/l]	-0.01199816	0.038754703	0.095770422	-0.026620798	0.060100111	0.026007235	0.102281857	0.101354596	0.110873438	0.039221993	-0.074164949
[F][mg/l]	0.032293485	0.127960839	-0.29263355	0.484172691	0.103283368	-0.129521218	0.399159795	0.772462407	0.467688058	0.043030724	0.20157064
[Fe][ug/l]	0.005190008	0.989272396	0.13527278	0.304233956	0.11794359	0.058918915	0.203289011	0.354253092	0.21699192	0.893237317	0.7155968
[Hg][ug/l]	0.049241235	0.20313997	0.136060747	0.296245551	0.108060024	-0.016952085	-0.074413223	0.319203388	0.069341528	0.152258309	0.103686957
[K][mg/l]	-0.154948957	-0.005199368	0.106268463	0.162595889	0.251162751	-0.073986632	0.069151157	-0.21163004	0.039664605	0.134852466	-0.029317473
[Li][ug/l]	-0.050037913	0.254476791	-0.370285681	0.439574219	0.336815015	-0.225484969	0.835082772	0.675729508	0.906742976	0.288549212	0.337510398
[Mg][mg/l]	-0.026994008	0.009839793	0.018689675	0.212476865	-0.034235466	-0.048139472	0.308980356	0.298644483	0.310317181	0.078697277	-0.060136273
[Mn][ug/l]	-0.064303733	0.483609916	0.499127343	-0.38979511	-0.219142167	0.203889432	-0.070613874	-0.67497941	-0.133527697	0.480848334	0.108207332
[Mo][ug/l]	-0.154601779	-0.090709617	0.07885825	0.123528036	0.671222706	-0.17190653	-0.037551157	0.325532601	-0.067807856	0.204927027	-0.088283506
[Na][mg/l]	-0.104375982	0.284214966	-0.359928642	0.391436494	0.266356545	-0.15337889	0.985060125	0.581823801	0.986214655	0.300651351	0.406481845
[NH4][mg/l]	0.007570929	-0.044627475	-0.073267762	0.174701976	0.161754181	-0.100097768	0.02388513	0.383083587	0.093169602	0.059774422	0.004585193
[Ni][ug/l]	0.001139017	0.554104615	0.457071463	0.0775847	0.210613307	0.113754416	-0.010948705	0.00096448	-0.082820621	0.773719036	0.227526837
[NO3][mg/l]	0.069964562	-0.049875079	-0.01467486	0.082405801	0.197918582	0.137580877	-0.106982476	0.003460904	-0.074182614	0.102010687	-0.00890259
[Pb][ug/l]	0.034054682	0.992168487	-0.040862785	0.322220945	0.068295974	0.090198483	0.300190123	0.094829432	0.282484358	0.867154176	0.724627324
[PO4][mg/l]	-0.066261435	-0.005520733	-0.075124303	-0.042249397	-0.042232023	-0.117853248	-0.007555985	0.253653665	-0.028785756	-0.053458183	0.001183882
[Sb][ug/l]	0.885393923	0.003069275	-0.124409849	0.393875242	-0.25083815	0.827480813	-0.142001572	-0.059341098	-0.148673054	0.001196921	0.234950679
[Se][ug/l]	0.467288281	0.056594588	-0.454593655	0.597022176	-0.090083194	0.19995259	0.306594992	0.737900644	0.366840742	0.045800364	0.323783996
[Silica][mg/l]	-0.036863888	0.00904115	-0.400656774	0.541523251	0.51488761	-0.156805893	0.272165249	0.54402061	0.298809672	-0.184018153	0.402496196
[SO4][mg/l]	-0.242934159	0.201644341	-0.262508718	0.088752766	0.372094836	-0.163896985	0.89749025	0.311062541	0.884479377	0.288838365	0.252808874
[Sr][ug/l]	-0.114707751	0.313594635	-0.368351742	0.377211525	0.181573452	-0.193361207	0.9308012	0.462649866	0.9651481	0.295084037	0.394895312
[TDS][mg/l]	**-0.167746993**	**0.290092864**	**-0.30959461**	**0.338311077**	**0.313963246**	**-0.228562628**	**0.987507099**	**0.627227552**	**0.994302041**	**0.310726747**	**0.392037058**
[TKN][mg/l]	0.065922808	-0.033075447	-0.064280906	0.182458539	0.042832798	0.018664663	0.033018162	0.287099391	0.172963215	0.005033853	0.03489209
[Tl][ug/l]	0.474213038	0.043958748	-0.246120704	0.560128942	-0.028389725	0.449820127	0.063674888	0.406874864	0.058517259	0.0817366	0.145564343
[Total_P][mg/l]	-0.081761643	-0.016540699	-0.021257292	0.239609355	0.587108905	-0.079979631	0.008461967	-0.181053465	0.064731876	0.039875521	0.05027271
[TSS][mg/l]	-0.034992743	0.00932904	-0.139921933	0.30386594	0.617983571	-0.097988511	0.005243395	0.247790784	0.053859533	0.063338852	0.128944224
[U][ug/l]	-0.081735286	0.417057071	0.226365516	0.030947076	0.006285535	0.059491333	0.172300653	-0.012706987	0.120509381	0.573981827	0.119972919
[V][ug/l]	0.189362071	0.638163088	-0.225680864	0.621589208	0.248121952	0.147842387	0.30380955	0.316640496	0.260411593	0.528395886	0.814666308
[Zn][ug/l]	0.125785876	0.524105185	-0.031078291	0.264989275	0.00946888	0.196864331	0.069934079	-0.176455381	0.058384544	0.478845238	0.376896396

Correlation Legend:

	0.5 to 0.7
	=>0.7
	-0.5 to -0.7
	=< -0.7

Notes:

All matrices were calculated using half-detection limits.

Table III-1 SNP 02-01 Correlation Matrix (Underground)

	[Cu][ug/l]	[F][mg/l]	[Fe][ug/l]	[Hg][ug/l]	[K][mg/l]	[Li][ug/l]	[Mg][mg/l]	[Mn][ug/l]	[Mo][ug/l]	[Na][mg/l]	[NH4][mg/l]
[Ag][ug/l]											
[Al][ug/l]											
[Alk][mg/l]											
[As][ug/l]											
[Ba][ug/l]											
[Be][ug/l]											
[Ca][mg/l]											
[Cd][ug/l]											
[Cl][mg/l]											
[Co][ug/l]											
[Cr][ug/l]											
[Cu][ug/l]	1										
[F][mg/l]	0.011417849	1									
[Fe][ug/l]	0.047057552	0.291221426	1								
[Hg][ug/l]	-0.169599575	0.586662997	0.233769911	1							
[K][mg/l]	0.029963221	0.053233081	-0.02597859	-0.07262429	1						
[Li][ug/l]	0.158170644	0.557383211	0.278674602	0.170426726	-0.017675713	1					
[Mg][mg/l]	0.061796092	0.255225185	0.049151739	0.071452424	0.56387929	0.126142442	1				
[Mn][ug/l]	0.045776878	-0.234803638	0.670212618	-0.300967883	0.142877995	-0.345394805	0.04521027	1			
[Mo][ug/l]	0.133907754	0.097624476	-0.032629594	0.144521244	0.44393439	0.193924376	0.064146362	-0.223313715	1		
[Na][mg/l]	0.092084732	0.455910206	0.191821975	0.05696354	0.068816347	0.895465963	0.29938967	-0.127667115	0.018206813	1	
[NH4][mg/l]	0.089836413	0.349293899	-0.014698228	0.193737148	0.16030005	0.298074561	0.13399682	-0.221246184	0.21439383	0.076181334	1
[Ni][ug/l]	0.043264319	-0.151615478	0.589009413	0.233657534	0.186755662	0.025246251	0.070480839	0.517843395	0.342711723	-0.029390846	0.06742956
[NO3][mg/l]	0.01993552	0.181050097	-0.068477514	0.063127546	0.400501013	-0.010610995	0.135327332	-0.05192341	0.513555345	-0.060780448	0.747002558
[Pb][ug/l]	0.074978269	0.152790454	0.990839089	0.12091758	-0.005068024	0.268409462	0.013002297	0.477362295	-0.087355228	0.293010626	-0.028804469
[PO4][mg/l]	-0.025581263	0.062045997	-0.015590263	0.015068536	-0.059064001	0.043974024	-0.017249669	-0.080928019	-0.033491452	-0.013727606	-0.006587104
[Sb][ug/l]	-0.064929469	-0.039580307	-0.028041879	-0.004780134	-0.089550531	-0.136529879	-0.065618963	-0.015599898	-0.210042295	-0.12648409	-0.039499469
[Se][ug/l]	-0.069208945	0.478598083	0.056047524	0.228911775	-0.128867323	0.446959976	0.095178575	-0.480991456	-0.067745384	0.349458366	0.17237728
[Silica][mg/l]	-0.127262846	0.478578802	-0.0023567	0.002050784	0.059228897	0.472857196	0.036944606	-0.701116622	0.067374786	0.312870658	0.19663983
[SO4][mg/l]	0.159762729	0.277840387	0.092909814	-0.197352312	0.195332748	0.598118329	0.297399344	0.060523081	0.2737568	0.887788689	-0.012938952
[Sr][ug/l]	0.130621087	0.425929895	0.316650058	0.070924906	0.050928228	0.881540538	0.160528701	-0.156747918	0.000891904	0.956157798	0.16174199
[TDS][mg/l]	**0.121701319**	**0.445792469**	**0.226417129**	**0.052938804**	**0.104023846**	**0.890255141**	**0.324581015**	**-0.069786069**	**0.037882181**	**0.988538028**	**0.100737236**
[TKN][mg/l]	-0.005743311	0.378289038	-0.016625753	0.294031221	0.229368733	0.164435938	0.147030673	-0.16069621	0.110720883	0.18321177	0.986033068
[Tl][ug/l]	-0.076565881	0.034614221	0.039615937	0.109484329	-0.016970436	0.049728847	-0.029609548	-0.079209017	-0.001847217	0.074875443	0.007879896
[Total_P][mg/l]	-0.06220078	0.311757539	-0.002701314	0.535731478	0.203452259	0.074269738	0.154716602	-0.240730493	0.412863671	0.043215552	0.245607067
[TSS][mg/l]	-0.044712426	0.408990412	0.013340829	0.52781285	0.245238566	0.212534083	0.145988702	-0.297372704	0.397029085	0.075545533	0.330483125
[U][ug/l]	0.07699794	-0.092899072	0.440697503	0.121728594	0.363664834	0.14940626	0.234725015	0.449966448	0.294139477	0.193802954	0.08638607
[V][ug/l]	-0.045443725	0.328096608	0.634045776	0.203293385	0.055295331	0.275949476	-0.014371924	-0.026580778	0.068292432	0.279148285	-0.007818723
[Zn][ug/l]	0.107728604	0.049140055	0.50995548	-0.112493659	-0.022547017	0.092038511	-0.066742767	0.27638809	-0.018617542	0.073098539	-0.023242894

Table III-1 SNP 02-01 Correlation Matrix (Underground)

	[Ni][ug/l]	[NO3][mg/l]	[Pb][ug/l]	[PO4][mg/l]	[Sb][ug/l]	[Se][ug/l]	[Silica][mg/l]	[SO4][mg/l]	[Sr][ug/l]	**[TDS][mg/l]**	[TKN][mg/l]
[Ag][ug/l]											
[Al][ug/l]											
[Alk][mg/l]											
[As][ug/l]											
[Ba][ug/l]											
[Be][ug/l]											
[Ca][mg/l]											
[Cd][ug/l]											
[Cl][mg/l]											
[Co][ug/l]											
[Cr][ug/l]											
[Cu][ug/l]											
[F][mg/l]											
[Fe][ug/l]											
[Hg][ug/l]											
[K][mg/l]											
[Li][ug/l]											
[Mg][mg/l]											
[Mn][ug/l]											
[Mo][ug/l]											
[Na][mg/l]											
[NH4][mg/l]											
[Ni][ug/l]	1										
[NO3][mg/l]	0.163934366	1									
[Pb][ug/l]	0.539919094	-0.037827561	1								
[PO4][mg/l]	-0.09229721	-0.000614359	-0.008185189	1							
[Sb][ug/l]	-0.039376035	0.105372462	0.007121366	-0.060091162	1						
[Se][ug/l]	-0.205023964	0.062799431	0.075584465	-0.041437292	0.348978379	1					
[Silica][mg/l]	-0.550389034	0.039064783	0.074836604	0.120868008	-0.045002132	0.412611803	1				
[SO4][mg/l]	0.078450534	0.043907808	0.203695061	-0.016681775	-0.207399684	0.040742412	0.207779115	1			
[Sr][ug/l]	-0.023630999	0.01833232	0.32679263	-0.000805016	-0.14648207	0.360346581	0.407956174	0.736830395	1		
[TDS][mg/l]	**0.021562857**	**-0.011052977**	**0.295833525**	**0.145564097**	**-0.163676039**	**0.319763149**	**0.29121461**	**0.914882356**	**0.962459309**	1	
[TKN][mg/l]	0.010354419	0.836445993	-0.01673218	-0.002693552	0.084541056	0.198902338	0.143683908	0.10066718	0.14142869	**0.250583026**	1
[Tl][ug/l]	0.064969651	0.113198146	0.05534698	-0.050816225	0.400287676	0.261816446	0.157283295	-0.025702739	0.065529999	**0.032712986**	0.043264704
[Total_P][mg/l]	0.31993148	0.303476248	-0.031034423	-0.054365249	-0.054160691	0.045722482	0.335607118	0.020201889	0.02281777	**0.096580642**	0.271688476
[TSS][mg/l]	0.262941043	0.329755802	-0.002529716	-0.042466041	-0.065111066	0.102748373	0.343013766	0.070676853	0.12871355	**0.094043943**	0.399124789
[U][ug/l]	0.712067467	0.230607802	0.403068459	-0.029534832	-0.095909269	-0.160679123	-0.360065847	0.362925629	0.19003868	**0.23102325**	0.029114285
[V][ug/l]	0.207375376	-0.02946617	0.638201316	0.009722869	0.147923801	0.323625242	0.375788836	0.113680642	0.253480798	**0.256124178**	0.012603861
[Zn][ug/l]	0.358261584	0.031093632	0.528897923	-0.026375468	0.128714319	-0.009038646	0.023263525	0.138852115	0.099056472	**0.078937715**	0.009229385

Table III-1 SNP 02-01 Correlation Matrix (Underground)

	[Tl][ug/l]	[Total_P][mg/l]	[TSS][mg/l]	[U][ug/l]	[V][ug/l]	[Zn][ug/l]
[Ag][ug/l]						
[Al][ug/l]						
[Alk][mg/l]						
[As][ug/l]						
[Ba][ug/l]						
[Be][ug/l]						
[Ca][mg/l]						
[Cd][ug/l]						
[Cl][mg/l]						
[Co][ug/l]						
[Cr][ug/l]						
[Cu][ug/l]						
[F][mg/l]						
[Fe][ug/l]						
[Hg][ug/l]						
[K][mg/l]						
[Li][ug/l]						
[Mg][mg/l]						
[Mn][ug/l]						
[Mo][ug/l]						
[Na][mg/l]						
[NH4][mg/l]						
[Ni][ug/l]						
[NO3][mg/l]						
[Pb][ug/l]						
[PO4][mg/l]						
[Sb][ug/l]						
[Se][ug/l]						
[Silica][mg/l]						
[SO4][mg/l]						
[Sr][ug/l]						
[TDS][mg/l]						
[TKN][mg/l]						
[Tl][ug/l]	1					
[Total_P][mg/l]	0.093161874	1				
[TSS][mg/l]	0.059985169	0.643321994	1			
[U][ug/l]	0.006921157	0.162476644	0.149445807	1		
[V][ug/l]	0.101896977	0.161811691	0.226651993	0.030721744	1	
[Zn][ug/l]	0.017766148	-0.067644201	-0.068497867	0.225714036	0.342965756	1

Table III-2 SNP 02-02 Correlation Matrix (North Pile)

	[Ag_d][ug/l]	[Al_d][ug/l]	[Alk][mg/l]	[As_d][ug/l]	[Ba_d][ug/l]	[Be_d][ug/l]	[Ca][mg/l]	[Cd_d][ug/l]	[Cl][mg/l]	[Co_d][ug/l]
[Ag_d][ug/l]	1									
[Al_d][ug/l]	0.251698131	1								
[Alk][mg/l]	0.673842236	-0.144370985	1							
[As_d][ug/l]	0.904416197	0.152361295	0.645795692	1						
[Ba_d][ug/l]	0.192124284	0.129387772	0.065617316	0.307786416	1					
[Be_d][ug/l]	0.889011533	0.157542588	0.741600716	0.824405846	0.13441835	1				
[Ca][mg/l]	0.537107044	-0.013178593	0.636900589	0.578432952	0.455946406	0.601074859	1			
[Cd_d][ug/l]	0.323779517	0.498377628	-0.095424767	-0.129326914	0.528995072	0.040977513	0.55531382	1		
[Cl][mg/l]	0.452593007	0.037571416	0.426228687	0.540684203	0.728820833	0.491108124	0.836595497	0.481077248	1	
[Co_d][ug/l]	0.420266653	0.291379508	0.278111793	0.368279209	0.324974018	0.435208933	0.580838503	0.616999849	0.471139257	1
[Cr_d][ug/l]	0.580465885	-0.027227956	0.077084131	0.570130239	0.136868132	0.334857935	0.303404805	0.336369608	0.128640312	0.098860159
[Cu_d][ug/l]	0.146775903	0.100342158	0.170501224	0.06288354	-0.136835983	0.262304485	0.277202976	0.27829523	0.101151734	0.221040891
[F][mg/l]	0.061242817	-0.340391151	0.280200015	0.142758663	0.385266488	0.146517199	0.385982845	0.001321816	0.578753648	-0.189904963
[Fe_d][ug/l]	0.025287659	0.011419508	-0.063925165	-0.037469753	0.008286181	0.106983188	0.072734089	-0.023497022	-0.009151856	0.36553481
[Hg_d][ug/l]	-0.012853574	-0.072624919	-0.064193237	0.123662357	0.161014067	-0.039944054	0.011507668	0.095294474	0.035128165	-0.081525097
[K][mg/l]	0.427515294	-0.124707585	0.62050232	0.451564429	0.496622248	0.538379812	0.840639741	0.382781293	0.851463294	0.417161499
[Li_d][ug/l]	-0.236884051	-0.155723123	-0.01909054	-0.083100986	0.641378157	-0.183551082	0.241612146	0.208721521	0.574102025	-0.013733351
[Mg][mg/l]	0.470784506	-0.00640449	0.552250245	0.459098877	0.401396358	0.519106238	0.932400235	0.578041463	0.760431462	0.517502841
[Mn_d][ug/l]	0.170958655	0.138115657	0.154242557	0.118460318	0.200847419	0.234373753	0.586704507	0.54626991	0.385827708	0.843801942
[Mo_d][ug/l]	0.183221603	-0.319738995	0.472302597	0.301334416	0.348368589	0.301546067	0.738078993	0.126817053	0.720007237	0.061672648
[Na][mg/l]	0.412578661	-0.043805444	0.542212285	0.414324651	0.555710155	0.509805057	0.877021998	0.499626147	0.893288342	0.553051038
[NH4][mg/l]	0.068863274	-0.296548611	0.251975876	0.112560862	0.361414339	0.148284741	0.449373989	0.218501079	0.436438955	0.03715407
[Ni_d][ug/l]	0.883477401	0.133226895	0.794995877	0.843213678	0.203587549	0.84071888	0.754807041	0.360670548	0.587601469	0.55356806
[NO3][mg/l]	0.568458968	-0.056369321	0.621956145	0.512243853	0.43072805	0.605787233	0.868833364	0.44142941	0.665676762	0.621613857
[Pb_d][ug/l]	0.860226323	0.211726579	0.548848654	0.853564691	0.181816156	0.837116758	0.43044444	-0.086241367	0.379541022	0.322261542
[PO4][mg/l]	-0.057206842	-0.134307096	0.044527145	-0.017329304	-0.168412446	-0.059414396	-0.076795504	-0.164182024	-0.105266296	-0.110899467
[Sb_d][ug/l]	0.398680892	-0.234771203	0.458478836	0.406067157	0.176865085	0.579735604	0.444656235	-0.086885367	0.389498408	0.041345054
[Se_d][ug/l]	0.390425334	0.170087295	0.345112809	0.38035843	0.15374028	0.365327805	0.716464193	0.563736776	0.473716191	0.357670465
[Silica][mg/l]	0.489322755	-0.043558216	0.55250427	0.495510614	0.417103735	0.558694252	0.659190468	0.07333395	0.737262776	0.545916211
[SO4][mg/l]	0.33456008	-0.036603694	0.534084042	0.362134131	0.142204567	0.466688007	0.869281711	0.487646358	0.583161872	0.420721139
[Sr_d][ug/l]	0.455728876	-0.060371785	0.626091084	0.521586086	0.517067311	0.544217076	0.964963097	0.476322913	0.891546984	0.497503379
[TDS][mg/l]	**0.562251446**	**-0.029342126**	**0.632454765**	**0.518266913**	**0.519036131**	**0.624637128**	**0.968800622**	**0.51689891**	**0.837129711**	**0.567270472**
[TKN][mg/l]	0.001152394	-0.267290244	0.20584374	0.03195052	0.343840871	0.061790136	0.301198187	0.194274576	0.364496875	-0.106581841
[Tl_d][ug/l]	0.619087803	0.04196382	0.586984711	0.688786852	0.493640091	0.619593768	0.706178185	0.456054578	0.653462693	0.354853497
[Total_P][mg/l]	-0.017959317	-0.102440142	0.012013643	-0.039110923	0.203591288	-0.064813734	0.017235432	-0.10604967	0.083094547	-0.123914452
[TSS][mg/l]	-0.01802993	-0.093277762	0.004065992	-0.044839983	0.189210994	-0.060220205	0.006800226	-0.117609649	0.06820262	-0.115008481
[U_d][ug/l]	0.701114957	0.001772005	0.879105324	0.692771164	0.043558316	0.768504934	0.761442575	0.102202229	0.515300973	0.33318946
[V_d][ug/l]	0.64401952	0.045114797	0.60321532	0.78042401	0.16168066	0.671119603	0.585279505	0.023618491	0.388660227	0.338456737
[Zn_d][ug/l]	0.207151356	0.0117991	0.314451009	0.317335656	0.078170337	0.243558485	0.595839672	0.211498001	0.393123678	0.47075961

Correlation Legend:

(orange)	0.5 to 0.7
(red)	=>0.7
(blue)	-0.5 to -0.7
(green)	=< -0.7

Notes:

All matrices were calculated using half-detection limits.

Table III-2 SNP 02-02 Correlation Matrix (North Pile)

	[Cr_d][ug/l]	*[Cu_d][ug/l]*	*[F][mg/l]*	*[Fe_d][ug/l]*	*[Hg_d][ug/l]*	*[K][mg/l]*	*[Li_d][ug/l]*	*[Mg][mg/l]*	*[Mn_d][ug/l]*	*[Mo_d][ug/l]*
[Ag_d][ug/l]										
[Al_d][ug/l]										
[Alk][mg/l]										
[As_d][ug/l]										
[Ba_d][ug/l]										
[Be_d][ug/l]										
[Ca][mg/l]										
[Cd_d][ug/l]										
[Cl][mg/l]										
[Co_d][ug/l]										
[Cr_d][ug/l]	1									
[Cu_d][ug/l]	-0.083780965	1								
[F][mg/l]	-0.089088853	-0.114946204	1							
[Fe_d][ug/l]	0.061597467	-0.036075175	-0.123072796	1						
[Hg_d][ug/l]	0.656672974	-0.125977797	0.005911544	-0.057554081	1					
[K][mg/l]	0.03507932	0.202852528	0.630459204	0.012782663	-0.121065865	1				
[Li_d][ug/l]	-0.123675407	-0.226100739	0.66077416	-0.087668234	0.083265106	0.453651423	1			
[Mg][mg/l]	0.231560332	0.347932849	0.422479651	0.085448303	-0.063101913	0.798146587	0.144810302	1		
[Mn_d][ug/l]	0.157555224	0.296907136	-0.206582991	0.259102218	-0.070519077	0.356087959	-0.051472804	0.560038353	1	
[Mo_d][ug/l]	0.21514105	0.09648687	0.821004212	-0.027207392	0.050425553	0.792744315	0.485445958	0.732225247	0.130991632	1
[Na][mg/l]	0.049713432	0.233646763	0.546189604	0.030360684	-0.087172501	0.968601517	0.468200416	0.823524105	0.500620786	0.733272874
[NH4][mg/l]	0.004990824	-0.091684284	0.651154319	0.007424329	-0.10879926	0.594620846	0.552226274	0.467488348	0.118476184	0.643718703
[Ni_d][ug/l]	0.316096819	0.186963121	0.173616474	0.050206579	-0.06928287	0.656543094	-0.145165252	0.69868716	0.359973092	0.423942581
[NO3][mg/l]	0.08147432	0.212576634	0.315649828	0.064551122	-0.097120216	0.846528726	0.202077215	0.817784274	0.549627343	0.545026528
[Pb_d][ug/l]	0.300395005	0.094901359	0.070531212	0.067505564	0.095410949	0.332904454	-0.221352269	0.374065929	0.091859906	0.16179333
[PO4][mg/l]	-0.064790134	-0.132341982	0.082174467	-0.065799476	-0.043887938	-0.020307833	0.064346264	-0.097012506	-0.169880666	-0.002150259
[Sb_d][ug/l]	0.290873782	-0.09576231	0.418836598	0.186886434	-0.152124085	0.52846271	0.381826275	0.314231591	-0.007446593	0.51813366
[Se_d][ug/l]	0.385907852	0.27570886	0.242169253	0.056135791	-0.051437318	0.461620213	-0.073040842	0.820063449	0.452107197	0.530064545
[Silica][mg/l]	0.016242174	0.075978445	0.384238178	0.075246511	-0.068978415	0.720165047	0.307155007	0.564981412	0.430602987	0.522523464
[SO4][mg/l]	0.24924592	0.350008576	0.315579985	0.128228004	-0.141786642	0.672144457	0.031828131	0.875479475	0.541293503	0.705462147
[Sr_d][ug/l]	0.236246268	0.201809407	0.547850173	0.04685268	0.032237846	0.901793533	0.404414184	0.905787095	0.479155138	0.823701646
[TDS][mg/l]	**0.082735022**	**0.262322043**	**0.455932421**	**0.019281626**	**-0.078369294**	**0.926279314**	**0.321044337**	**0.912033262**	**0.520918321**	**0.692175901**
[TKN][mg/l]	-0.046635195	-0.076364651	0.66536053	-0.090835203	-0.079518572	0.476945634	0.577687743	0.341048791	-0.008037041	0.550641516
[Tl_d][ug/l]	0.194696984	0.133792413	0.384040507	-0.035579765	0.2147889	0.610399604	0.15991912	0.686477742	0.210489903	0.511365524
[Total_P][mg/l]	-0.063564954	-0.054058378	0.277138547	-0.049657971	-0.007662093	0.046754711	0.200584193	0.076305759	-0.129788717	0.141227213
[TSS][mg/l]	-0.062553277	-0.057883743	0.266058099	-0.044041395	-0.014432675	0.033647892	0.200761085	0.052849134	-0.123872707	0.125264175
[U_d][ug/l]	0.168928352	0.236355543	0.293045992	-0.000194679	-0.029565325	0.643163571	-0.066640721	0.695564275	0.263109402	0.555411167
[V_d][ug/l]	0.740061935	0.067819711	0.084880192	0.083343124	0.201643974	0.404876312	-0.199188667	0.524000538	0.259744047	0.405918777
[Zn_d][ug/l]	0.184313692	0.186889891	0.10920799	0.097136783	-0.07411014	0.431098369	0.111566538	0.491304558	0.453346885	0.444610837

Table III-2 SNP 02-02 Correlation Matrix (North Pile)

	[Na][mg/l]	*[NH4][mg/l]*	*[Ni_d][ug/l]*	*[NO3][mg/l]*	*[Pb_d][ug/l]*	*[PO4][mg/l]*	*[Sb_d][ug/l]*	*[Se_d][ug/l]*	*[Silica][mg/l]*	*[SO4][mg/l]*
[Ag_d][ug/l]										
[Al_d][ug/l]										
[Alk][mg/l]										
[As_d][ug/l]										
[Ba_d][ug/l]										
[Be_d][ug/l]										
[Ca][mg/l]										
[Cd_d][ug/l]										
[Cl][mg/l]										
[Co_d][ug/l]										
[Cr_d][ug/l]										
[Cu_d][ug/l]										
[F][mg/l]										
[Fe_d][ug/l]										
[Hg_d][ug/l]										
[K][mg/l]										
[Li_d][ug/l]										
[Mg][mg/l]										
[Mn_d][ug/l]										
[Mo_d][ug/l]										
[Na][mg/l]	1									
[NH4][mg/l]	0.535708911	1								
[Ni_d][ug/l]	0.640113808	0.211910801	1							
[NO3][mg/l]	0.864946882	0.604630023	0.759499988	1						
[Pb_d][ug/l]	0.314217868	0.018682815	0.744817446	0.414611276	1					
[PO4][mg/l]	-0.051932744	0.004564895	-0.020504705	-0.053769042	-0.102501794	1				
[Sb_d][ug/l]	0.444014104	0.465197193	0.400730092	0.392185098	0.233793465	0.231012221	1			
[Se_d][ug/l]	0.497232075	0.271077568	0.515128117	0.48529199	0.301375585	-0.087564164	0.18091287	1		
[Silica][mg/l]	0.756983607	0.289453311	0.579045261	0.64787448	0.459244505	0.05177405	0.306959536	0.36090504	1	
[SO4][mg/l]	0.693054695	0.392946421	0.595583993	0.70496702	0.287622662	-0.037040431	0.404643136	0.806023395	0.402506159	1
[Sr_d][ug/l]	0.928970845	0.525428113	0.694114708	0.844265921	0.400473512	-0.032830946	0.501084226	0.663995193	0.710012046	0.84098294
[TDS][mg/l]	**0.949604363**	**0.521151148**	**0.73334462**	**0.938902128**	**0.427011959**	**-0.064983182**	**0.443683045**	**0.603895217**	**0.716778373**	**0.829895297**
[TKN][mg/l]	0.417729073	0.90868642	0.033848982	0.478522179	-0.028319977	0.000642188	0.376577685	0.214722121	0.245624162	0.241091145
[Tl_d][ug/l]	0.613852862	0.36300897	0.722311534	0.608364113	0.653318653	-0.119536558	0.188884862	0.466776069	0.523026865	0.545703495
[Total_P][mg/l]	0.033134427	0.110032792	0.00122748	0.028158095	0.067972947	-0.040288483	-0.071548454	0.026387416	0.146787412	-0.018246565
[TSS][mg/l]	0.022027249	0.100703835	-0.008723188	0.016372454	0.071501022	-0.036724775	-0.062833571	0.008358985	0.145024747	-0.025546455
[U_d][ug/l]	0.602480876	0.340769263	0.811368956	0.649305878	0.577160353	0.053039839	0.505195869	0.557942729	0.477203997	0.728023594
[V_d][ug/l]	0.35542721	0.187961497	0.746042815	0.491659898	0.627223697	-0.065635393	0.403565391	0.448022099	0.391603827	0.498280969
[Zn_d][ug/l]	0.472367267	0.273235778	0.47968944	0.47906858	0.186207807	0.297503206	0.428110726	0.414745323	0.337681925	0.632358287

Table III-2 SNP 02-02 Correlation Matrix (North Pile)

	[Sr_d][ug/l]	***[TDS][mg/l]***	*[TKN][mg/l]*	*[Tl_d][ug/l]*	*[Total_P][mg/l]*	*[TSS][mg/l]*	*[U_d][ug/l]*	*[V_d][ug/l]*	*[Zn_d][ug/l]*
[Ag_d][ug/l]									
[Al_d][ug/l]									
[Alk][mg/l]									
[As_d][ug/l]									
[Ba_d][ug/l]									
[Be_d][ug/l]									
[Ca][mg/l]									
[Cd_d][ug/l]									
[Cl][mg/l]									
[Co_d][ug/l]									
[Cr_d][ug/l]									
[Cu_d][ug/l]									
[F][mg/l]									
[Fe_d][ug/l]									
[Hg_d][ug/l]									
[K][mg/l]									
[Li_d][ug/l]									
[Mg][mg/l]									
[Mn_d][ug/l]									
[Mo_d][ug/l]									
[Na][mg/l]									
[NH4][mg/l]									
[Ni_d][ug/l]									
[NO3][mg/l]									
[Pb_d][ug/l]									
[PO4][mg/l]									
[Sb_d][ug/l]									
[Se_d][ug/l]									
[Silica][mg/l]									
[SO4][mg/l]									
[Sr_d][ug/l]	1								
[TDS][mg/l]	**0.962280359**	**1**							
[TKN][mg/l]	0.388223788	**0.467966826**	1						
[Tl_d][ug/l]	0.720581013	**0.658132482**	0.270909268	1					
[Total_P][mg/l]	0.049744886	**0.040394865**	0.13026998	0.124107566	1				
[TSS][mg/l]	0.037894151	**0.027650692**	0.124827339	0.108453904	0.996276091	1			
[U_d][ug/l]	0.713115572	**0.702670224**	0.233489778	0.66371625	-0.071733416	-0.075443486	1		
[V_d][ug/l]	0.514857734	**0.430041989**	0.008583102	0.591326552	-0.027527452	-0.02610322	0.618677303	1	
[Zn_d][ug/l]	0.584584184	**0.446883031**	0.034961985	0.353106068	-0.066876325	-0.060897136	0.473679703	0.444065286	1

Table III-3 SNP 02-4 Correlation Matrix (Airstrip/Roads)

	[Ag_d] [mg/l]	*[Al_d] [mg/l]*	*[Alk][mg/l]*	*[As_d] [mg/l]*	*[Ba_d] [mg/l]*	*[Be_d] [mg/l]*	*[Ca] [mg/l]*	*[Cd_d] [mg/l]*	*[Cl] [mg/l]*	*[Co_d] [mg/l]*
[Ag_d] [mg/l]	1									
[Al_d] [mg/l]	0.456443412	1								
[Alk][mg/l]	0.079283306	-0.011835988	1							
[As_d] [mg/l]	0.470934438	0.27177943	0.472189962	1						
[Ba_d] [mg/l]	0.122666207	0.175268725	0.106672215	0.043248527	1					
[Be_d] [mg/l]	0.987217976	0.449885393	0.066402982	0.498717809	0.103123006	1				
[Ca] [mg/l]	0.041644177	-0.100207666	0.542318101	0.113601579	0.525415565	0.023517737	1			
[Cd_d] [mg/l]	0.351103223	-0.16153803	0.201583608	0.173690717	0.013051147	0.4083302	0.098068126	1		
[Cl] [mg/l]	0.298769354	0.160333528	0.209296425	0.123320172	0.435923717	0.290591878	0.585596133	0.005861239	1	
[Co_d] [mg/l]	0.068970851	0.074485816	0.354684745	0.106479706	0.649475726	0.057529329	0.907441933	0.067710654	0.596535456	1
[Cr_d] [mg/l]	0.087091905	0.327537943	0.576966109	0.55743644	0.180665339	0.098606092	0.270565498	-0.031399415	0.248549643	0.213110392
[Cu_d] [mg/l]	-0.229043804	0.205525467	0.456488561	0.189612941	-0.043661846	-0.219642255	0.20093878	0.047502933	0.049138055	0.039298215
[F] [mg/l]	0.210028228	0.005254073	0.694756551	0.317696701	0.285463397	0.172375318	0.446862343	0.223459866	0.236314457	0.225921202
[Fe_d] [mg/l]	0.226758693	0.38662512	0.504733854	0.604340676	0.082802204	0.233045568	0.023152716	0.110476948	0.066763065	0.134601425
[Hg_d] [mg/l]	0.303916955	-0.017779681	0.130987687	0.120450311	-0.004815549	0.391743824	-0.002185693	2.39802E-16	-0.020295888	-0.01924578
[K] [mg/l]	0.091856094	0.053954703	0.748714723	0.270079597	0.554202154	0.064136389	0.770180198	0.127194207	0.431482279	0.609243736
[Li_d] [mg/l]	0.060185104	0.282351461	0.542289765	0.501035977	0.175960784	0.066901155	0.308209166	0.250778636	0.101982303	0.171551335
[Mg] [mg/l]	0.035891695	-0.048362667	0.373420379	0.058631622	0.748766507	0.017420552	0.940958285	0.107242613	0.597671446	0.937421259
[Mn_d] [mg/l]	0.100138385	0.17743903	0.308603793	0.105459334	0.569904713	0.09675834	0.774995567	0.019101137	0.529708894	0.90572492
[Mo_d] [mg/l]	0.118149527	-0.110616002	0.607121353	0.188876758	0.203045057	0.095400522	0.878274035	0.08772608	0.48950228	0.723292086
[Na] [mg/l]	0.22739857	0.016971103	0.411261241	0.311392041	0.623795808	0.219143147	0.709960107	0.130410071	0.607019763	0.696550389
[NH4] [mg/l]	0.05963301	0.098460847	-0.084579754	-0.062152318	0.878051584	0.047751758	0.330100594	-0.014374732	0.328974527	0.450769199
[Ni_d] [mg/l]	0.005254215	-0.003245213	0.540719478	0.113874542	0.32311921	-0.011112965	0.941194331	0.110310482	0.529348063	0.865210551
[NO3] [mg/l]	0.044122997	0.017702102	-0.039987375	-0.121125319	0.954349612	0.023310751	0.553370256	0.004635674	0.449891453	0.637915996
[Pb_d] [mg/l]	0.05670692	0.441626938	0.386006883	0.222470664	-0.010541185	0.035293686	0.05098134	-0.079202704	0.066951332	-0.065479833
[PO4] [mg/l]	0.392831809	0.39326282	0.336421253	0.585518995	0.214253706	0.415150612	0.043383034	-0.077486121	0.296499259	0.227799722
[Sb_d] [mg/l]	0.813919555	0.301723683	0.152271651	0.514820987	0.062185818	0.879568142	0.134452399	0.580453218	0.341075638	0.13442205
[Se_d] [mg/l]	0.647794246	0.232204023	0.125293557	0.162856296	0.140819806	0.59842618	0.065790295	0.000209805	0.149258022	0.046806102
[Silica] [mg/l]	0.603891098	0.604467377	0.498417409	0.373639478	0.678144257	0.5875534	0.634486089	0.717422714	0.56085183	0.838547976
[SO4] [mg/l]	-0.019265271	-0.140658127	0.441179074	0.046480022	0.263853374	-0.03355251	0.926162656	0.095033523	0.493554266	0.841189005
[Sr_d] [mg/l]	0.111083183	0.029922006	0.430729923	0.150873595	0.840273181	0.090880169	0.896279613	0.087141539	0.595262181	0.904872928
[TDS] [mg/l]	**0.055250803**	**-0.069291549**	**0.393940697**	**0.059416056**	**0.756590861**	**0.036496687**	**0.940810217**	**0.086798411**	**0.62565505**	**0.913376135**
[TKN] [mg/l]	0.194177789	0.20730731	0.120873485	0.121561981	0.903052463	0.168893699	0.44042983	0.09574904	0.407348071	0.523995194
[Tl_d] [mg/l]	0.722872903	0.250036233	0.109448888	0.291878659	0.268699755	0.722187563	0.100168906	0.238082392	0.230586561	0.124155897
[Total_P] [mg/l]	0.191463381	0.324523287	0.395078524	0.246828393	0.19232115	0.18922213	0.132489247	0.094301581	0.22638402	0.224643694
[TSS] [mg/l]	0.133052872	0.320630121	0.198380551	0.155990783	0.311044686	0.124187128	0.101969377	-0.057763787	0.174102309	0.252416027
[U_d] [mg/l]	0.086845096	0.466127994	0.53460914	0.100899146	0.042232807	0.038451247	0.2740594	-0.077494559	0.173029462	0.147917329
[V_d] [mg/l]	0.159502322	0.491784555	0.493078469	0.574112473	0.135682157	0.161400866	0.096292594	0.186014309	0.138659244	0.176218058
[Zn_d] [mg/l]	0.306348432	0.309060079	0.196001371	0.251594975	0.411708365	0.321459647	0.304107214	-0.011552241	0.326171868	0.423830749

Correlation Legend:

	0.5 to 0.7
	=>0.7
	-0.5 to -0.7
	=< -0.7

Notes:

All matrices were calculated using half-detection limits.

Table III-3 SNP 02-4 Correlation Matrix (Airstrip/Roads)

	[Cr_d] [mg/l]	*[Cu_d] [mg/l]*	*[F] [mg/l]*	*[Fe_d] [mg/l]*	*[Hg_d] [mg/l]*	*[K] [mg/l]*	*[Li_d] [mg/l]*	*[Mg] [mg/l]*	*[Mn_d] [mg/l]*	*[Mo_d] [mg/l]*
[Ag_d] [mg/l]										
[Al_d] [mg/l]										
[Alk][mg/l]										
[As_d] [mg/l]										
[Ba_d] [mg/l]										
[Be_d] [mg/l]										
[Ca] [mg/l]										
[Cd_d] [mg/l]										
[Cl] [mg/l]										
[Co_d] [mg/l]										
[Cr_d] [mg/l]	1									
[Cu_d] [mg/l]	0.550049221	1								
[F] [mg/l]	0.393326904	0.458009425	1							
[Fe_d] [mg/l]	0.589513677	0.181613002	0.122463891	1						
[Hg_d] [mg/l]	-0.0231011	0.013377058	0.108093076	0.157974864	1					
[K] [mg/l]	0.508281153	0.445298506	0.73224651	0.234023179	0.040187679	1				
[Li_d] [mg/l]	0.67477996	0.722499334	0.575338408	0.298866076	0.021153478	0.60590772	1			
[Mg] [mg/l]	0.21276265	0.113361255	0.373889067	-0.001259963	-0.012264017	0.718076555	0.247477221	1		
[Mn_d] [mg/l]	0.241989384	0.047530641	0.126152089	0.237693065	-0.016849516	0.554970848	0.209375001	0.791512357	1	
[Mo_d] [mg/l]	0.186287586	0.191512122	0.401953961	0.061905413	0.091618387	0.628967509	0.189974073	0.727423777	0.561946445	1
[Na] [mg/l]	0.435769121	0.005438609	0.303715648	0.280410575	0.047297484	0.629641232	0.209967521	0.748933612	0.566479185	0.598027838
[NH4] [mg/l]	-0.000474913	-0.140394035	0.186301754	-0.06848817	-0.023597689	0.367276781	0.055597813	0.560228519	0.373287001	0.04505437
[Ni_d] [mg/l]	0.329823062	0.323263363	0.364144136	0.098198687	0.007685103	0.662423633	0.353679419	0.834347351	0.744586484	0.889275269
[NO3] [mg/l]	0.013629209	-0.113710532	0.201785337	-0.158906419	-0.035388431	0.496830994	0.061360586	0.767284366	0.539600856	0.228576621
[Pb_d] [mg/l]	0.610196943	0.796494847	0.396787257	0.309193638	0.057158133	0.400075411	0.675258923	-0.00646838	0.031834789	0.051490235
[PO4] [mg/l]	0.385380576	-0.080422681	0.117531356	0.71848394	0.318403128	0.199689251	0.110151359	0.064133708	0.283333567	0.064094844
[Sb_d] [mg/l]	0.215109703	-0.082554342	0.193710592	0.191859936	0.534245927	0.133583309	0.152674739	0.092794761	0.164055855	0.158210567
[Se_d] [mg/l]	0.011217085	-0.133367875	0.241916545	0.205201632	0.037530598	0.140516217	-0.056104277	0.060694591	0.033735713	0.184319442
[Silica] [mg/l]	0.583371145	-0.211153563	0.733582555	0.538986057	#DIV/0!	0.641843843	0.239206736	0.62494869	0.804786236	-0.044271532
[SO4] [mg/l]	0.121401189	0.160453921	0.310008763	-0.092518077	-0.0165322	0.567389051	0.184460722	0.812167253	0.685949713	0.910584024
[Sr_d] [mg/l]	0.307413234	0.113617483	0.435253112	0.116130092	0.006873101	0.778653745	0.306824477	0.974418684	0.776101511	0.655281738
[TDS] [mg/l]	**0.212661368**	**0.094762561**	**0.410737863**	**-0.032003409**	**-0.008375961**	**0.744435782**	**0.238788322**	**0.984180464**	**0.761988798**	**0.740038875**
[TKN] [mg/l]	0.199404186	0.017458229	0.319796853	0.087788825	-0.015433378	0.574165346	0.257235578	0.648892551	0.456243579	0.155442435
[Tl_d] [mg/l]	0.038993963	-0.129181299	0.221264845	0.17109523	0.850187266	0.163927924	0.057609002	0.150376703	0.141378678	0.122314875
[Total_P] [mg/l]	0.368323457	0.216144404	0.254257992	0.428118084	-0.039430211	0.370143892	0.268361711	0.124648176	0.357327842	0.069711696
[TSS] [mg/l]	0.323910453	0.072567804	0.066877028	0.416964711	-0.004373336	0.227674566	0.131503336	0.170390826	0.327918401	-0.013596829
[U_d] [mg/l]	0.508237836	0.710685147	0.517167714	0.216539471	-0.021700974	0.557204003	0.643209169	0.153831927	0.243806406	0.293427849
[V_d] [mg/l]	0.79345381	0.34890456	0.177566737	0.861568559	-0.118749869	0.354444094	0.482342378	0.066413217	0.280944162	0.062743594
[Zn_d] [mg/l]	0.257889899	0.033364405	0.227178284	0.318232221	0.222582877	0.294139262	0.195911982	0.36829574	0.415928827	0.225532744

Table III-3 SNP 02-4 Correlation Matrix (Airstrip/Roads)

	[Na] [mg/l]	[NH4] [mg/l]	[Ni_d] [mg/l]	[NO3] [mg/l]	[Pb_d] [mg/l]	[PO4] [mg/l]	[Sb_d] [mg/l]	[Se_d] [mg/l]	[Silica] [mg/l]	[SO4] [mg/l]
[Ag_d] [mg/l]										
[Al_d] [mg/l]										
[Alk][mg/l]										
[As_d] [mg/l]										
[Ba_d] [mg/l]										
[Be_d] [mg/l]										
[Ca] [mg/l]										
[Cd_d] [mg/l]										
[Cl] [mg/l]										
[Co_d] [mg/l]										
[Cr_d] [mg/l]										
[Cu_d] [mg/l]										
[F] [mg/l]										
[Fe_d] [mg/l]										
[Hg_d] [mg/l]										
[K] [mg/l]										
[Li_d] [mg/l]										
[Mg] [mg/l]										
[Mn_d] [mg/l]										
[Mo_d] [mg/l]										
[Na] [mg/l]	1									
[NH4] [mg/l]	0.464535238	1								
[Ni_d] [mg/l]	0.59190326	0.132675554	1							
[NO3] [mg/l]	0.615516812	0.858858814	0.329382045	1						
[Pb_d] [mg/l]	-0.017120502	-0.091422302	0.171080966	-0.120547186	1					
[PO4] [mg/l]	0.352777859	0.147216113	0.03861411	0.006508308	0.057112315	1				
[Sb_d] [mg/l]	0.280771656	-0.003473555	0.098287653	0.002764542	0.003746115	0.409555257	1			
[Se_d] [mg/l]	0.192414132	0.062338378	0.041890265	0.096676152	0.120326733	0.249519106	0.363068711	1		
[Silica] [mg/l]	0.544830832	0.508530283	0.78808566	0.501984915	0.238565064	0.546594768	0.621428739	0.58826269	1	
[SO4] [mg/l]	0.5470368	0.122644307	0.957838321	0.324003527	-0.037483492	-0.041876108	0.084405737	0.02063693	-0.117723375	1
[Sr_d] [mg/l]	0.789510325	0.638003189	0.755221001	0.821507241	0.02846042	0.18618578	0.14365673	0.123071953	0.718609013	0.707858302
[TDS] [mg/l]	**0.780490084**	**0.584198594**	**0.816034886**	**0.791726311**	**-0.022071193**	**0.069142635**	**0.114739703**	**0.093419984**	**0.584684373**	**0.809303737**
[TKN] [mg/l]	0.616742492	0.842430922	0.241296665	0.865669052	0.119029982	0.22658053	0.091445519	0.15157863	0.604069126	0.181062533
[Tl_d] [mg/l]	0.240826532	0.179856425	0.027961644	0.204113144	0.060716259	0.296242857	0.601396601	0.418060552	0.719824646	-0.019998202
[Total_P] [mg/l]	0.184070717	0.05944678	0.122628822	0.042023198	0.371458114	0.513351968	0.234496688	0.087773762	0.728753469	0.013423395
[TSS] [mg/l]	0.240517368	0.151517477	0.08376334	0.191838861	0.214891237	0.403524585	0.155938817	0.081656199	0.800537967	-0.045460166
[U_d] [mg/l]	0.021779271	-0.087913545	0.368679945	-0.067021956	0.807094194	0.06607443	-0.04268183	0.155212881	0.528779879	0.216667296
[V_d] [mg/l]	0.347467501	-0.021071913	0.179892477	-0.071227788	0.523066736	0.64314001	0.163188502	0.052158305	0.590879156	-0.03243954
[Zn_d] [mg/l]	0.277466607	0.357908084	0.296072477	0.290281996	0.178069112	0.420695315	0.337688048	0.145704918	0.747983722	0.23060062

Table III-3 SNP 02-4 Correlation Matrix (Airstrip/Roads)

	[Sr_d] [mg/l]	***[TDS] [mg/l]***	*[TKN] [mg/l]*	*[Tl_d] [mg/l]*	*[Total_P] [mg/l]*	*[TSS] [mg/l]*	*[U_d] [mg/l]*	*[V_d] [mg/l]*	*[Zn_d] [mg/l]*
[Ag_d] [mg/l]									
[Al_d] [mg/l]									
[Alk][mg/l]									
[As_d] [mg/l]									
[Ba_d] [mg/l]									
[Be_d] [mg/l]									
[Ca] [mg/l]									
[Cd_d] [mg/l]									
[Cl] [mg/l]									
[Co_d] [mg/l]									
[Cr_d] [mg/l]									
[Cu_d] [mg/l]									
[F] [mg/l]									
[Fe_d] [mg/l]									
[Hg_d] [mg/l]									
[K] [mg/l]									
[Li_d] [mg/l]									
[Mg] [mg/l]									
[Mn_d] [mg/l]									
[Mo_d] [mg/l]									
[Na] [mg/l]									
[NH4] [mg/l]									
[Ni_d] [mg/l]									
[NO3] [mg/l]									
[Pb_d] [mg/l]									
[PO4] [mg/l]									
[Sb_d] [mg/l]									
[Se_d] [mg/l]									
[Silica] [mg/l]									
[SO4] [mg/l]									
[Sr_d] [mg/l]	1								
[TDS] [mg/l]	**0.972578136**	**1**							
[TKN] [mg/l]	0.740174788	**0.663356325**	1						
[Tl_d] [mg/l]	0.220582041	**0.152876543**	0.283125891	1					
[Total_P] [mg/l]	0.211131183	**0.115562216**	0.314397047	0.113180422	1				
[TSS] [mg/l]	0.255482463	**0.138350002**	0.310877053	0.141825684	0.720393489	1			
[U_d] [mg/l]	0.185076989	**0.157364039**	0.140158786	0.026288005	0.432162932	0.22799811	1		
[V_d] [mg/l]	0.175752762	**0.050266538**	0.194785863	0.035856885	0.530697482	0.473536713	0.419169443	1	
[Zn_d] [mg/l]	0.411549064	**0.354122539**	0.32803078	0.338990177	0.239918184	0.227355156	0.068667753	0.304969129	1

	[Ag_d] [ug/l]	*[Al_d] [ug/l]*	*[Alk][mg/l]*	*[As_d] [ug/l]*	*[Ba_d] [ug/l]*	*[Be_d] [ug/l]*	*[Ca] [mg/l]*	*[Cd_d] [ug/l]*	*[Cl] [mg/l]*	*[Co_d] [ug/l]*
[Ag_d] [ug/l]	1									
[Al_d] [ug/l]	-0.096424774	1								
[Alk][mg/l]	-0.099062527	-0.554328083	1							
[As_d] [ug/l]	0.087022518	-0.091123608	0.594824303	1						
[Ba_d] [ug/l]	0.176470529	-0.488787665	0.423371033	-0.056325574	1					
[Be_d] [ug/l]	0.989676659	-0.083900469	-0.079745566	0.172618275	0.153105915	1				
[Ca] [mg/l]	0.206599062	-0.497488034	0.386873536	-0.070915236	0.957815496	0.179793335	1			
[Cd_d] [ug/l]	-0.189673048	-0.081682557	0.122921495	-0.020061	0.381519724	-0.185884504	0.336160574	1		
[Cl] [mg/l]	0.202217781	-0.419176195	0.336272097	0.008685937	0.788601449	0.090493848	0.610440409	0.128833175	1	
[Co_d] [ug/l]	-0.083385518	0.134544412	0.212446116	0.325428909	0.356713967	-0.063193366	0.322484066	0.482003985	0.268557321	1
[Cr_d] [ug/l]	0.038224859	0.302565706	-0.089517409	-0.046146461	0.005012026	0.037844154	-0.007895183	-0.007381014	0.22208397	0.113342396
[Cu_d] [ug/l]	-0.224862893	0.575220018	-0.232747536	0.123782183	-0.241976587	-0.200191777	-0.203603232	0.246691289	-0.332678253	0.440623547
[F] [mg/l]	0.105411396	-0.522765102	0.496755608	0.024850602	0.670690748	0.070942384	0.643105525	0.416123158	0.525341691	0.237391368
[Fe_d] [ug/l]	-0.315499886	0.133236619	0.534802498	0.655202121	-0.081352464	-0.261503114	-0.134674496	-0.054107191	-0.016475329	0.495400999
[Hg_d] [ug/l]	-8.19218E-18	2.75675E-16	1.55829E-16	-2.4413E-16	-1.58703E-16	1.27953E-16	-1.98072E-16	-2.89589E-16	-1.36037E-17	3.47217E-16
[K] [mg/l]	0.163594508	-0.488594507	0.506853295	0.010170371	0.936873336	0.133065881	0.953974165	0.36003216	0.666890026	0.364786947
[Li_d] [ug/l]	0.082927783	0.055279133	0.034001247	-0.194455874	0.598706952	0.035332064	0.601741956	0.06709826	0.513142917	0.291239467
[Mg] [mg/l]	0.174609645	-0.539001951	0.400181122	-0.076399302	0.957147506	0.144765984	0.988933552	0.331087637	0.644407014	0.306668469
[Mn_d] [ug/l]	-0.275186569	-0.075001769	0.636101934	0.71389692	0.091064627	-0.235110074	0.035143446	0.078265482	0.116532296	0.590228825
[Mo_d] [ug/l]	0.151691885	-0.560814245	0.409372579	-0.082371457	0.702297451	0.127354454	0.771041977	0.264583415	0.584008605	0.142677743
[Na] [mg/l]	0.248702236	-0.256393402	0.317243835	-0.05069207	0.871066399	0.231097907	0.868521619	0.306724963	0.694306221	0.369270554
[NH4] [mg/l]	-0.154433103	0.168336303	0.150668583	0.267185149	0.061423205	-0.108485403	0.044660523	0.124130444	0.207330321	0.405885123
[Ni_d] [ug/l]	0.044784227	0.101046836	-0.018499622	0.044942681	0.461285992	0.071989473	0.426664308	0.549993507	0.14974524	0.846138892
[NO3] [mg/l]	0.258282976	-0.137531973	0.055801373	-0.25735751	0.656231181	0.232329758	0.634166731	-0.002600893	0.67285608	0.07265802
[Pb_d] [ug/l]	-0.043008802	0.564080871	-0.251897077	0.197290317	-0.413817564	-0.011703805	-0.451273334	-0.077247642	-0.24726991	0.149326307
[PO4] [mg/l]	-0.145755287	0.209777238	-0.172577183	0.080348858	-0.114375523	-0.124740193	-0.191606069	-0.026591426	-0.117052635	0.013068962
[Sb_d] [ug/l]	0.819200192	-0.077624282	-0.085750471	0.181896078	0.260440692	0.837253953	0.280394674	0.089874652	0.225537069	0.052895019
[Se_d] [ug/l]	0.131063877	-0.263148244	0.097078843	-0.17514715	0.393032234	0.099135184	0.435051322	0.203124741	0.325442602	-0.032730498
[Silica] [mg/l]	0.410092219	-0.359126992	0.704038232	0.377629605	0.744906283	0.43079731	0.72728883	0.209900317	0.725057845	0.559277501
[SO4] [mg/l]	0.202479019	-0.495706762	0.287646295	-0.124807946	0.927244755	0.179285298	0.968812486	0.388170754	0.489589791	0.309383327
[Sr_d] [ug/l]	0.217393214	-0.549860399	0.458067848	-0.047440671	0.967087069	0.190973918	0.975844329	0.352443476	0.792726097	0.327298855
[TDS] [mg/l]	**0.200973267**	**-0.515342832**	**0.393221996**	**-0.068957439**	**0.96517076**	**0.17302683**	**0.995052697**	**0.326248668**	**0.650630416**	**0.300298434**
[TKN] [mg/l]	0.000221278	0.3704043	0.006253278	0.167962146	-0.055436611	0.005974689	-0.056858034	-0.09629723	0.058475858	0.180510725
[Tl_d] [ug/l]	0.921421073	-0.139026689	0.045112826	0.213291525	0.211242445	0.941541074	0.239483346	0.162637844	0.124037293	0.014718906
[Total_P] [mg/l]	-0.295478122	0.500838241	-0.333980305	0.083203169	-0.500941131	-0.249605059	-0.570046935	-0.04885441	-0.368455691	0.064616588
[TSS] [mg/l]	-0.06026578	0.123189178	-0.234568648	-0.140628505	-0.20898688	-0.092607142	-0.251928254	0.054463609	-0.02868696	-0.05627326
[U_d] [ug/l]	0.239193662	-0.10659334	0.189477632	0.017843001	0.221709095	0.210385575	0.29000499	-0.003824414	-0.038845831	-0.020991539
[V_d] [ug/l]	0.130184241	0.486956769	-0.024203515	0.205392404	0.133896121	0.179276985	0.107316285	-0.044899877	0.211840869	0.418004045
[Zn_d] [ug/l]	0.054826285	0.205877467	-0.166480424	-0.005313616	0.353919278	0.042854771	0.336697035	0.51705969	0.310995066	0.792727292

Correlation Legend:

	0.5 to 0.7
	=>0.7
	-0.5 to -0.7
	=< -0.7

Notes:

All matrices were calculated using half-detection limits.

	[Cr_d] [ug/l]	*[Cu_d] [ug/l]*	*[F] [mg/l]*	*[Fe_d] [ug/l]*	*[Hg_d] [ug/l]*	*[K] [mg/l]*	*[Li_d] [ug/l]*	*[Mg] [mg/l]*	*[Mn_d] [ug/l]*	*[Mo_d] [ug/l]*
[Ag_d] [ug/l]										
[Al_d] [ug/l]										
[Alk][mg/l]										
[As_d] [ug/l]										
[Ba_d] [ug/l]										
[Be_d] [ug/l]										
[Ca] [mg/l]										
[Cd_d] [ug/l]										
[Cl] [mg/l]										
[Co_d] [ug/l]										
[Cr_d] [ug/l]	1									
[Cu_d] [ug/l]	0.064771106	1								
[F] [mg/l]	0.007420312	-0.223279668	1							
[Fe_d] [ug/l]	0.083857676	0.152140201	-0.049068214	1						
[Hg_d] [ug/l]	-6.63769E-17	-4.48581E-16	-1.56876E-16	-2.41553E-16	1					
[K] [mg/l]	0.07205083	-0.173489491	0.692859708	-0.024471242	2.53582E-16	1				
[Li_d] [ug/l]	-0.001104434	0.019678696	0.339203309	-0.112410085	1.12428E-15	0.531232943	1			
[Mg] [mg/l]	0.004484274	-0.259603826	0.673438759	-0.133719105	1.03448E-15	0.94837318	0.574316528	1		
[Mn_d] [ug/l]	-0.004591651	0.072415745	0.126462136	0.881251302	-5.02201E-18	0.128703887	-0.020039122	0.038397291	1	
[Mo_d] [ug/l]	0.055834597	-0.403695761	0.760624593	-0.132384832	1.3766E-16	0.771404965	0.293235202	0.785930494	0.044750496	1
[Na] [mg/l]	0.209525349	-0.168619911	0.548805838	-0.053707663	1.04785E-16	0.876545413	0.64824689	0.846439831	0.045035898	0.694291283
[NH4] [mg/l]	0.154914906	0.192993482	-0.047929922	0.394144426	-3.82108E-17	0.119068746	-0.150803791	0.032712444	0.365262288	-0.095821208
[Ni_d] [ug/l]	0.017100442	0.456096595	0.242672513	0.063760255	7.12902E-17	0.419848202	0.464882997	0.395788856	0.209594637	0.157710054
[NO3] [mg/l]	0.352006476	-0.340315915	0.462404803	-0.220005774	-2.06883E-16	0.650002344	0.584257659	0.639939126	-0.164165376	0.623562343
[Pb_d] [ug/l]	0.117537507	0.398170502	-0.447171776	0.319677893	-8.57376E-16	-0.376983281	-0.111492508	-0.476749598	0.134380442	-0.577053696
[PO4] [mg/l]	0.003413964	0.086032211	-0.23940589	-0.012281874	4.0132E-16	-0.199371456	0.064304087	-0.187840682	0.021160538	-0.198885869
[Sb_d] [ug/l]	0.197795488	-0.147164443	0.155400854	-0.260844387	-7.19323E-17	0.232746749	0.09557643	0.244077522	-0.204084011	0.196764691
[Se_d] [ug/l]	0.064661957	-0.292472868	0.409198909	-0.227814692	3.69969E-16	0.432390127	0.150912546	0.455074478	-0.126152898	0.58098586
[Silica] [mg/l]	0.241869402	-0.32762259	0.875933775	0.448727772	#DIV/0!	0.789710599	0.326341983	0.752362884	0.499063898	0.73052103
[SO4] [mg/l]	-0.072055501	-0.141327799	0.582226183	-0.216705586	5.87056E-16	0.888016818	0.559248733	0.956825242	-0.046711716	0.717052882
[Sr_d] [ug/l]	0.025789268	-0.293560267	0.710585604	-0.110281978	3.17917E-16	0.951012261	0.588708963	0.975911383	0.072606133	0.803811666
[TDS] [mg/l]	**0.022853948**	**-0.244890415**	**0.656084127**	**-0.135421266**	**-2.87289E-16**	**0.952974037**	**0.593180873**	**0.992577953**	**0.030073403**	**0.780480149**
[TKN] [mg/l]	0.01929661	0.298044917	-0.16478667	0.252518487	-8.08231E-16	0.01109725	0.049257425	-0.106166624	0.203210207	-0.202007427
[Tl_d] [ug/l]	0.037759565	-0.120347399	0.243998012	-0.162447257	2.60337E-15	0.210351418	0.020435565	0.211380808	-0.144586635	0.171721734
[Total_P] [mg/l]	0.057829266	0.292029758	-0.428587201	0.195321725	6.74963E-16	-0.523536098	-0.265366675	-0.561311944	0.107024597	-0.524048995
[TSS] [mg/l]	0.005513584	-0.082740633	-0.174201113	-0.026359505	1.28543E-16	-0.233309796	-0.219843776	-0.215105975	-0.062458462	-0.188590914
[U_d] [ug/l]	-0.214418692	-0.071692025	0.05661621	-0.006157216	4.76915E-16	0.258766181	0.327450158	0.212581021	0.06207915	0.159186012
[V_d] [ug/l]	0.320312032	0.224774532	-0.081277515	0.346463236	-5.97078E-16	0.087597921	0.338798546	0.073281158	0.240034077	-0.055685815
[Zn_d] [ug/l]	0.200313022	0.456330566	0.169694136	-0.026667868	2.21525E-17	0.324277095	0.396420601	0.323802426	0.106085157	0.1542182

Table III-4 SNP 02-05 Correlation Matrix (Developed Areas)

	[Na] [mg/l]	*[NH4] [mg/l]*	*[Ni_d] [ug/l]*	*[NO3] [mg/l]*	*[Pb_d] [ug/l]*	*[PO4] [mg/l]*	*[Sb_d] [ug/l]*	*[Se_d] [ug/l]*	*[Silica] [mg/l]*	*[SO4] [mg/l]*
[Ag_d] [ug/l]										
[Al_d] [ug/l]										
[Alk][mg/l]										
[As_d] [ug/l]										
[Ba_d] [ug/l]										
[Be_d] [ug/l]										
[Ca] [mg/l]										
[Cd_d] [ug/l]										
[Cl] [mg/l]										
[Co_d] [ug/l]										
[Cr_d] [ug/l]										
[Cu_d] [ug/l]										
[F] [mg/l]										
[Fe_d] [ug/l]										
[Hg_d] [ug/l]										
[K] [mg/l]										
[Li_d] [ug/l]										
[Mg] [mg/l]										
[Mn_d] [ug/l]										
[Mo_d] [ug/l]										
[Na] [mg/l]	1									
[NH4] [mg/l]	0.258142277	1								
[Ni_d] [ug/l]	0.393407408	0.124736535	1							
[NO3] [mg/l]	0.795471851	0.215583114	0.129046052	1						
[Pb_d] [ug/l]	-0.240900436	0.269418499	0.025622012	-0.238042533	1					
[PO4] [mg/l]	-0.136190602	-0.026106939	0.027384557	-0.130588332	0.186779675	1				
[Sb_d] [ug/l]	0.342815988	0.027089076	0.198795377	0.305009822	0.032221168	0.009851684	1			
[Se_d] [ug/l]	0.401016976	-0.081522688	0.049698385	0.393779822	-0.340388299	-0.050131651	0.249028707	1		
[Silica] [mg/l]	0.611067806	0.519399566	0.398228927	0.361206475	-0.153681087	-0.467255858	-0.050391329	0.505507124	1	
[SO4] [mg/l]	0.765053678	-0.040439123	0.478265816	0.489659476	-0.473681066	-0.163752449	0.280100268	0.414506082	0.638559227	1
[Sr_d] [ug/l]	0.883331226	-0.014807493	0.432722359	0.684065455	-0.476686188	-0.170168078	0.289376877	0.438176376	0.763507033	0.93909109
[TDS] [mg/l]	**0.874354783**	**0.060159556**	**0.395598234**	**0.666001426**	**-0.465769184**	**-0.187616851**	**0.27314069**	**0.447715911**	**0.738583935**	**0.961734921**
[TKN] [mg/l]	0.126072411	0.581627402	0.070735881	0.159574156	0.37624555	0.075237827	0.011909321	-0.190685078	0.525010712	-0.110243959
[Tl_d] [ug/l]	0.25588474	-0.075297406	0.116281138	0.182679568	-0.007396058	-0.17690189	0.812237968	0.141622659	0.752077989	0.249076837
[Total_P] [mg/l]	-0.474511997	0.241327991	-0.008085713	-0.313181511	0.413170066	0.291025197	-0.22348955	-0.258386373	-0.69438102	-0.548157364
[TSS] [mg/l]	-0.219517678	0.273271233	-0.136237169	-0.069244014	0.225315295	0.037904773	-0.053788018	0.06909866	-0.722446556	-0.239995686
[U_d] [ug/l]	0.203954568	-0.285898988	0.060906538	-0.054280253	0.05158782	-0.02078605	0.164106132	0.036161295	0.751423606	0.324223734
[V_d] [ug/l]	0.415750028	0.395031648	0.247570902	0.33964328	0.327034974	0.005263411	0.156067184	-0.106635936	0.337637274	0.023603372
[Zn_d] [ug/l]	0.396268298	0.230054982	0.896957014	0.241615617	0.072914446	0.082587901	0.225485108	0.106879923	0.168949939	0.361974101

Table III-4 SNP 02-05 Correlation Matrix (Developed Areas)

	[Sr_d] [ug/l]	***[TDS] [mg/l]***	*[TKN] [mg/l]*	*[Tl_d] [ug/l]*	*[Total_P] [mg/l]*	*[TSS] [mg/l]*	*[U_d] [ug/l]*	*[V_d] [ug/l]*	*[Zn_d] [ug/l]*
[Ag_d] [ug/l]									
[Al_d] [ug/l]									
[Alk][mg/l]									
[As_d] [ug/l]									
[Ba_d] [ug/l]									
[Be_d] [ug/l]									
[Ca] [mg/l]									
[Cd_d] [ug/l]									
[Cl] [mg/l]									
[Co_d] [ug/l]									
[Cr_d] [ug/l]									
[Cu_d] [ug/l]									
[F] [mg/l]									
[Fe_d] [ug/l]									
[Hg_d] [ug/l]									
[K] [mg/l]									
[Li_d] [ug/l]									
[Mg] [mg/l]									
[Mn_d] [ug/l]									
[Mo_d] [ug/l]									
[Na] [mg/l]									
[NH4] [mg/l]									
[Ni_d] [ug/l]									
[NO3] [mg/l]									
[Pb_d] [ug/l]									
[PO4] [mg/l]									
[Sb_d] [ug/l]									
[Se_d] [ug/l]									
[Silica] [mg/l]									
[SO4] [mg/l]									
[Sr_d] [ug/l]	1								
[TDS] [mg/l]	**0.982733404**	**1**							
[TKN] [mg/l]	-0.143949709	**-0.053569884**	1						
[Tl_d] [ug/l]	0.242980345	**0.235712403**	-0.014628938	1					
[Total_P] [mg/l]	-0.594261552	**-0.564363543**	0.291387755	-0.303068172	1				
[TSS] [mg/l]	-0.255784188	**-0.230057028**	0.183899442	-0.164347515	0.579855111	1			
[U_d] [ug/l]	0.244547117	**0.247988786**	0.201230804	0.222447973	-0.302782286	-0.23921555	1		
[V_d] [ug/l]	0.078489016	**0.111763573**	0.398900307	0.143121174	0.131971292	-0.01839517	0.007586252	1	
[Zn_d] [ug/l]	0.350325218	**0.322581167**	0.057473592	0.052589651	4.55925E-05	-0.040117517	-0.142238034	0.307870624	1

Table III-5 SNP 02-17 Correlation Matrix (Water Treatment Plant)

	[Ag_d] [ug/l]	[Al_d] [ug/l]	[Alk][mg/l]	[As_d] [ug/l]	[Ba_d] [ug/l]	[Be_d] [ug/l]	[Ca] [mg/l]	[Cd_d] [ug/l]	[Cl] [mg/l]	[Co_d] [ug/l]
[Ag_d] [ug/l]	1.00									
[Al_d] [ug/l]	-0.03	1.00								
[Alk][mg/l]	-0.13	-0.02	1.00							
[As_d] [ug/l]	0.24	0.09	-0.24	1.00						
[Ba_d] [ug/l]	0.16	0.09	0.28	0.21	1.00					
[Be_d] [ug/l]	0.49	0.15	-0.15	0.33	0.00	1.00				
[Ca] [mg/l]	0.08	0.06	-0.30	0.17	0.17	0.06	1.00			
[Cd_d] [ug/l]	0.04	0.02	0.06	0.14	0.38	-0.05	0.10	1.00		
[Cl] [mg/l]	0.11	0.04	-0.31	0.20	0.22	0.08	0.97	0.13	1.00	
[Co_d] [ug/l]	-0.03	0.22	0.31	0.23	0.53	0.02	-0.15	0.31	-0.14	1.00
[Cr_d] [ug/l]	0.04	-0.02	-0.29	0.21	-0.07	0.07	0.25	0.00	0.26	-0.05
[Cu_d] [ug/l]	0.17	-0.09	0.11	-0.06	0.17	-0.04	-0.12	0.19	-0.12	0.00
[F] [mg/l]	0.40	-0.07	-0.22	0.36	0.37	0.24	0.57	0.19	0.62	-0.09
[Fe_d] [ug/l]	0.01	-0.02	-0.02	0.09	0.07	-0.01	-0.04	0.01	-0.04	0.08
[Hg_d] [ug/l]	0.26	-0.11	0.14	0.04	0.13	0.32	-0.16	0.02	-0.08	-0.08
[K] [mg/l]	-0.09	0.11	0.25	-0.14	0.87	-0.05	-0.04	0.30	-0.03	0.61
[Li_d] [ug/l]	0.13	0.04	-0.21	0.16	0.25	0.11	0.86	0.15	0.88	0.04
[Mg] [mg/l]	0.02	0.05	0.29	-0.10	0.92	0.01	0.21	0.32	0.24	0.53
[Mn_d] [ug/l]	-0.20	0.21	0.51	-0.10	0.40	-0.17	-0.18	0.20	-0.24	0.72
[Mo_d] [ug/l]	0.24	0.07	0.22	0.07	0.79	0.01	-0.19	0.24	-0.15	0.39
[Na] [mg/l]	0.16	0.04	-0.30	0.25	0.35	0.14	0.97	0.19	0.97	-0.04
[NH4] [mg/l]	0.18	0.00	-0.03	-0.08	0.35	0.02	-0.07	-0.04	-0.07	0.05
[Ni_d] [ug/l]	0.02	0.06	0.54	-0.02	0.73	-0.08	-0.17	0.26	-0.17	0.51
[NO3] [mg/l]	-0.08	0.11	0.15	-0.25	0.65	-0.05	-0.16	0.20	-0.16	0.57
[Pb_d] [ug/l]	0.20	0.03	-0.04	0.08	0.10	0.36	0.08	-0.04	0.09	0.09
[PO4] [mg/l]	0.07	0.01	-0.11	0.16	0.02	0.03	0.34	0.01	0.24	-0.02
[Sb_d] [ug/l]	0.41	0.11	0.12	0.07	0.33	0.59	-0.01	0.20	0.01	0.21
[Se_d] [ug/l]	0.12	-0.08	-0.36	0.09	0.18	0.01	0.31	0.02	0.36	0.02
[Silica] [mg/l]	0.24	0.09	-0.46	0.31	-0.03	0.18	0.61	0.02	0.62	-0.31
[SO4] [mg/l]	-0.02	0.09	-0.06	-0.01	0.73	0.02	0.46	0.26	0.43	0.43
[Sr_d] [ug/l]	0.08	0.06	-0.25	0.18	0.07	0.12	0.91	0.09	0.91	-0.03
[TDS] [mg/l]	**0.13**	**0.04**	**-0.21**	**0.18**	**0.45**	**0.11**	**0.94**	**0.20**	**0.95**	**0.04**
[TKN] [mg/l]	0.05	0.00	0.01	-0.06	0.31	0.01	-0.04	-0.02	-0.04	0.09
[Tl_d] [ug/l]	0.23	0.10	-0.03	0.13	0.21	0.41	0.10	0.05	0.09	0.20
[Total_P] [mg/l]	0.15	0.03	-0.01	0.12	0.02	0.10	0.00	-0.03	0.02	-0.01
[TSS] [mg/l]	-0.05	0.06	0.01	-0.01	-0.04	0.06	-0.05	-0.04	-0.05	-0.01
[U_d] [ug/l]	0.04	0.17	0.52	0.02	0.52	0.00	0.17	0.16	0.15	0.26
[V_d] [ug/l]	0.10	-0.01	-0.44	0.38	0.04	0.34	0.12	-0.01	0.15	0.14
[Zn_d] [ug/l]	-0.01	0.20	0.09	0.33	0.40	-0.01	0.00	0.28	-0.02	0.83

Correlation Legend:

- 0.5 to 0.7
- =>0.7
- -0.5 to -0.7
- =< -0.7

Notes:

All matrices were calculated using half-detection limits.

Table III-5 SNP 02-17 Correlation Matrix (Water Treatment Plant)

	[Cr_d] [ug/l]	*[Cu_d] [ug/l]*	*[F] [mg/l]*	*[Fe_d] [ug/l]*	*[Hg_d] [ug/l]*	*[K] [mg/l]*	*[Li_d] [ug/l]*	*[Mg] [mg/l]*	*[Mn_d] [ug/l]*	*[Mo_d] [ug/l]*
[Ag_d] [ug/l]										
[Al_d] [ug/l]										
[Alk][mg/l]										
[As_d] [ug/l]										
[Ba_d] [ug/l]										
[Be_d] [ug/l]										
[Ca] [mg/l]										
[Cd_d] [ug/l]										
[Cl] [mg/l]										
[Co_d] [ug/l]										
[Cr_d] [ug/l]	1.00									
[Cu_d] [ug/l]	-0.09	1.00								
[F] [mg/l]	0.20	0.05	1.00							
[Fe_d] [ug/l]	-0.04	0.01	0.00	1.00						
[Hg_d] [ug/l]	0.00	0.03	0.48	0.01	1.00					
[K] [mg/l]	-0.11	0.00	0.12	-0.02	-0.09	1.00				
[Li_d] [ug/l]	0.27	-0.04	0.58	-0.03	0.04	-0.04	1.00			
[Mg] [mg/l]	-0.10	0.10	0.43	-0.06	0.12	0.87	0.23	1.00		
[Mn_d] [ug/l]	-0.18	0.00	-0.39	0.09	-0.21	0.54	-0.16	0.39	1.00	
[Mo_d] [ug/l]	-0.12	0.20	0.17	0.03	0.12	0.86	-0.04	0.76	0.32	1.00
[Na] [mg/l]	0.26	-0.16	0.62	-0.09	-0.10	0.12	0.88	0.36	-0.30	-0.04
[NH4] [mg/l]	-0.10	0.05	0.17	-0.03	0.05	0.49	-0.14	0.41	0.12	0.67
[Ni_d] [ug/l]	-0.15	0.16	-0.07	0.05	-0.10	0.82	-0.13	0.72	0.59	0.71
[NO3] [mg/l]	-0.18	0.02	0.05	-0.03	0.00	0.87	-0.19	0.72	0.49	0.86
[Pb_d] [ug/l]	0.00	0.12	0.10	-0.01	0.13	0.03	0.07	0.08	-0.07	0.12
[PO4] [mg/l]	0.11	0.00	0.29	0.00	0.01	-0.16	0.21	-0.04	-0.13	-0.01
[Sb_d] [ug/l]	-0.11	0.14	0.17	-0.09	0.21	0.37	0.08	0.40	0.12	0.36
[Se_d] [ug/l]	0.01	0.16	0.50	0.02	0.00	-0.07	0.15	0.07	-0.14	0.19
[Silica] [mg/l]	0.39	-0.19	0.54	-0.13	0.17	-0.16	0.68	-0.02	-0.54	-0.28
[SO4] [mg/l]	0.01	-0.09	0.31	-0.07	-0.21	0.63	0.38	0.63	0.28	0.52
[Sr_d] [ug/l]	0.26	-0.09	0.47	-0.03	-0.04	-0.16	0.85	0.11	-0.15	-0.21
[TDS] [mg/l]	**0.21**	**-0.14**	**0.62**	**-0.10**	**-0.06**	**0.24**	**0.85**	**0.47**	**-0.20**	**0.09**
[TKN] [mg/l]	-0.09	0.01	0.17	-0.02	0.01	0.45	-0.11	0.39	0.15	0.58
[Tl_d] [ug/l]	0.04	0.03	0.14	0.00	-0.01	0.15	0.13	0.14	-0.01	0.23
[Total_P] [mg/l]	-0.03	0.03	0.07	0.00	0.01	-0.04	-0.04	-0.02	-0.08	0.06
[TSS] [mg/l]	-0.03	-0.04	-0.03	-0.01	-0.04	-0.02	-0.09	-0.03	0.02	0.01
[U_d] [ug/l]	-0.17	0.09	0.06	0.01	-0.07	0.63	0.10	0.65	0.38	0.49
[V_d] [ug/l]	0.24	-0.07	0.19	0.00	0.14	-0.05	0.13	0.00	-0.21	-0.03
[Zn_d] [ug/l]	-0.06	0.02	0.02	0.19	-0.05	0.16	0.11	0.10	0.75	0.29

Table III-5 SNP 02-17 Correlation Matrix (Water Treatment Plant)

	[Na] [mg/l]	*[NH4] [mg/l]*	*[Ni_d] [ug/l]*	*[NO3] [mg/l]*	*[Pb_d] [ug/l]*	*[PO4] [mg/l]*	*[Sb_d] [ug/l]*	*[Se_d] [ug/l]*	*[Silica] [mg/l]*	*[SO4] [mg/l]*
[Ag_d] [ug/l]										
[Al_d] [ug/l]										
[Alk][mg/l]										
[As_d] [ug/l]										
[Ba_d] [ug/l]										
[Be_d] [ug/l]										
[Ca] [mg/l]										
[Cd_d] [ug/l]										
[Cl] [mg/l]										
[Co_d] [ug/l]										
[Cr_d] [ug/l]										
[Cu_d] [ug/l]										
[F] [mg/l]										
[Fe_d] [ug/l]										
[Hg_d] [ug/l]										
[K] [mg/l]										
[Li_d] [ug/l]										
[Mg] [mg/l]										
[Mn_d] [ug/l]										
[Mo_d] [ug/l]										
[Na] [mg/l]	1.00									
[NH4] [mg/l]	-0.05	1.00								
[Ni_d] [ug/l]	-0.07	0.41	1.00							
[NO3] [mg/l]	-0.03	0.69	0.73	1.00						
[Pb_d] [ug/l]	0.08	0.20	0.06	0.09	1.00					
[PO4] [mg/l]	0.35	-0.04	-0.03	-0.22	-0.03	1.00				
[Sb_d] [ug/l]	0.07	0.25	0.25	0.38	0.34	0.08	1.00			
[Se_d] [ug/l]	0.45	-0.07	0.11	-0.12	0.17	0.13	0.19	1.00		
[Silica] [mg/l]	0.61	-0.07	-0.43	-0.23	-0.01	0.29	-0.09	0.33	1.00	
[SO4] [mg/l]	0.53	0.42	0.57	0.59	0.08	-0.06	0.32	0.14	0.30	1.00
[Sr_d] [ug/l]	0.88	-0.19	-0.26	-0.28	0.06	0.22	0.03	0.04	0.61	0.33
[TDS] [mg/l]	**0.98**	**0.05**	**0.06**	**0.10**	**0.09**	**0.30**	**0.13**	**0.41**	**0.58**	**0.64**
[TKN] [mg/l]	-0.01	0.82	0.44	0.63	0.12	-0.05	0.20	-0.03	-0.06	0.40
[Tl_d] [ug/l]	0.12	0.12	0.17	0.13	0.39	0.20	0.27	0.13	0.10	0.10
[Total_P] [mg/l]	0.01	0.02	0.00	-0.05	-0.02	0.16	0.06	0.00	0.04	-0.06
[TSS] [mg/l]	-0.06	0.02	0.00	-0.01	-0.02	0.01	-0.01	-0.09	0.00	-0.04
[U_d] [ug/l]	0.21	0.30	0.66	0.56	0.08	0.00	0.24	0.03	-0.20	0.64
[V_d] [ug/l]	0.27	-0.08	-0.09	-0.22	0.39	0.08	0.04	0.05	0.52	0.08
[Zn_d] [ug/l]	-0.05	-0.05	0.31	0.09	-0.01	0.02	0.12	0.01	-0.22	0.06

Table III-5 SNP 02-17 Correlation Matrix (Water Treatment Plant)

	[Sr_d] [ug/l]	***[TDS] [mg/l]***	*[TKN] [mg/l]*	*[Tl_d] [ug/l]*	*[Total_P] [mg/l]*	*[TSS] [mg/l]*	*[U_d] [ug/l]*	*[V_d] [ug/l]*	*[Zn_d] [ug/l]*
[Ag_d] [ug/l]									
[Al_d] [ug/l]									
[Alk][mg/l]									
[As_d] [ug/l]									
[Ba_d] [ug/l]									
[Be_d] [ug/l]									
[Ca] [mg/l]									
[Cd_d] [ug/l]									
[Cl] [mg/l]									
[Co_d] [ug/l]									
[Cr_d] [ug/l]									
[Cu_d] [ug/l]									
[F] [mg/l]									
[Fe_d] [ug/l]									
[Hg_d] [ug/l]									
[K] [mg/l]									
[Li_d] [ug/l]									
[Mg] [mg/l]									
[Mn_d] [ug/l]									
[Mo_d] [ug/l]									
[Na] [mg/l]									
[NH4] [mg/l]									
[Ni_d] [ug/l]									
[NO3] [mg/l]									
[Pb_d] [ug/l]									
[PO4] [mg/l]									
[Sb_d] [ug/l]									
[Se_d] [ug/l]									
[Silica] [mg/l]									
[SO4] [mg/l]									
[Sr_d] [ug/l]	1.00								
[TDS] [mg/l]	**0.85**	**1.00**							
[TKN] [mg/l]	-0.15	**0.08**	1.00						
[Tl_d] [ug/l]	0.11	**0.11**	0.07	1.00					
[Total_P] [mg/l]	-0.04	**0.00**	0.01	0.05	1.00				
[TSS] [mg/l]	-0.08	**-0.06**	0.01	-0.01	0.89	1.00			
[U_d] [ug/l]	0.05	**0.33**	0.35	0.11	0.09	0.13	1.00		
[V_d] [ug/l]	0.13	**0.22**	-0.06	0.51	0.04	-0.01	-0.15	1.00	
[Zn_d] [ug/l]	0.05	**-0.03**	-0.03	0.09	-0.01	-0.01	0.18	-0.05	1

Table III-6 Streams 1 27 Correlation Matrix (Undeveloped Areas)

	[Ag_d] [ug/l]	*[Al_d] [ug/l]*	*[Alk][mg/l]*	*[As_d] [ug/l]*	*[Ba_d] [ug/l]*	*[Be_d] [ug/l]*	*[Ca] [mg/l]*	*[Cd_d] [ug/l]*	*[Cl] [mg/l]*	*[Co_d] [ug/l]*
[Ag_d] [ug/l]	1									
[Al_d] [ug/l]	-0.260426785	1								
[Alk][mg/l]	0.035577431	-0.027760144	1							
[As_d] [ug/l]	-0.088067139	0.633897287	0.022828195	1						
[Ba_d] [ug/l]	0.276157476	0.741657827	0.560117169	0.536670658	1					
[Be_d] [ug/l]	0.99148932	-0.13559424	0.02980448	-0.007650642	0.405562116	1				
[Ca] [mg/l]	-0.235713676	0.18152736	0.720504812	0.043722995	0.63991951	-0.244353996	1			
[Cd_d] [ug/l]	0.557086144	-0.349801237	0.144768301	-0.085220753	-0.245175527	0.548094164	0.067914953	1		
[Cl] [mg/l]	-0.267519648	0.210411622	0.017650508	0.149230612	0.106957642	-0.266656518	0.144783685	-0.248100597	1	
[Co_d] [ug/l]	0.209226211	0.297125325	0.268730444	0.273064323	0.459826393	0.269244007	0.199576694	0.001762315	0.014589721	1
[Cr_d] [ug/l]	-0.038121649	0.799687347	-0.182254287	0.501077412	0.785915571	0.083705628	-0.034580034	-0.203773609	0.118583761	0.296405365
[Cu_d] [ug/l]	0.112187295	0.167947364	0.39148792	0.234786754	0.313432065	0.135211558	0.392676668	0.452709958	-0.125011657	0.042213336
[F] [mg/l]	0.234436807	-0.313249071	0.423654984	-0.061170936	-0.009943744	0.223590004	0.336771339	0.524710028	-0.091413236	0.252459563
[Fe_d] [ug/l]	-0.635654417	0.300560234	0.108859088	0.313969574	-0.035446564	-0.637511654	0.319495243	-0.073205148	0.105438357	0.334333908
[Hg_d] [ug/l]	-2.05866E-15	4.41016E-16	1.27796E-16	-7.56599E-16	1.12125E-15	-2.08882E-15	-4.23512E-16	-5.3671E-16	4.02959E-17	-6.82595E-17
[K] [mg/l]	-0.635452322	0.701169978	0.062583886	0.327056698	0.461655124	-0.628693399	0.14284263	-0.474615108	0.471113127	0.01709894
[Li_d] [ug/l]	0.31768495	0.688998051	0.23699364	0.528414547	0.970734573	0.431111342	0.349818137	0.157778487	0.214492254	0.444305875
[Mg] [mg/l]	-0.515667475	0.497577938	0.448173121	0.196425943	0.810852872	-0.518062602	0.62415485	-0.156135613	0.235136662	-0.038988964
[Mn_d] [ug/l]	-0.225569475	0.899635366	0.027037532	0.567863506	0.708894687	-0.063982506	0.1737278	-0.317762417	0.181368447	0.443789546
[Mo_d] [ug/l]	0.511988248	-0.150462009	0.224551007	0.028764695	0.155917334	0.482189803	0.229451898	0.519704734	-0.141061434	0.345513663
[Na] [mg/l]	-0.309486214	0.271002367	0.576921751	0.090810461	0.716393624	-0.313713952	0.663998042	-0.013913612	0.221384961	-0.077808479
[NH4] [mg/l]	-0.516593942	0.474994404	0.292025658	0.256773663	0.153072506	-0.483350604	0.404291541	-0.275417578	0.135065705	0.131771895
[Ni_d] [ug/l]	0.327116789	0.688613988	0.022352052	0.483377698	0.934314193	0.497301806	0.243135252	0.036561304	0.0803261	0.54167783
[NO3] [mg/l]	-0.511910075	0.482509358	0.274356128	0.173122791	0.717053133	-0.508266044	0.385707479	-0.371274827	0.264175412	-0.040063407
[Pb_d] [ug/l]	0.51562868	0.41786298	0.207191316	0.224125048	0.620797981	0.568399593	0.096670564	0.364656104	-0.265012923	0.267321588
[PO4] [mg/l]	0.166180738	-0.162085862	-0.028218539	-0.26520738	-0.067827724	0.149515892	-0.154899694	0.063572862	-0.007704126	0.459980569
[Sb_d] [ug/l]	0.396162722	0.577169504	0.299097895	0.45535577	0.898804967	0.508373852	0.272091248	0.07287023	-0.048733644	0.745705743
[Se_d] [ug/l]	0.953285144	-0.480504802	0.048567081	-0.235975388	-0.010519362	0.905152742	-0.227121799	0.546600514	-0.267756312	0.085330053
[Silica] [mg/l]	-0.401638377	0.138831045	-0.174920887	0.201005079	-0.076059914	-0.401638377	-0.237504014	-0.330532116	0.533940265	-0.126028766
[SO4] [mg/l]	-0.444530213	0.306617136	-0.26519852	0.021744688	-0.040448854	-0.443478212	-0.017903179	-0.3101808	0.73068924	-0.131814152
[Sr_d] [ug/l]	0.338546676	0.679774298	0.777782391	0.514856212	0.992768974	0.462174203	0.826551722	0.06823523	0.072392381	0.459599447
[TDS] [mg/l]	**-0.520727201**	**0.415529481**	**0.640261799**	**0.186949334**	**0.729077568**	**-0.521841292**	**0.649194701**	**-0.281677592**	**0.531978804**	**0.072875564**
[TKN] [mg/l]	-0.118968149	0.319523186	0.253810033	0.091002532	0.220810237	-0.092270605	0.281003743	0.041302959	0.026825803	0.053895653
[Tl_d] [ug/l]	0.999688449	-0.269423049	0.02980448	-0.096369892	0.262351995	0.989605259	-0.244353996	0.544116243	-0.266656518	0.203346615
[Total_P] [mg/l]	-0.312296038	0.528775091	0.042633422	0.432727795	0.237317238	-0.266770054	0.025883611	-0.066449015	0.022678215	0.109478242
[TSS] [mg/l]	0.315946853	0.317379268	0.006190101	0.23462721	0.540827775	0.375349471	-0.093113535	0.035669691	-0.078420368	0.232415811
[U_d] [ug/l]	-0.441359226	0.883918566	0.250174648	0.533168007	0.565098097	-0.330268593	0.43518567	-0.226157276	0.223717922	0.186560651
[V_d] [ug/l]	-0.091556109	0.854308796	0.083487374	0.602715298	0.789647085	0.028350502	0.233873701	-0.128600757	0.170012357	0.48097935
[Zn_d] [ug/l]	0.393082156	0.853547123	-0.240567288	0.532541257	0.925172928	0.515101127	-0.175148721	-0.029201647	0.005944343	0.409399369

Correlation Legend:

(orange)	0.5 to 0.7
(red)	=>0.7
(blue)	-0.5 to -0.7
(green)	=< -0.7

Notes:

All matrices were calculated using half-detection limits.

Table III-6 Streams 1 27 Correlation Matrix (Undeveloped Areas)

	[Cr_d] [ug/l]	*[Cu_d] [ug/l]*	*[F] [mg/l]*	*[Fe_d] [ug/l]*	*[Hg_d] [ug/l]*	*[K] [mg/l]*	*[Li_d] [ug/l]*	*[Mg] [mg/l]*	*[Mn_d] [ug/l]*	*[Mo_d] [ug/l]*
[Ag_d] [ug/l]										
[Al_d] [ug/l]										
[Alk][mg/l]										
[As_d] [ug/l]										
[Ba_d] [ug/l]										
[Be_d] [ug/l]										
[Ca] [mg/l]										
[Cd_d] [ug/l]										
[Cl] [mg/l]										
[Co_d] [ug/l]										
[Cr_d] [ug/l]	1									
[Cu_d] [ug/l]	0.278072168	1								
[F] [mg/l]	-0.190056816	0.486486103	1							
[Fe_d] [ug/l]	0.091621193	0.25557577	0.105251203	1						
[Hg_d] [ug/l]	-1.11653E-16	#DIV/0!	-7.13359E-16	-6.58803E-16	1					
[K] [mg/l]	0.502922208	-0.283602547	-0.15241226	0.40042666	-5.2539E-16	1				
[Li_d] [ug/l]	0.779987618	0.301738444	0.120672063	-0.041143041	1.22455E-15	0.458459499	1			
[Mg] [mg/l]	0.204637515	0.06818457	0.011587561	0.347160842	4.0812E-16	0.419343337	0.423722471	1		
[Mn_d] [ug/l]	0.813510893	0.206612743	-0.19744678	0.328259742	1.41635E-16	0.722434198	0.657392173	0.379720479	1	
[Mo_d] [ug/l]	0.024698753	0.683023653	0.389520619	0.059122636	6.0673E-16	-0.432718499	0.189603527	-0.288265186	-0.061919234	1
[Na] [mg/l]	0.029046	0.270804121	0.329995437	0.174587123	1.22141E-16	0.32113534	0.341868965	0.81070379	0.161890226	-0.116524524
[NH4] [mg/l]	0.113920763	-0.153403731	0.029487113	0.404471123	-2.39994E-17	0.419241942	0.062585082	0.625108684	0.302678202	-0.378074186
[Ni_d] [ug/l]	0.78149854	0.34006837	0.087279112	-0.017709837	-4.14964E-17	0.214105989	0.918086457	-0.109784257	0.742554806	0.28520492
[NO3] [mg/l]	0.18206774	-0.195006466	-0.104135118	0.193318573	-1.67843E-17	0.370577287	0.335925975	0.675530029	0.238672494	-0.484039639
[Pb_d] [ug/l]	0.421677496	0.622510079	0.219580263	-0.204336843	-7.88658E-16	-0.215977959	0.586777098	-0.140480973	0.444962004	0.421725282
[PO4] [mg/l]	-0.125941561	-0.153182626	0.088124753	0.060049903	3.37793E-15	-0.178057146	-0.084393571	-0.05696824	-0.062093505	0.17840187
[Sb_d] [ug/l]	0.659010196	0.21521798	0.201754408	0.033907373	2.92927E-16	-0.006091422	0.880714218	0.044622353	0.626491022	0.307222178
[Se_d] [ug/l]	-0.287178735	-0.016763628	0.232394101	-0.658645729	-3.4046E-16	-0.622643978	0.035027325	-0.568914139	-0.432521529	0.460815524
[Silica] [mg/l]	0.182898869	-0.099657723	-0.200148072	0.32181729	#DIV/0!	0.544413075	0.293818275	0.028247863	0.159428006	-0.26950869
[SO4] [mg/l]	0.411036665	-0.093815557	-0.287116667	0.208811276	8.17119E-16	0.565323342	0.210177706	0.083864798	0.365086114	-0.173729341
[Sr_d] [ug/l]	0.763340318	0.360993124	0.281300331	-0.068066098	-8.75272E-16	0.266080031	0.978443151	0.79065426	0.658227859	0.226974717
[TDS] [mg/l]	**0.175959213**	**0.065948375**	**0.099048387**	**0.367838993**	**3.92412E-16**	**0.582687549**	**0.473581996**	**0.705961913**	**0.358625224**	**-0.218873058**
[TKN] [mg/l]	0.23109343	-0.011199536	0.206465566	0.110353903	9.65004E-17	0.189574313	0.174380797	0.31059261	0.256667364	-0.038207181
[Tl_d] [ug/l]	-0.050980984	0.087188943	0.223590004	-0.643298302	2.17349E-17	-0.628693399	0.304022609	-0.518062602	-0.234977575	0.499032679
[Total_P] [mg/l]	0.498281915	0.193576017	0.219402773	0.36069144	1.40419E-16	0.431423855	0.268341631	0.233375179	0.520748338	0.066072857
[TSS] [mg/l]	0.765785504	0.167158457	-0.062136861	-0.146491384	-5.2842E-17	-0.058345843	0.515430059	-0.130445847	0.317018666	0.110412745
[U_d] [ug/l]	0.581279331	0.331362751	-0.157166971	0.386716618	-5.65165E-16	0.584923023	0.486085477	0.713676578	0.780117308	-0.203331686
[V_d] [ug/l]	0.778936045	0.348360122	-0.024508796	0.345269969	-8.70019E-16	0.426607335	0.740819049	0.543238543	0.840158006	0.12446123
[Zn_d] [ug/l]	0.909579385	0.328219189	-0.039750329	-0.131661931	#DIV/0!	0.383009836	0.914536842	0.092255947	0.901903385	0.187527057

Table III-6 Streams 1 27 Correlation Matrix (Undeveloped Areas)

	[Na] [mg/l]	*[NH4] [mg/l]*	*[Ni_d] [ug/l]*	*[NO3] [mg/l]*	*[Pb_d] [ug/l]*	*[PO4] [mg/l]*	*[Sb_d] [ug/l]*	*[Se_d] [ug/l]*	*[Silica] [mg/l]*	*[SO4] [mg/l]*
[Ag_d] [ug/l]										
[Al_d] [ug/l]										
[Alk][mg/l]										
[As_d] [ug/l]										
[Ba_d] [ug/l]										
[Be_d] [ug/l]										
[Ca] [mg/l]										
[Cd_d] [ug/l]										
[Cl] [mg/l]										
[Co_d] [ug/l]										
[Cr_d] [ug/l]										
[Cu_d] [ug/l]										
[F] [mg/l]										
[Fe_d] [ug/l]										
[Hg_d] [ug/l]										
[K] [mg/l]										
[Li_d] [ug/l]										
[Mg] [mg/l]										
[Mn_d] [ug/l]										
[Mo_d] [ug/l]										
[Na] [mg/l]	1									
[NH4] [mg/l]	0.530342257	1								
[Ni_d] [ug/l]	-0.174333322	-0.049811073	1							
[NO3] [mg/l]	0.61156325	0.89750421	-0.334772329	1						
[Pb_d] [ug/l]	0.026515823	-0.182486373	0.659089044	-0.330165023	1					
[PO4] [mg/l]	-0.029466271	-0.026828761	-0.010570341	-0.104392639	-0.054979287	1				
[Sb_d] [ug/l]	0.059517306	0.120508925	0.907822431	0.182828042	0.562016282	0.163823481	1			
[Se_d] [ug/l]	-0.336636337	-0.547165734	0.05483401	-0.505087864	0.34029894	0.161655202	0.141632257	1		
[Silica] [mg/l]	-0.002740755	0.025205098	0.044473284	0.069453515	-0.287700144	-0.163418547	-0.126069358	-0.401638377	1	
[SO4] [mg/l]	-0.012495436	-0.033588167	0.31010615	0.095220912	-0.242023896	-0.239200937	-0.17111156	-0.436182889	0.600047953	1
[Sr_d] [ug/l]	0.804088274	0.088803999	0.937670581	0.607261678	0.62887674	-0.062704689	0.904844056	0.052371207	-0.133432056	-0.145939274
[TDS] [mg/l]	**0.710215278**	**0.602579384**	**0.014973261**	**0.669469771**	**-0.180685248**	**-0.193577052**	**0.1537227**	**-0.512387835**	**0.499342173**	**0.355603353**
[TKN] [mg/l]	0.214279489	0.358578736	0.15566643	0.468242681	0.091292057	-0.181562262	0.223666342	-0.160703294	-0.110093814	0.16195987
[Tl_d] [ug/l]	-0.313713952	-0.516973957	0.313046615	-0.508266044	0.504009188	0.168021508	0.384351979	0.957910753	-0.401638377	-0.443478212
[Total_P] [mg/l]	0.080603628	0.314657463	0.201151265	0.226808911	0.013083707	-0.141018688	0.161585412	-0.388917963	-0.064181857	0.128245254
[TSS] [mg/l]	-0.099672075	-0.087610759	0.544707364	-0.062826193	0.344622466	-0.05551353	0.505504334	0.1593507	#DIV/0!	-0.02611202
[U_d] [ug/l]	0.513473086	0.660662567	0.461272934	0.618714417	0.263784301	-0.145528817	0.363225123	-0.602002884	0.028473587	0.169295548
[V_d] [ug/l]	0.335116439	0.374601257	0.748186919	0.381849732	0.451951579	-0.0010713	0.710798186	-0.352884256	0.127192242	0.130935307
[Zn_d] [ug/l]	-0.067393721	-0.02807044	0.937557196	-0.040233461	0.592474238	-0.07207215	0.848514785	0.009591167	0.563376716	0.35738772

	[Sr_d] [ug/l]	***[TDS] [mg/l]***	*[TKN] [mg/l]*	*[Tl_d] [ug/l]*	*[Total_P] [mg/l]*	*[TSS] [mg/l]*	*[U_d] [ug/l]*	*[V_d] [ug/l]*	*[Zn_d] [ug/l]*
[Ag_d] [ug/l]									
[Al_d] [ug/l]									
[Alk][mg/l]									
[As_d] [ug/l]									
[Ba_d] [ug/l]									
[Be_d] [ug/l]									
[Ca] [mg/l]									
[Cd_d] [ug/l]									
[Cl] [mg/l]									
[Co_d] [ug/l]									
[Cr_d] [ug/l]									
[Cu_d] [ug/l]									
[F] [mg/l]									
[Fe_d] [ug/l]									
[Hg_d] [ug/l]									
[K] [mg/l]									
[Li_d] [ug/l]									
[Mg] [mg/l]									
[Mn_d] [ug/l]									
[Mo_d] [ug/l]									
[Na] [mg/l]									
[NH4] [mg/l]									
[Ni_d] [ug/l]									
[NO3] [mg/l]									
[Pb_d] [ug/l]									
[PO4] [mg/l]									
[Sb_d] [ug/l]									
[Se_d] [ug/l]									
[Silica] [mg/l]									
[SO4] [mg/l]									
[Sr_d] [ug/l]	1								
[TDS] [mg/l]	**0.737877939**	**1**							
[TKN] [mg/l]	0.193196089	**0.459390009**	1						
[Tl_d] [ug/l]	0.323754819	**-0.521841292**	-0.121918938	1					
[Total_P] [mg/l]	0.221169801	**0.21568579**	0.753294283	-0.316391791	1				
[TSS] [mg/l]	0.542454707	**#DIV/0!**	0.175467395	0.30858874	-0.011916266	1			
[U_d] [ug/l]	0.50491509	**0.576463872**	0.380451722	-0.450969335	0.537328336	0.177323073	1		
[V_d] [ug/l]	0.753818537	**0.369128227**	0.197922877	-0.104831227	0.501072812	0.321844226	0.73655584	1	
[Zn_d] [ug/l]	0.918662747	**-0.022751308**	0.146296069	0.374606329	0.310486208	0.931409416	0.63675787	0.894267367	1

APPENDIX IV

KINETIC RESULTS USED FOR NORTH PILE INFILTRATION CONCENTRATIONS

December 2013

De Beers Canada Inc.

Table IV-1 Data used to represent water quality of water infiltrating or interacting as runoff from the North Pile in the 2013 GoldSim Model

			Water Quality Guidelines		Material					Averages				
					Kimberlite - Sample 4 Degrit Screenover	Kimberlite - Pit 4	Processed Kimberlite	Processed Kimberlite	Kimberlite + Metavolcanic					
		ID Code			110	110	100	100	100					
Parameter Group	Parameter	Units	Drinking Water	Aquatic Life	Column 1 SA# 67421	Column 2 SA# 67417	HC 1 SA# 67420	HC 2 SA# 67422	Column 12 SA# 67459	All kimberlite	Coarse	Processed	Raw	Used to represent GoldSim infiltration and runoff on the North Pile
Physical	Alkalinity	mg/L			71.67	131.00	44.33	31.33	60.00	67.67	71.67	49.11	95.50	67.67
	Tot-Dissolved-Solids	mg/L			-	-	-	-	-	-	-	-	-	212[a]
	Tot-Suspended-Solids	mg/L			-	-	-	-	-	-	-	-	-	3[a]
Major Ions	Calcium	mg/L			20.03	26.93	15.10	8.20	22.73	18.60	20.03	14.44	24.83	18.60
	Chloride	mg/L	<250*		0.14	0.19	0.10	0.34	0.10	0.17	0.14	0.19	0.15	0.17
	Fluoride	mg/L	1.5		0.74	0.80	0.26	0.38	0.05	0.45	0.74	0.46	0.42	0.45
	Magnesium	mg/L			13.92	32.80	9.35	4.84	4.20	13.02	13.92	9.37	18.50	13.02
	Potassium	mg/L			8.65	3.93	6.95	4.60	5.22	5.87	8.65	6.73	4.58	5.87
	Reac-Silica	mg/L			-	-	-	-	-	-	-	-	-	2.6[a]
	Sodium	mg/L	<200*		2.02	2.32	0.65	0.55	2.10	1.53	2.02	1.07	2.21	1.53
	Sulphate	mg/L	<500*		23.4	27.2	3.8	10.4	23.8	17.72	23.40	12.53	25.50	17.72
Nutrients	Ammonia-N	mg/L		2.2	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
	NO3-N+NO2-N	mg/L												0.56
	Ortho-Phosphorous	mg/L			0.02	0.03	0.01	0.01	0.01	0.01	0.02	0.01	0.02	0.01
	T-Phosphorous	mg/L			0.10	0.06	0.01	0.01	0.01	0.04	0.10	0.04	0.04	0.04
	Tot-Kjeldahl Nitrogen	mg/L			1.25	-	0.50	0.50	0.50	0.69	1.25	0.75	0.50	0.69
Dissolved Metals	Aluminium	ug/L		5	0.003	0.003	0.009	0.016	0.012	0.01	0.00	0.01	0.01	8.60
	Antimony	ug/L			0.30	1.88	0.70	0.30	0.53	0.74	0.30	0.43	1.21	0.74
	Arsenic	ug/L	25	5	0.50	0.50	1.00	0.67	0.50	0.63	0.50	0.72	0.50	0.63
	Barium	ug/L	1000		7.72	7.75	7.40	14.67	8.90	9.29	7.72	9.93	8.33	9.29
	Beryllium	ug/L			0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
	Cadmium	ug/L	5	0.017	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
	Chromium	ug/L	50	8.9	0.67	1.50	1.00	0.50	0.33	0.80	0.67	0.72	0.92	0.80
	Cobalt	ug/L			0.28	0.45	0.54	0.29	0.19	0.35	0.28	0.37	0.32	0.35
	Copper	ug/L	<1000*	2	1.3	1.6	0.7	1.1	0.3	0.98	1.27	1.01	0.93	0.98
	Iron	mg/L	<0.3*	0.3	0.007	0.005	0.050	0.023	0.007	0.02	0.01	0.03	0.01	18.33
	Lead	ug/L	10	1	1.00	1.33	1.00	1.00	2.67	1.40	1.00	1.00	2.00	1.40
	Lithium	ug/L			-	-	-	-	-	-	-	-	-	2.2[a]
	Manganese	ug/L	<50*		1.6	4.1	2.5	2.7	5.0	3.16	1.63	2.24	4.54	3.16
	Mercury	ug/L	1	0.1	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50
	Molybdenum	ug/L		73	7.7	3.2	13.3	9.1	2.8	7.22	7.67	10.02	3.02	7.22
	Nickel	ug/L		25	19.00	51	15	4.3	1.7	18.27	19.00	12.91	26.30	18.27
	Selenium	ug/L	10	1	0.50	0.50	0.50	2.67	0.67	0.97	0.50	1.22	0.58	0.97
	Silver	ug/L		0.1	0.025	0.025	0.025	0.025	0.025	0.03	0.03	0.03	0.03	0.03
	Strontium	ug/L			107.23	122.90	66.10	45.57	95.37	87.43	107.23	72.97	109.13	87.43
	Thallium	ug/L		0.8	0.03	0.03	0.35	0.03	0.03	0.09	0.03	0.13	0.03	0.09
	Uranium	ug/L	100		9.85	14.30	1.85	0.25	1.45	5.54	9.85	3.98	7.88	5.54
	Vanadium	ug/L			6.00	2.67	6.00	4.67	16.67	7.20	6.00	5.56	9.67	7.20
	Zinc	ug/L	<5000*	30	0.83	3.08	0.25	0.42	1.58	1.23	0.83	0.50	2.33	1.23

Note: Data from De Beers 2002c (EAR) Kinetic test data and is used in GoldSim to represent water quality of water infiltrating or interacting as runoff from the North Pile.

a) Median value from monitoring data at station SNP02-05 used to supplement where lab data not available.

"-" = no result available; mg/L = milligrams per litre; ug/L = microgram per litre; + = plus; < = less than.

* Hardness dependent. Background values in Snap Lake are higher than the lower criteria limit.

APPENDIX V

CALIBRATION RESULTS

December 2013

V.1 MINE WATER (SNP 02-01)

Figure V.1- 1 Simulated and Measured Concentrations for Alkalinity (as $CaCO_3$) (SNP 02-01)

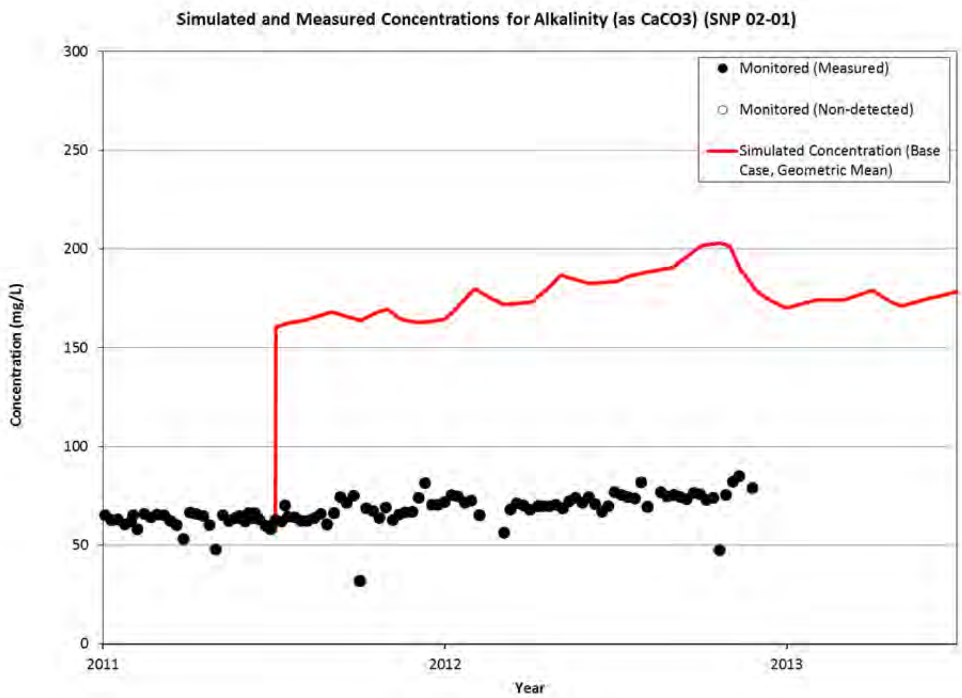


Figure V.1- 2 Simulated and Measured Concentrations for Aluminum (SNP 02-01)

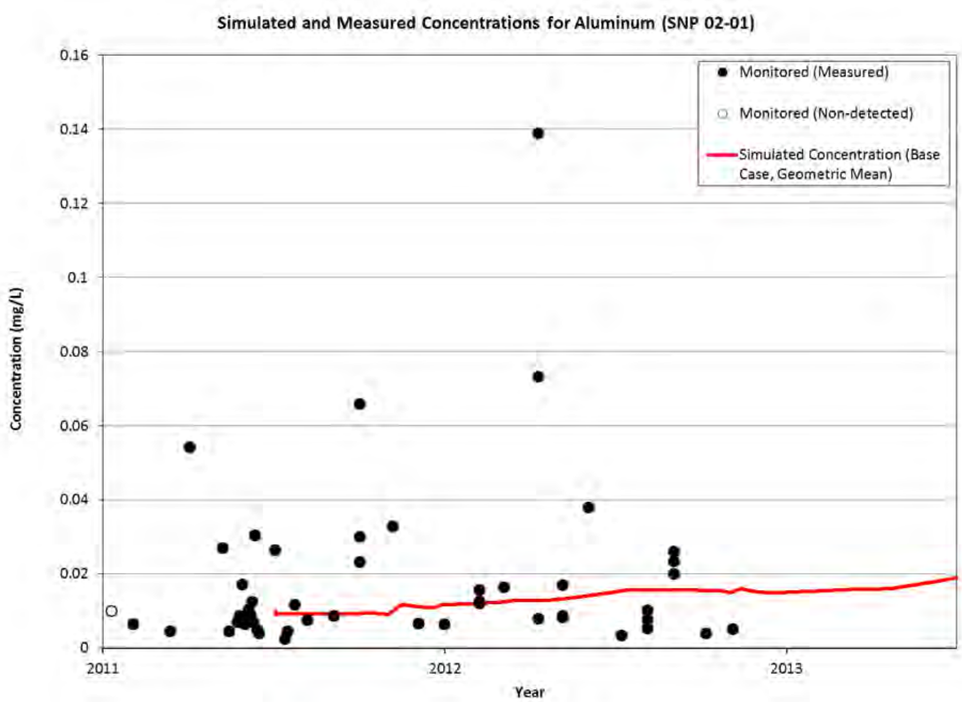


Figure V.1- 3 Simulated and Measured Concentrations for Antimony (SNP 02-01)

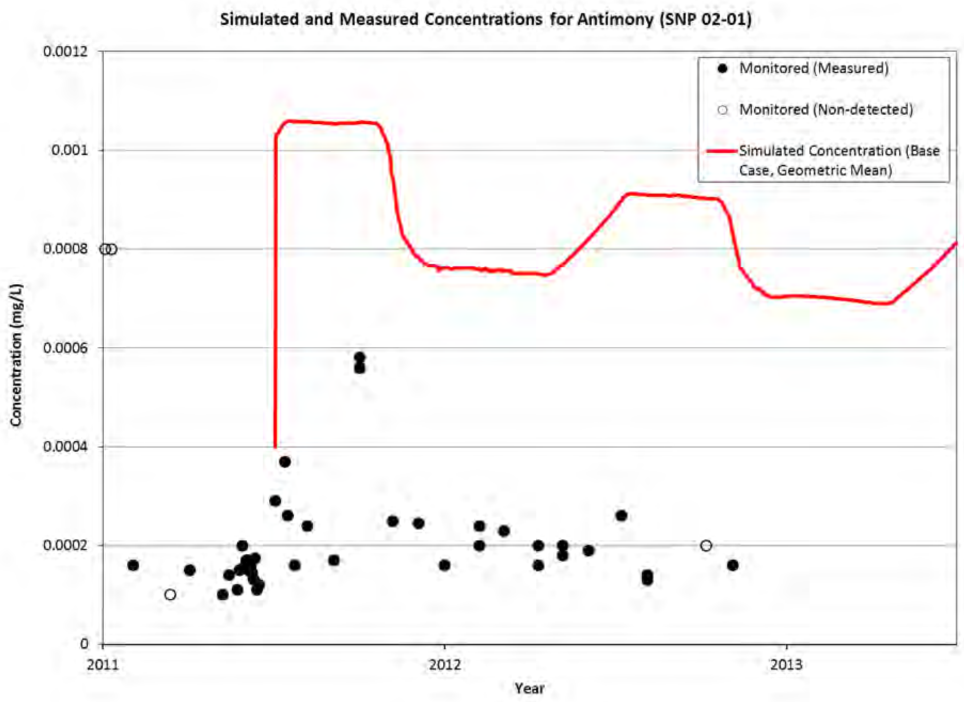


Figure V.1- 4 Simulated and Measured Concentrations for Arsenic (SNP 02-01)

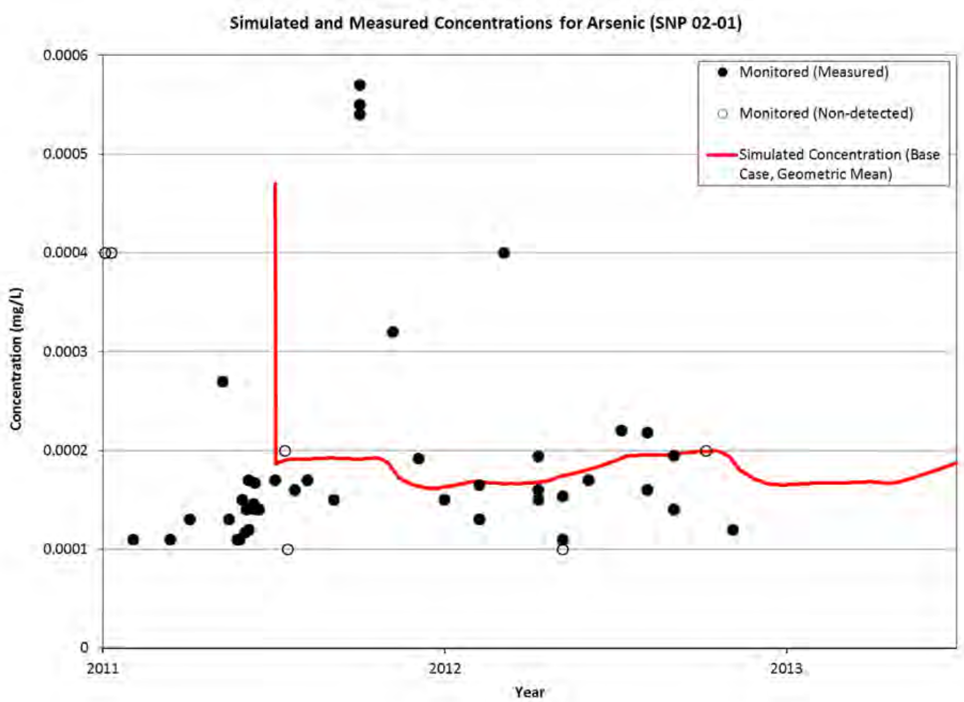


Figure V.1- 5 Simulated and Measured Concentrations for Barium (SNP 02-01)

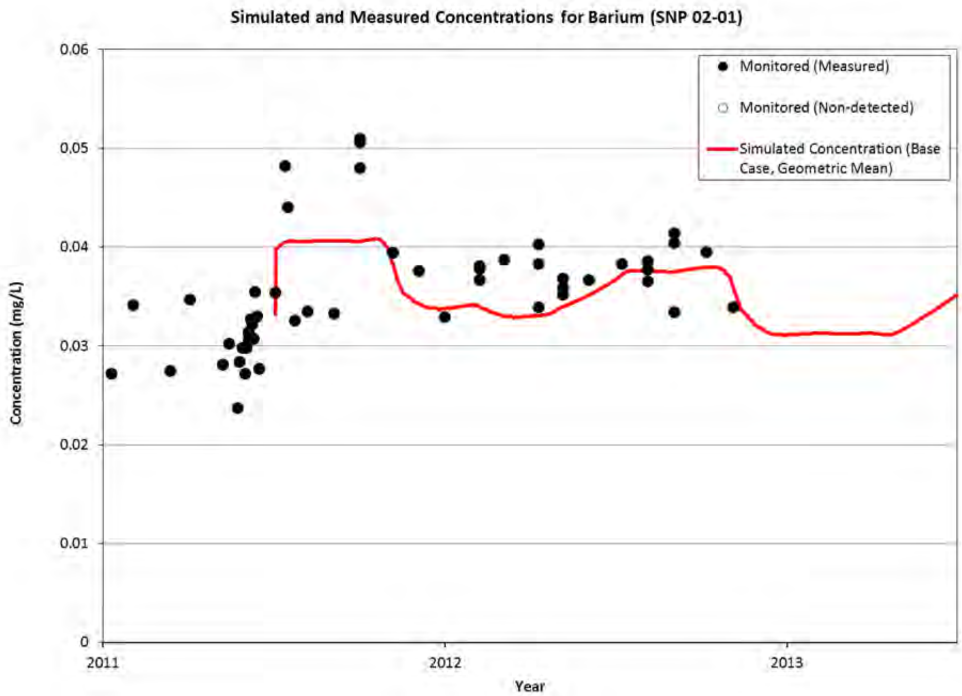


Figure V.1- 6 Simulated and Measured Concentrations for Beryllium (SNP 02-01)

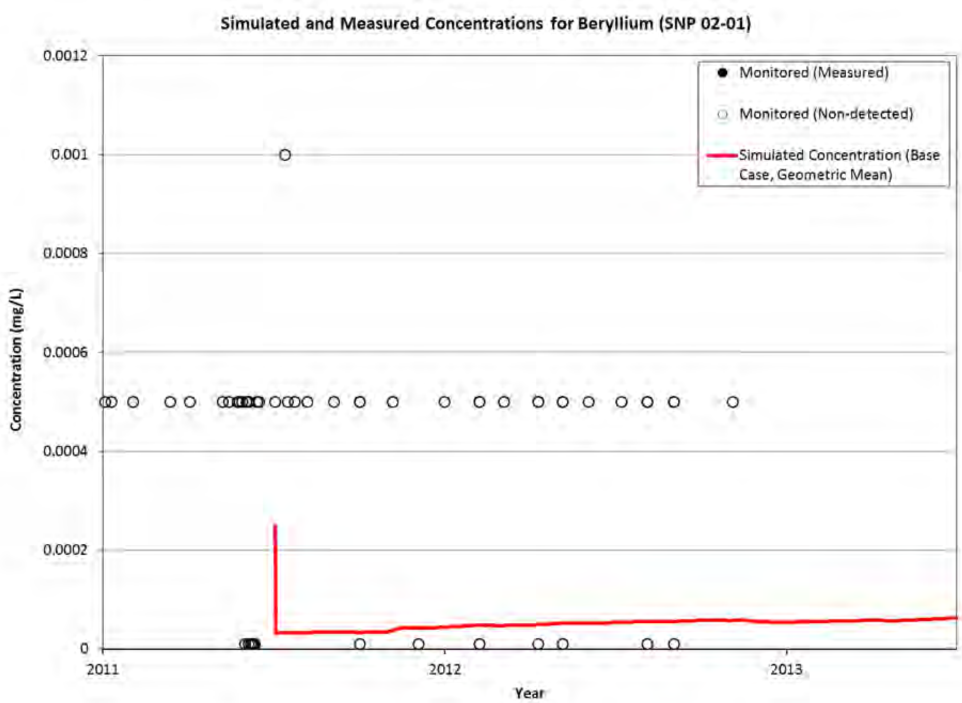


Figure V.1- 7 Simulated and Measured Concentrations for Cadmium (SNP 02-01)

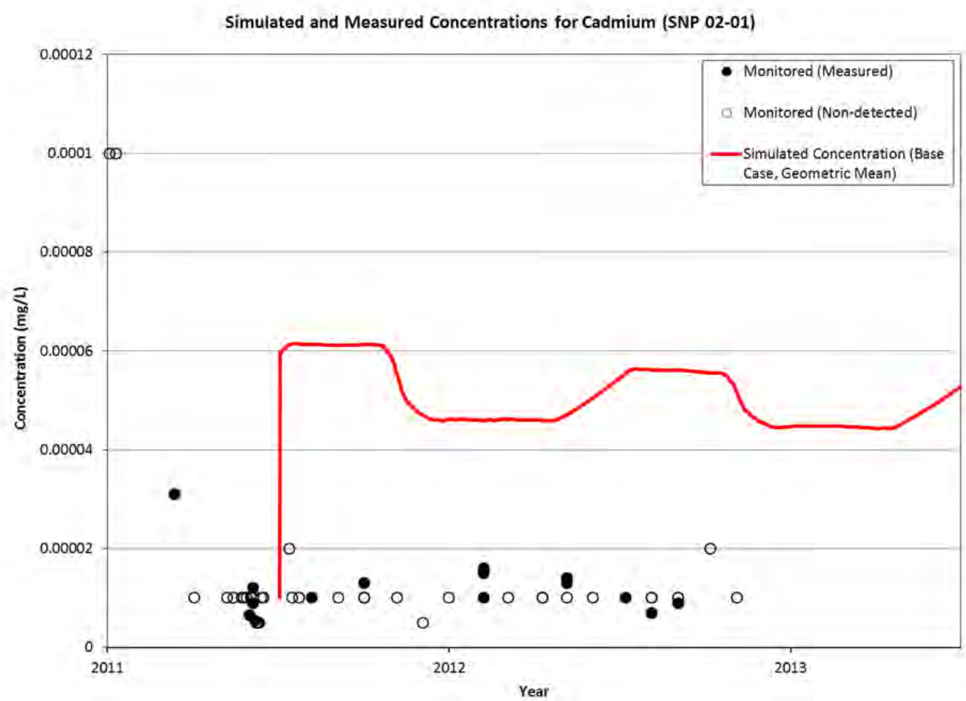


Figure V.1- 8 Simulated and Measured Concentrations for Calcium (SNP 02-01)

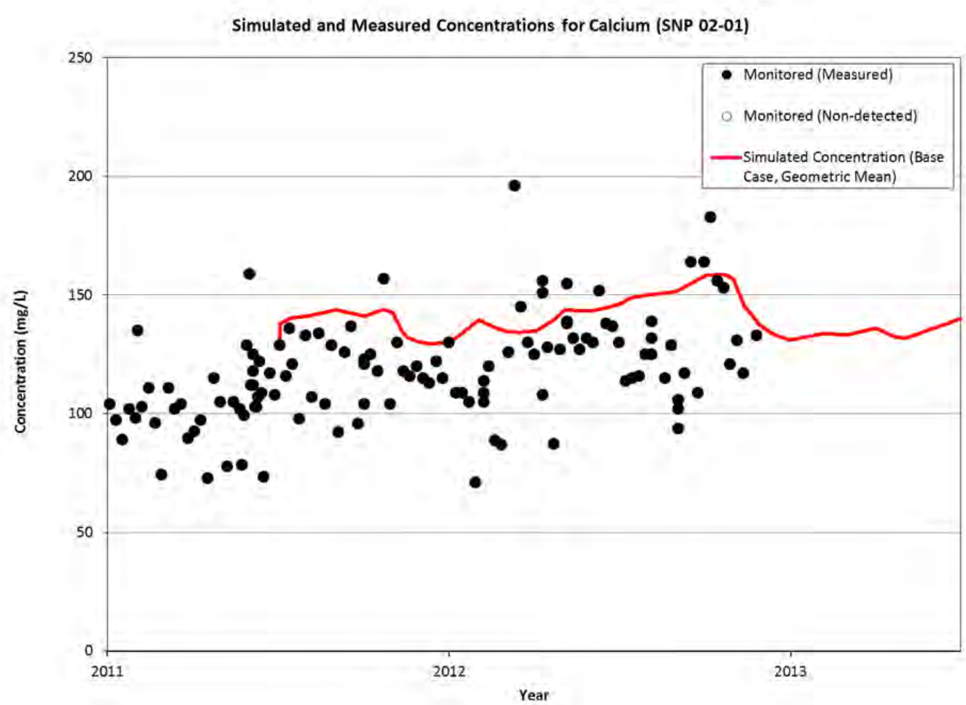


Figure V.1- 9 Simulated and Measured Concentrations for Chloride (SNP 02-01)

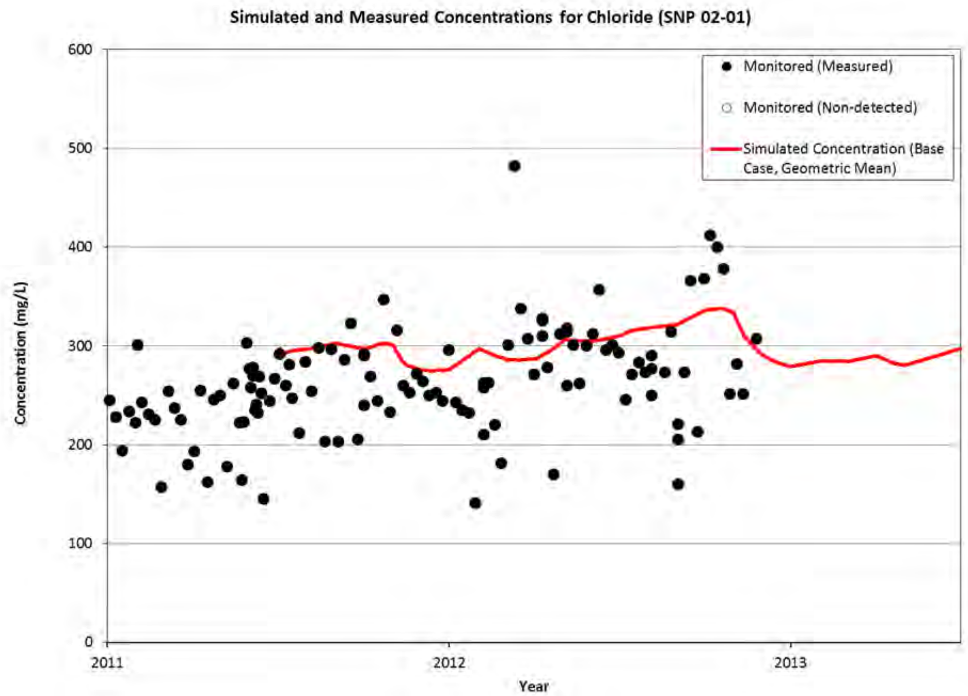


Figure V.1- 10 Simulated and Measured Concentrations for Chromium (SNP 02-01)

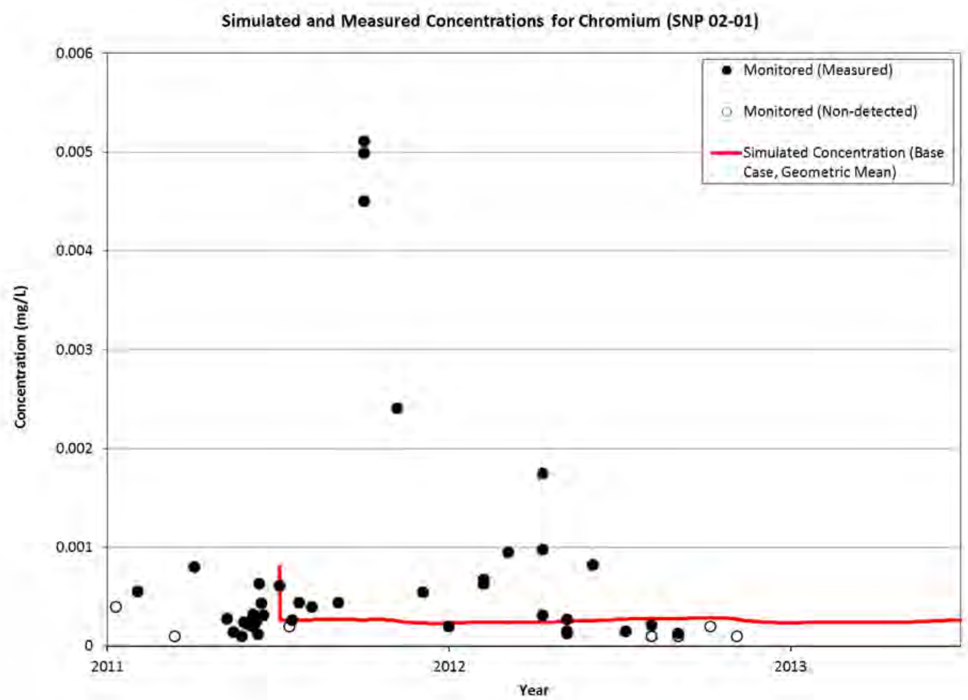


Figure V.1- 11 Simulated and Measured Concentrations for Cobalt (SNP 02-01)

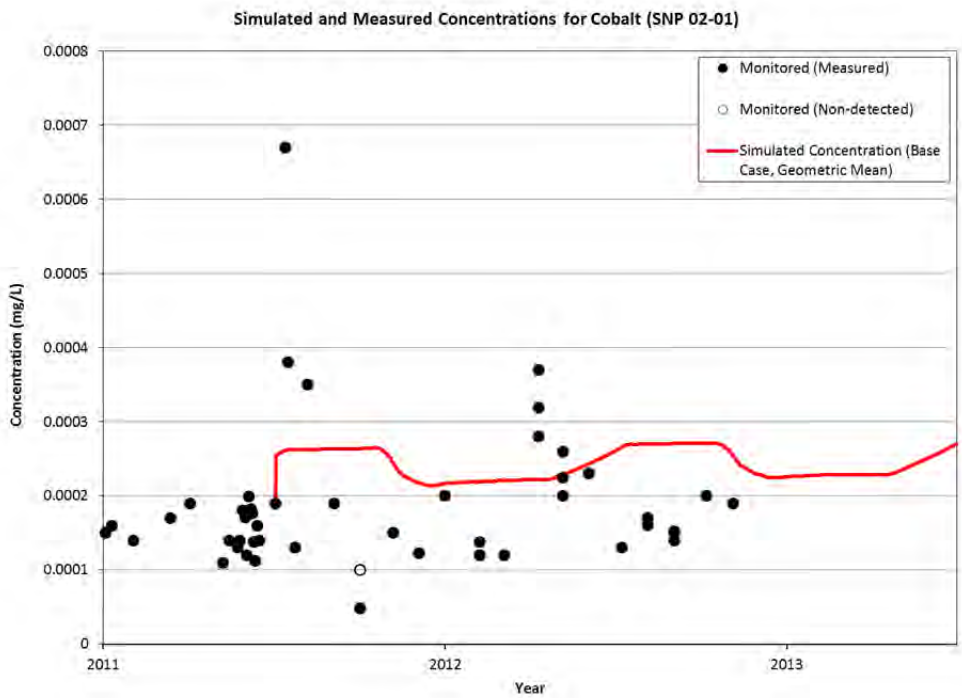


Figure V.1- 12 Simulated and Measured Concentrations for Copper (SNP 02-01)

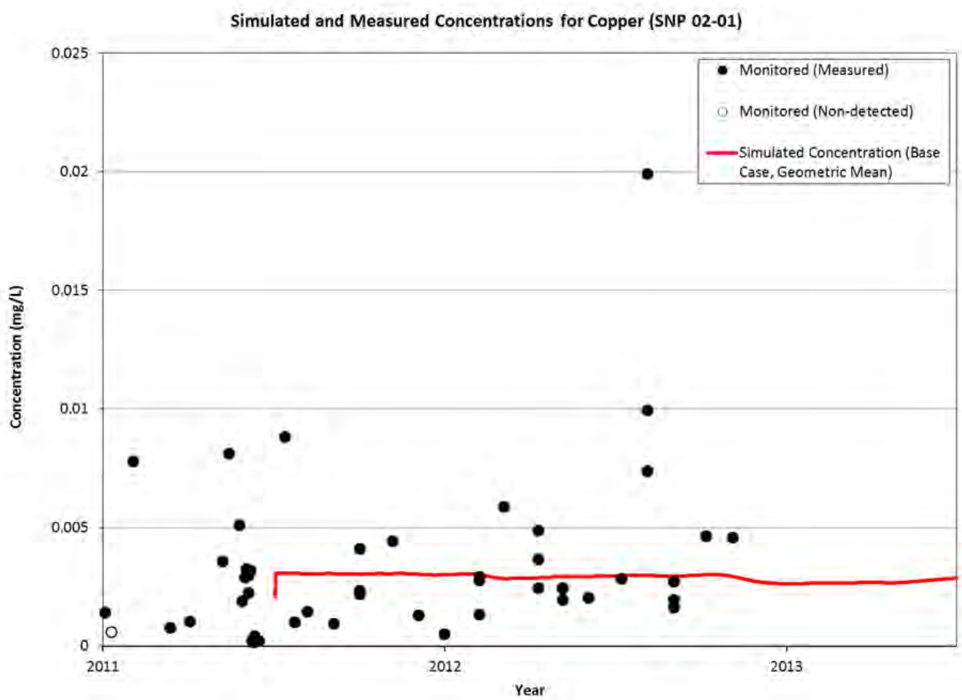


Figure V.1- 13 Simulated and Measured Concentrations for Fluoride (SNP 02-01)

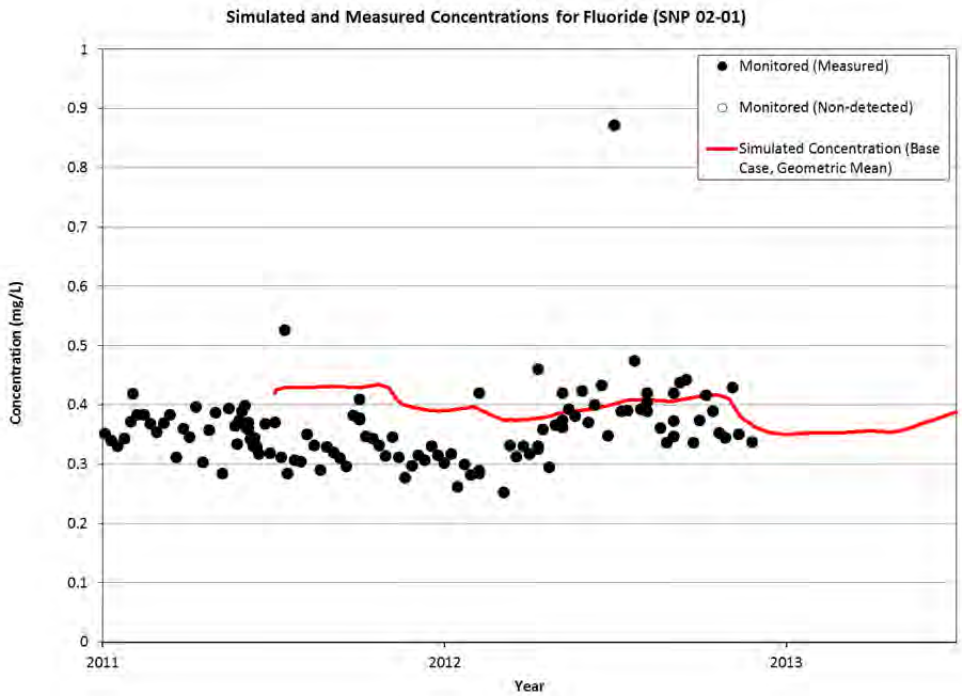


Figure V.1- 14 Simulated and Measured Concentrations for Iron (SNP 02-01)

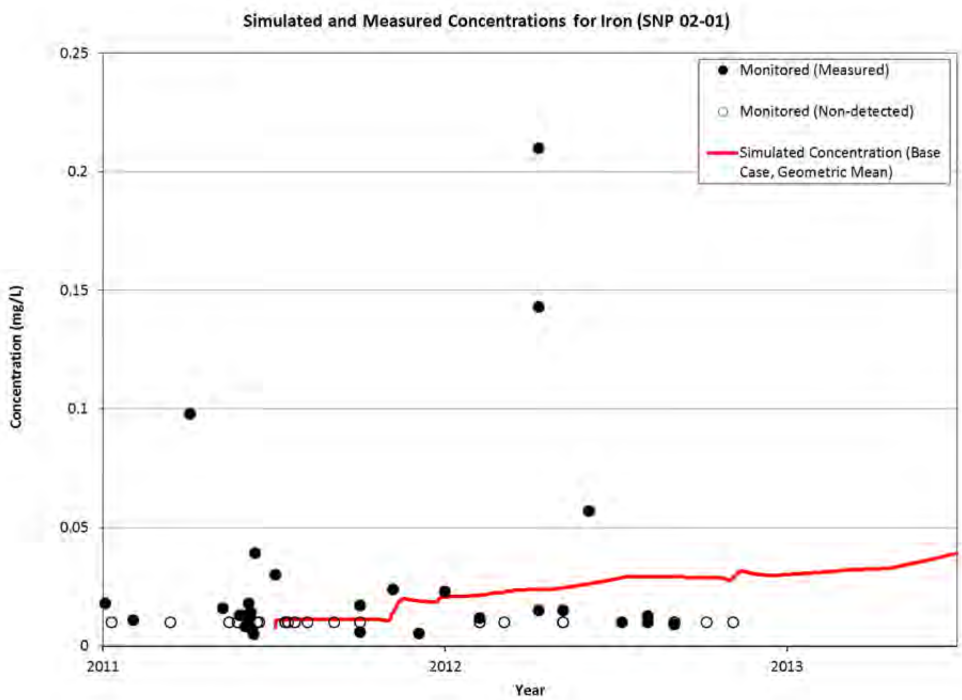


Figure V.1- 15 Simulated and Measured Concentrations for Lead (SNP 02-01)

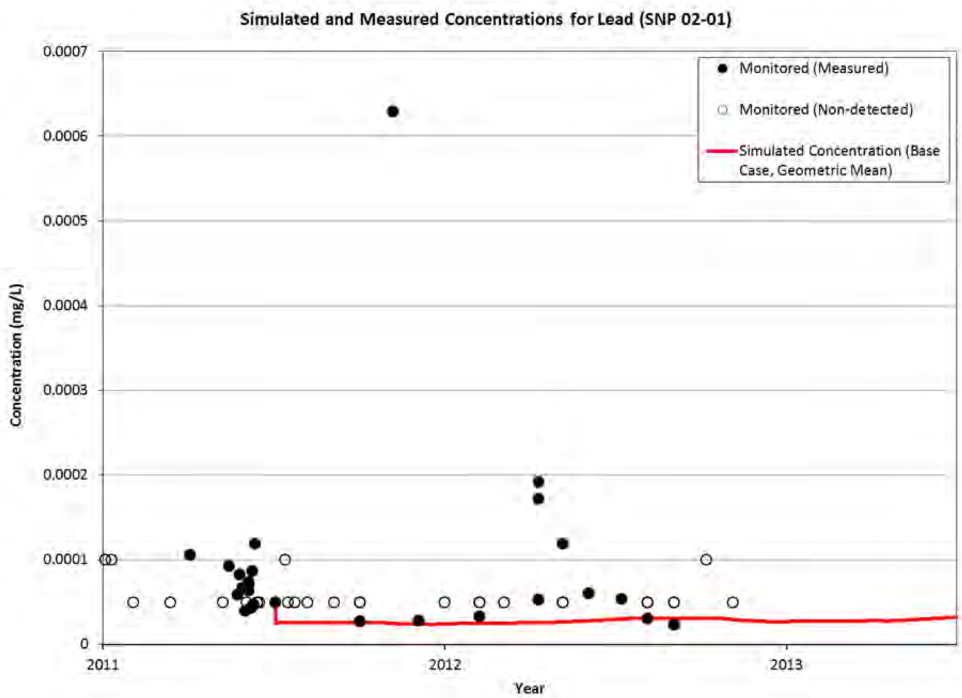


Figure V.1- 16 Simulated and Measured Concentrations for Lithium (SNP 02-01)

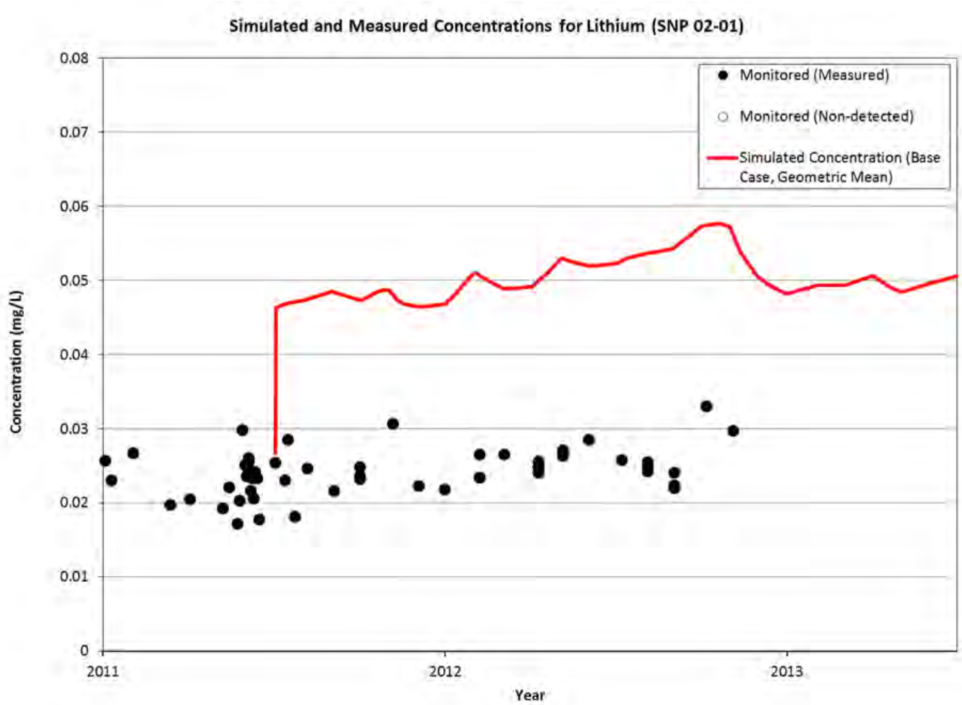


Figure V.1- 17 **Simulated and Measured Concentrations for Magnesium (SNP 02-01)**

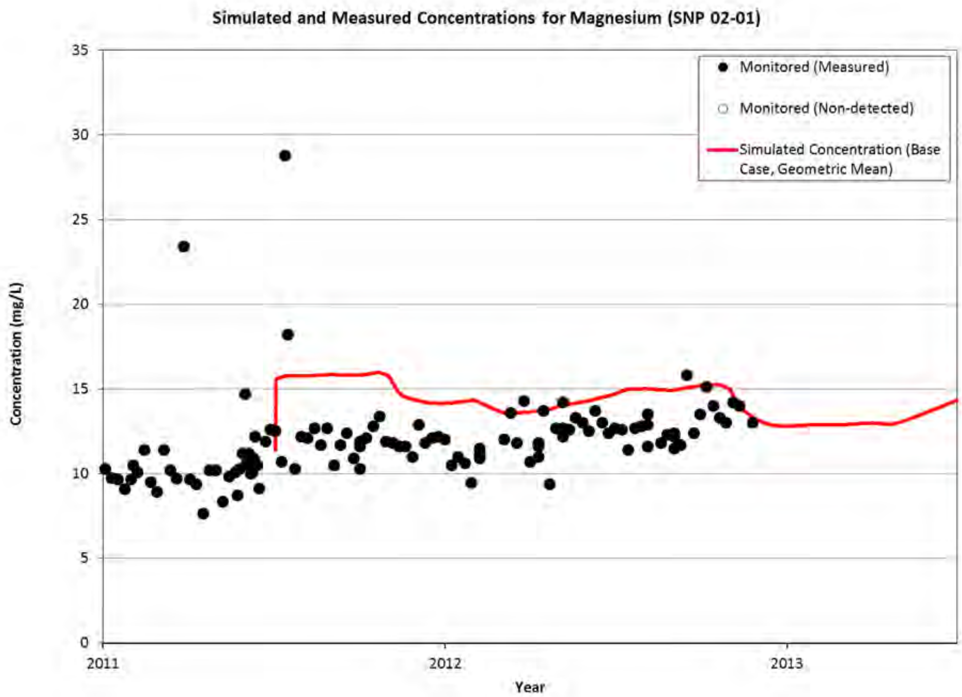


Figure V.1- 18 Simulated and Measured Concentrations for Manganese (SNP 02-01)

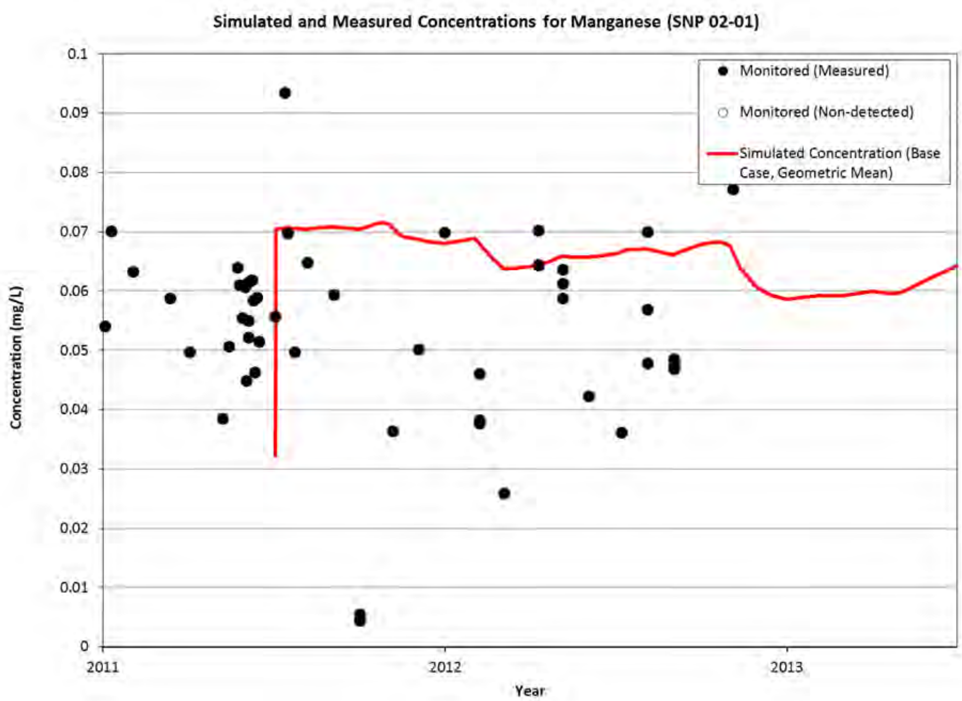


Figure V.1- 19 Simulated and Measured Concentrations for Mercury (SNP 02-01)

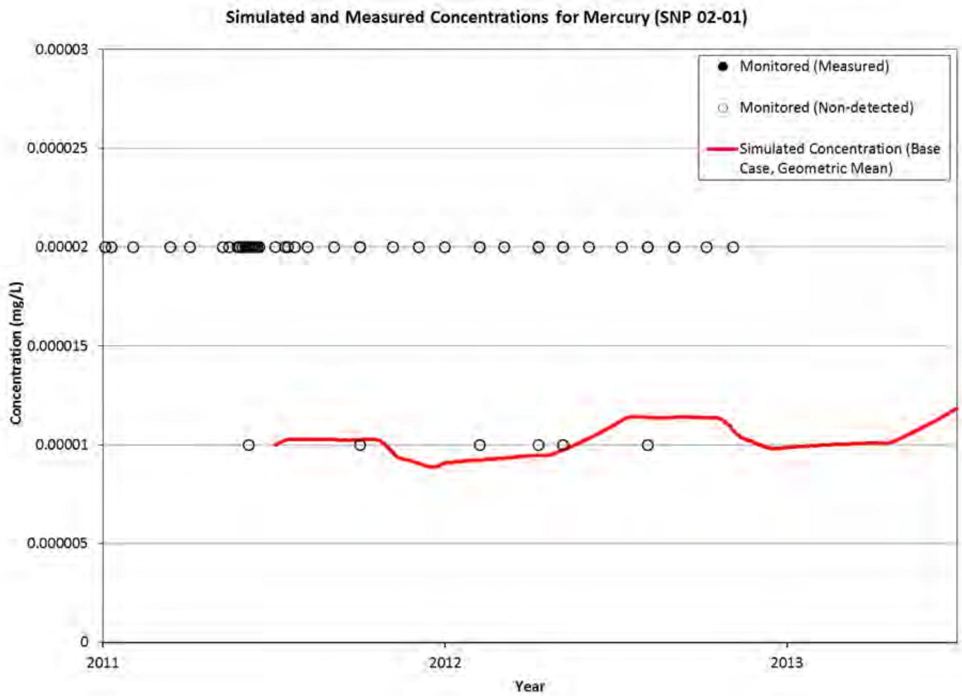


Figure V.1- 20 Simulated and Measured Concentrations for Molybdenum (SNP 02-01)

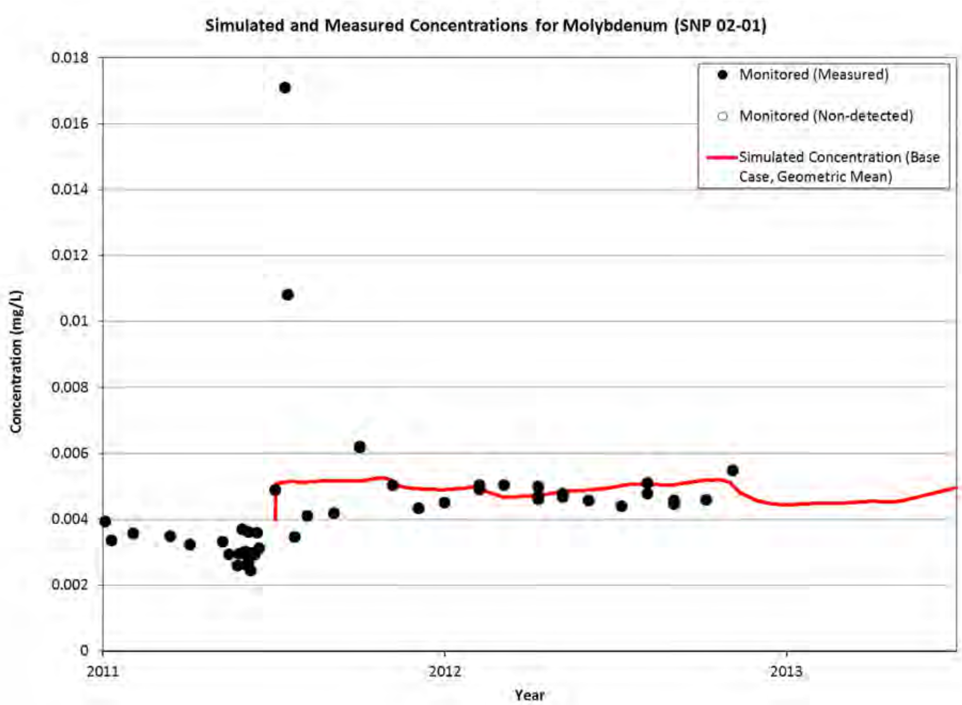


Figure V.1- 21 Simulated and Measured Concentrations for Nickel (SNP 02-01)

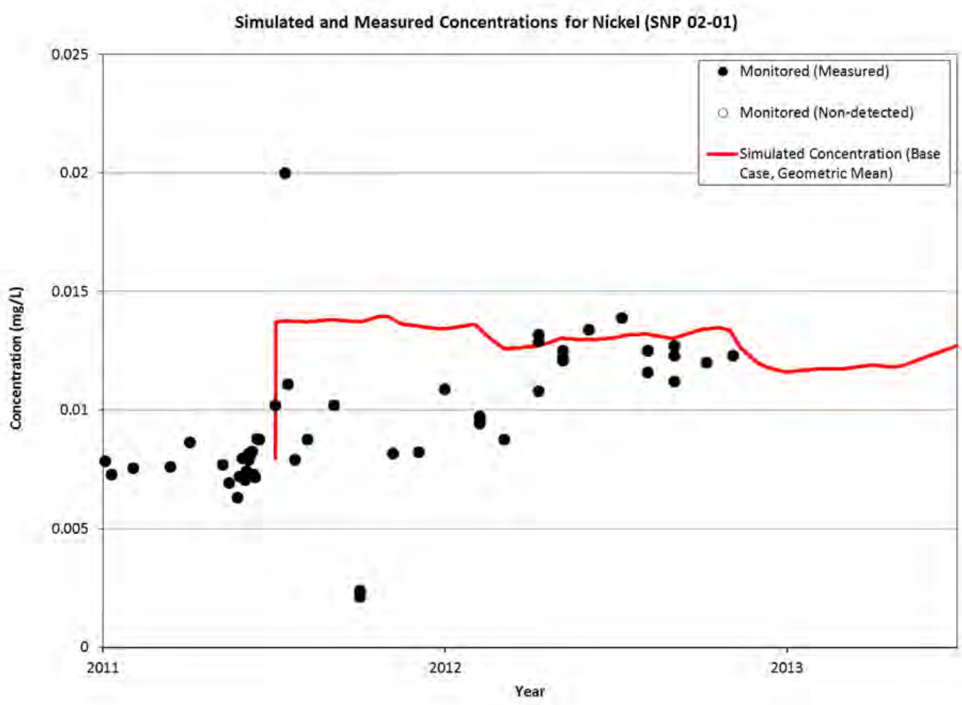


Figure V.1- 22 Simulated and Measured Concentrations for Nitrate/Nitrite, as N (SNP 02-01)

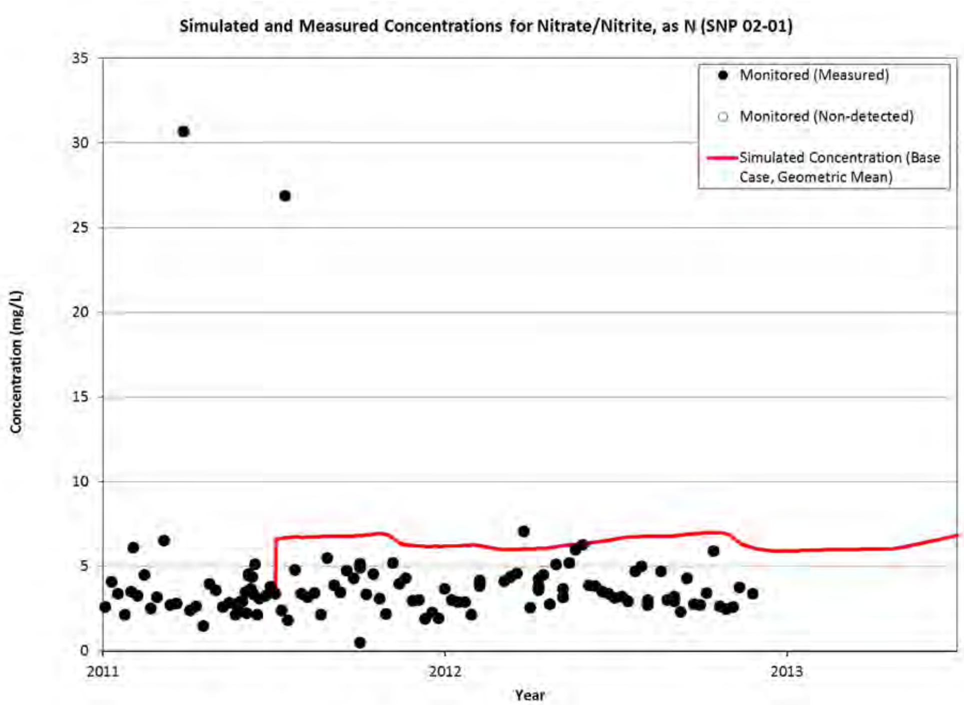


Figure V.1- 23 Simulated and Measured Concentrations for Ortho-Phosphate, as P (SNP 02-01)

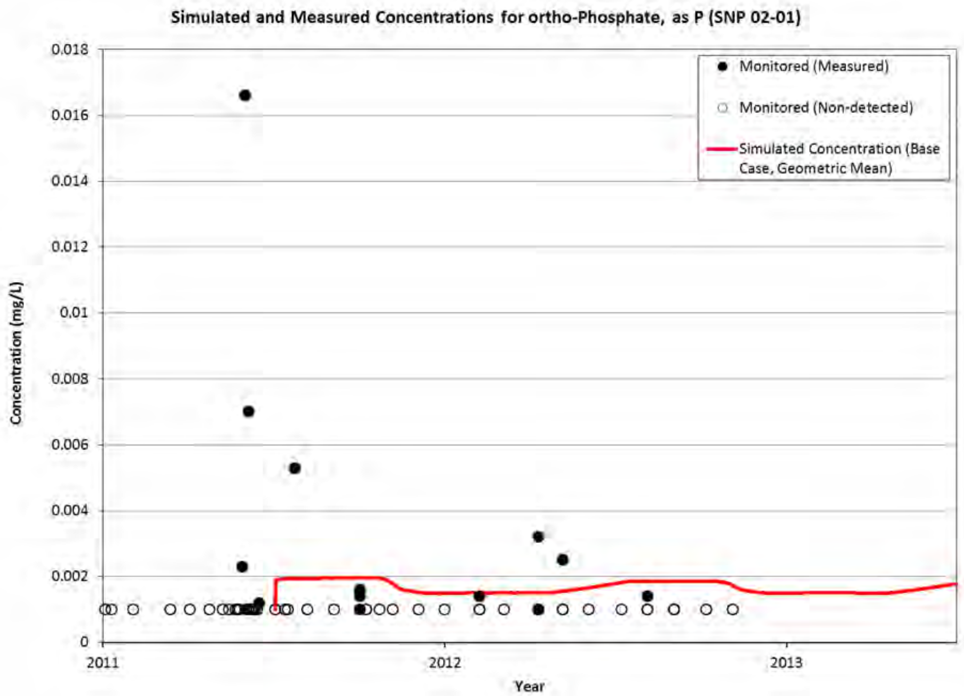


Figure V.1- 24 Simulated and Measured Concentrations for Potassium (SNP 02-01)

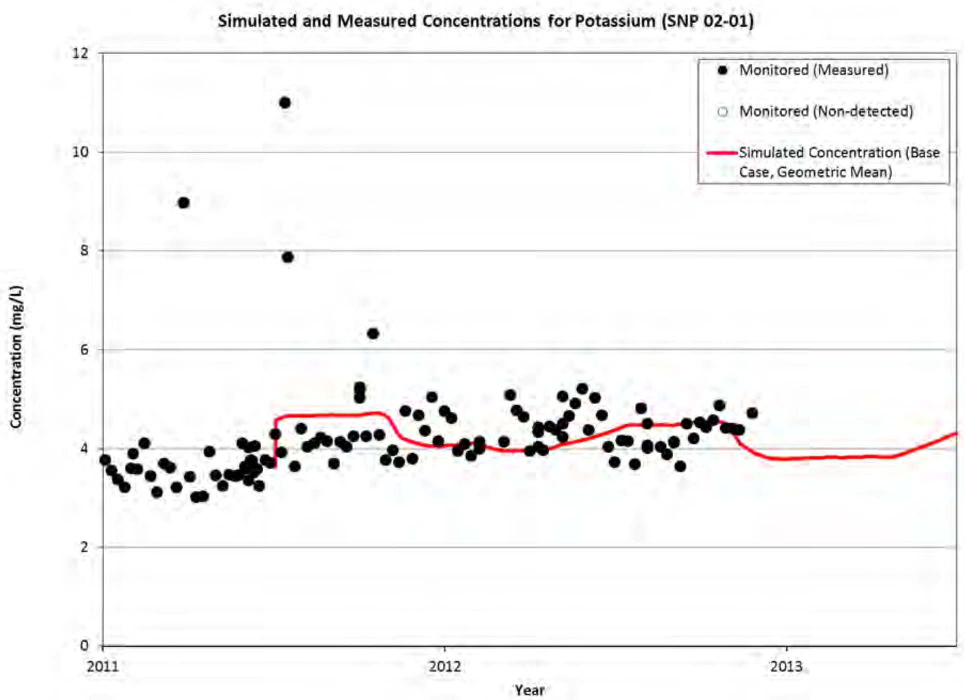


Figure V.1- 25 Simulated and Measured Concentrations for Reactive Silica, as SiO_2 (SNP 02-01)

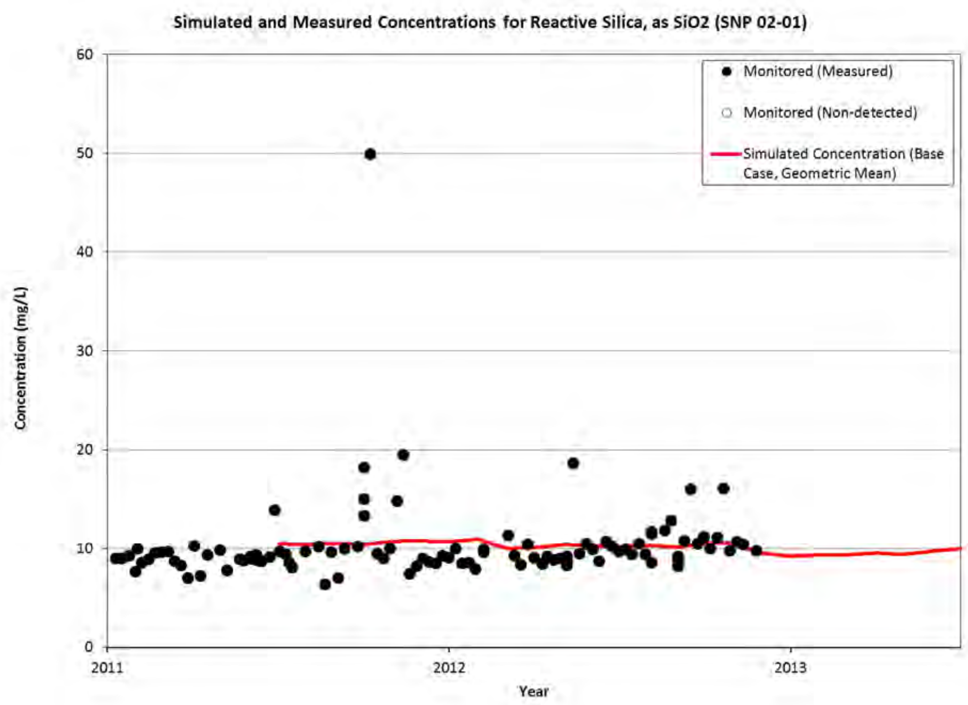


Figure V.1- 26 Simulated and Measured Concentrations for Selenium (SNP 02-01)

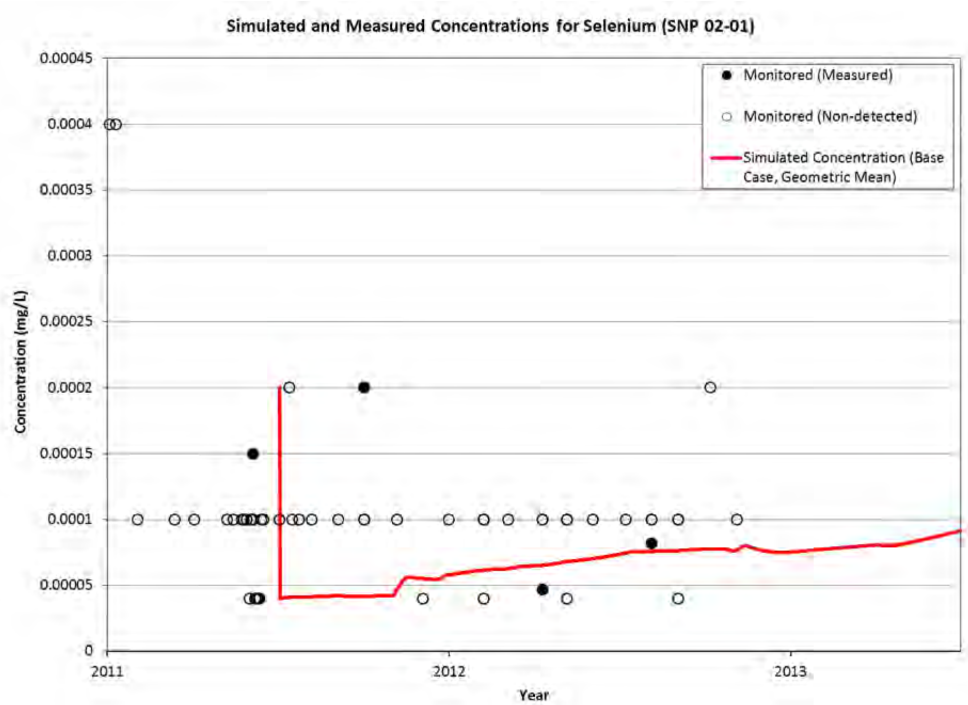


Figure V.1- 27 Simulated and Measured Concentrations for Silver (SNP 02-01)

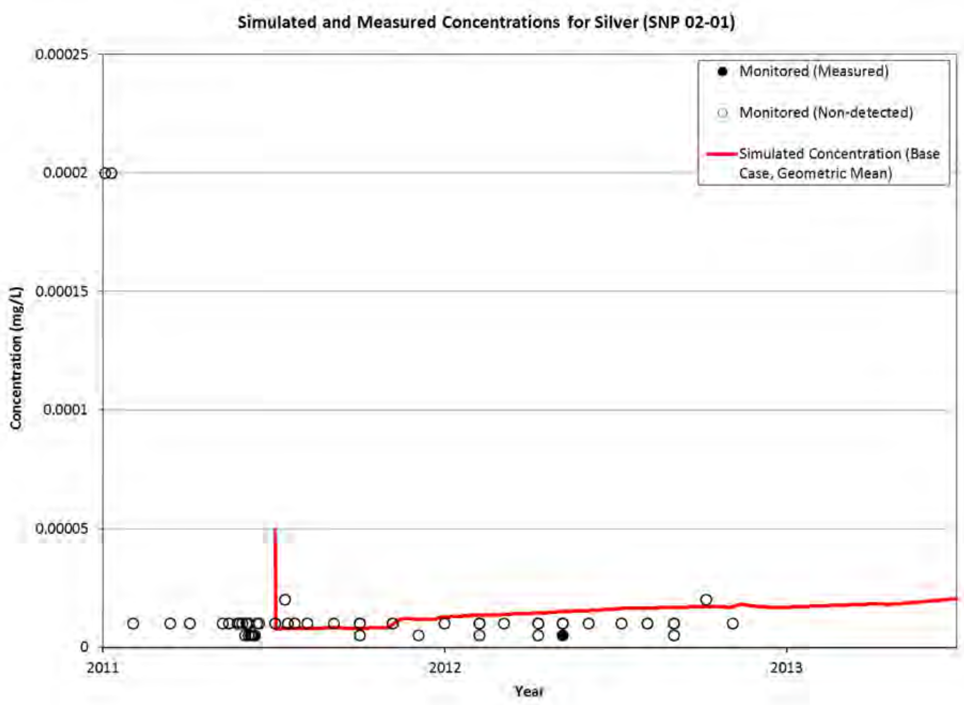


Figure V.1- 28 Simulated and Measured Concentrations for Sodium (SNP 02-01)

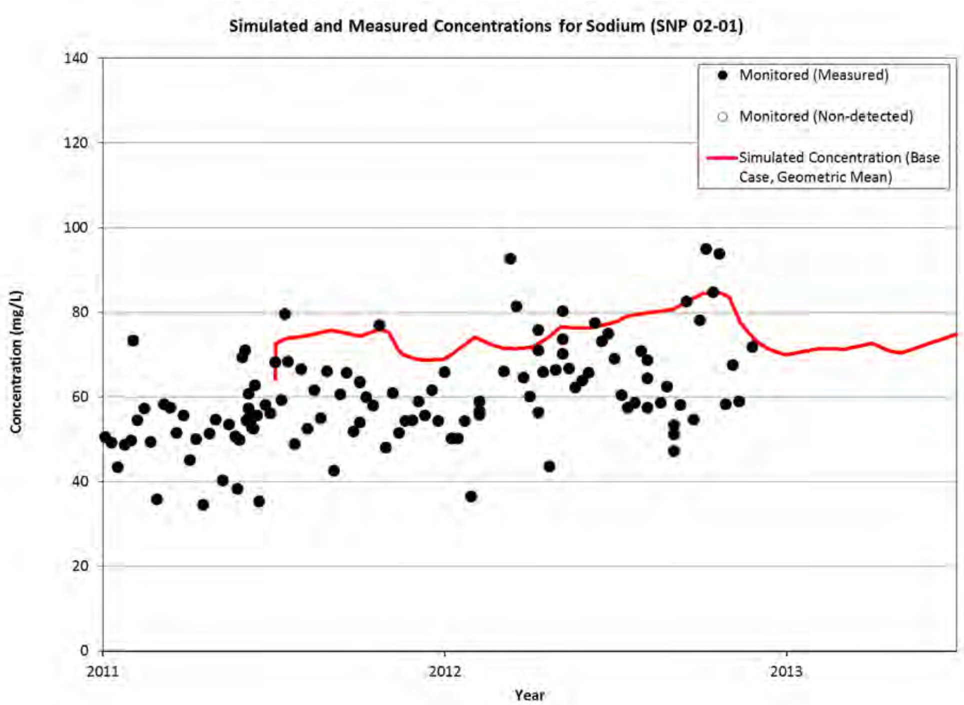


Figure V.1- 29 Simulated and Measured Concentrations for Strontium (SNP 02-01)

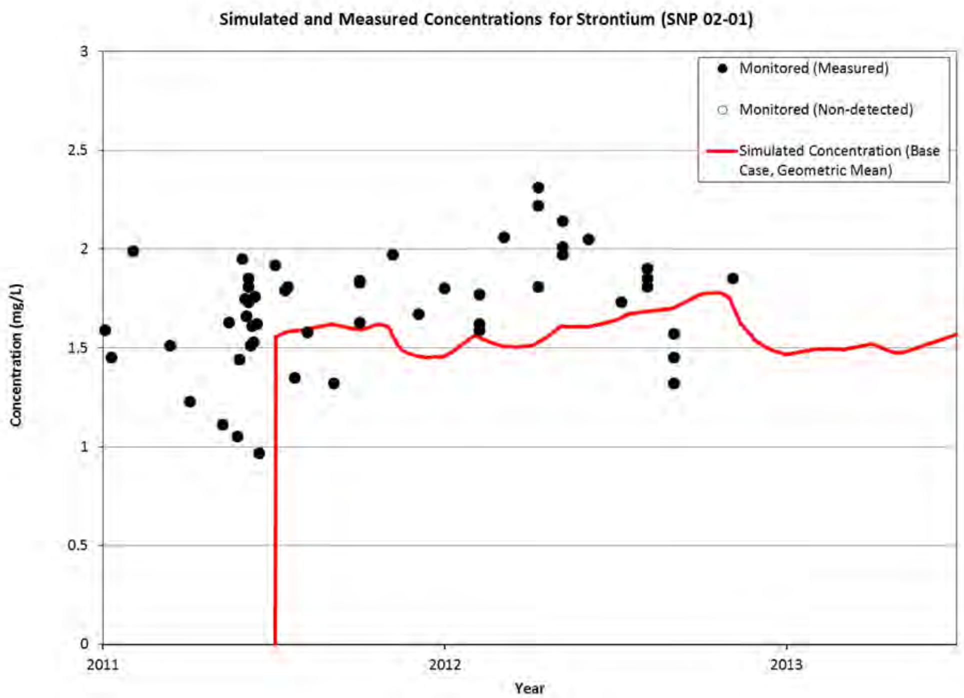


Figure V.1- 30 Simulated and Measured Concentrations for Sulphate (SNP 02-01)

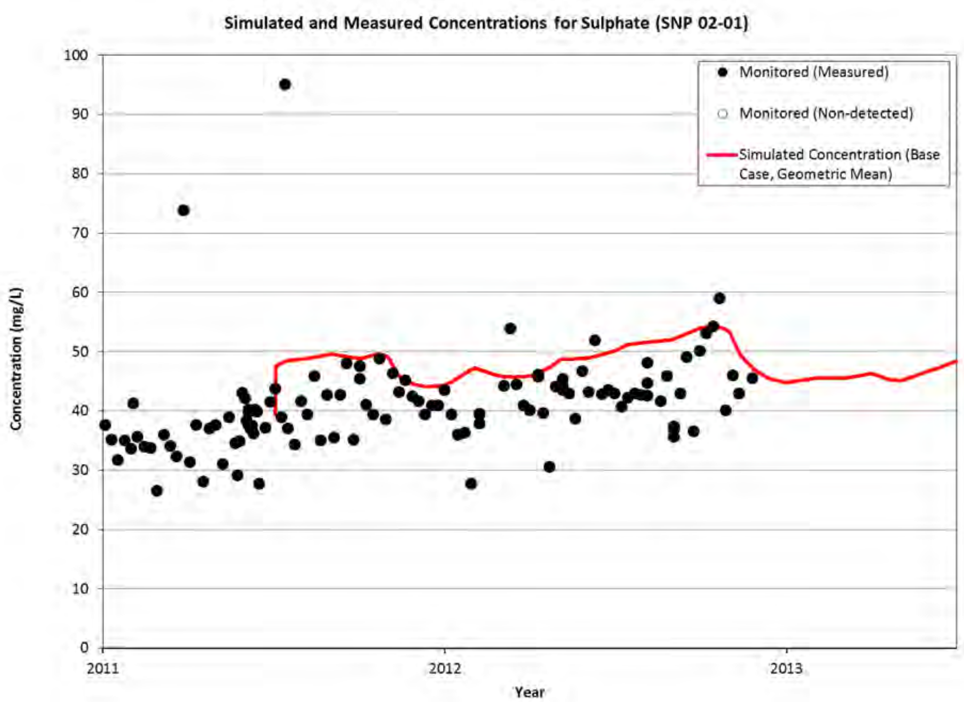


Figure V.1- 31 Simulated and Measured Concentrations for Thallium (SNP 02-01)

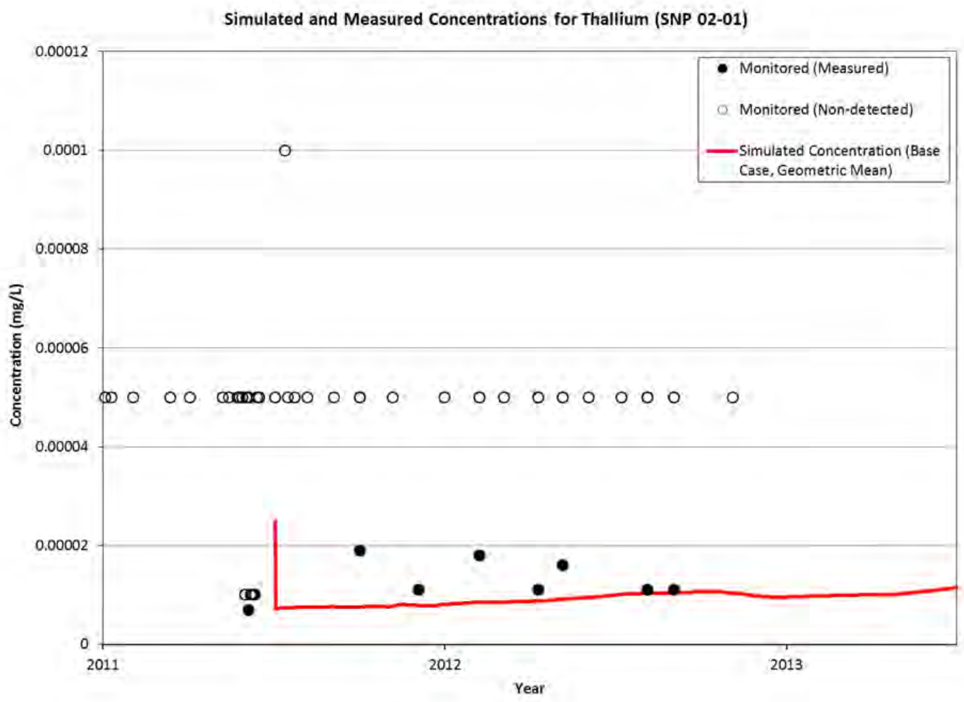


Figure V.1- 32 Simulated and Measured Concentrations for Total Ammonia, as N (SNP 02-01)

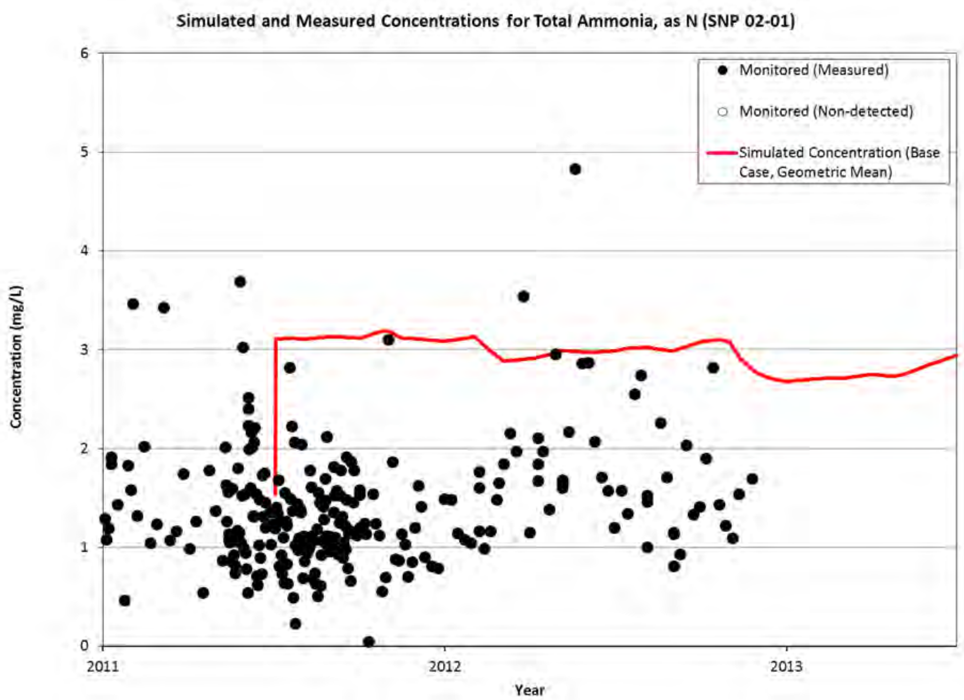


Figure V.1- 33 Simulated and Measured Concentrations for Total Dissolved Solids (SNP 02-01)

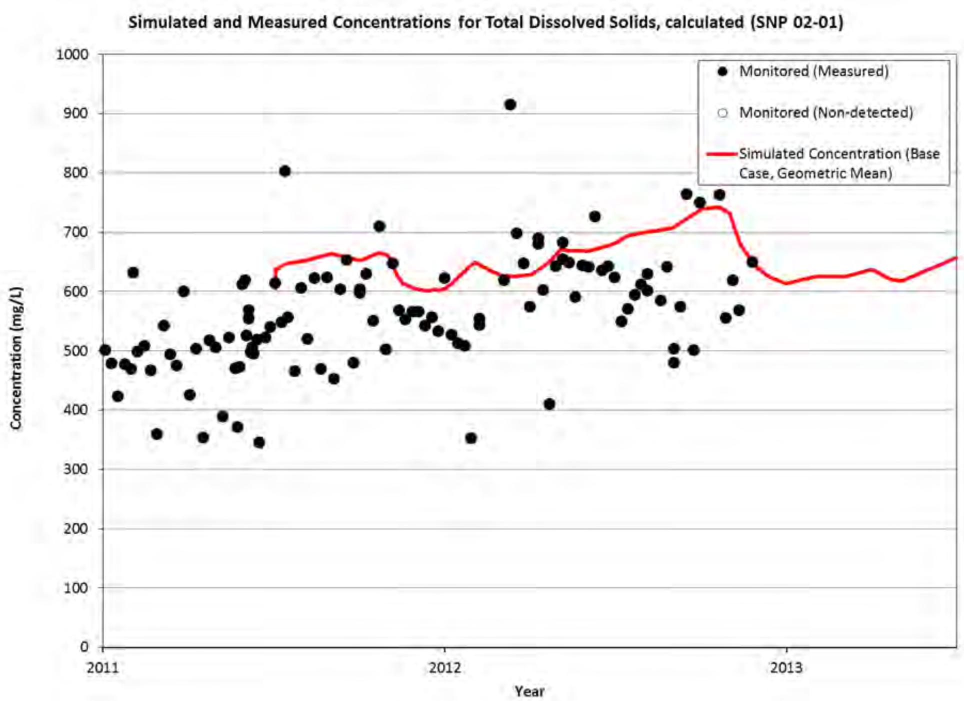


Figure V.1- 34 Simulated and Measured Concentrations for Total Kjeldahl Nitrogen (SNP 02-01)

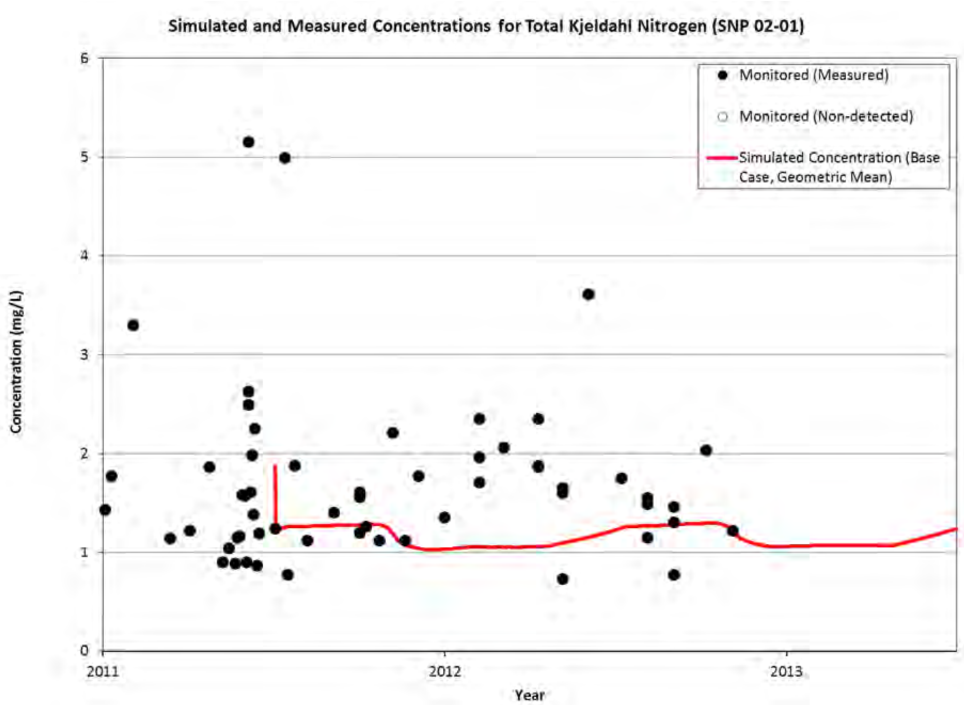


Figure V.1- 35 Simulated and Measured Concentrations for Total Phosphorus (SNP 02-01)

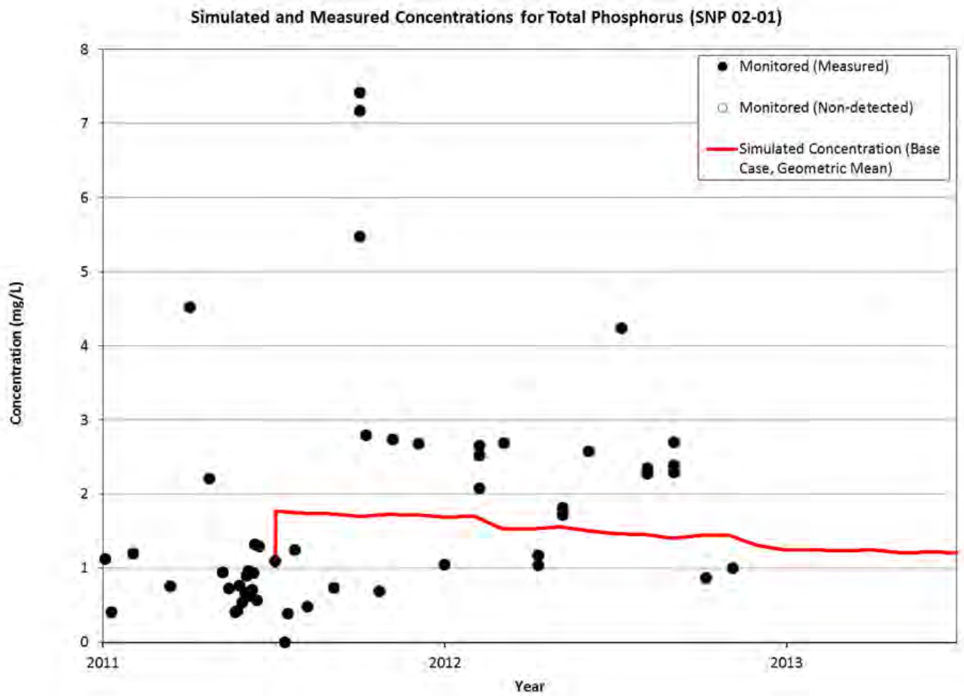


Figure V.1- 36 Simulated and Measured Concentrations for Total Suspended Solids (SNP 02-01)

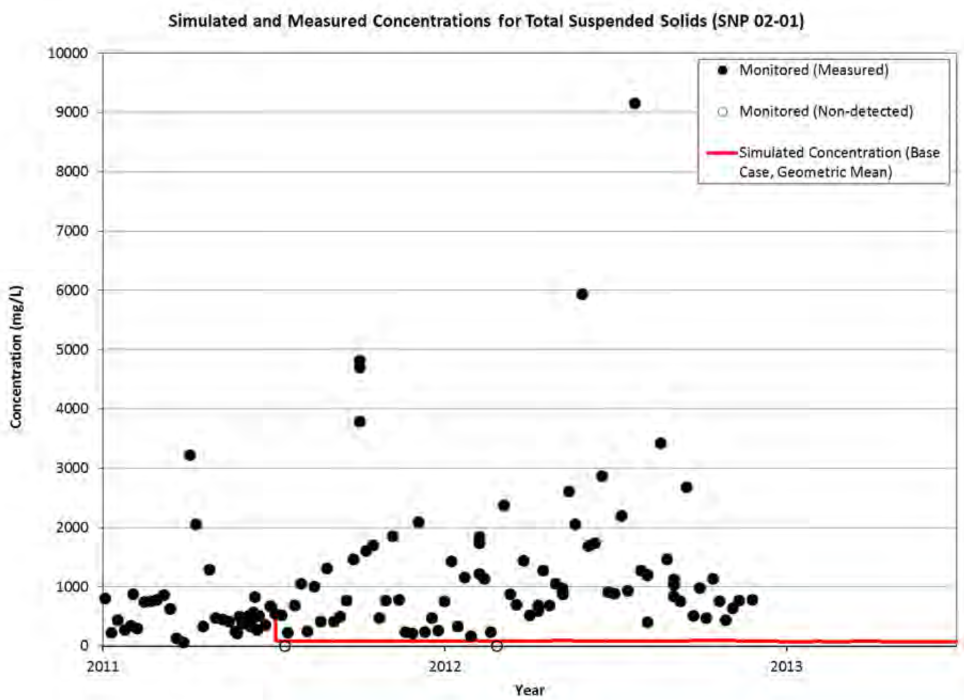


Figure V.1- 37 Simulated and Measured Concentrations for Uranium (SNP 02-01)

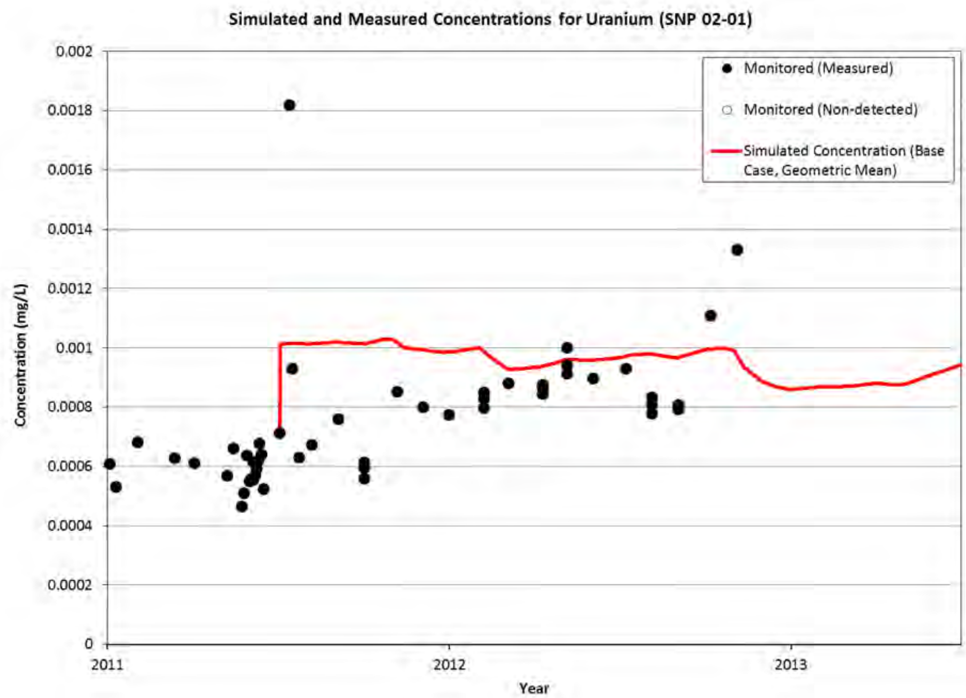


Figure V.1- 38 Simulated and Measured Concentrations for Vanadium (SNP 02-01)

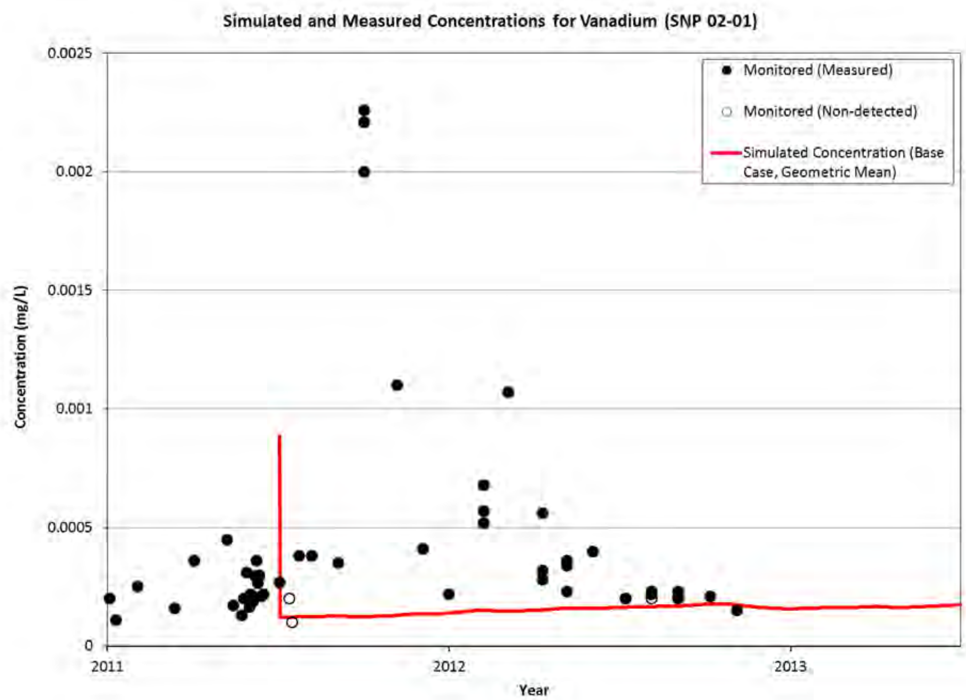
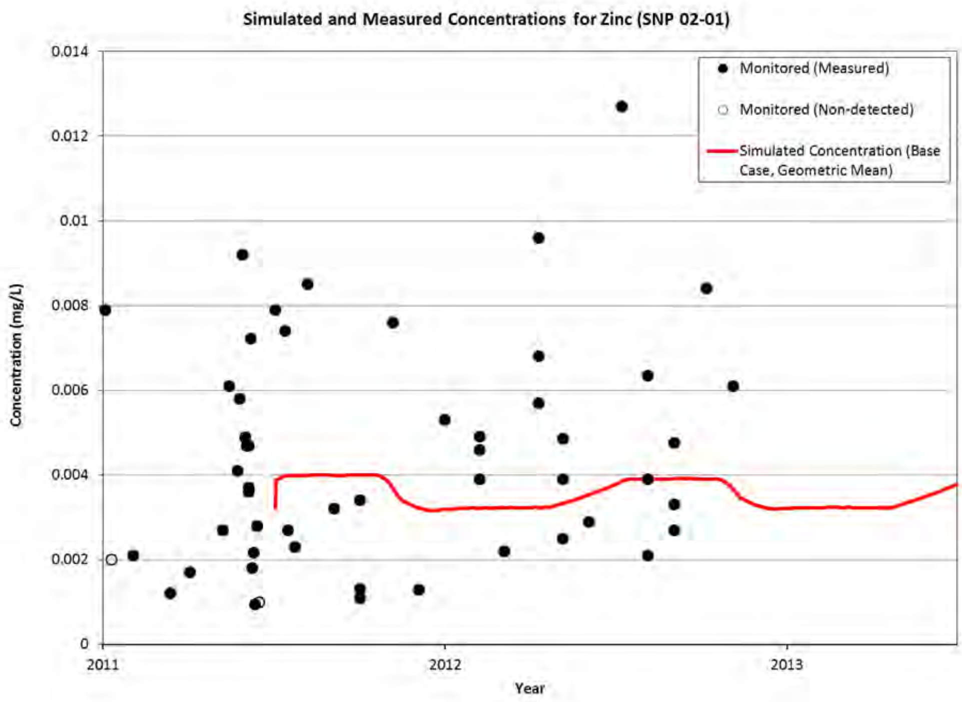


Figure V.1- 39 Simulated and Measured Concentrations for Zinc (SNP 02-01)



V.2 NORTH PILE DISCHARGE (SNP 02-02)

Figure V.2- 1 Simulated and Measured Concentrations for Alkalinity (as $CaCO_3$) (SNP 02-02)

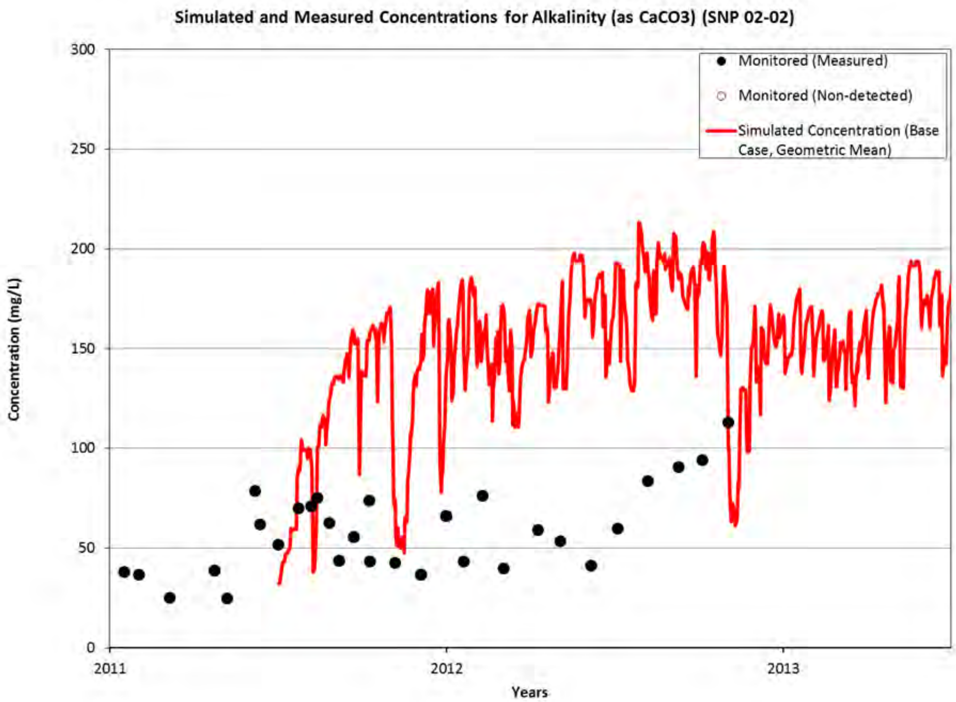


Figure V.2- 2 Simulated and Measured Concentrations for Aluminum (SNP 02-02)

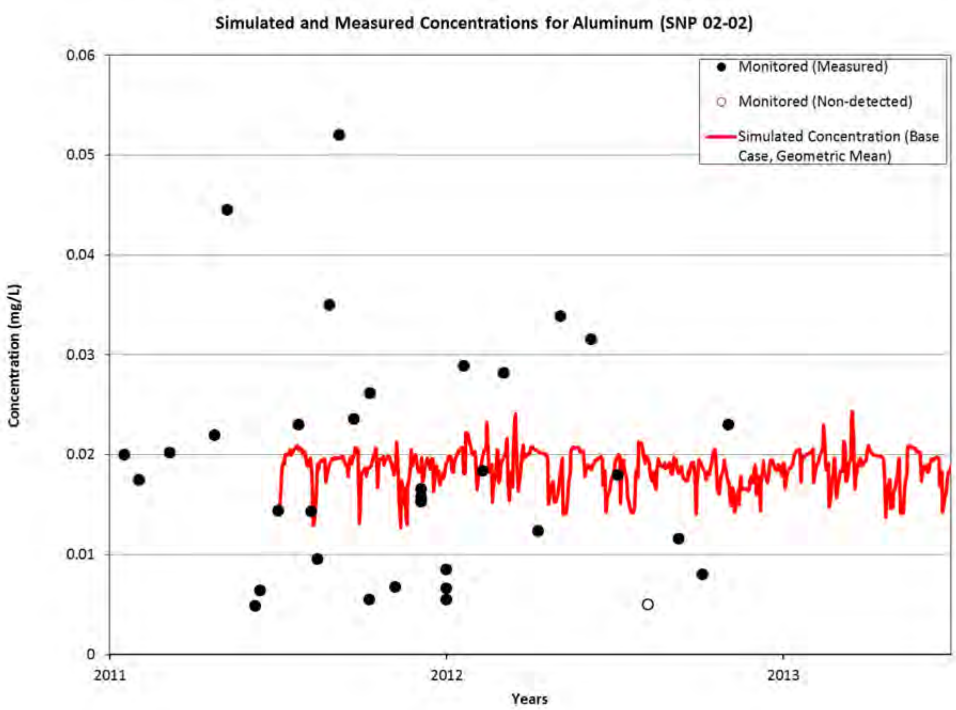


Figure V.2- 3 Simulated and Measured Concentrations for Antimony (SNP 02-02)

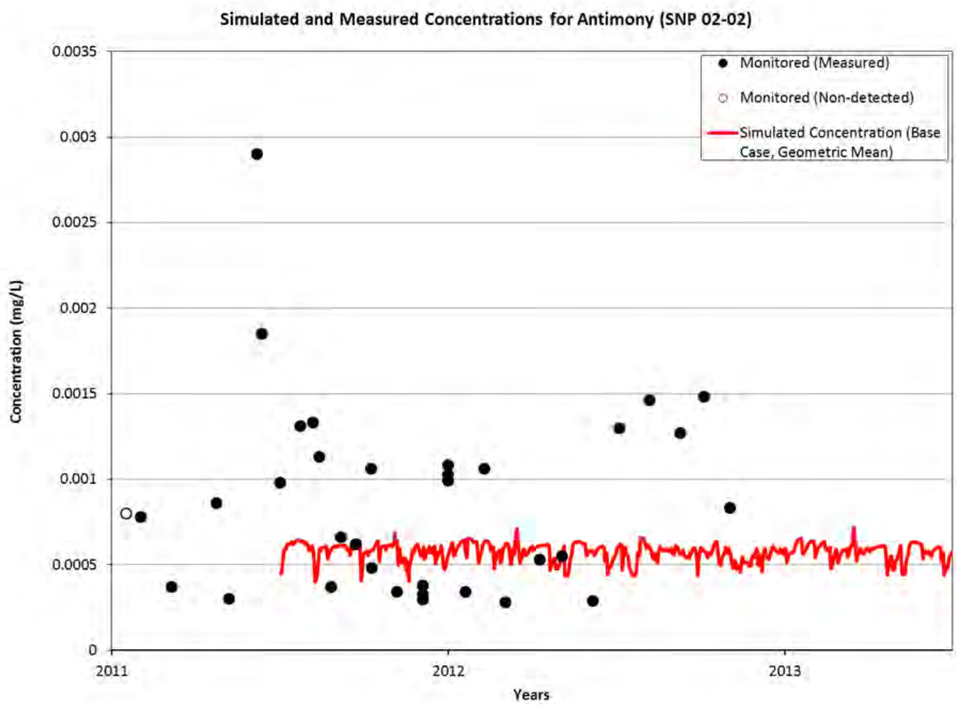


Figure V.2- 4 Simulated and Measured Concentrations for Arsenic (SNP 02-02)

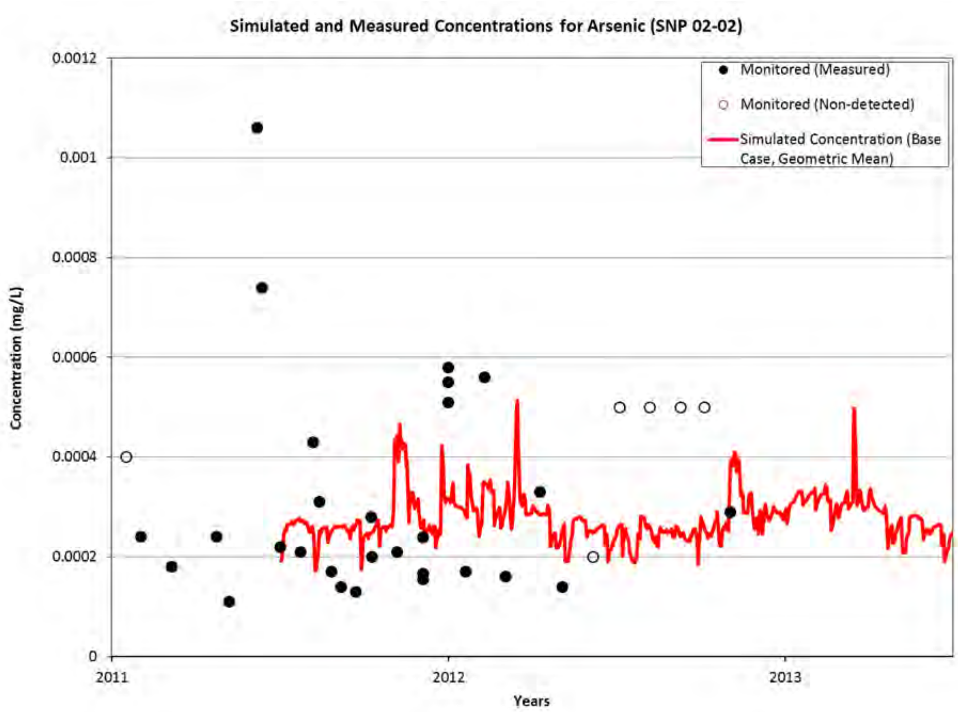


Figure V.2- 5 Simulated and Measured Concentrations for Barium (SNP 02-02)

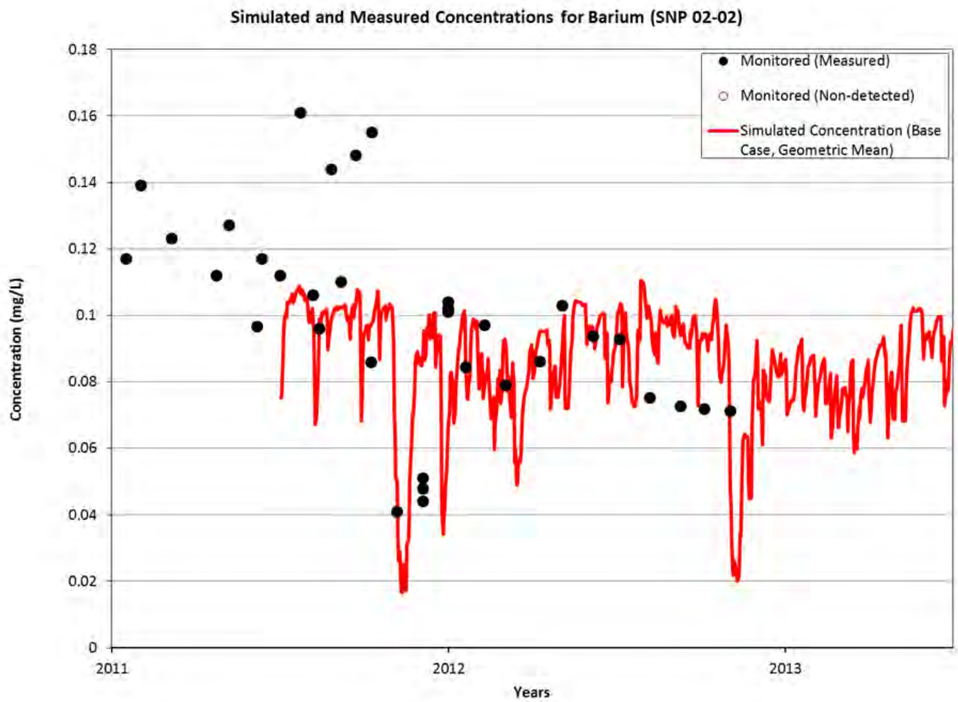


Figure V.2- 6 Simulated and Measured Concentrations for Beryllium (SNP 02-02)

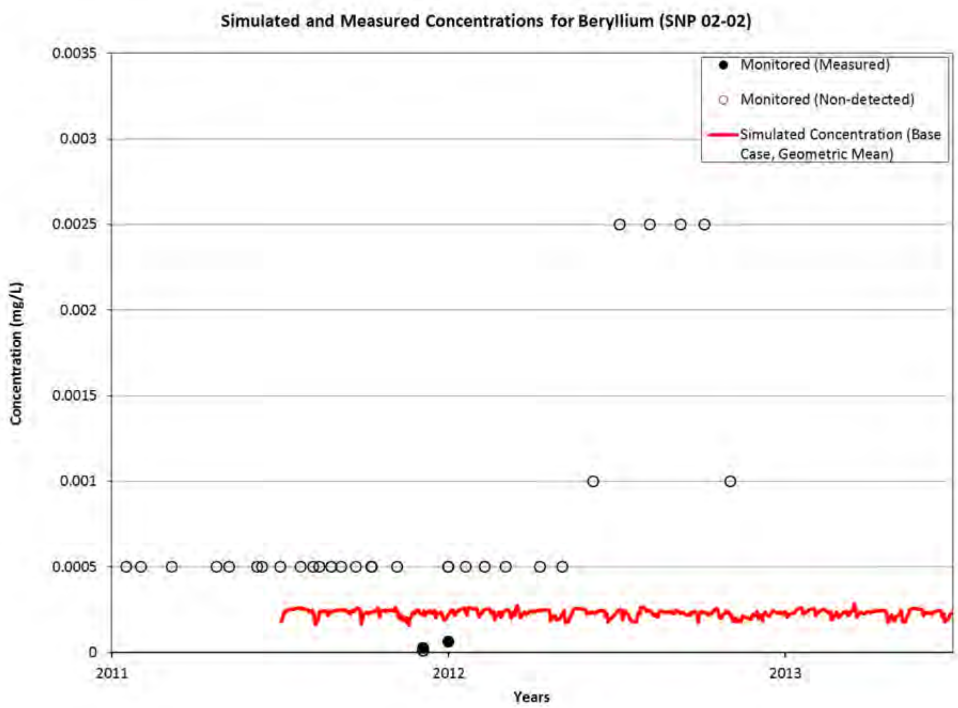


Figure V.2- 7 Simulated and Measured Concentrations for Cadmium (SNP 02-02)

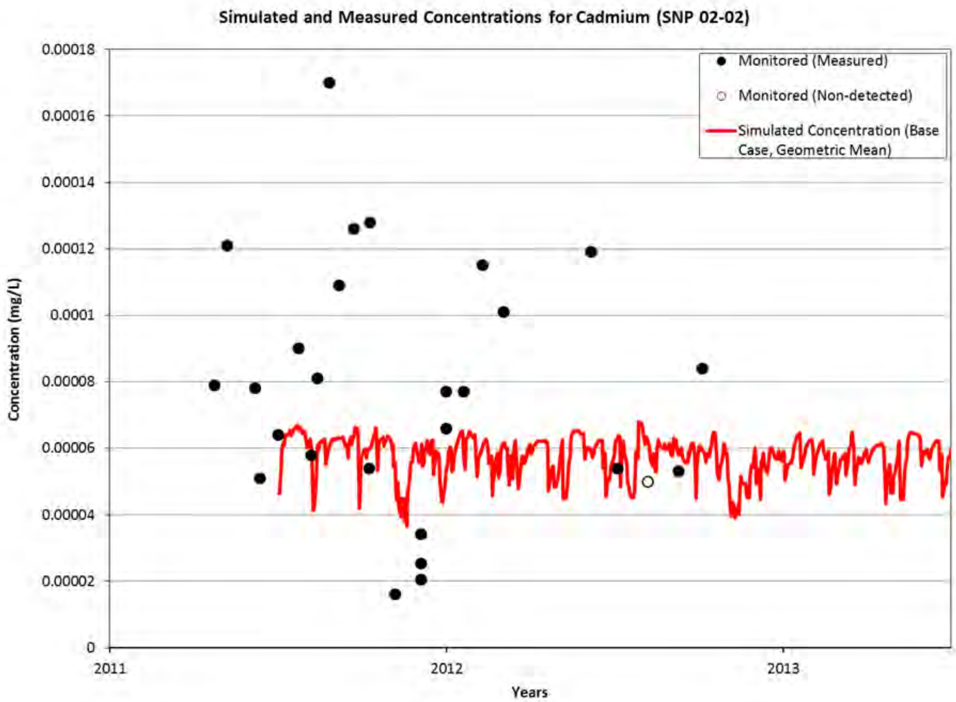


Figure V.2- 8 Simulated and Measured Concentrations for Calcium (SNP 02-02)

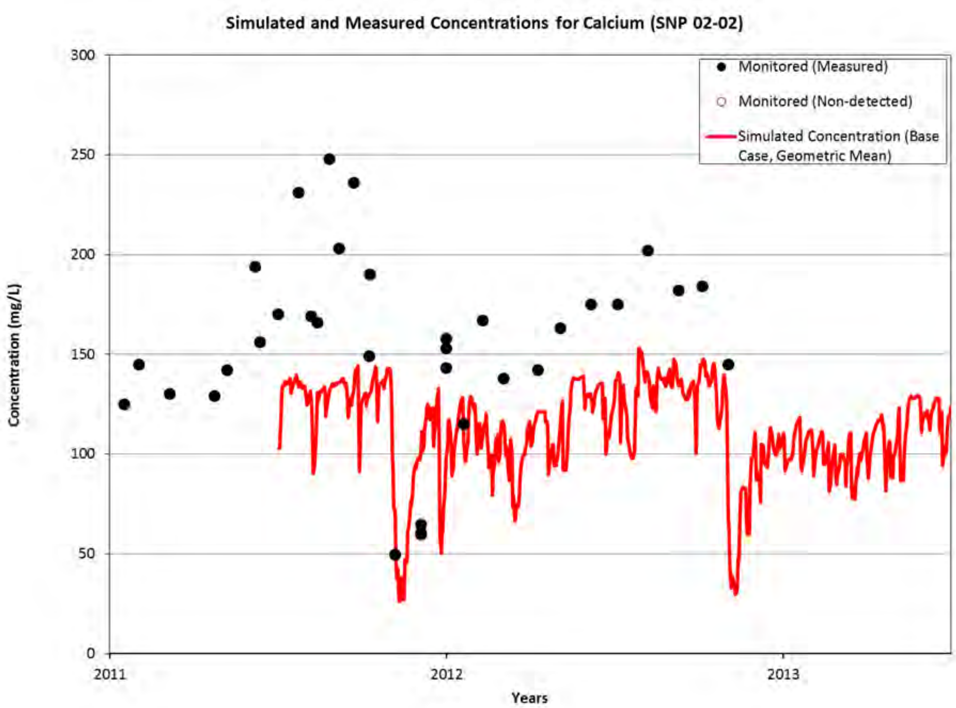


Figure V.2- 9 Simulated and Measured Concentrations for Chloride (SNP 02-02)

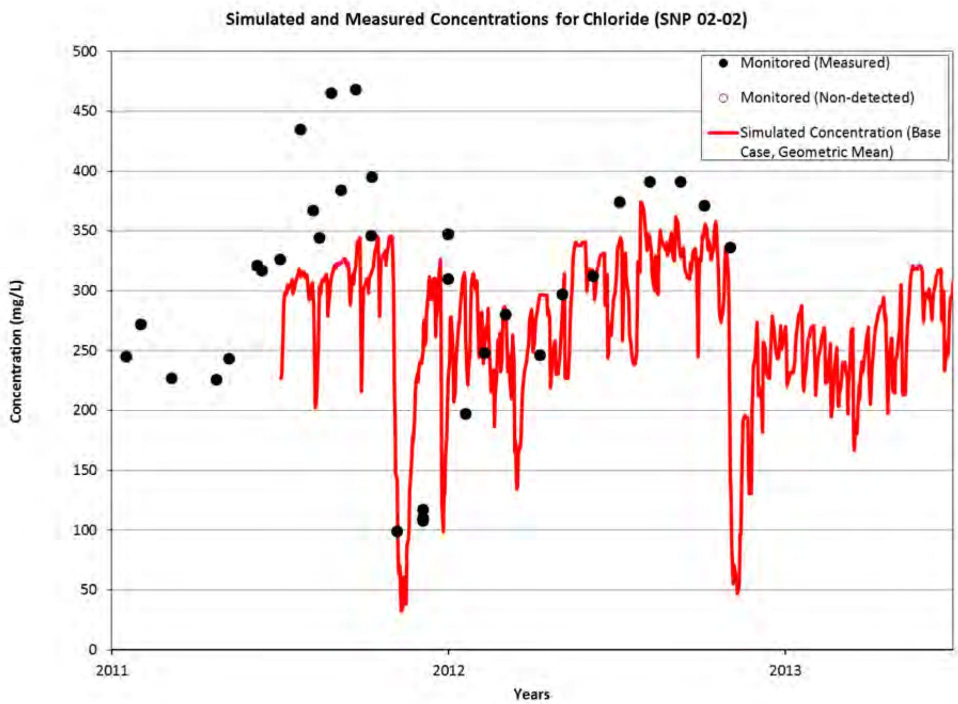


Figure V.2- 10 Simulated and Measured Concentrations for Chromium (SNP 02-02)

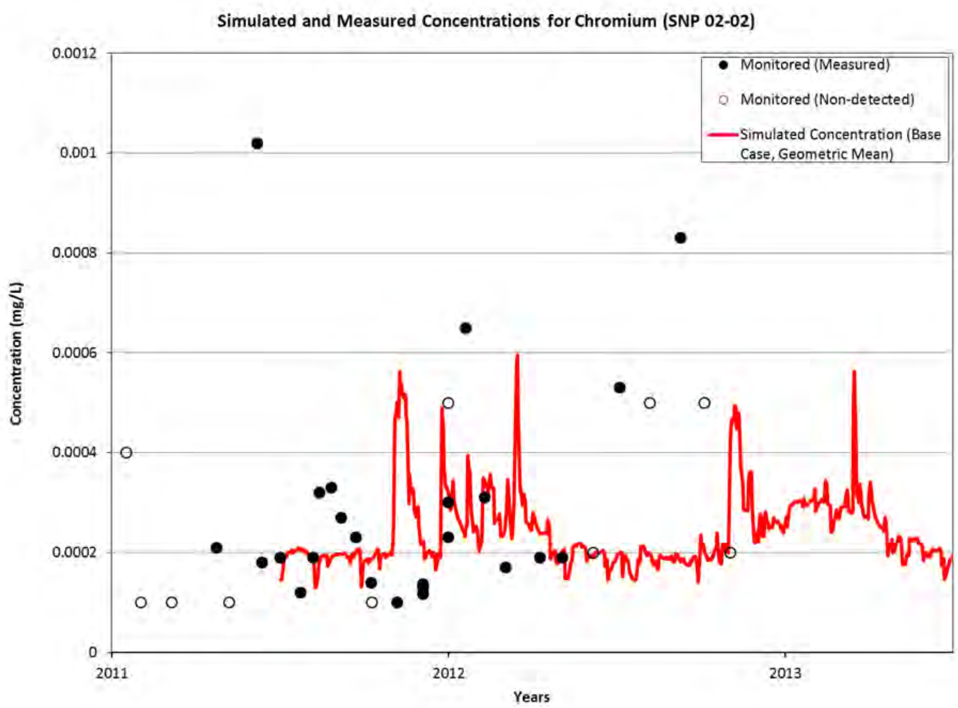


Figure V.2- 11 Simulated and Measured Concentrations for Cobalt (SNP 02-02)

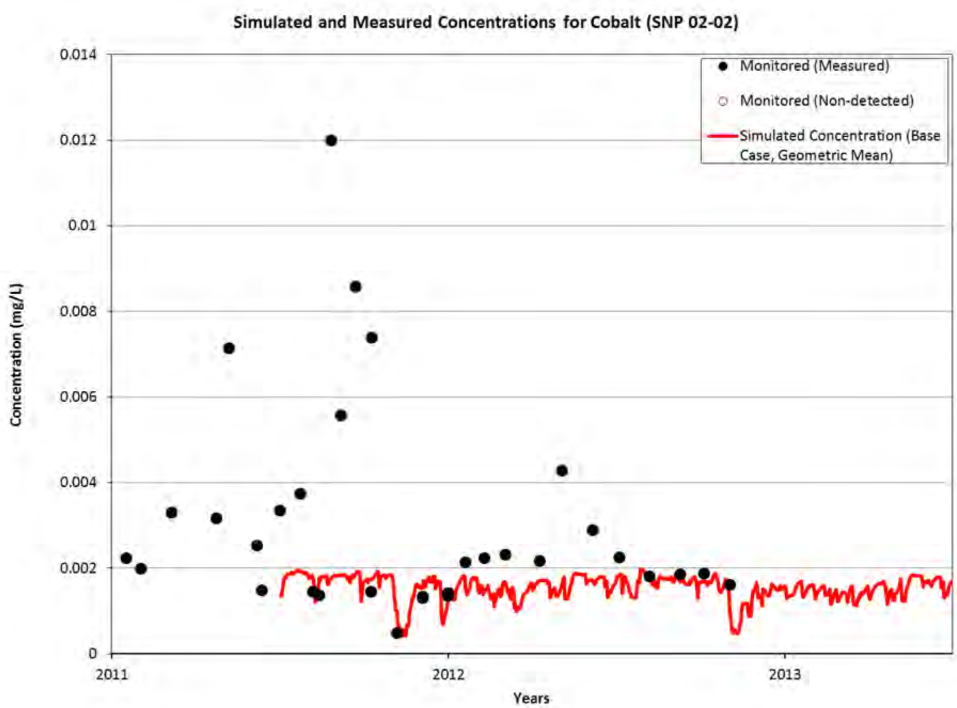


Figure V.2- 12 Simulated and Measured Concentrations for Copper (SNP 02-02)

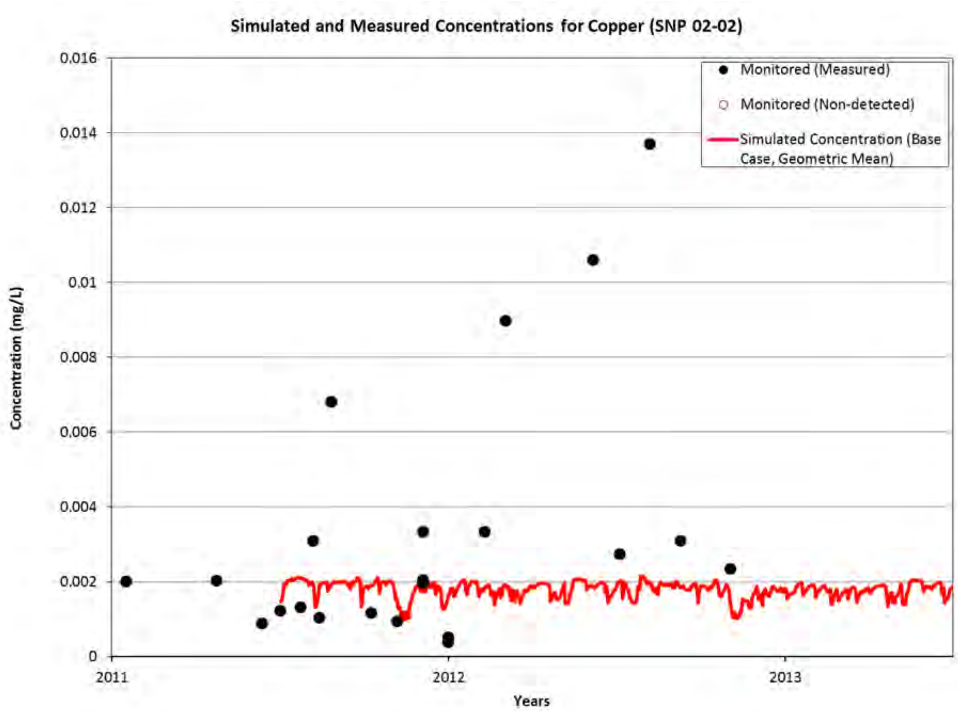


Figure V.2- 13 Simulated and Measured Concentrations for Fluoride (SNP 02-02)

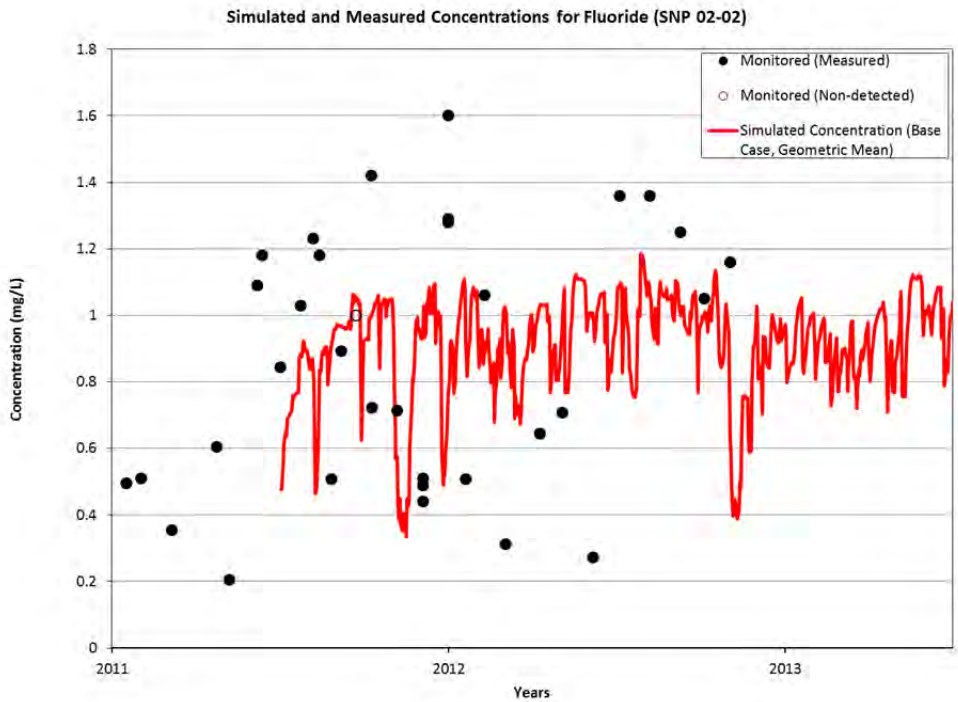


Figure V.2- 14 Simulated and Measured Concentrations for Iron (SNP 02-02)

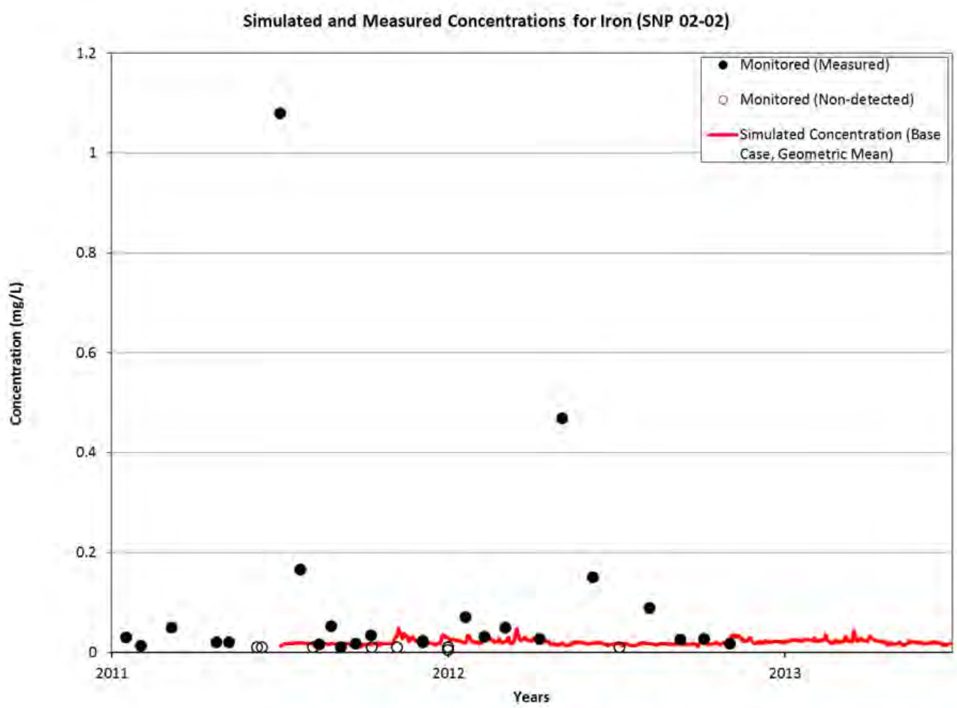


Figure V.2- 15 Simulated and Measured Concentrations for Lead (SNP 02-02)

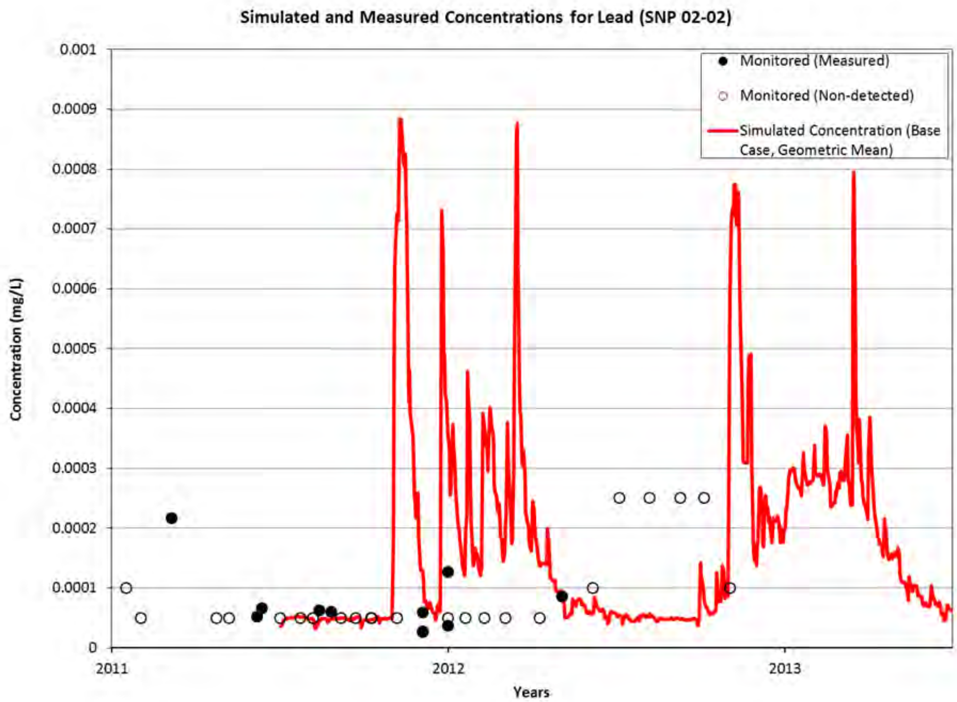


Figure V.2- 16 Simulated and Measured Concentrations for Lithium (SNP 02-02)

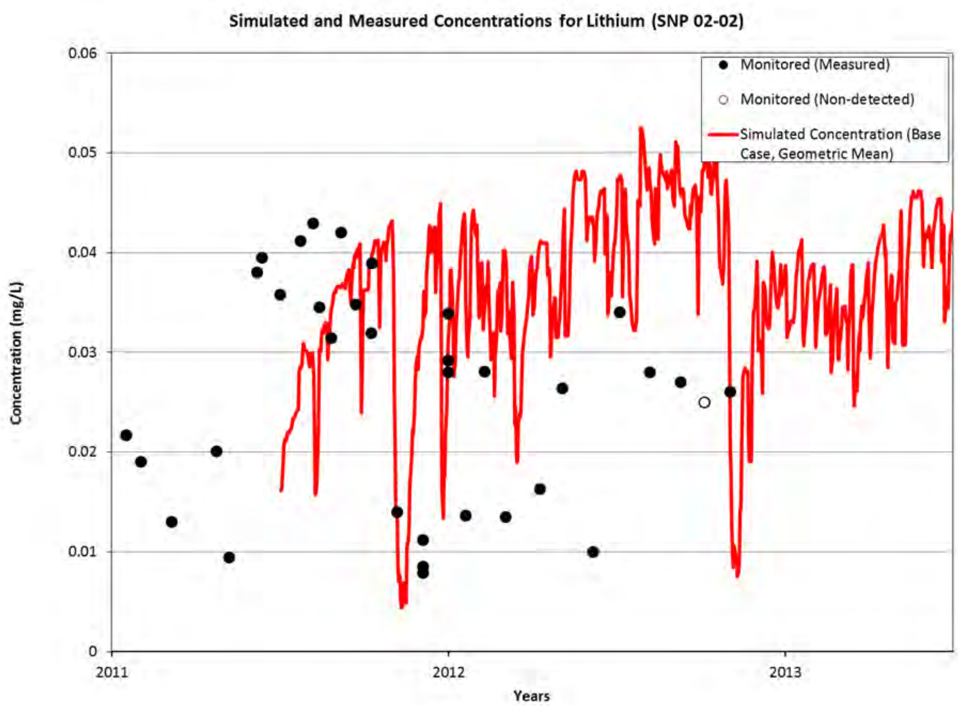


Figure V.2- 17 Simulated and Measured Concentrations for Magnesium (SNP 02-02)

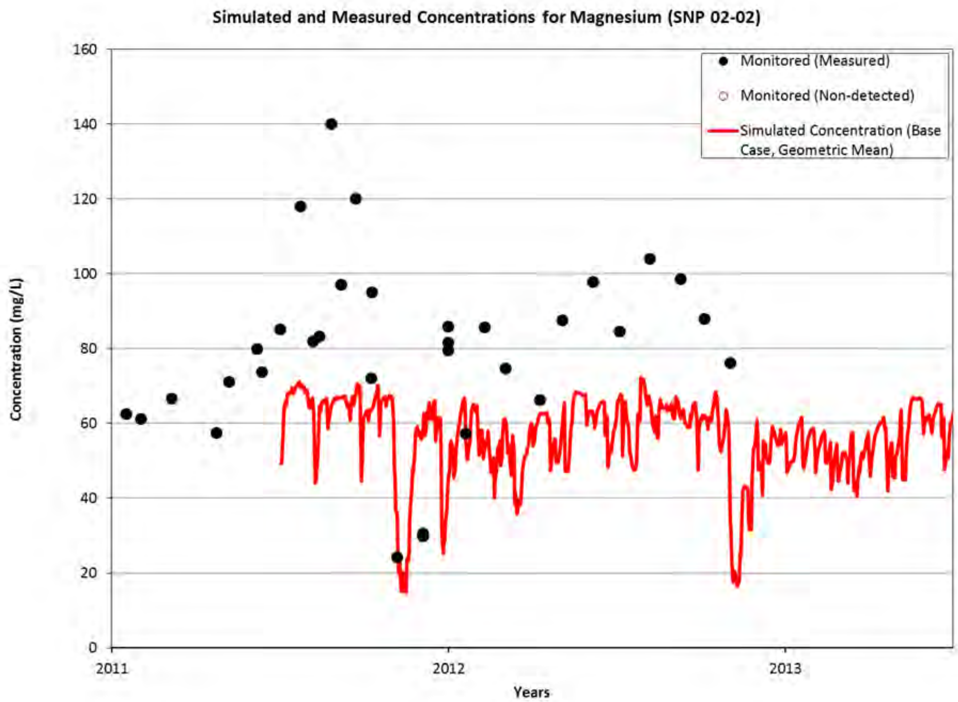


Figure V.2- 18 Simulated and Measured Concentrations for Manganese (SNP 02-02)

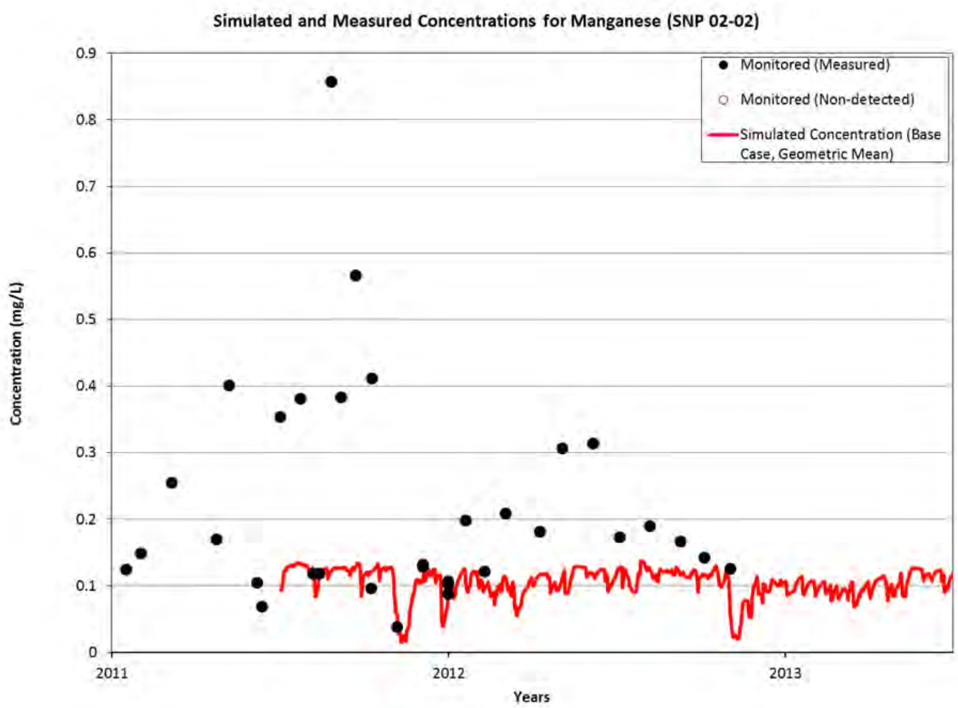


Figure V.2- 19 Simulated and Measured Concentrations for Mercury (SNP 02-02)

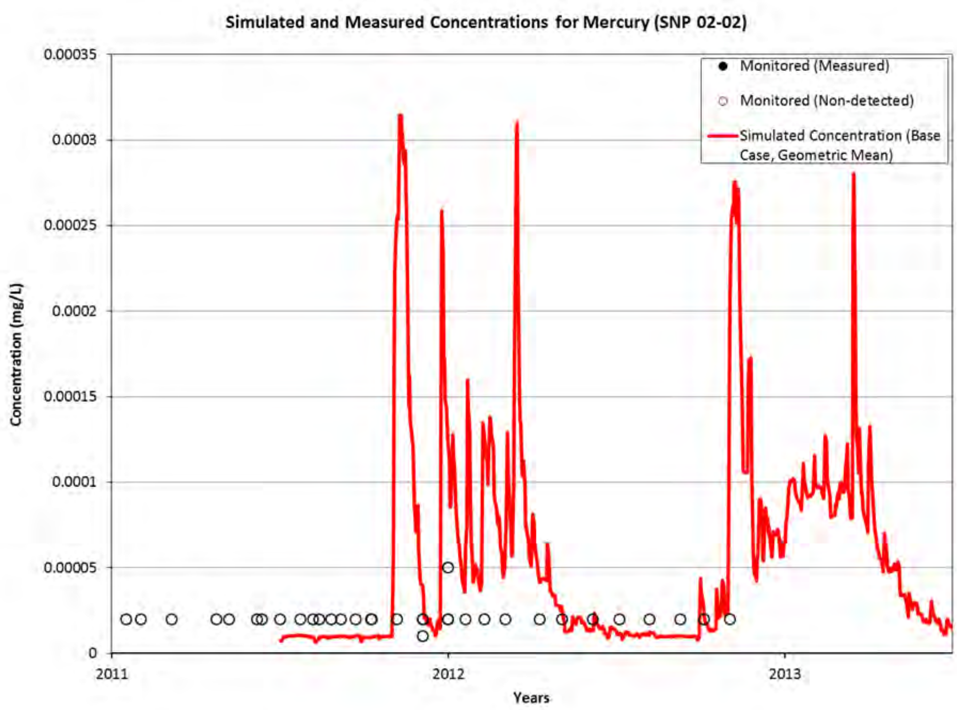


Figure V.2- 20 Simulated and Measured Concentrations for Molybdenum (SNP 02-02)

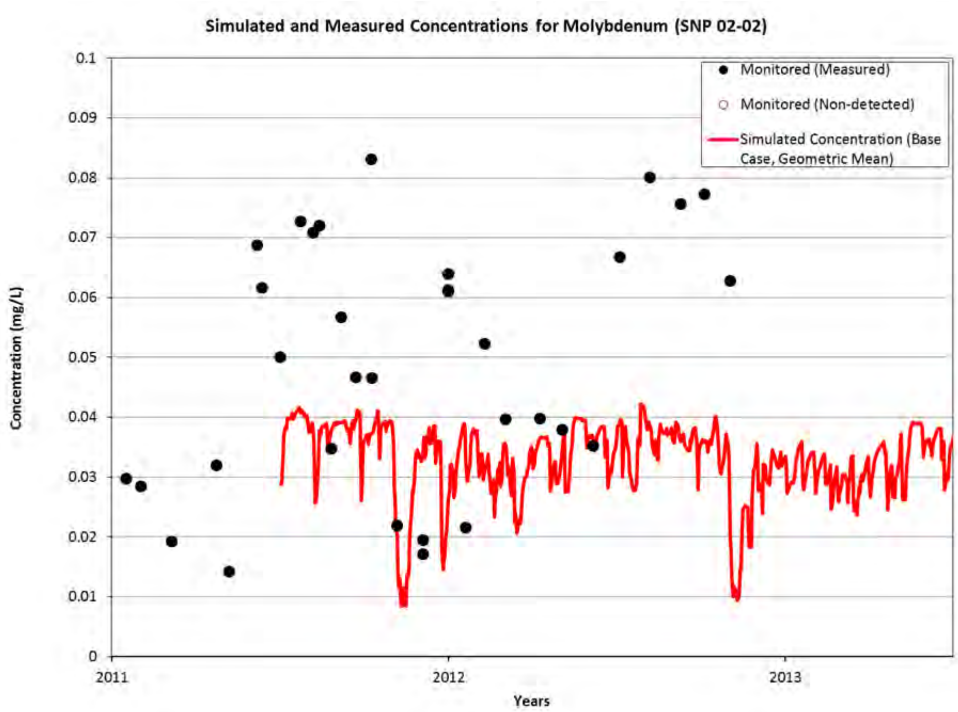


Figure V.2- 21 Simulated and Measured Concentrations for Nickel (SNP 02-02)

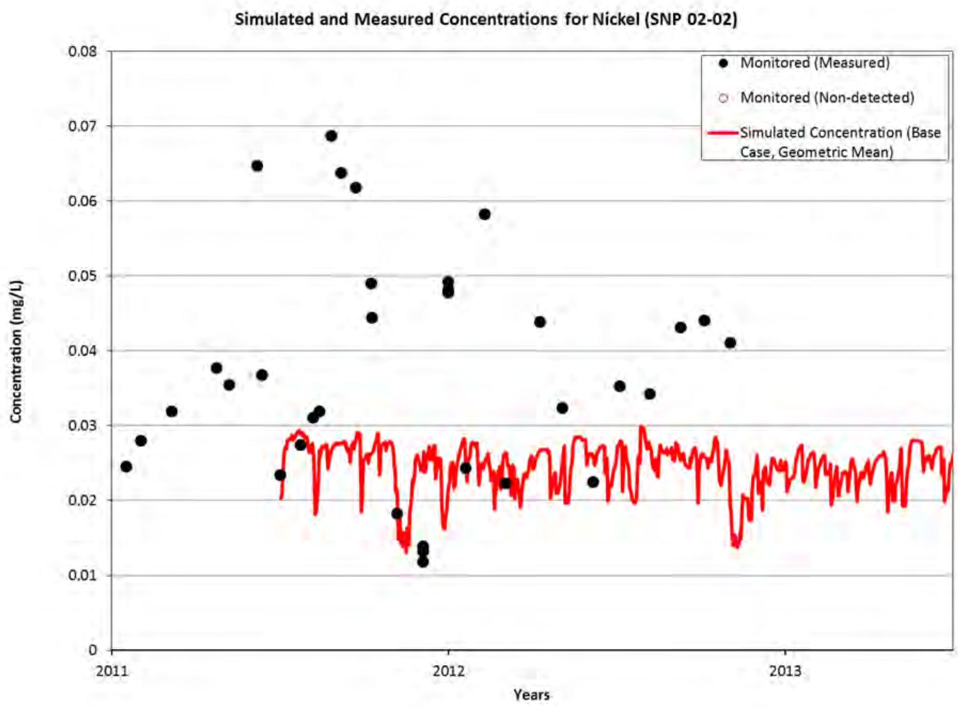


Figure V.2- 22 Simulated and Measured Concentrations for Nitrate/Nitrite, as N (SNP 02-02)

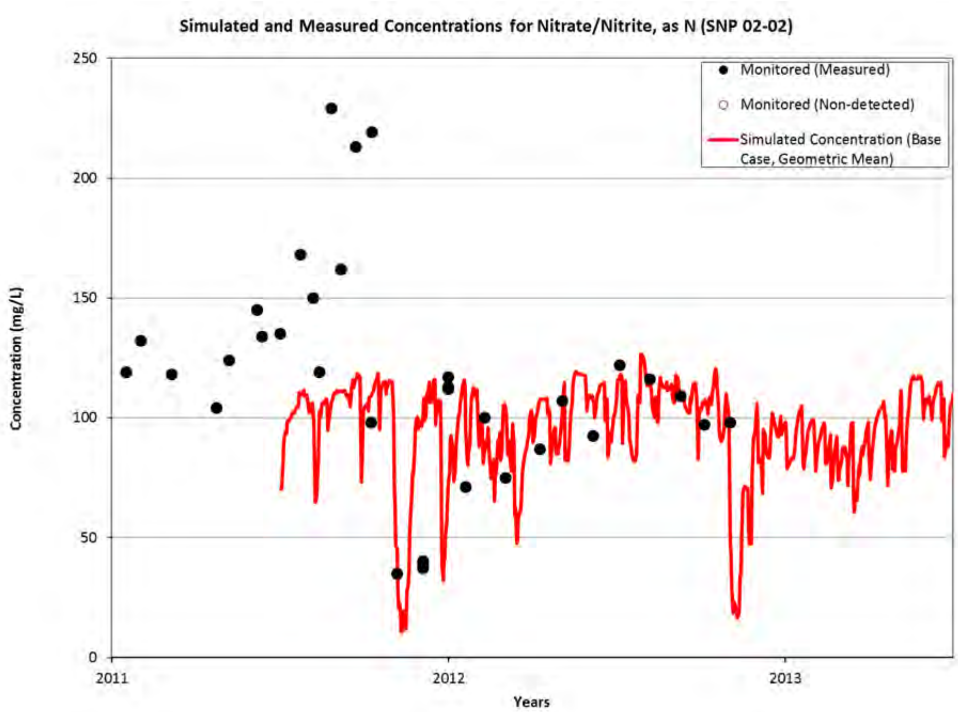


Figure V.2- 23 Simulated and Measured Concentrations for Ortho-Phosphate, as P (SNP 02-02)

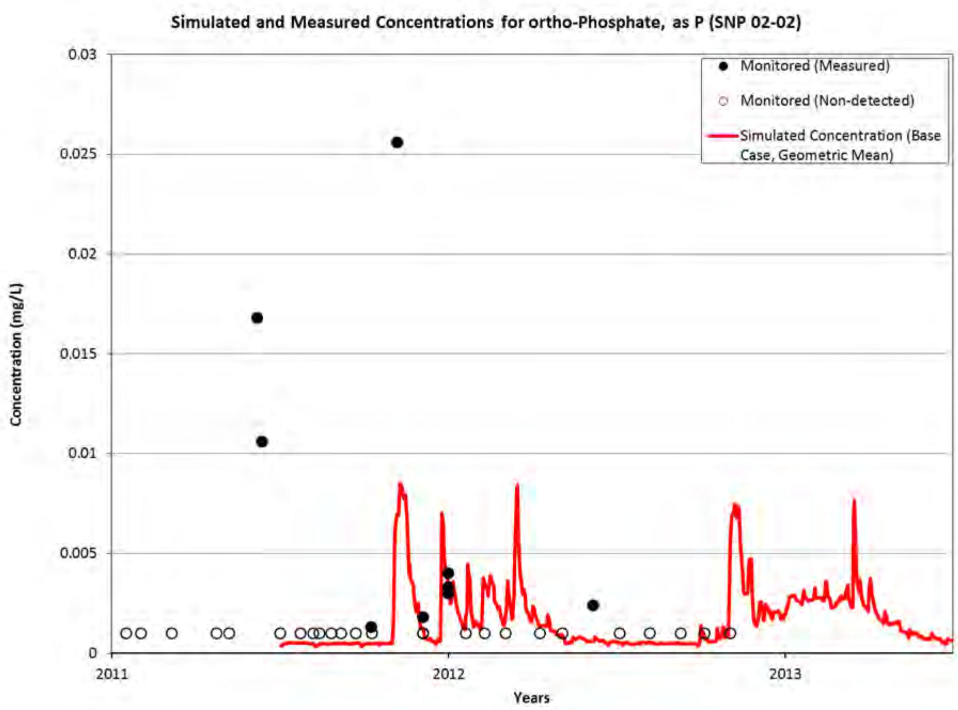


Figure V.2- 24 Simulated and Measured Concentrations for Potassium (SNP 02-02)

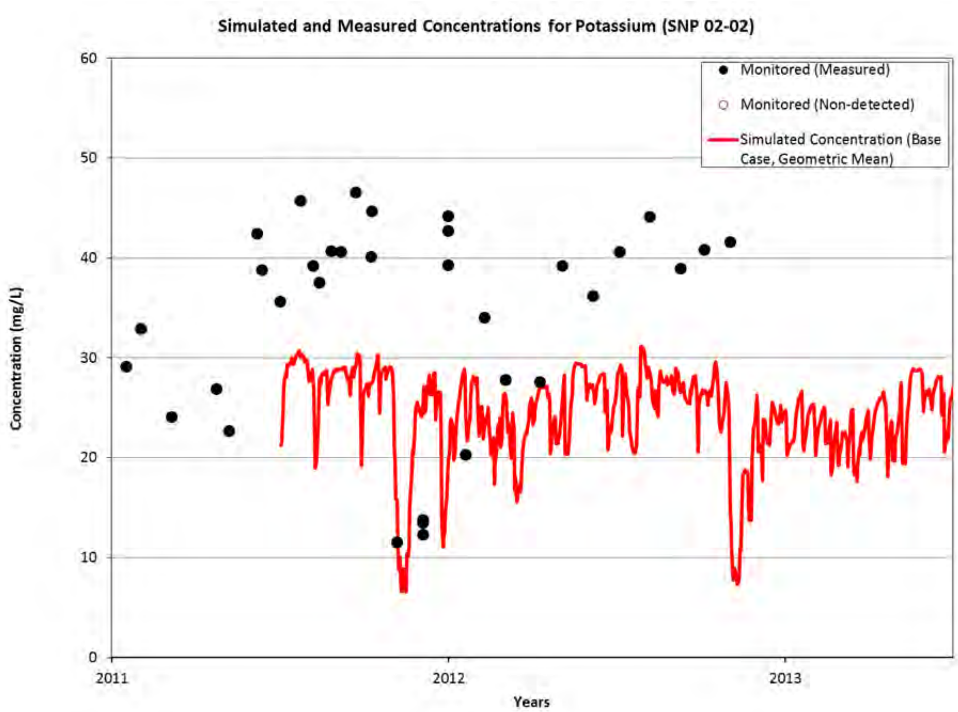


Figure V.2- 25 Simulated and Measured Concentrations for Reactive Silica, as SiO_2 (SNP 02-02)

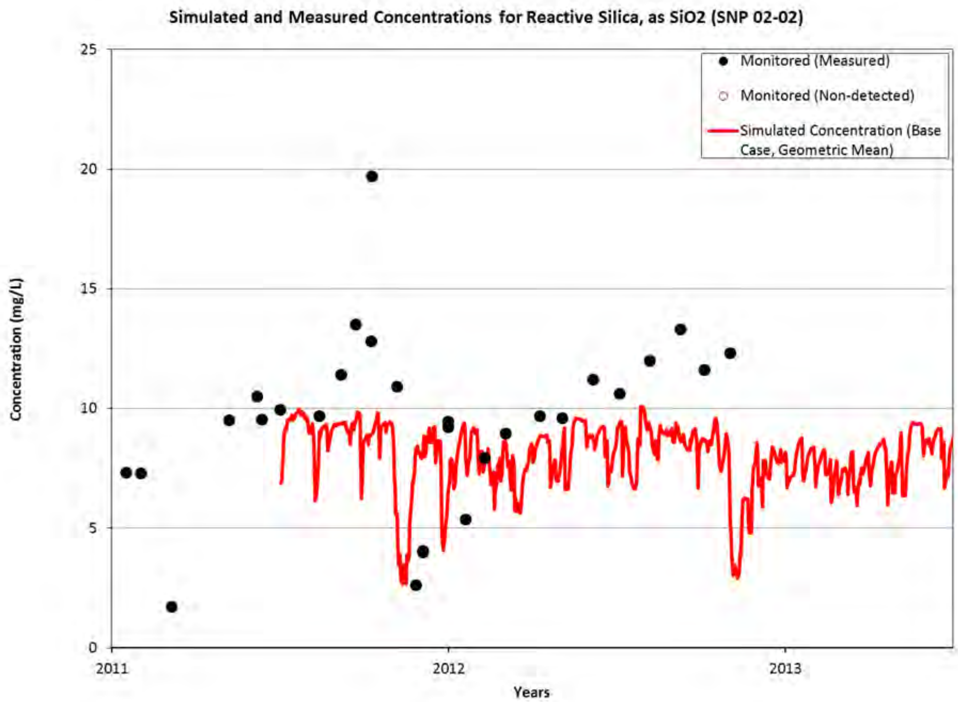


Figure V.2- 26 Simulated and Measured Concentrations for Selenium (SNP 02-02)

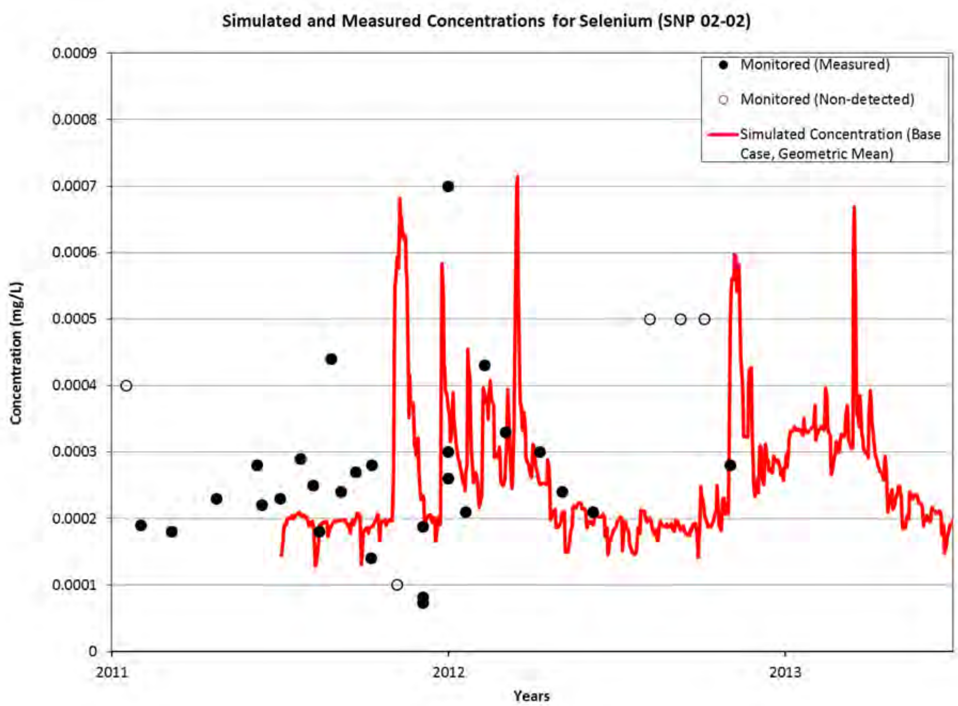


Figure V.2- 27 Simulated and Measured Concentrations for Silver (SNP 02-02)

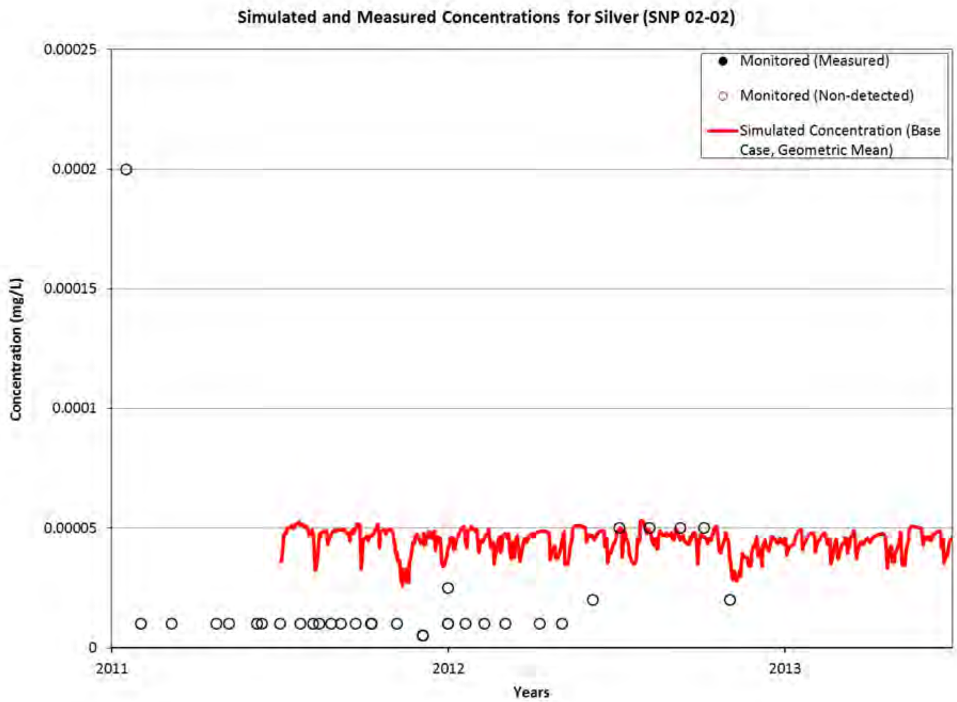


Figure V.2- 28 Simulated and Measured Concentrations for Sodium (SNP 02-02)

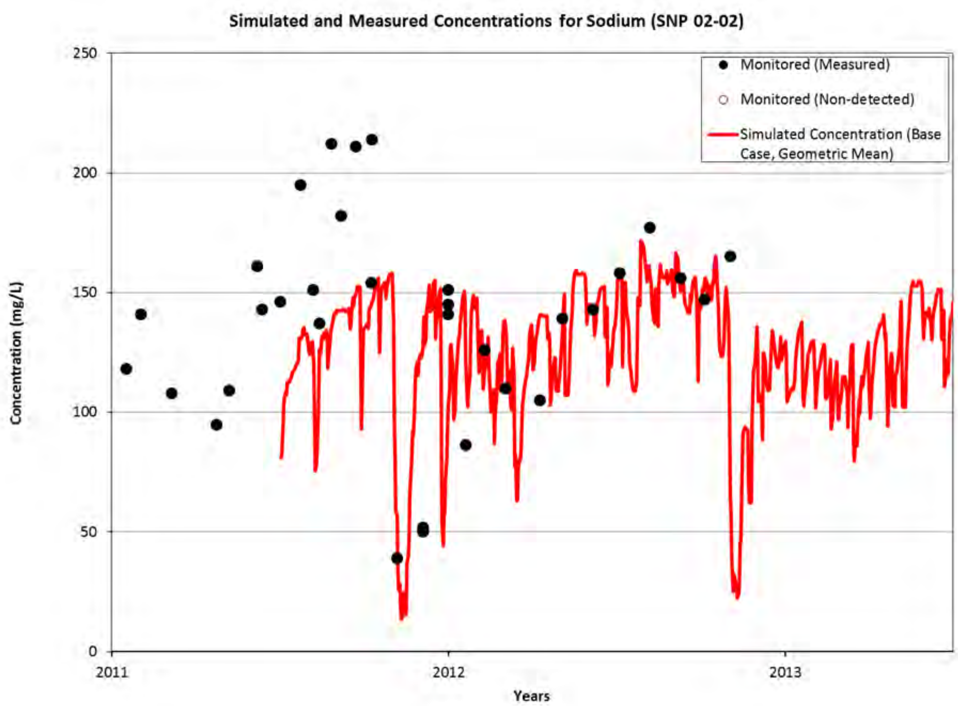


Figure V.2- 29 Simulated and Measured Concentrations for Strontium (SNP 02-02)

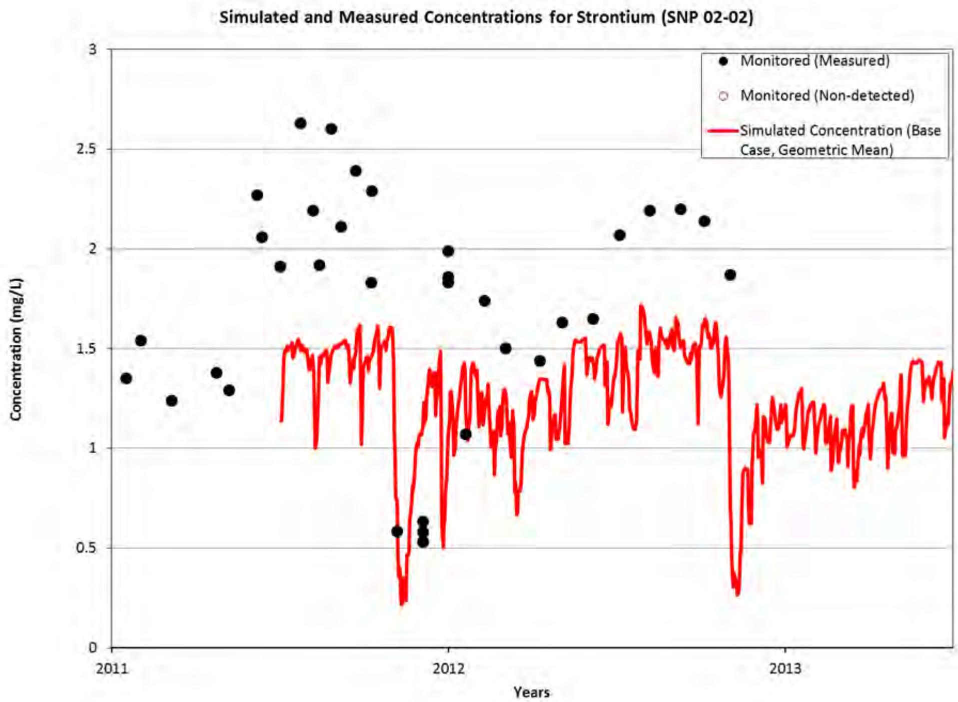


Figure V.2- 30 Simulated and Measured Concentrations for Sulphate (SNP 02-02)

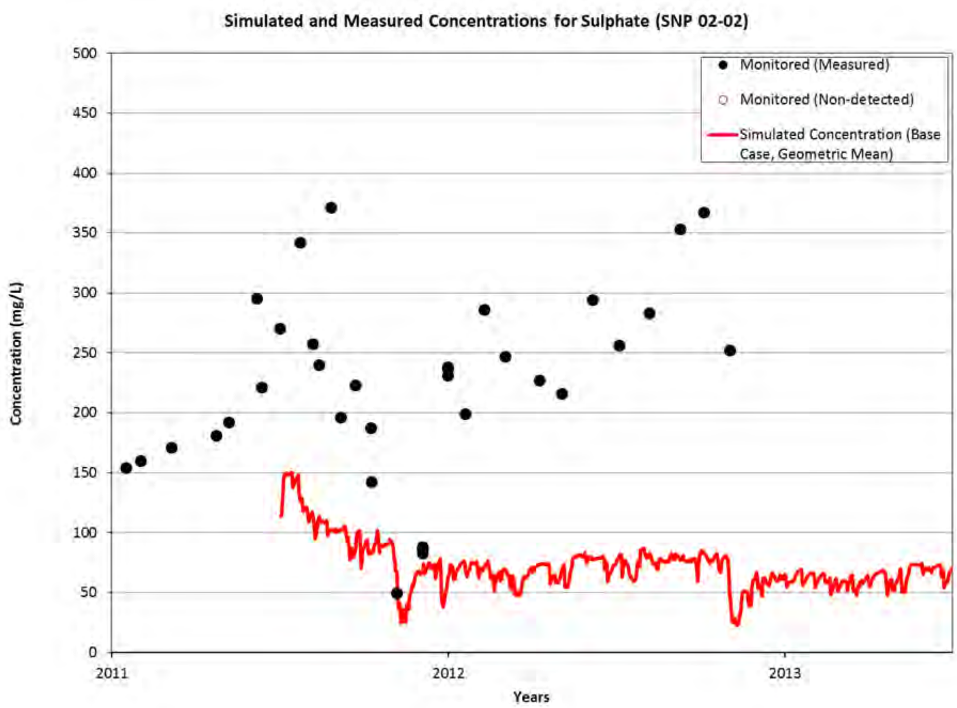


Figure V.2- 31 Simulated and Measured Concentrations for Thallium (SNP 02-02)

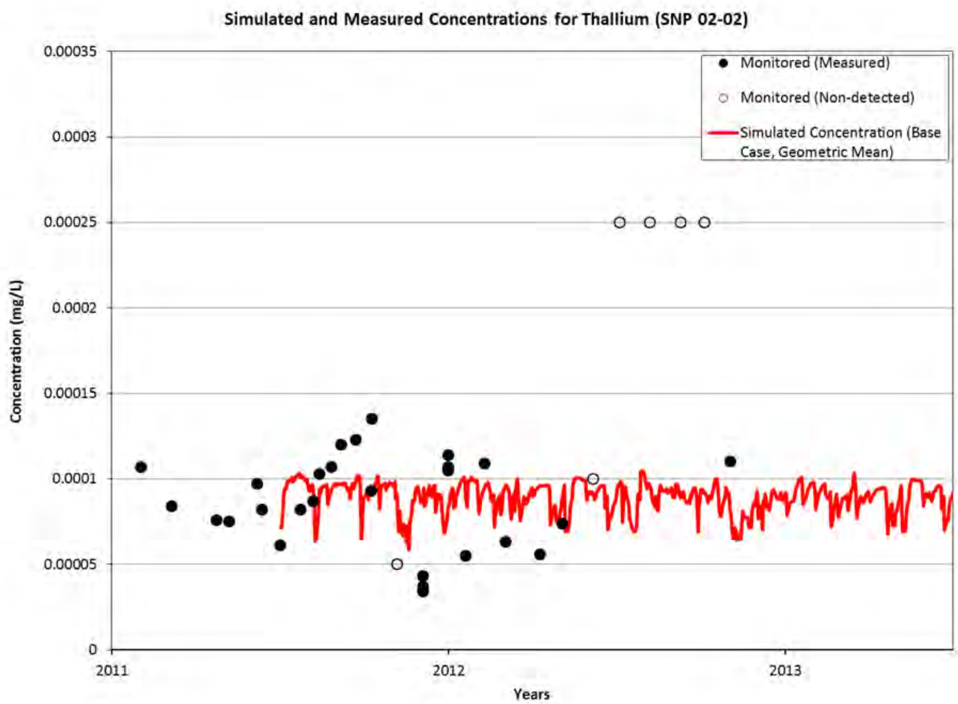


Figure V.2- 32 Simulated and Measured Concentrations for Total Ammonia, as N (SNP 02-02)

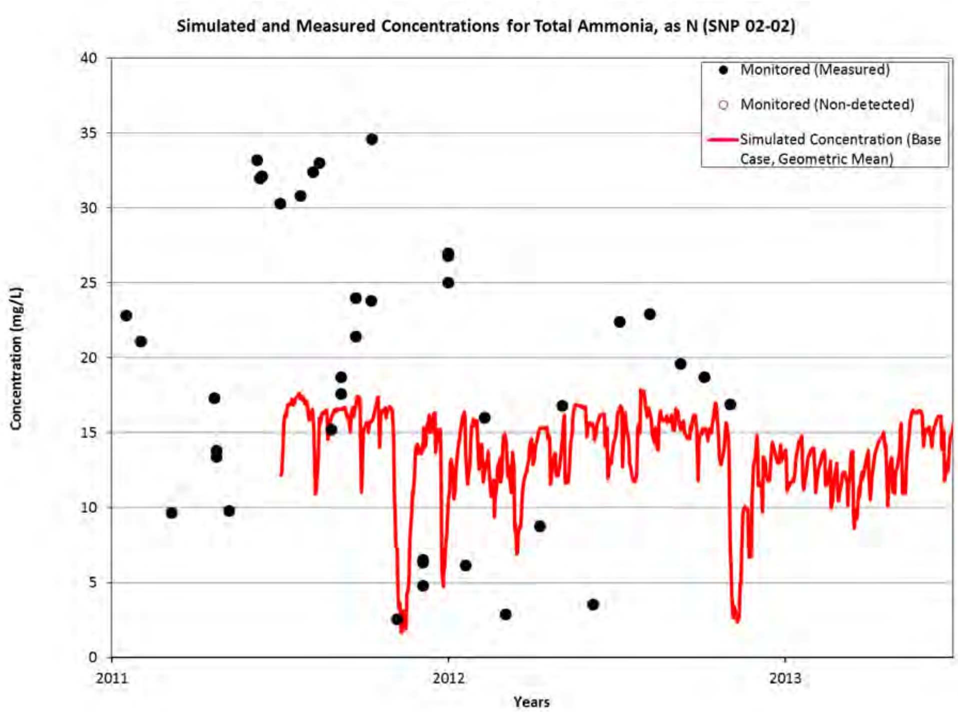


Figure V.2- 33 Simulated and Measured Concentrations for Total Dissolved Solids (SNP 02-02)

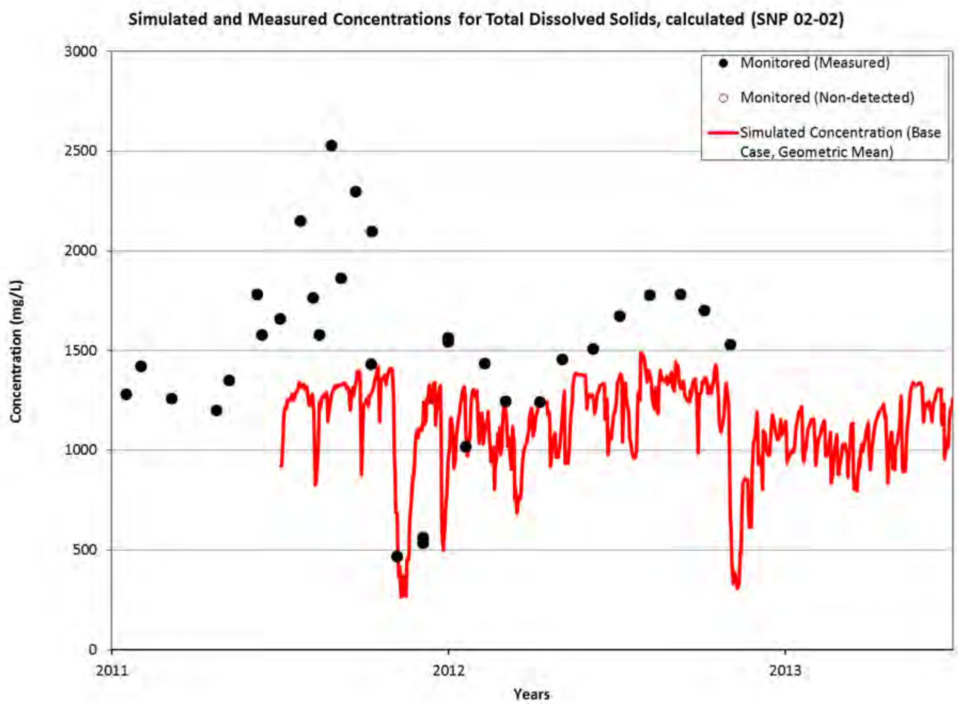


Figure V.2- 34 Simulated and Measured Concentrations for Total Kjeldahl Nitrogen (SNP 02-02)

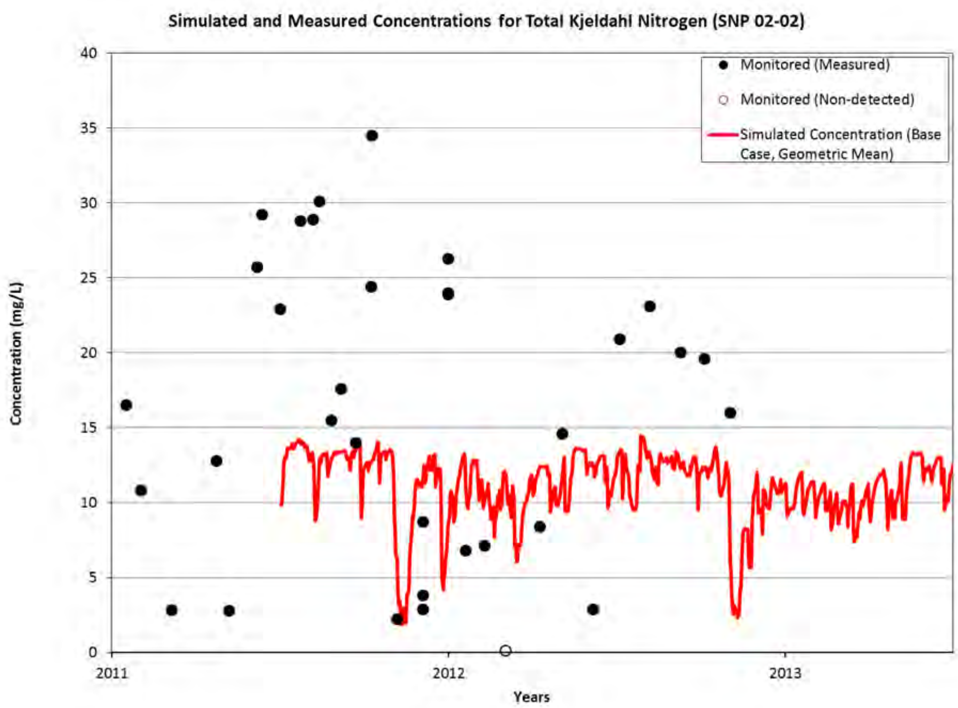


Figure V.2- 35 Simulated and Measured Concentrations for Total Phosphorus (SNP 02-02)

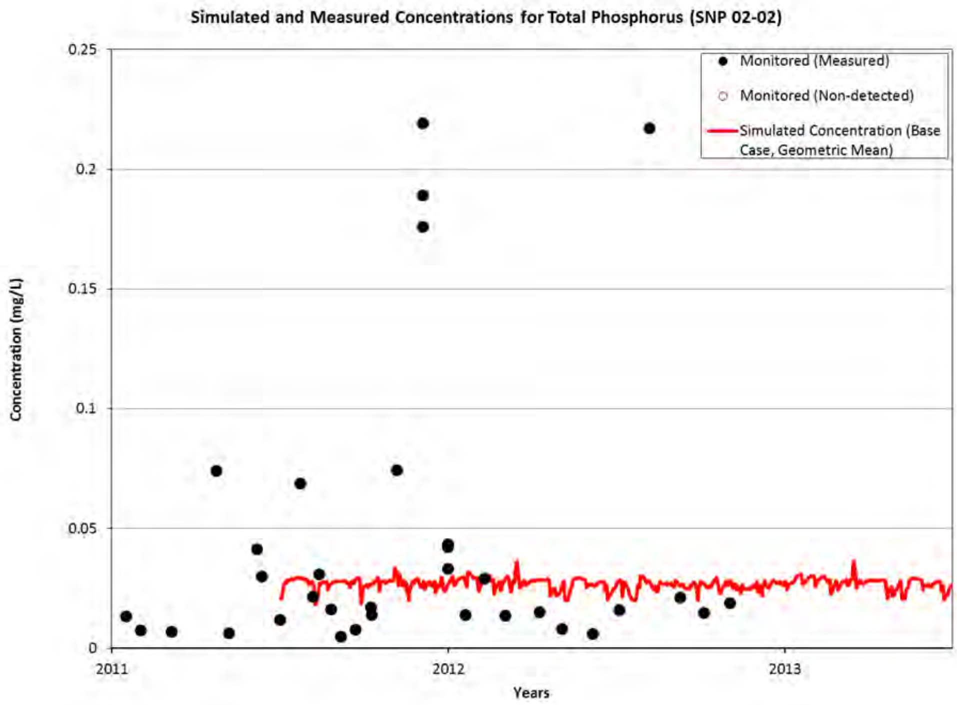


Figure V.2- 36 Simulated and Measured Concentrations for Total Suspended Solids (SNP 02-02)

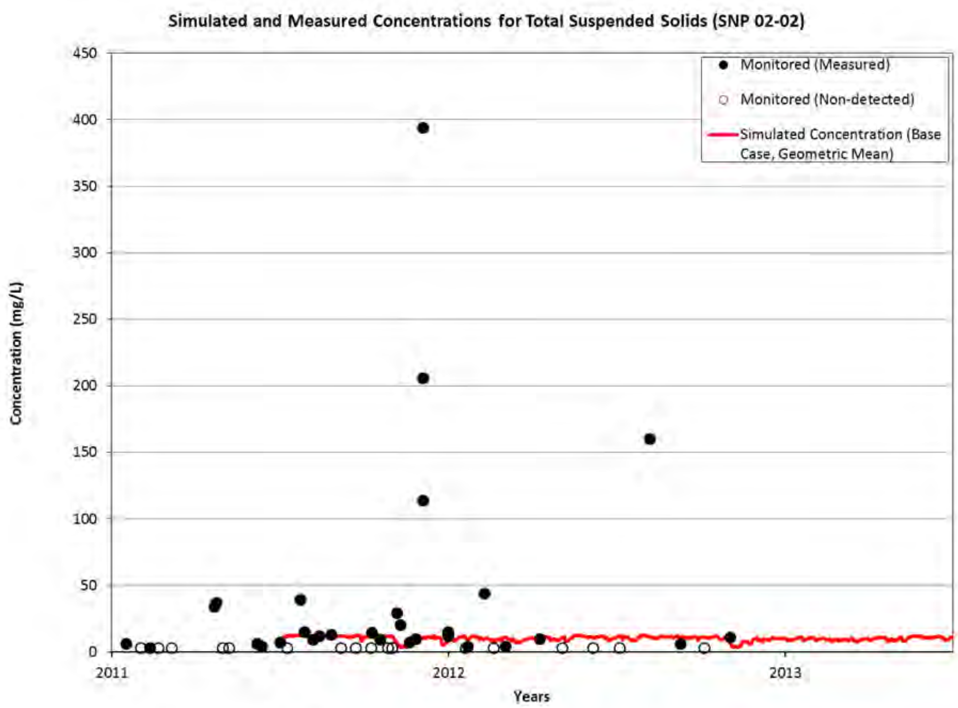


Figure V.2- 37 Simulated and Measured Concentrations for Uranium (SNP 02-02)

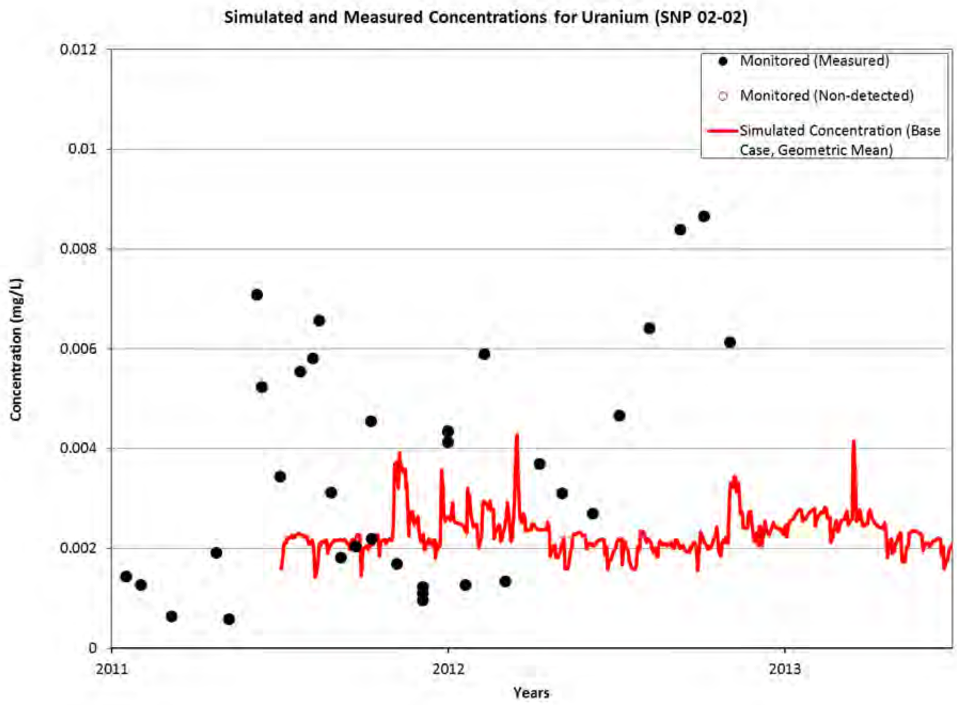


Figure V.2- 38 Simulated and Measured Concentrations for Vanadium (SNP 02-02)

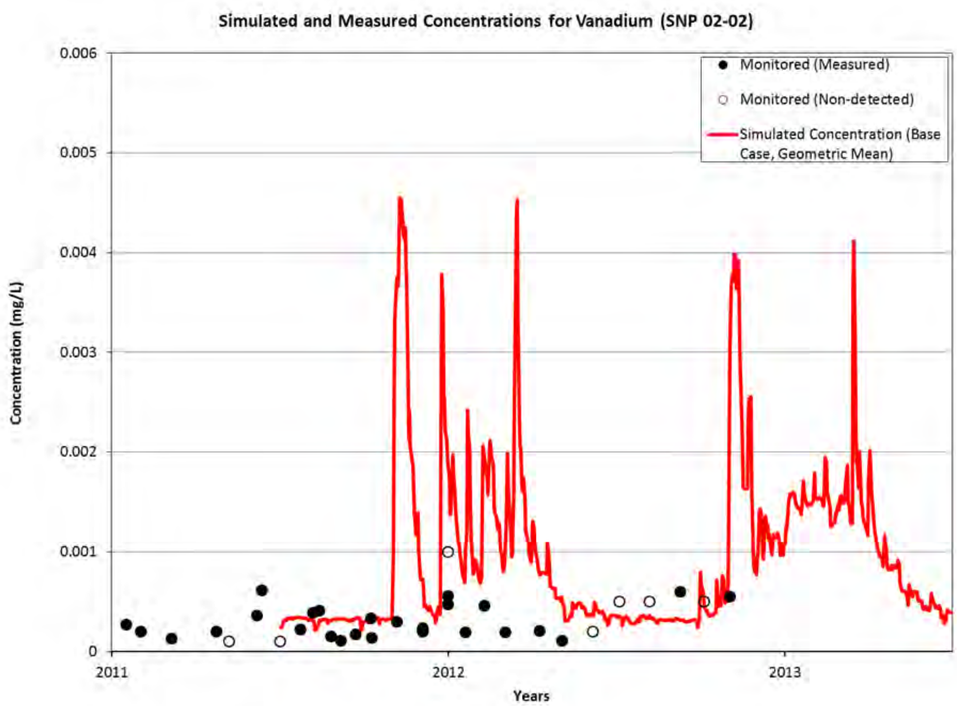
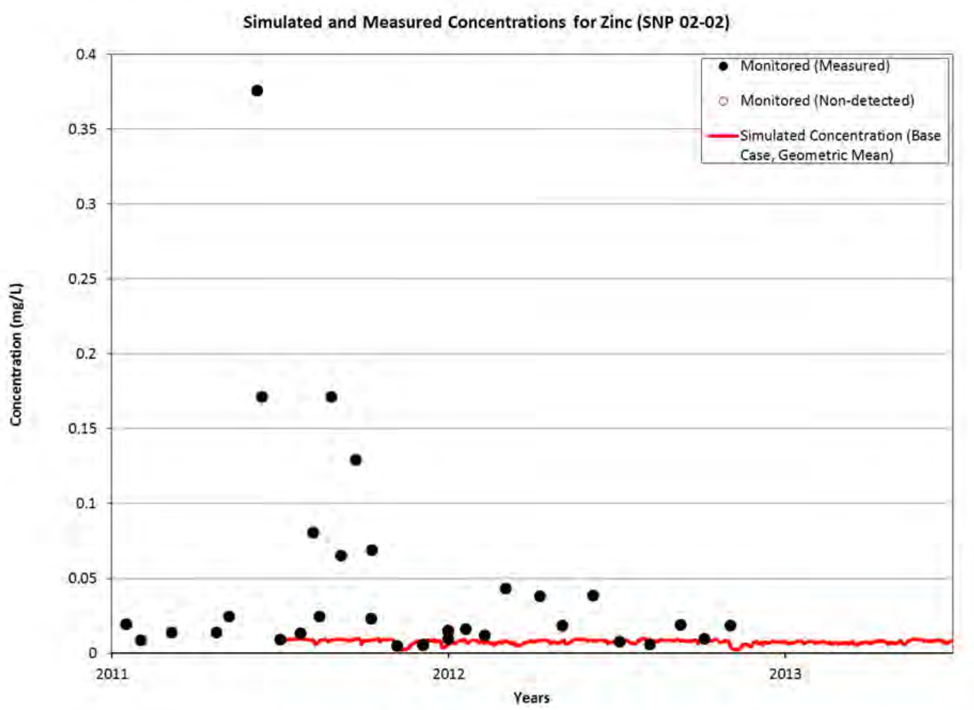


Figure V.2- 39 Simulated and Measured Concentrations for Zinc (SNP 02-02)



V.3 FINAL DISCHARGE (SNP 02-17B)

Figure V.3- 1 Simulated and Measured Concentrations for Alkalinity (as $CaCO_3$) (SNP 02-17B)

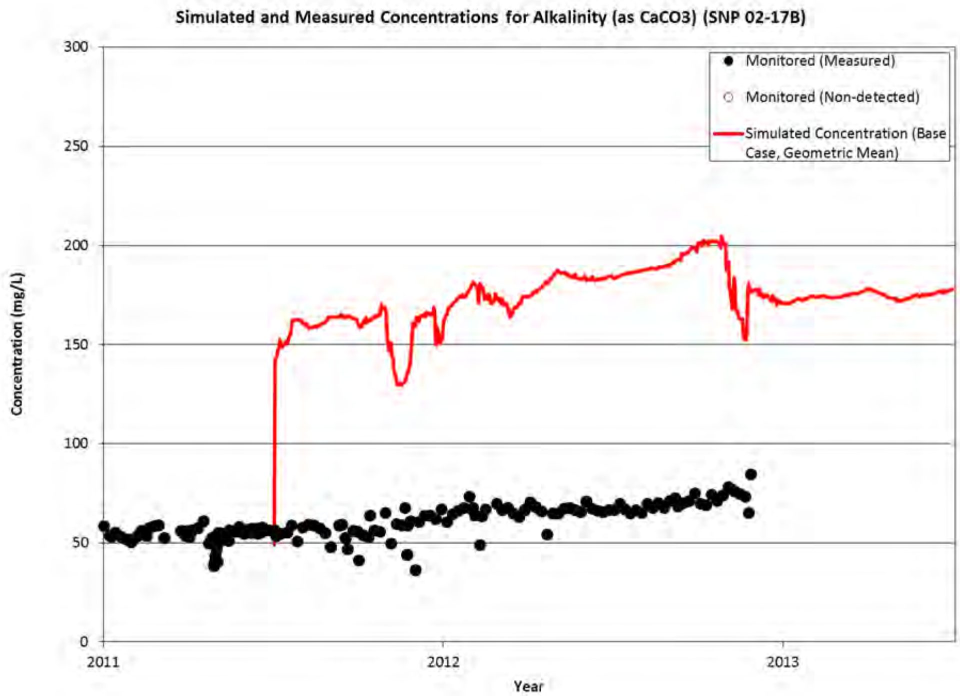


Figure V.3- 2 Simulated and Measured Concentrations for Aluminum (SNP 02-17B)

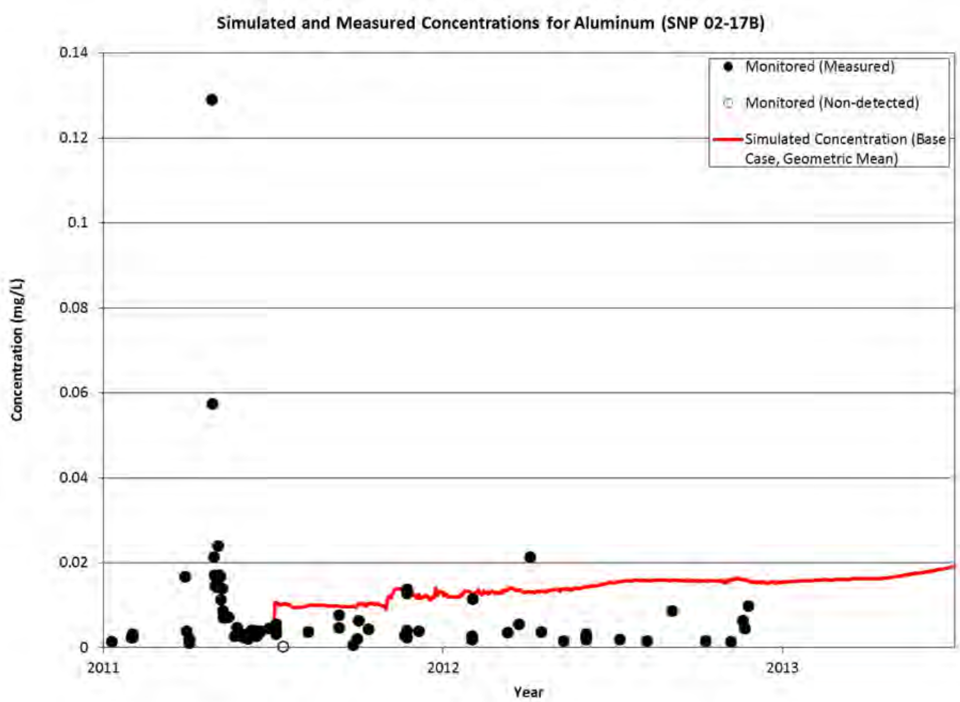


Figure V.3- 3 Simulated and Measured Concentrations for Antimony (SNP 02-17B)

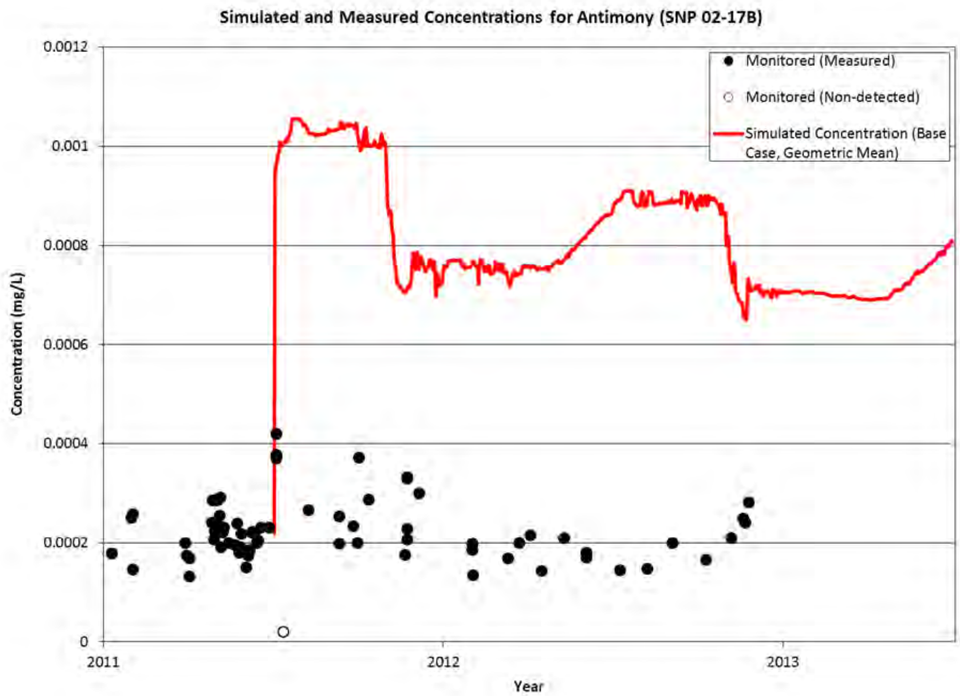


Figure V.3- 4 Simulated and Measured Concentrations for Arsenic (SNP 02-17B)

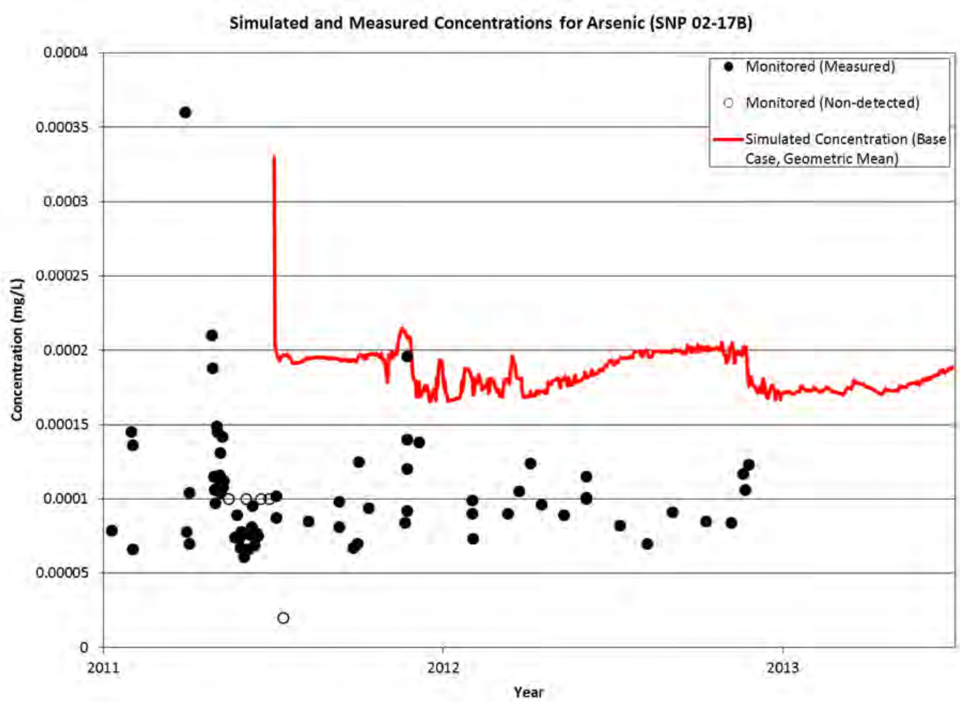


Figure V.3- 5 Simulated and Measured Concentrations for Barium (SNP 02-17B)

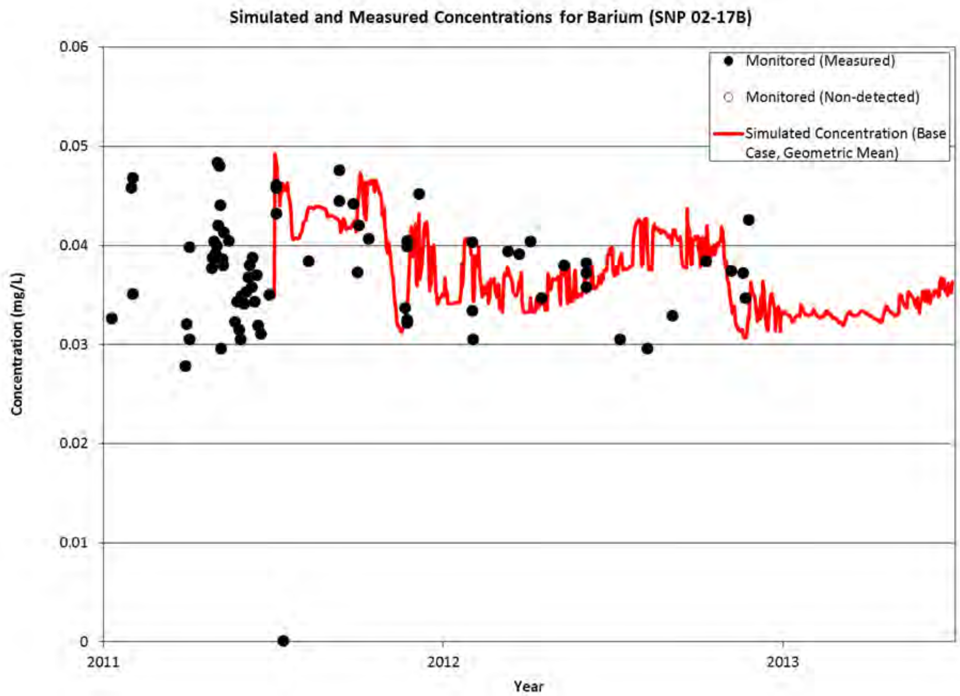


Figure V.3- 6 Simulated and Measured Concentrations for Beryllium (SNP 02-17B)

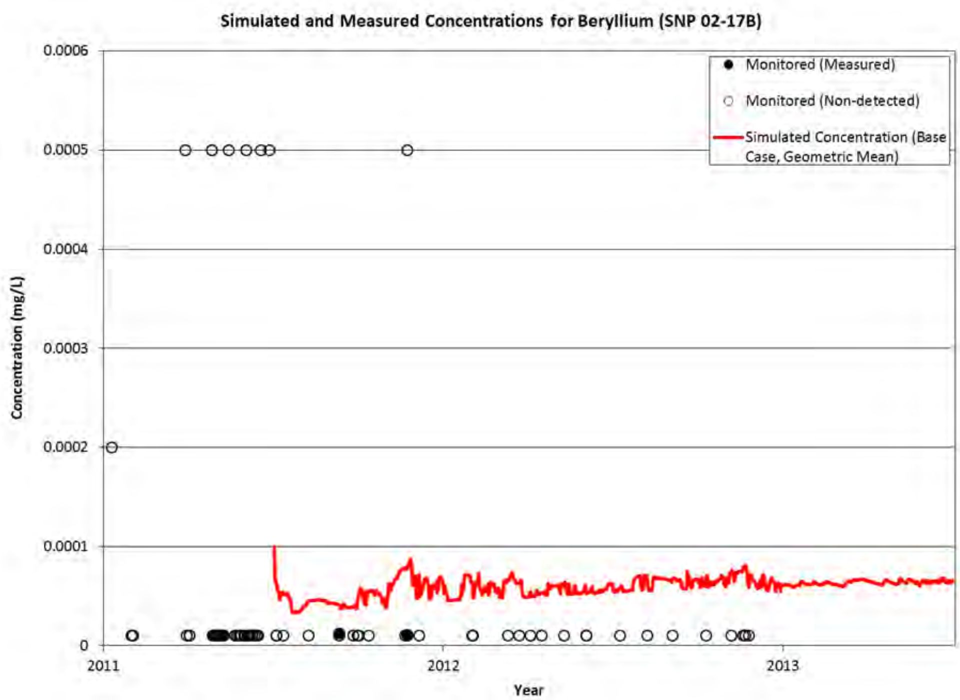


Figure V.3- 7 Simulated and Measured Concentrations for Cadmium (SNP 02-17B)

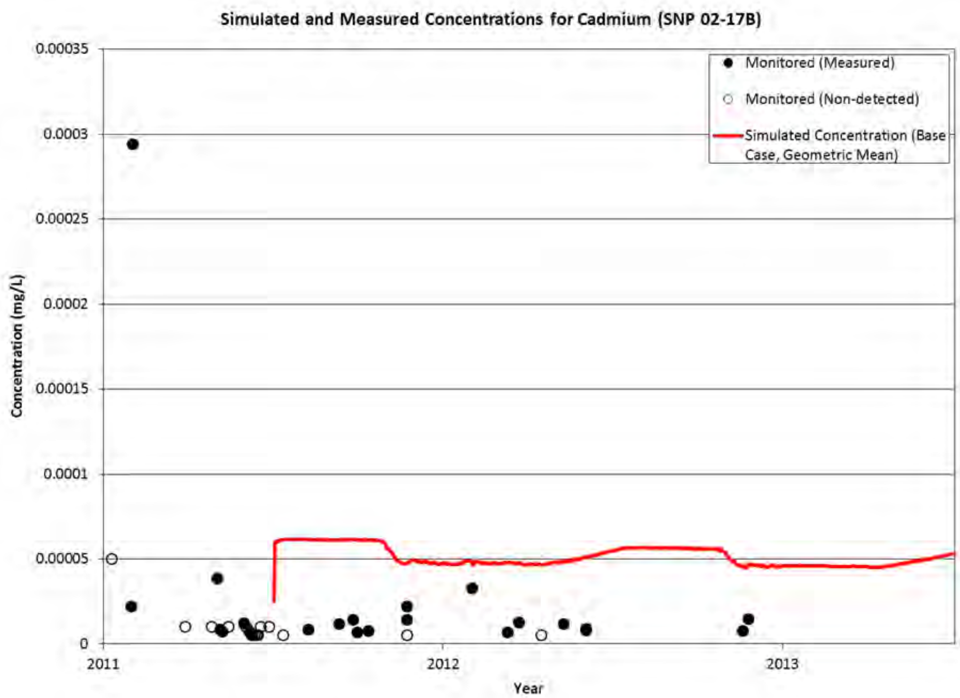


Figure V.3- 8 Simulated and Measured Concentrations for Calcium (SNP 02-17B)

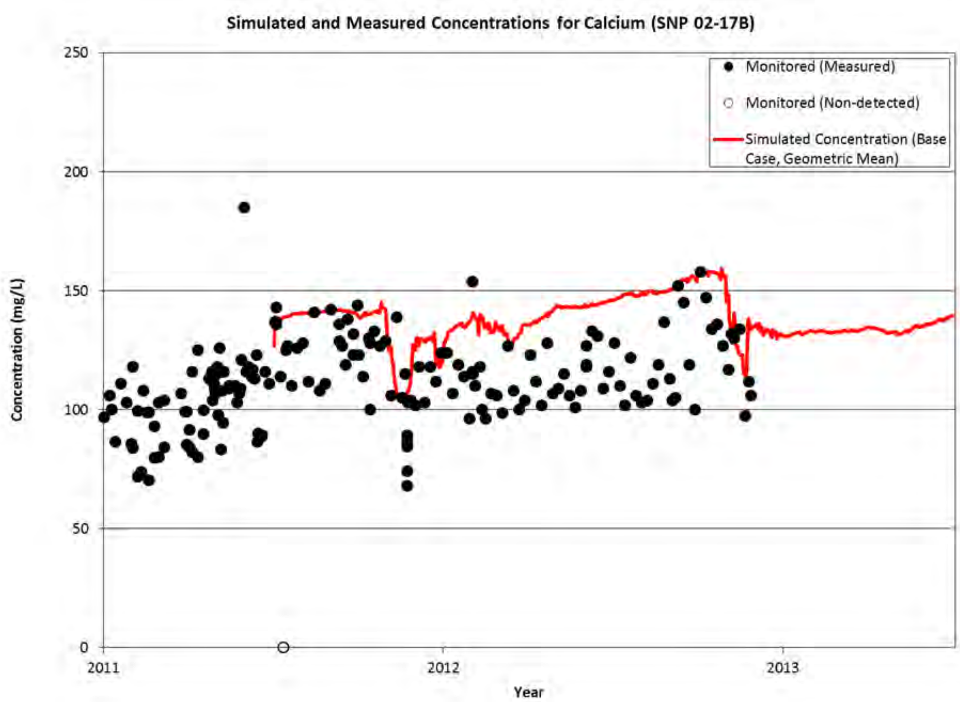


Figure V.3- 9 Simulated and Measured Concentrations for Chloride (SNP 02-17B)

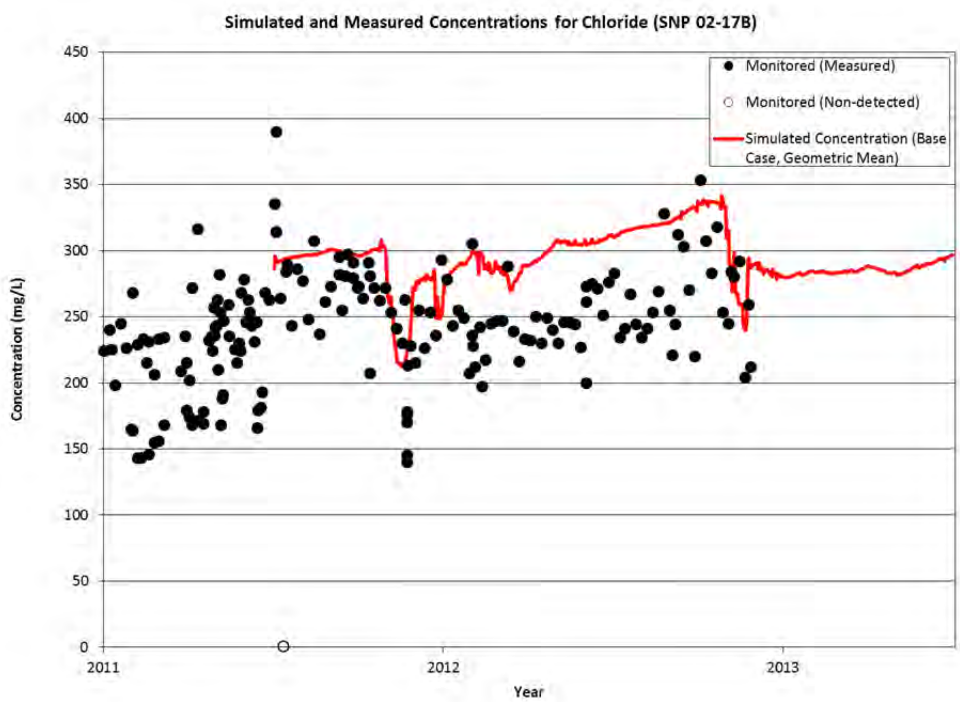


Figure V.3- 10 Simulated and Measured Concentrations for Chromium (SNP 02-17B)

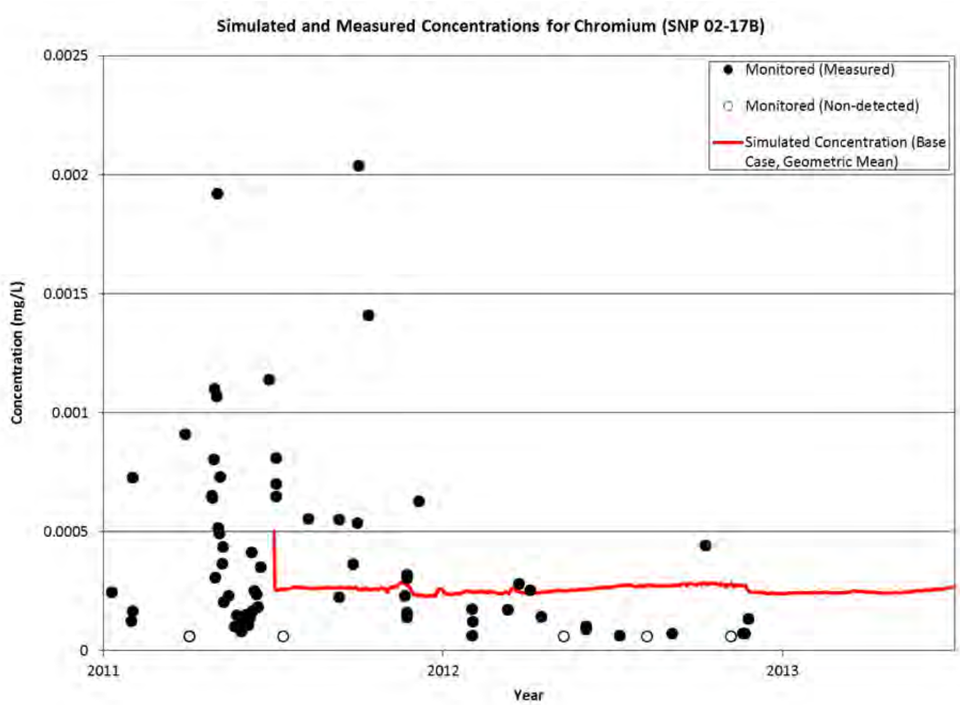


Figure V.3- 11 Simulated and Measured Concentrations for Cobalt (SNP 02-17B)

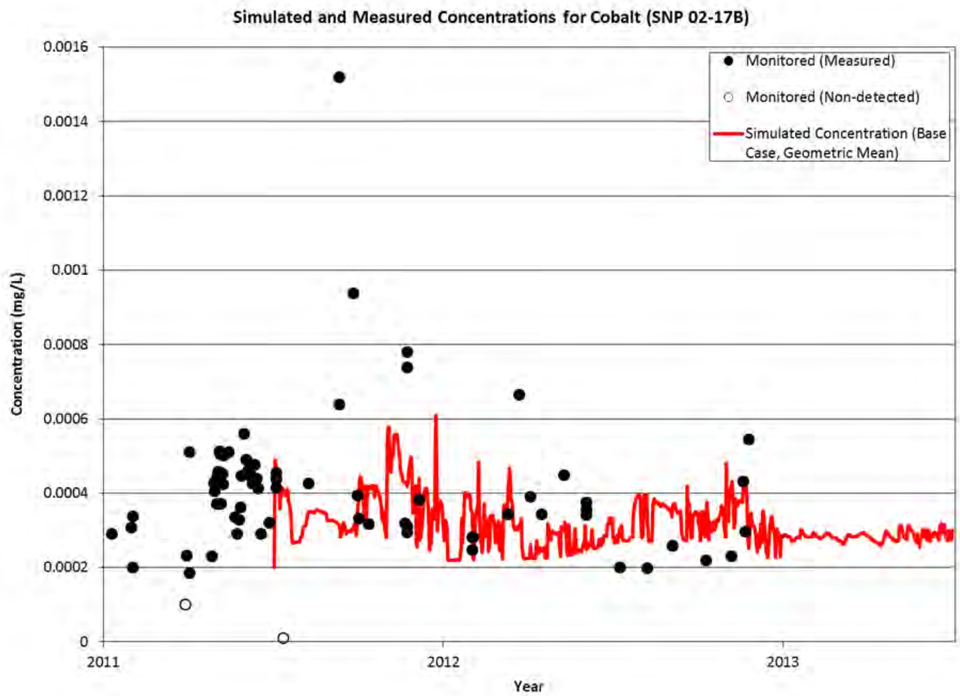


Figure V.3- 12 Simulated and Measured Concentrations for Copper (SNP 02-17B)

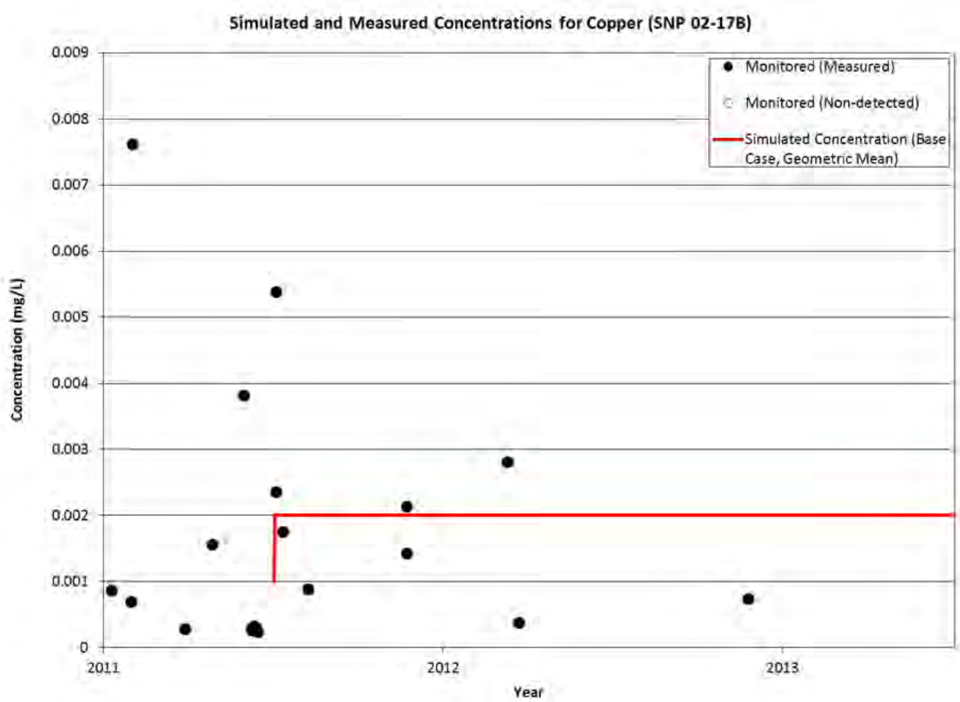


Figure V.3- 13 Simulated and Measured Concentrations for Fluoride (SNP 02-17B)

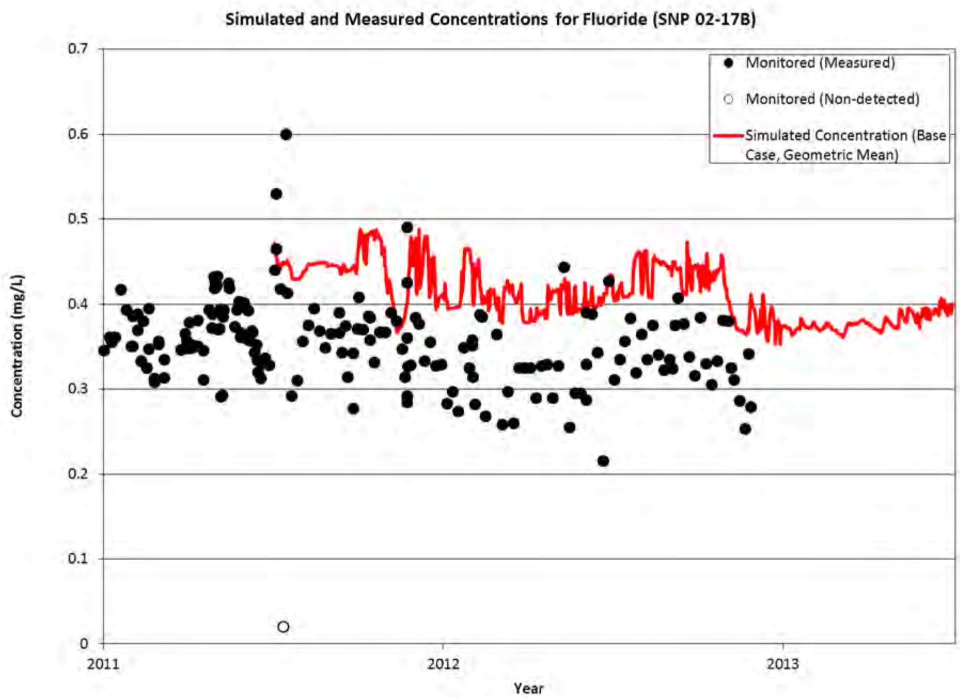


Figure V.3- 14 Simulated and Measured Concentrations for Iron (SNP 02-17B)

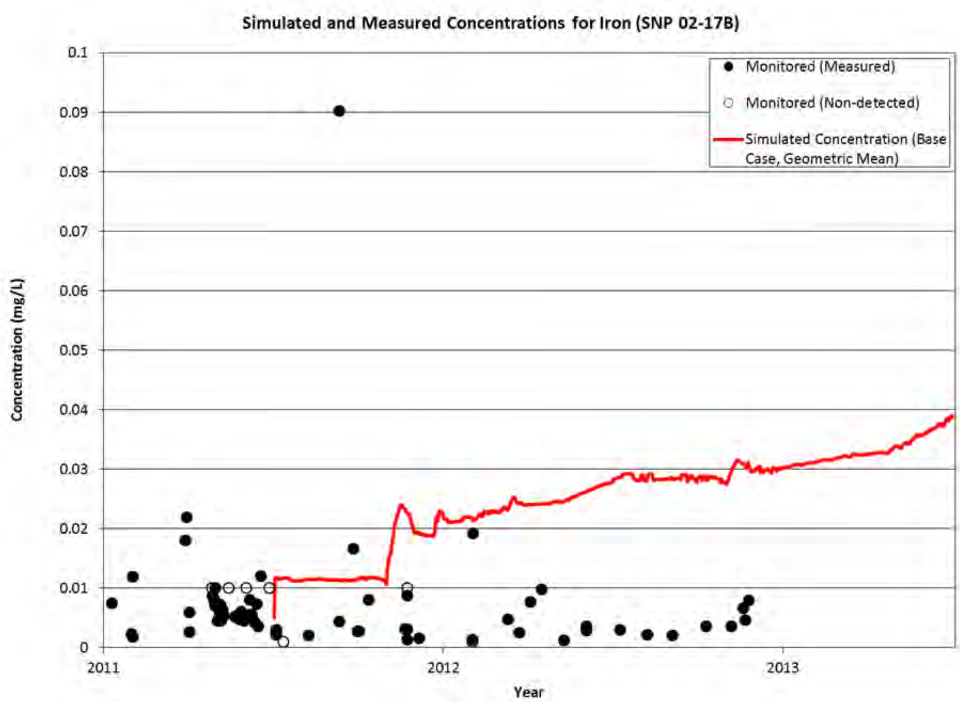


Figure V.3- 15 Simulated and Measured Concentrations for Lead (SNP 02-17B)

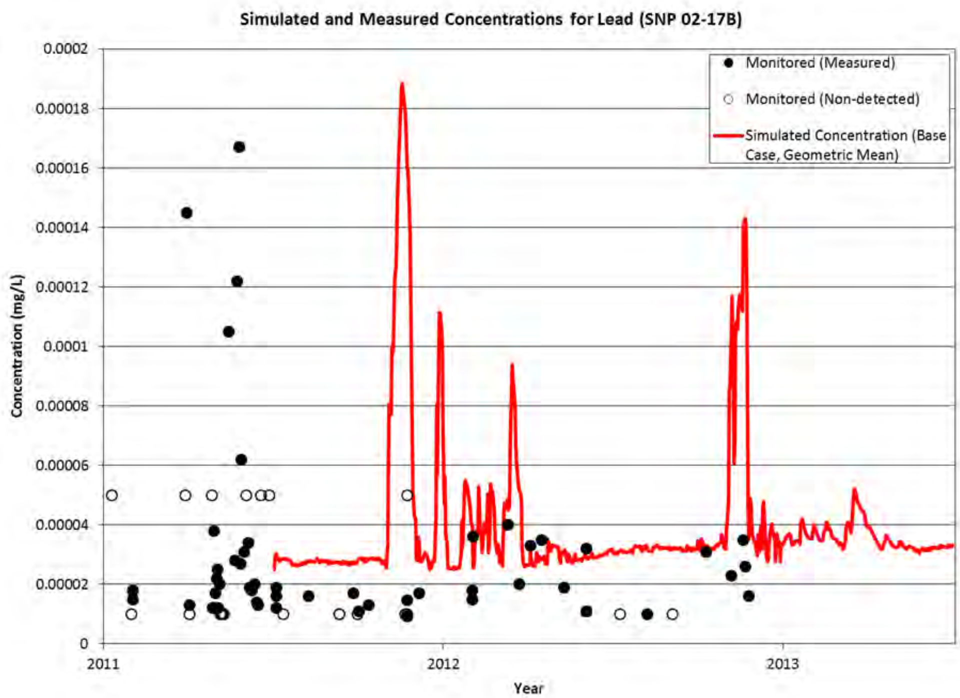


Figure V.3- 16 Simulated and Measured Concentrations for Lithium (SNP 02-17B)

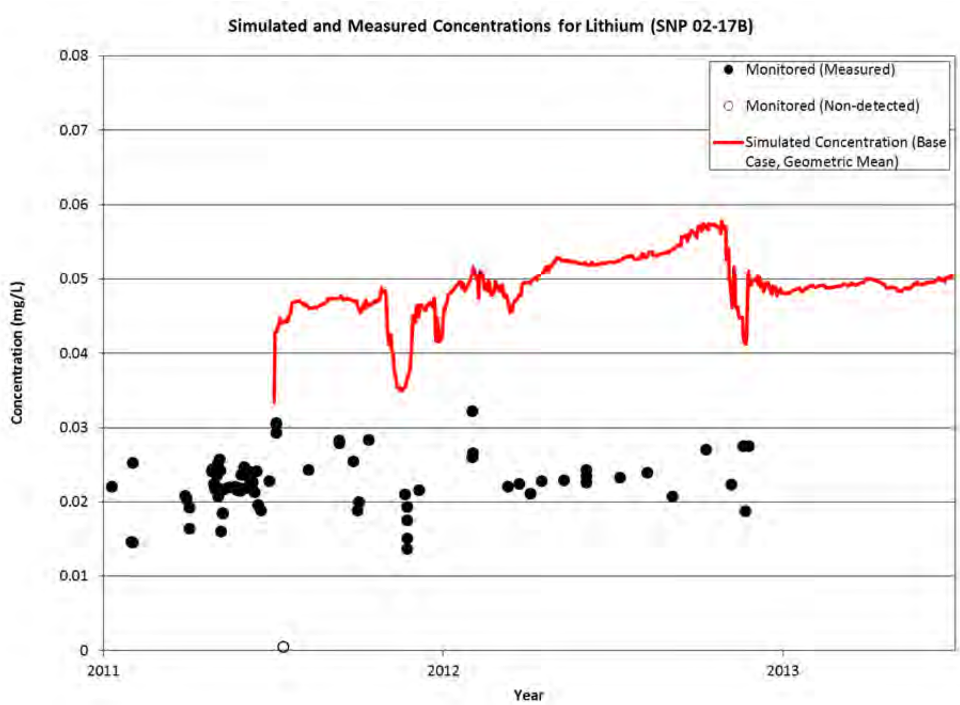


Figure V.3- 17 Simulated and Measured Concentrations for Magnesium (SNP 02-17B)

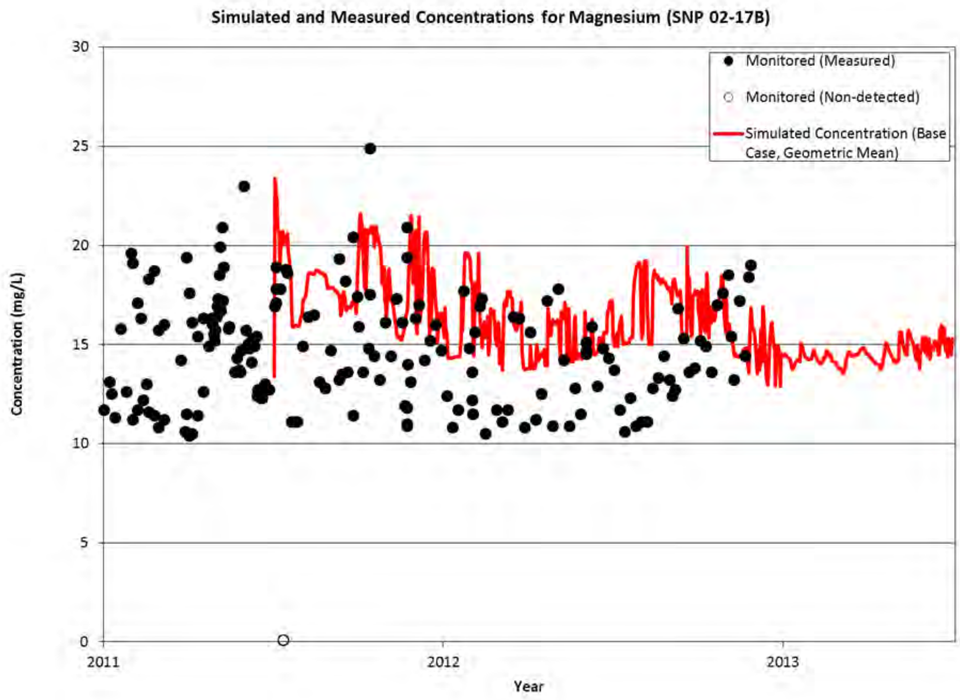


Figure V.3- 18 Simulated and Measured Concentrations for Manganese (SNP 02-17B)

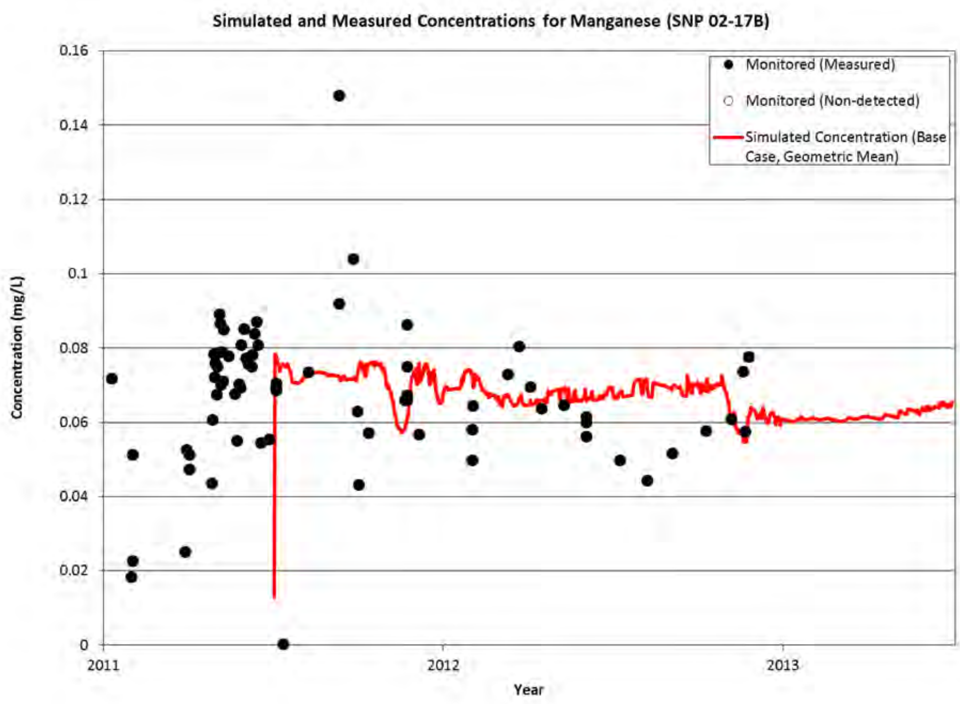


Figure V.3- 19 Simulated and Measured Concentrations for Mercury (SNP 02-17B)

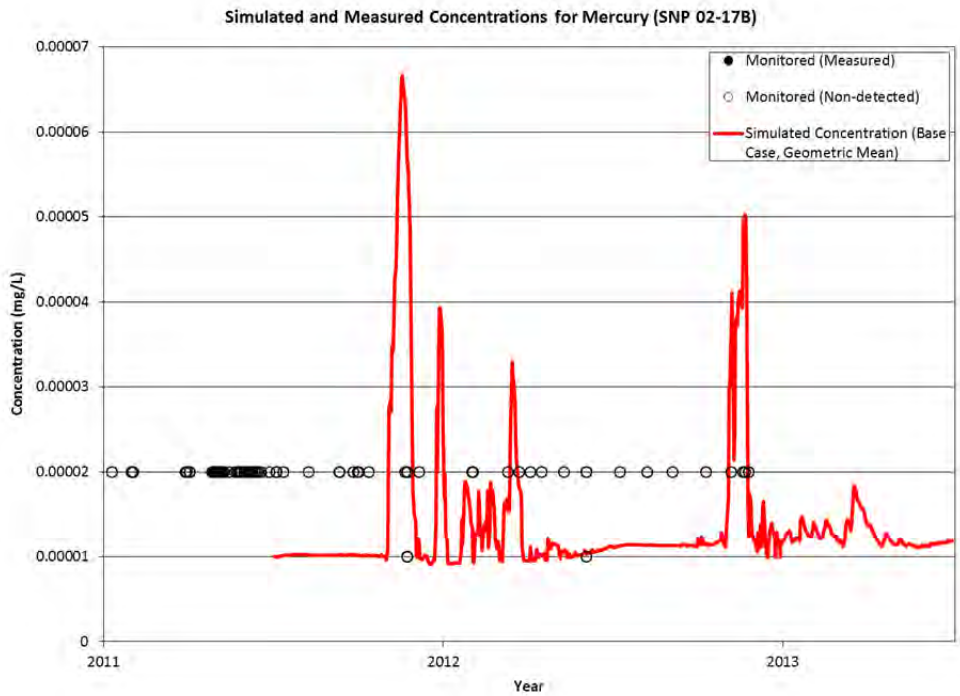


Figure V.3- 20 Simulated and Measured Concentrations for Molybdenum (SNP 02-17B)

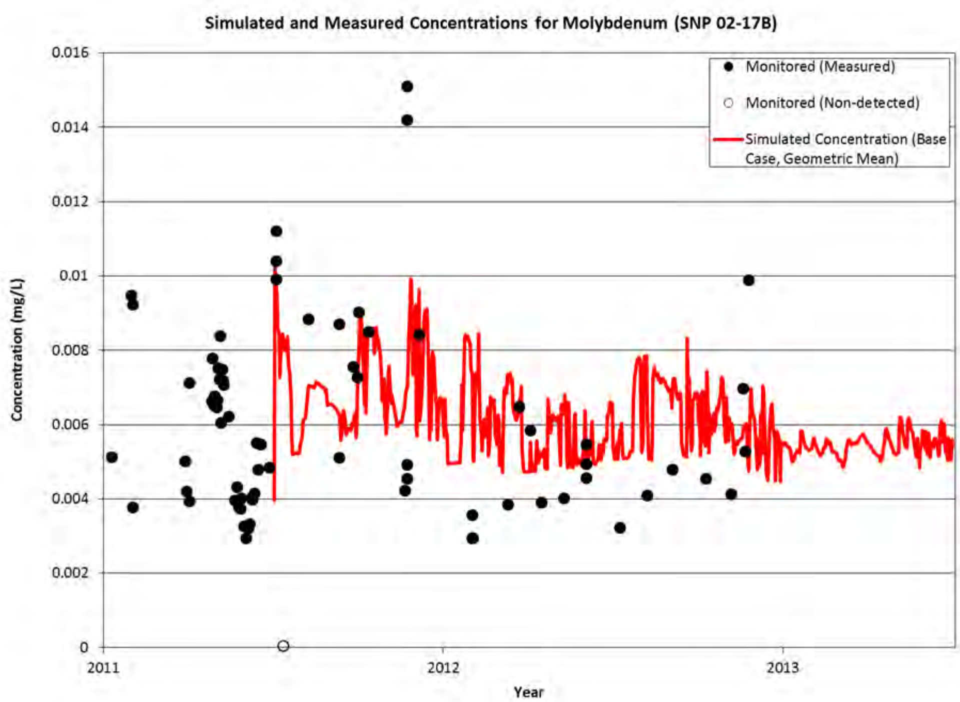


Figure V.3- 21 Simulated and Measured Concentrations for Nickel (SNP 02-17B)

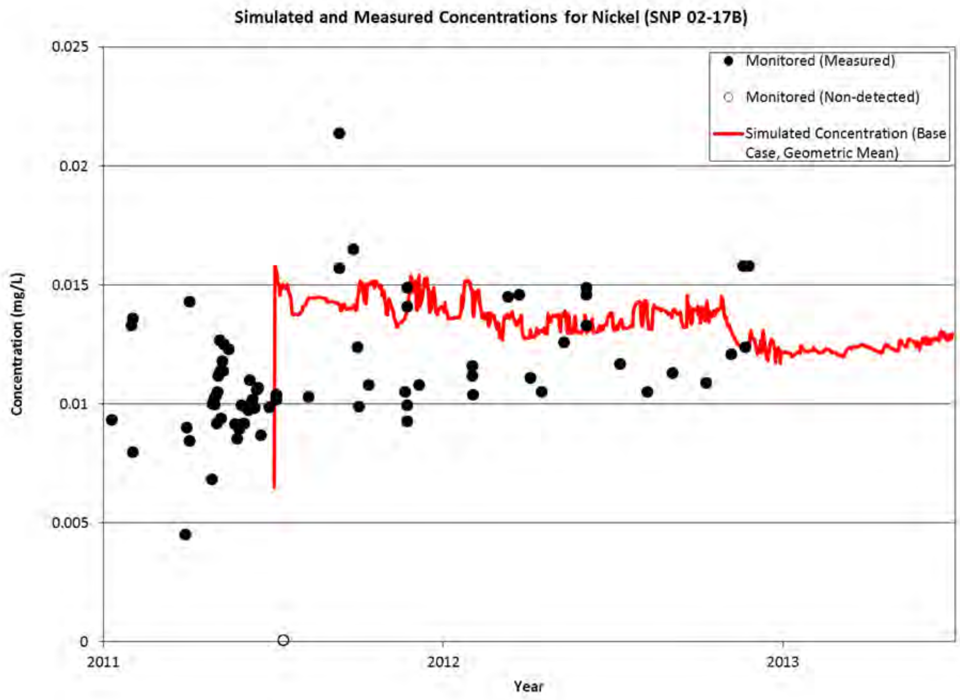


Figure V.3- 22 Simulated and Measured Concentrations for Nitrate/Nitrite, as N (SNP 02-17B)

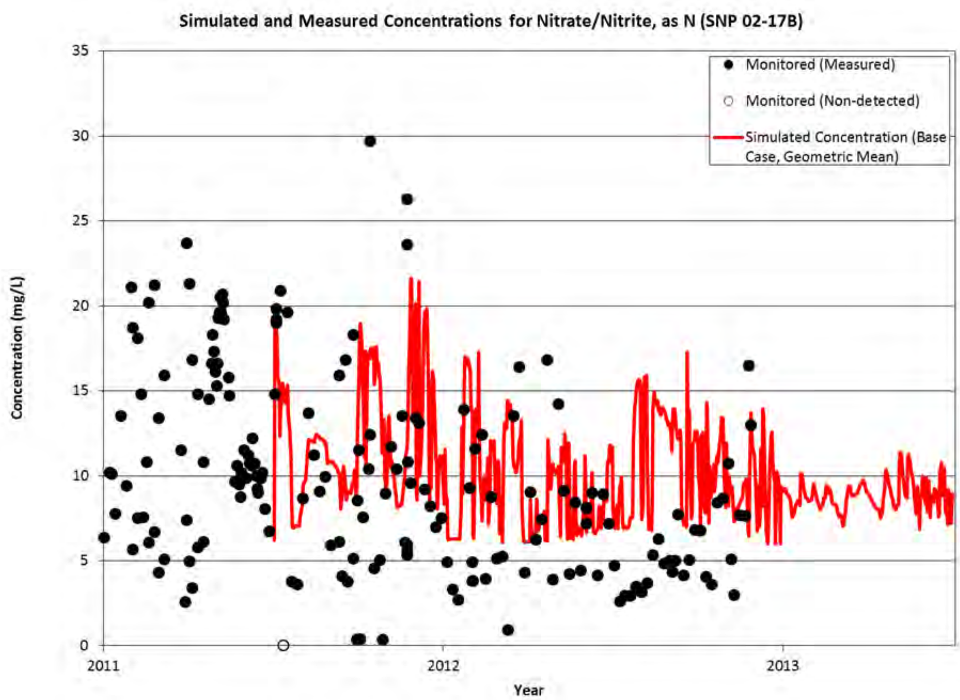


Figure V.3- 23 Simulated and Measured Concentrations for Ortho-Phophate, as P (SNP 02-17B)

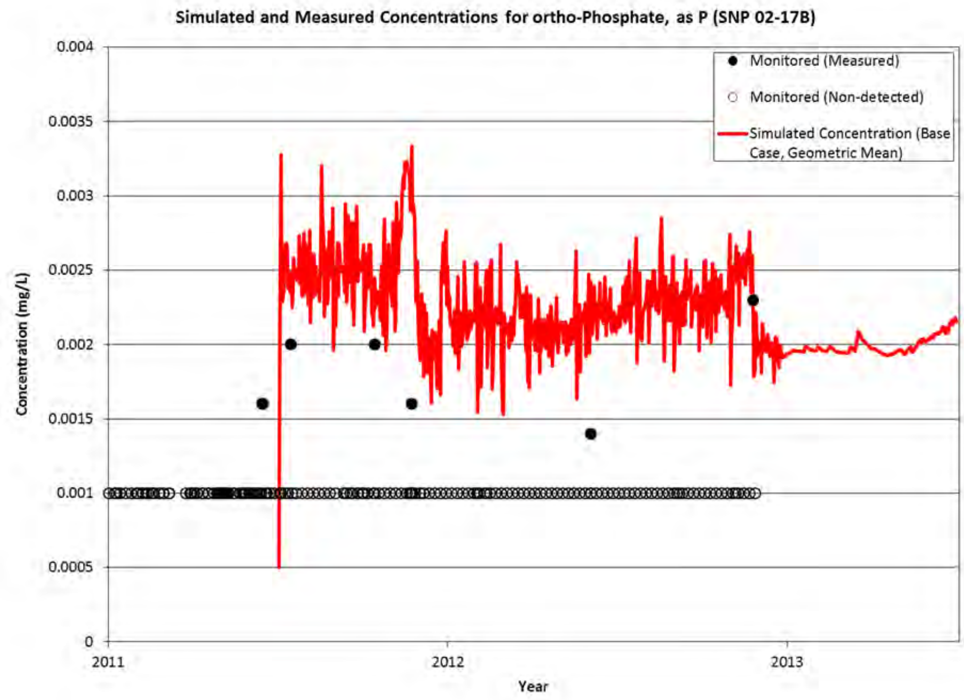


Figure V.3- 24 Simulated and Measured Concentrations for Potassium (SNP 02-17B)

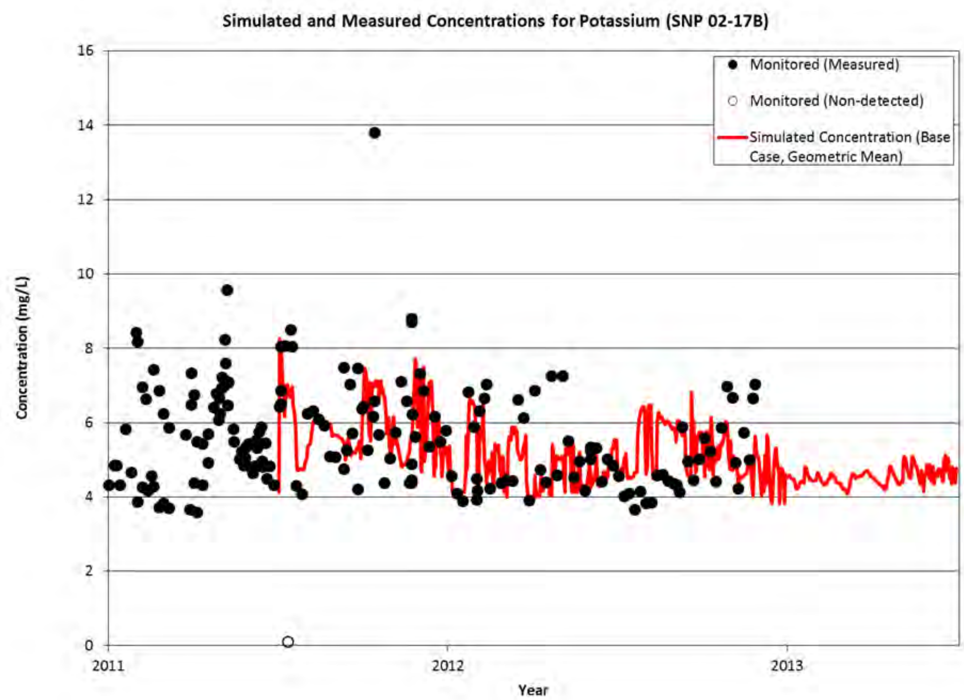


Figure V.3- 25 Simulated and Measured Concentrations for Reactive Silica, as SiO_2 (SNP 02-17B)

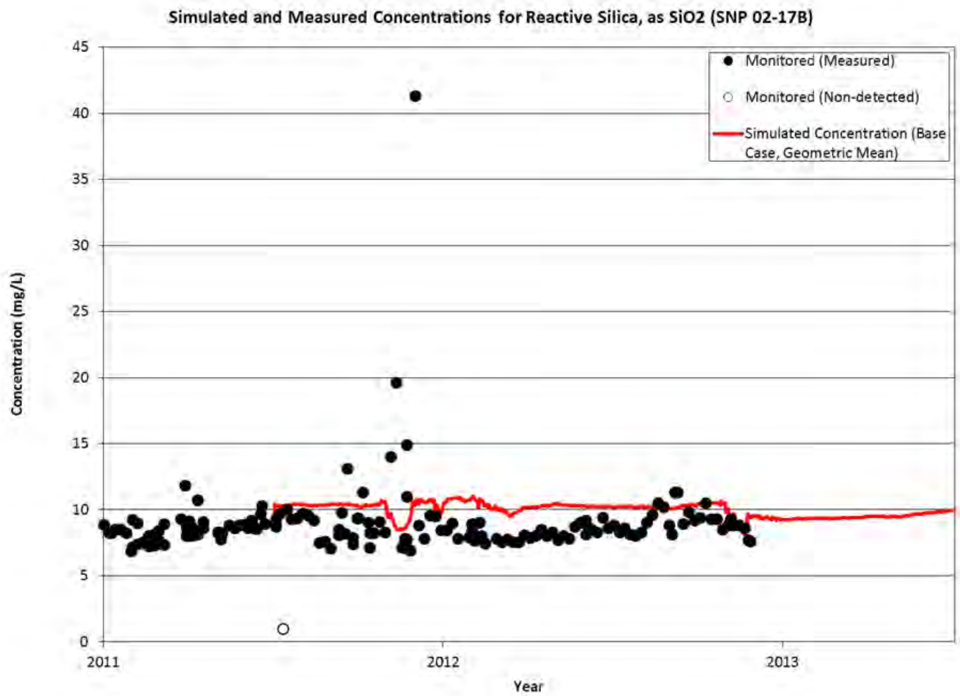


Figure V.3- 26 Simulated and Measured Concentrations for Selenium (SNP 02-17B)

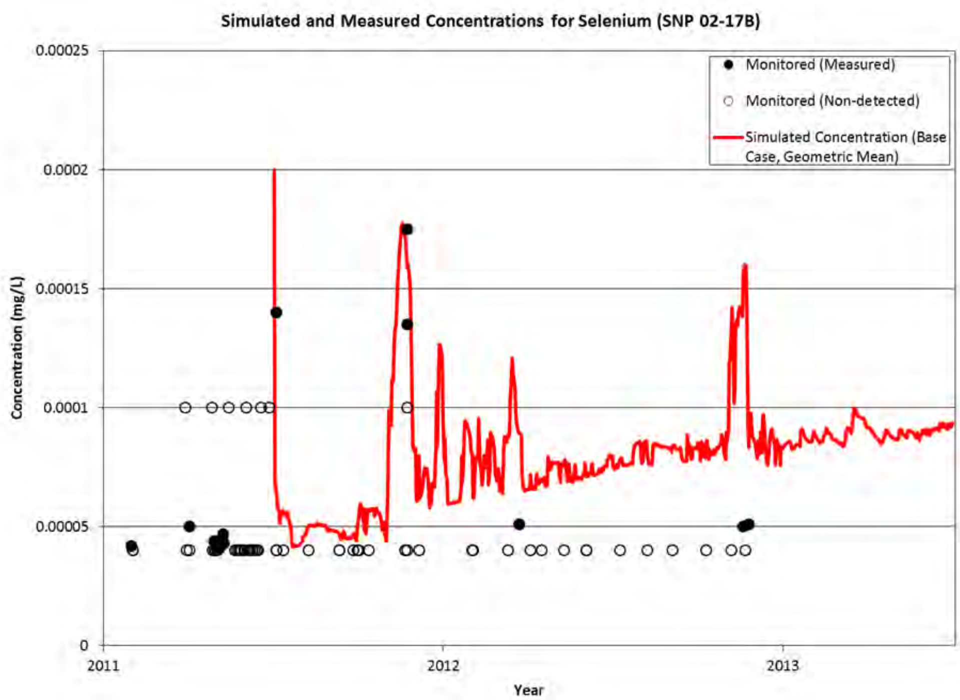


Figure V.3- 27 Simulated and Measured Concentrations for Silver (SNP 02-17B)

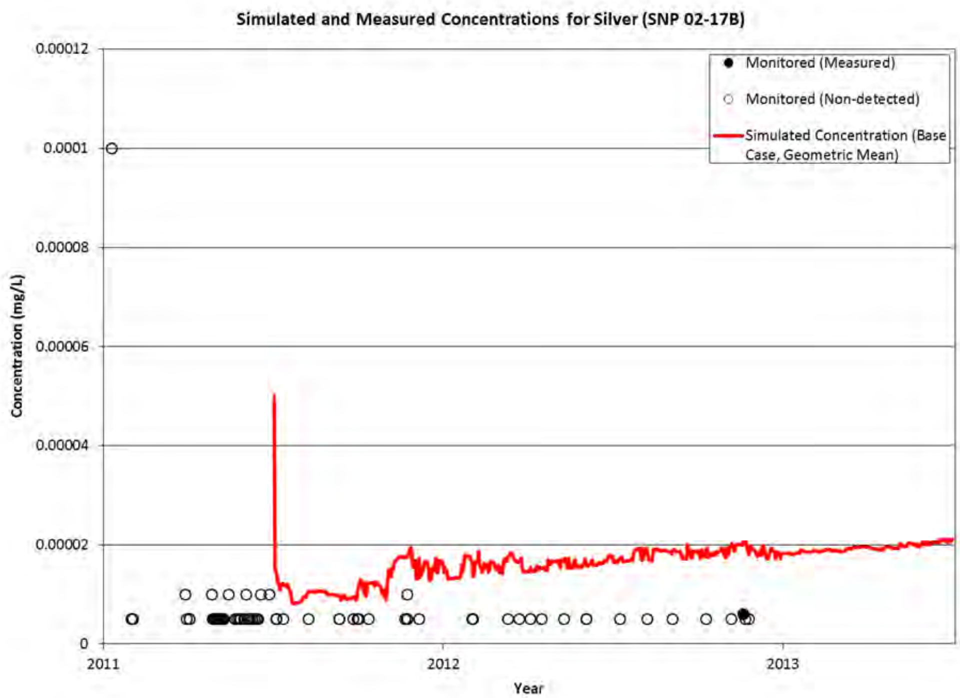


Figure V.3- 28 Simulated and Measured Concentrations for Sodium (SNP 02-17B)

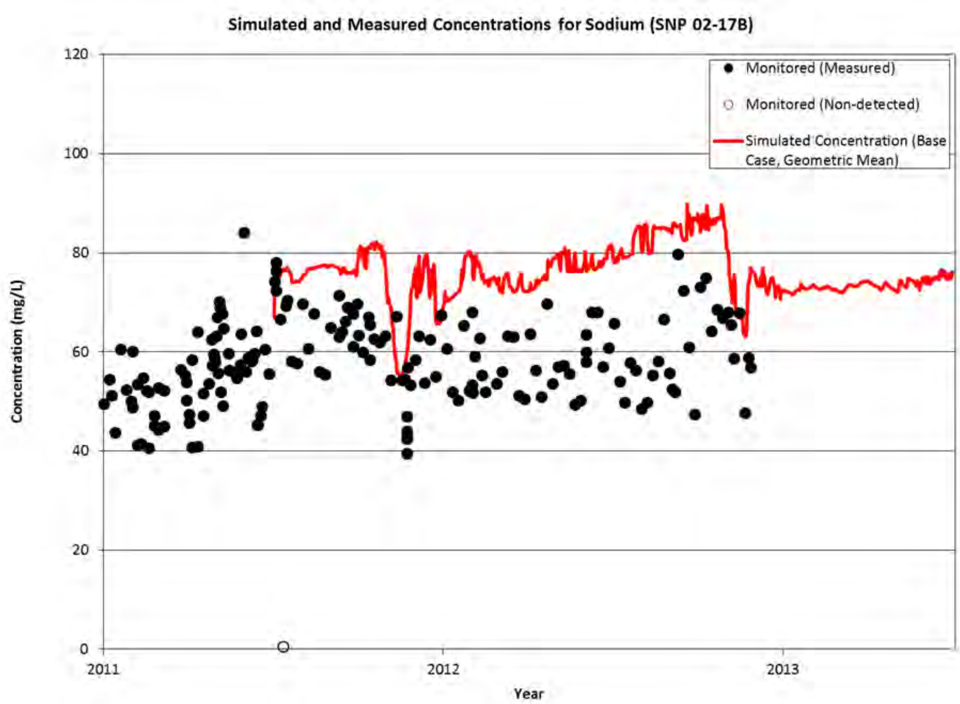


Figure V.3- 29 Simulated and Measured Concentrations for Strontium (SNP 02-17B)

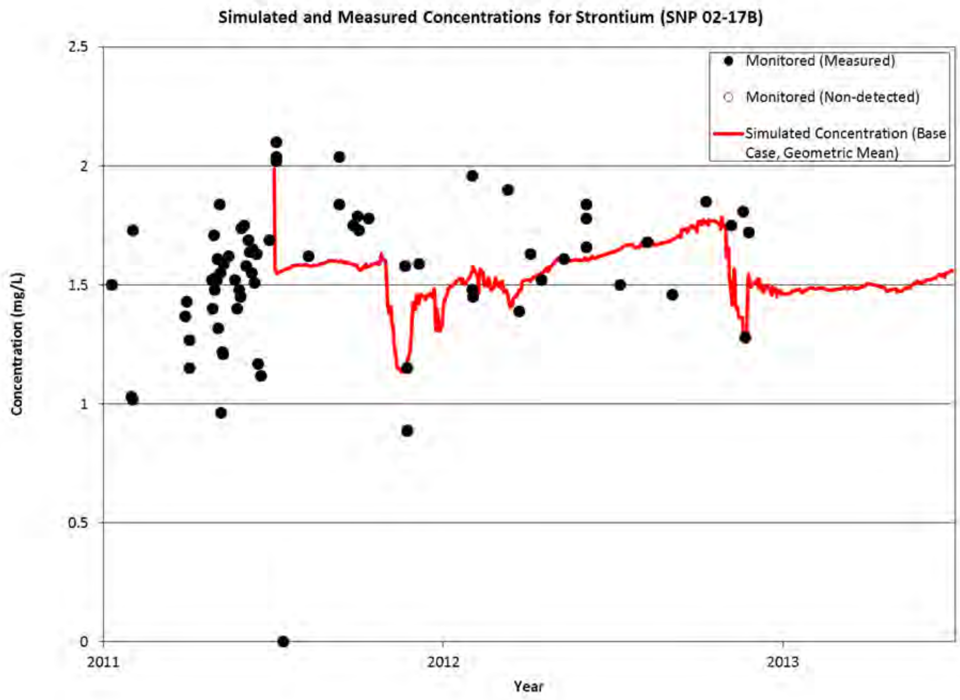


Figure V.3- 30 Simulated and Measured Concentrations for Sulphate (SNP 02-17B)

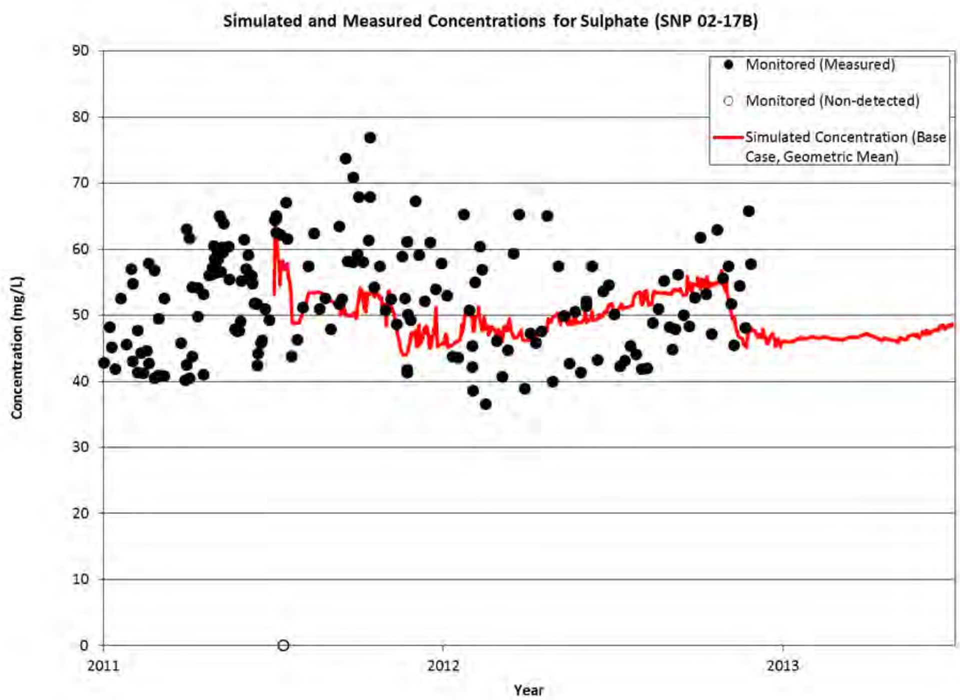


Figure V.3- 31 Simulated and Measured Concentrations for Thallium (SNP 02-17B)

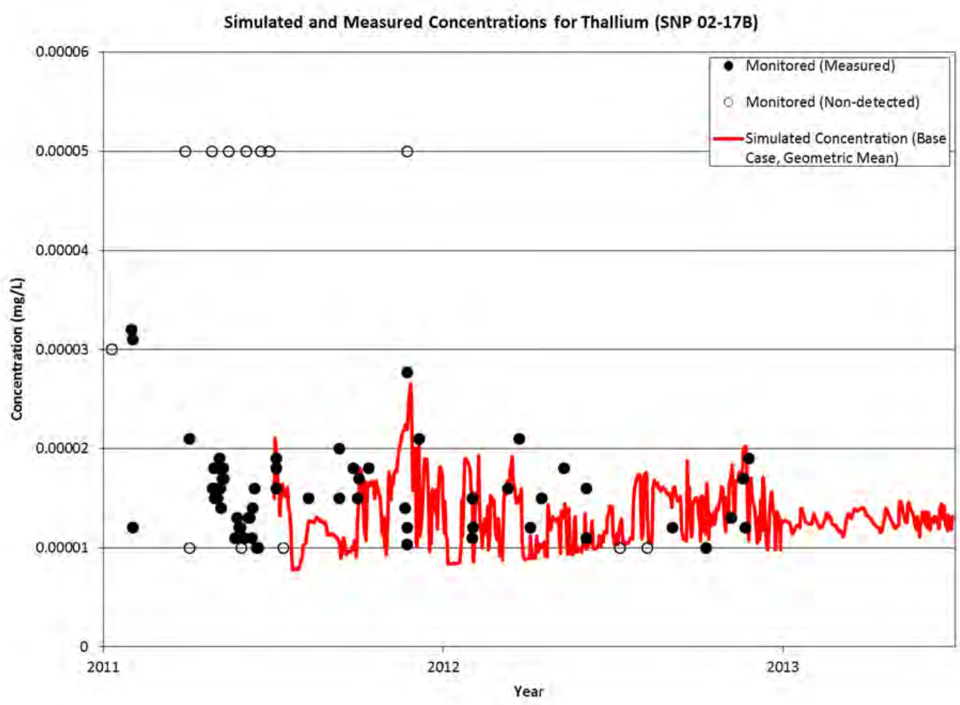


Figure V.3- 32 Simulated and Measured Concentrations for Total Ammonia, as N (SNP 02-17B)

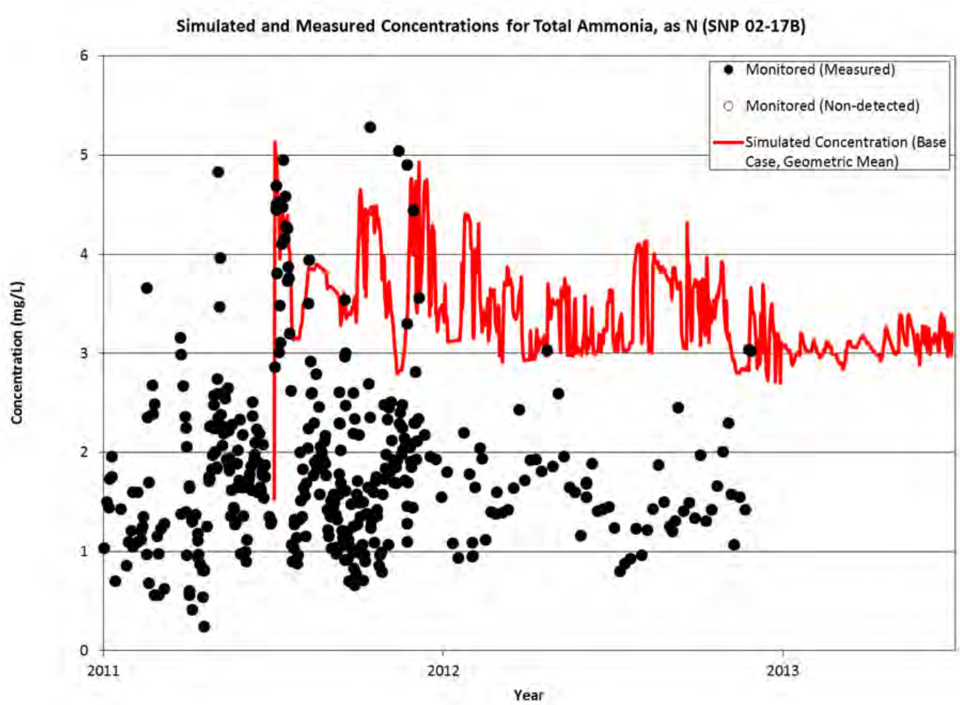


Figure V.3- 33 Simulated and Measured Concentrations for Total Dissolved Solids (SNP 02-17B)

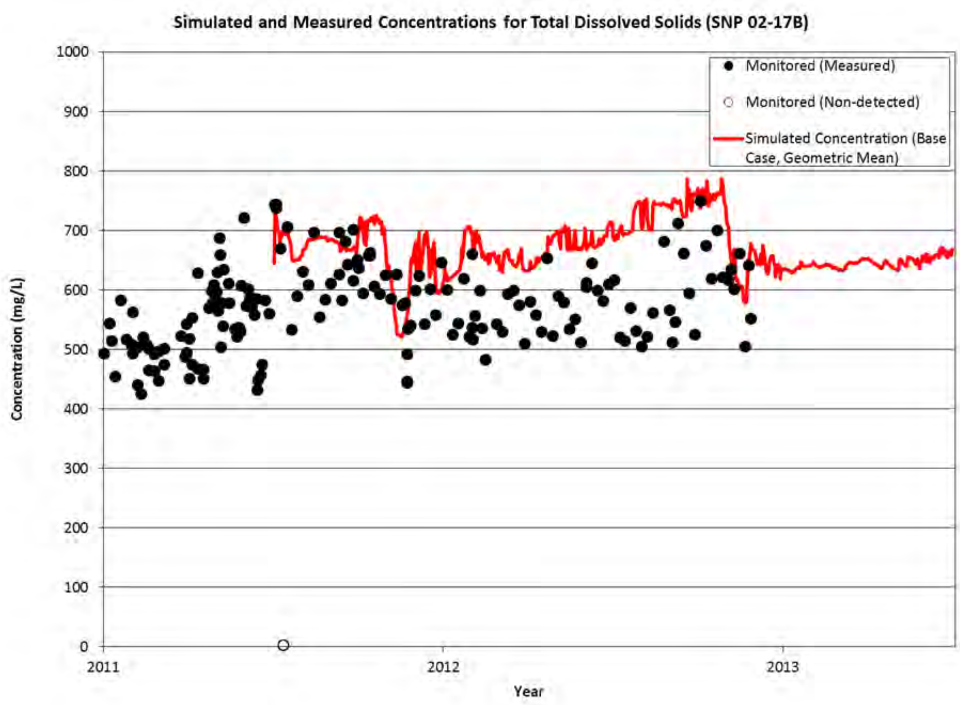


Figure V.3- 34 Simulated and Measured Concentrations for Total Kjeldahl Nitrogen (SNP 02-17B)

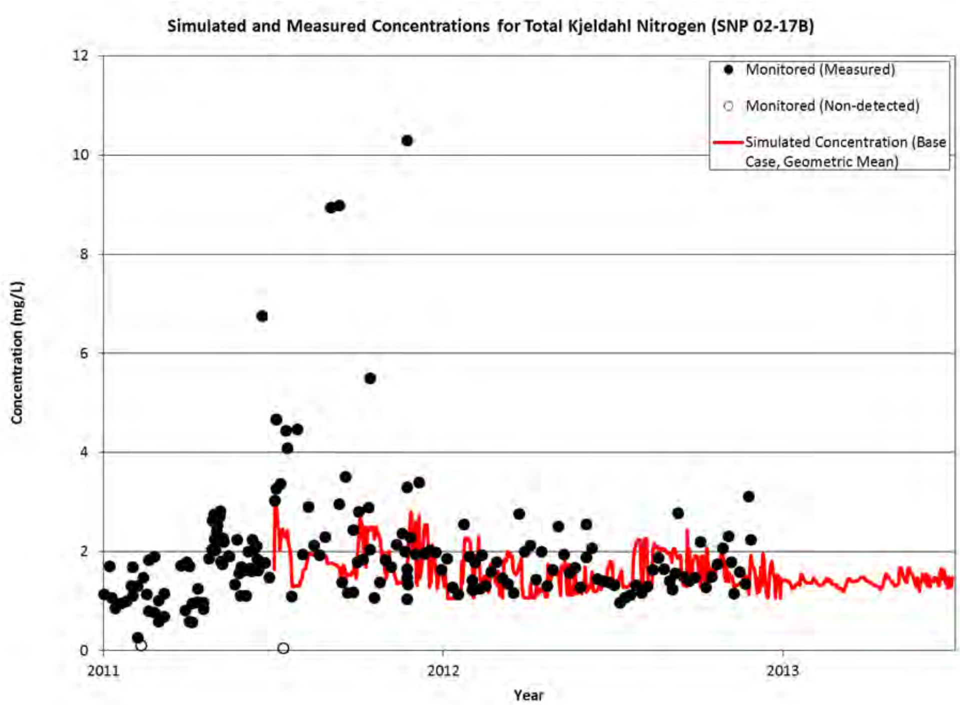


Figure V.3- 35 Simulated and Measured Concentrations for Total Phosphorus (SNP 02-17B)

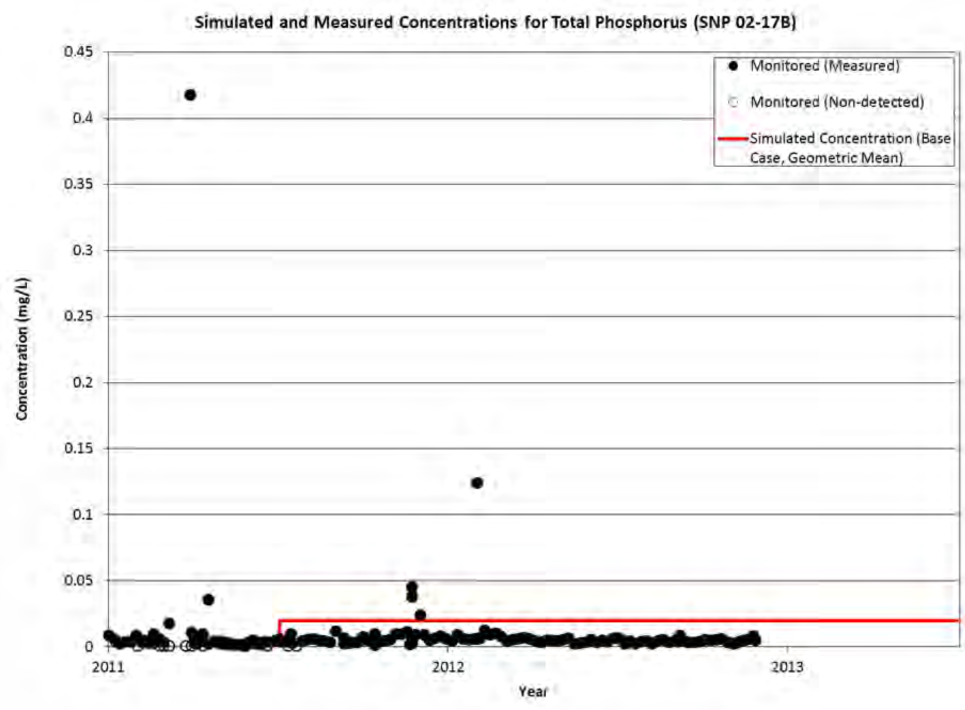


Figure V.3- 36 Simulated and Measured Concentrations for Total Suspended Solids (SNP 02-17B)

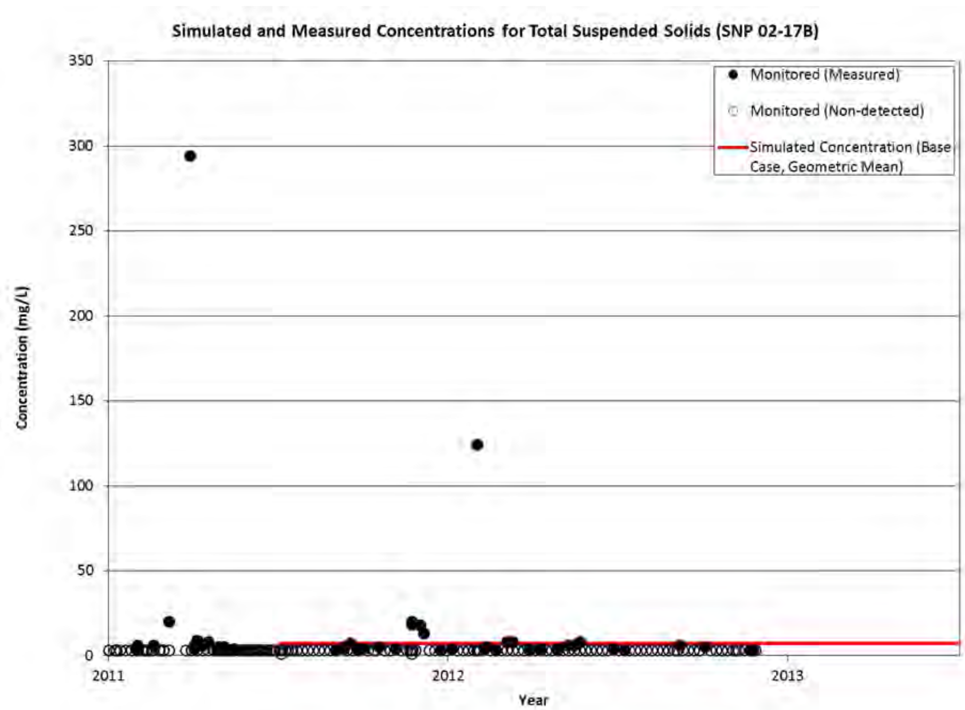


Figure V.3- 37 Simulated and Measured Concentrations for Uranium (SNP 02-17B)

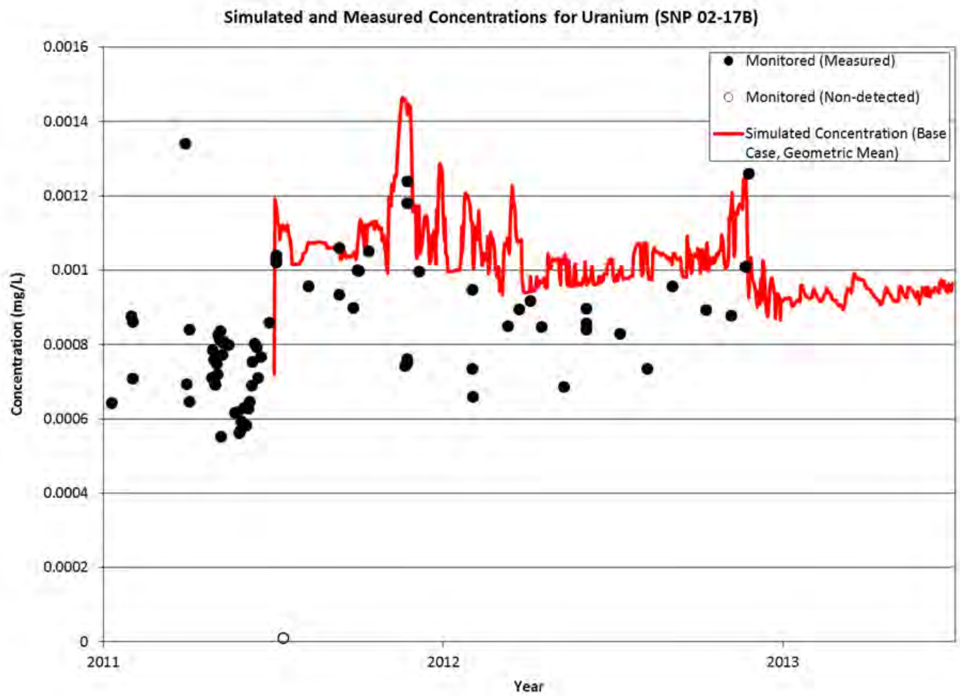


Figure V.3- 38 Simulated and Measured Concentrations for Vanadium (SNP 02-17B)

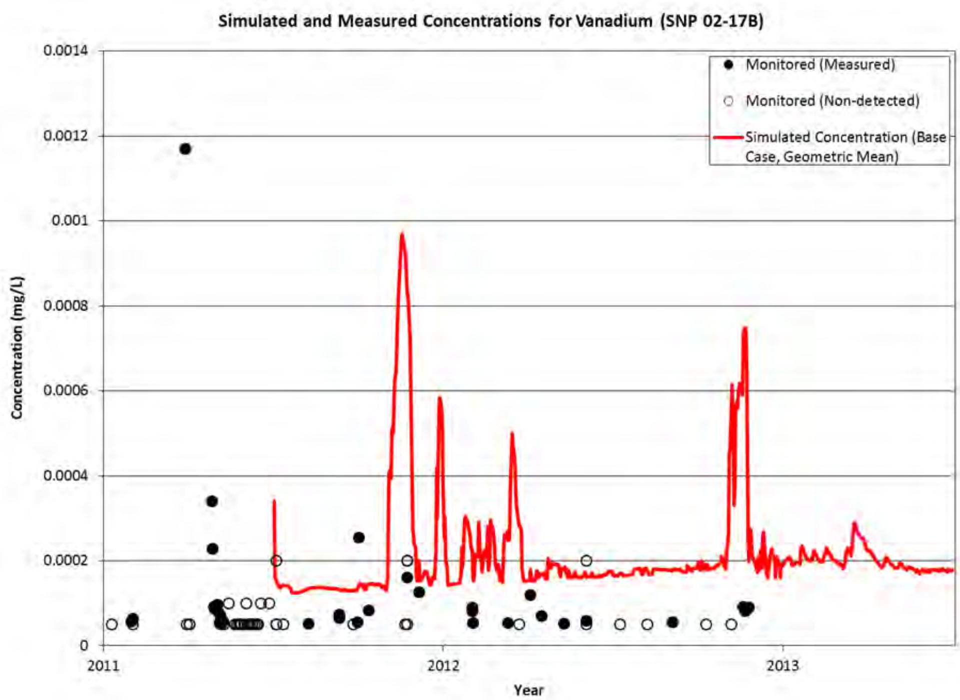
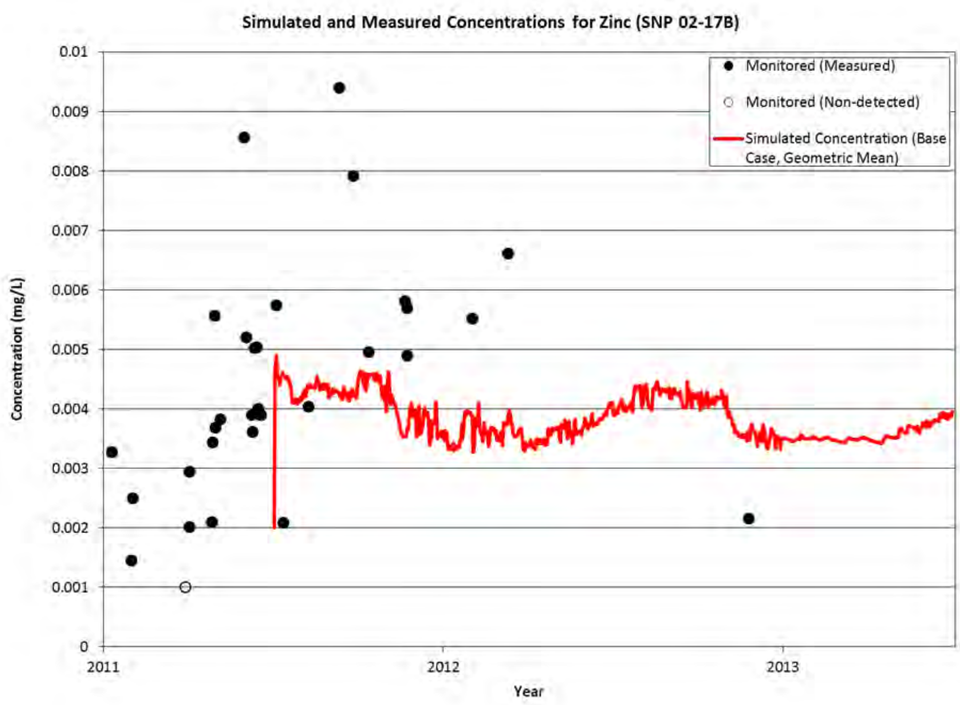


Figure V.3- 39 Simulated and Measured Concentrations for Zinc (SNP 02-17B)



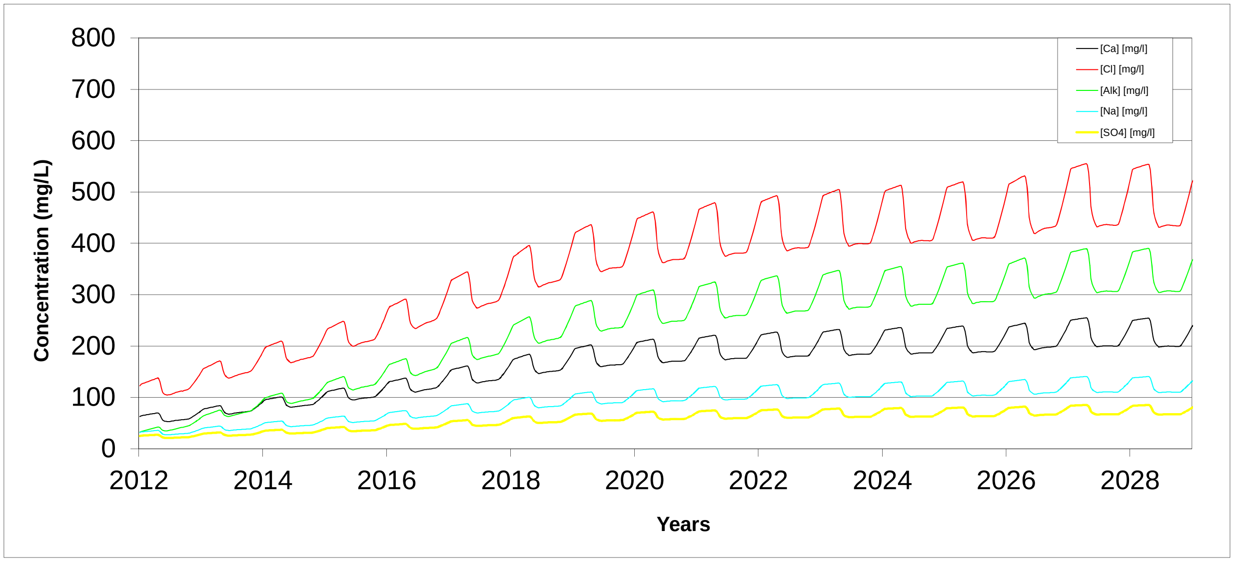
APPENDIX VI

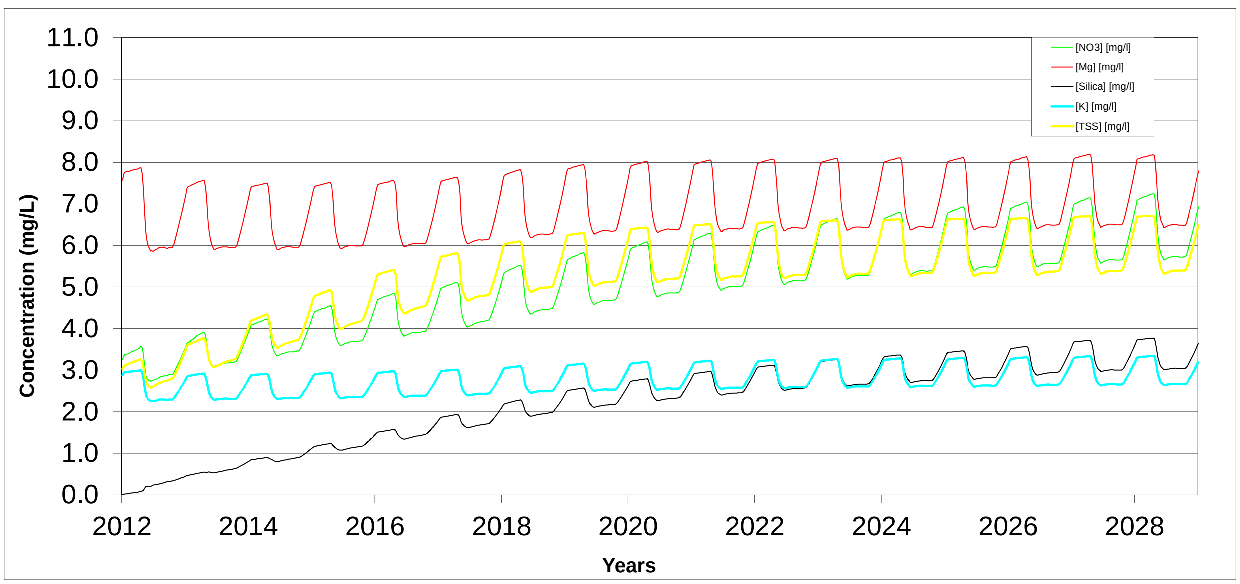
LOWER BOUND SCENARIO A

December 2013

Snap Lake Outflow Dissolved Concentrations

FIGURE VI-1a



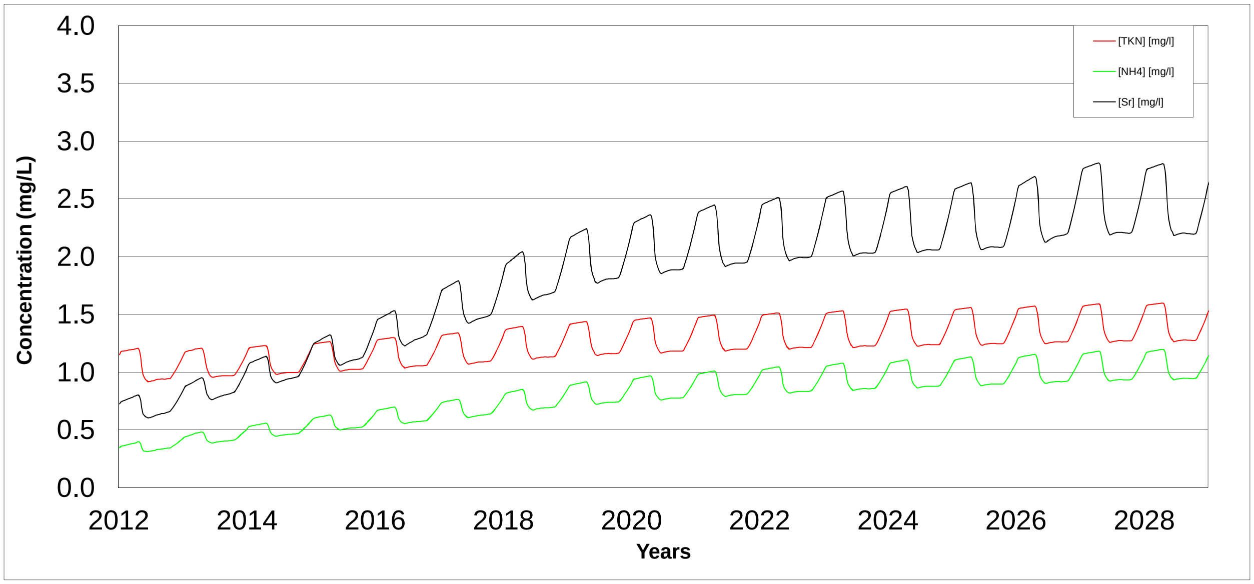


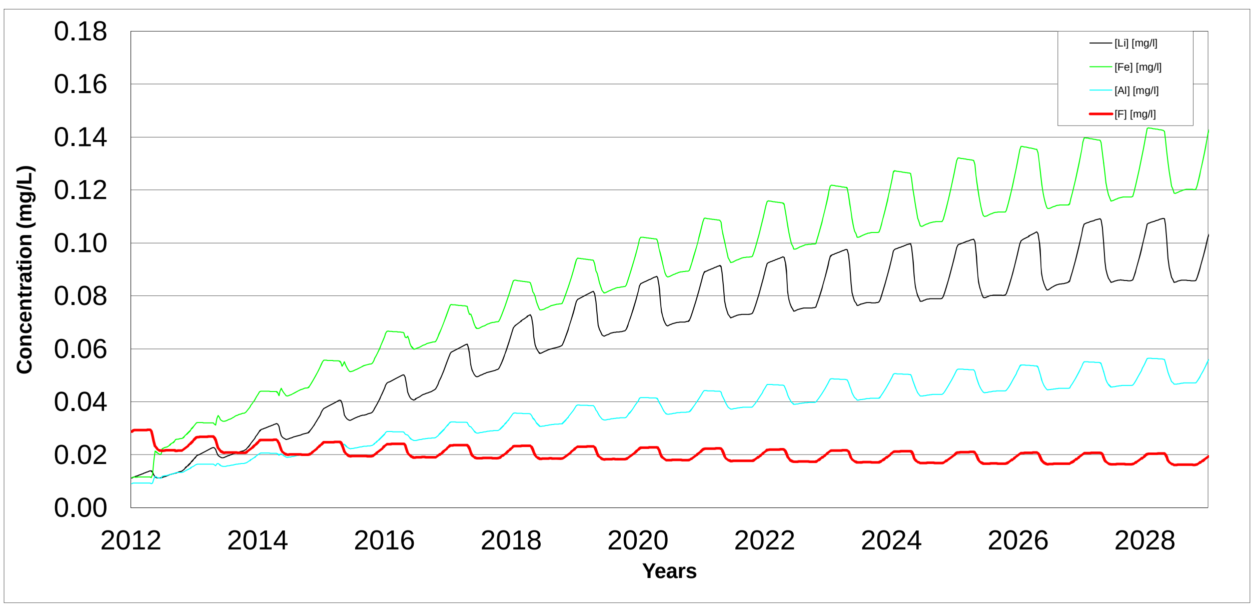
Date: December 2013
Project: 12-1337-0001

Drawn KAS
Chkd KJD

De Beers Canada Inc.

Snap Lake Outflow Dissolved Concentrations	FIGURE VI-1b





Date: December 2013
Project: 12-1337-0001

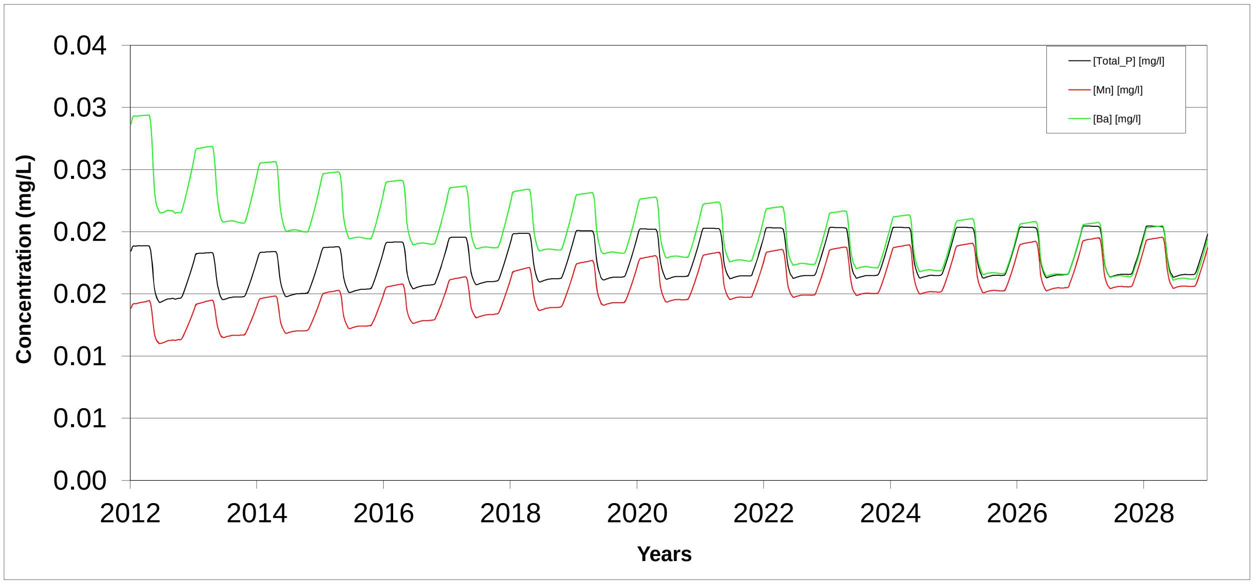
Drawn KAS
Chkd KJD

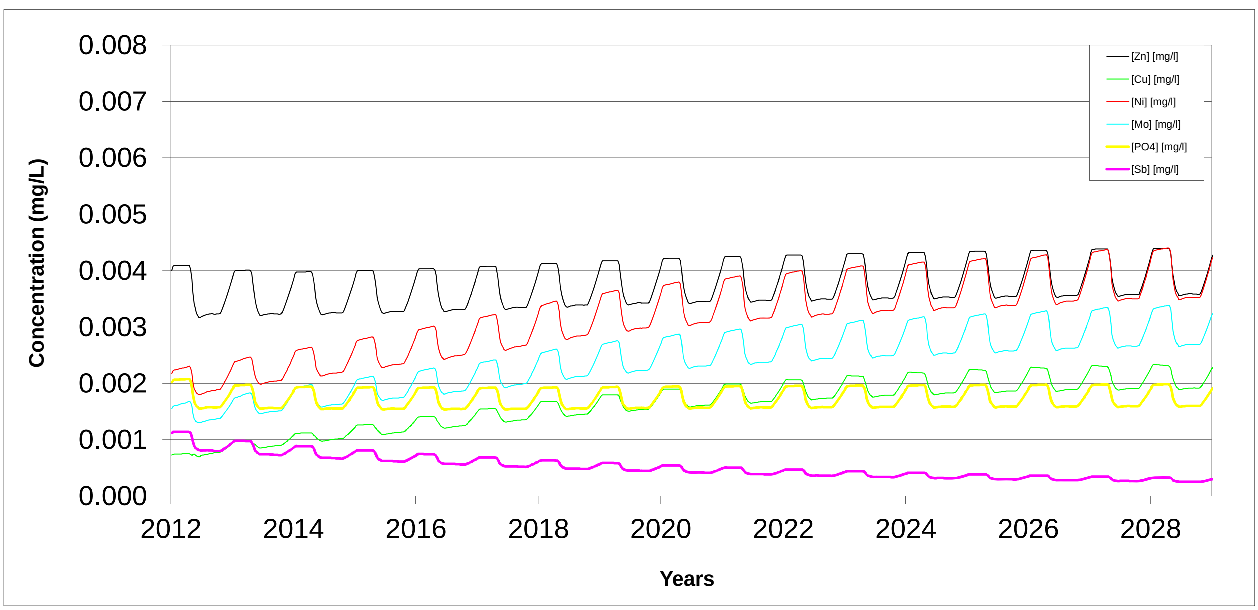
De Beers Canada Inc.

AppVI_Fig1.xls-AppVI-1b

Snap Lake Outflow Dissolved Concentrations

FIGURE VI-1c





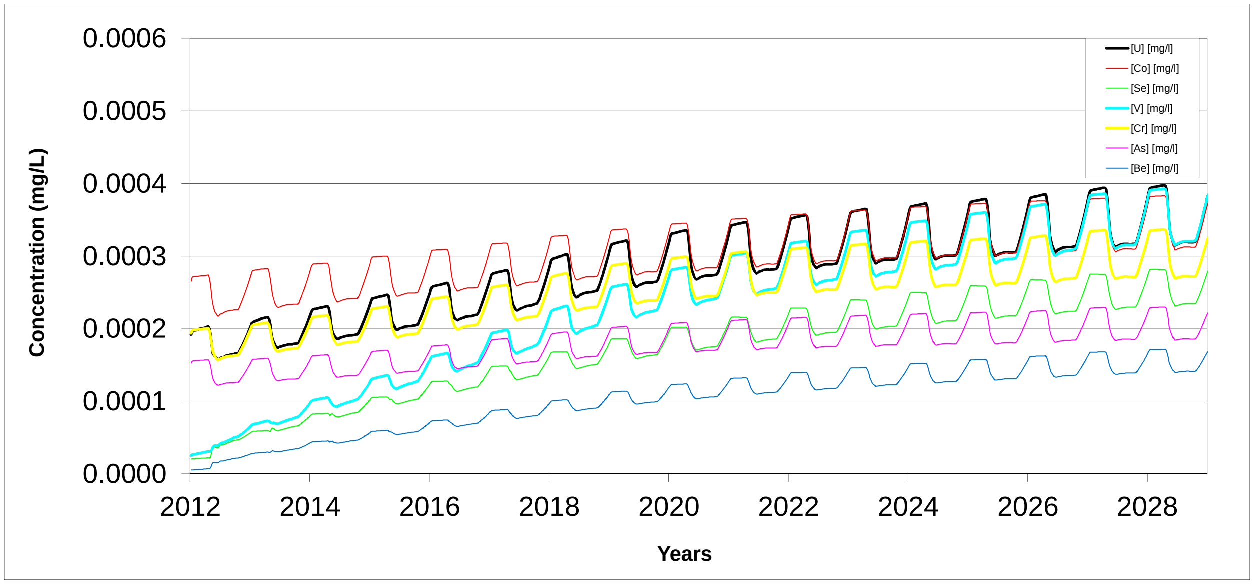
Date: December 2013
Project: 12-1337-0001

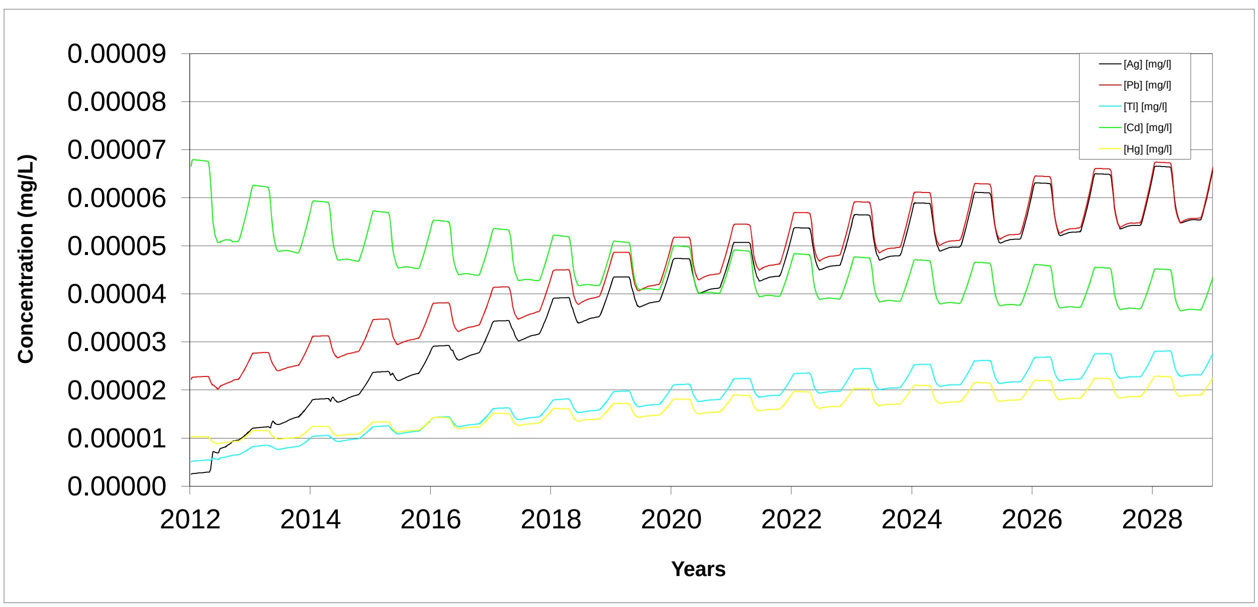
Drawn KAS
Chkd KJD

De Beers Canada Inc.

Snap Lake Outflow Dissolved Concentrations

FIGURE VI-1d



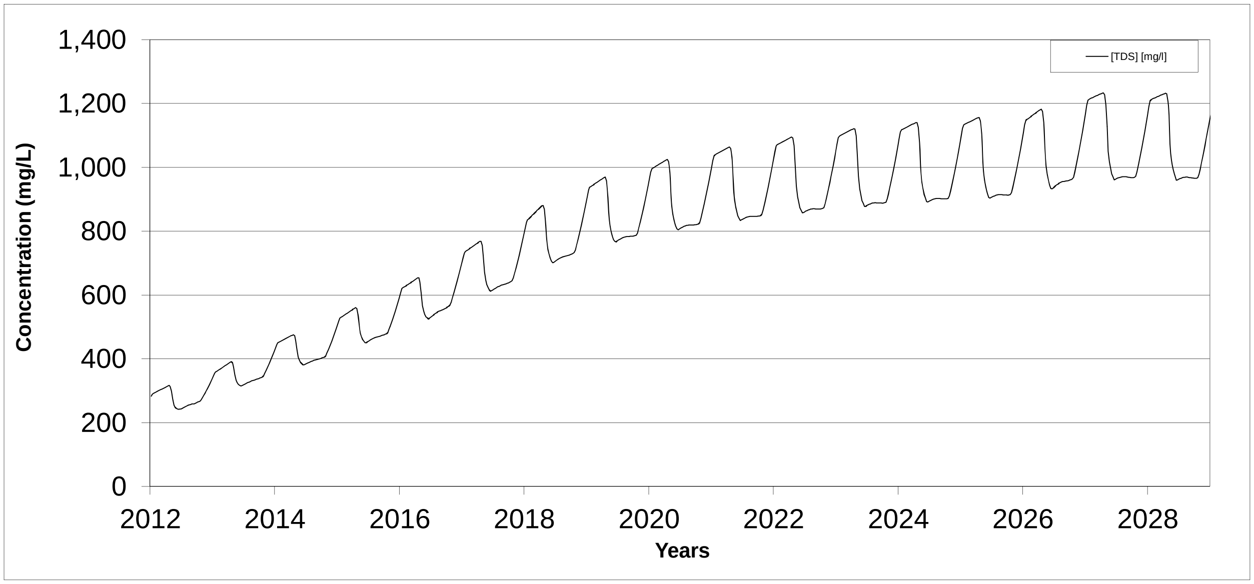


Date: December 2013
Project: 12-1337-0001

Drawn KAS
Chkd KJD

De Beers Canada Inc.

Snap Lake Outflow Dissolved Concentrations	FIGURE VI-1e



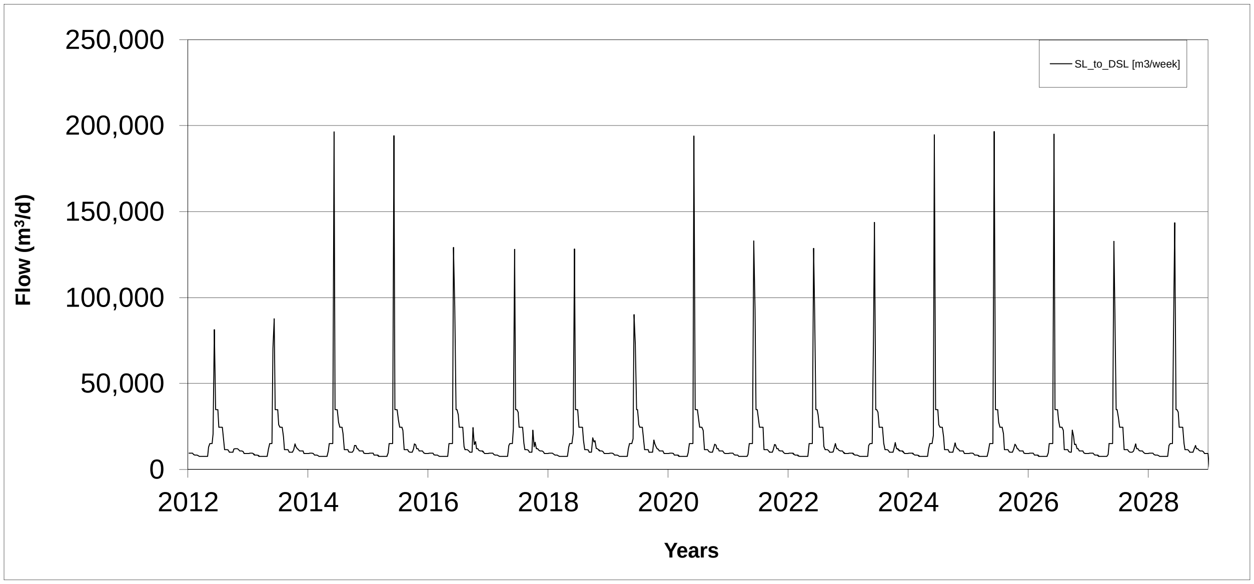
Date: December 2013
Project: 12-1337-0001

Drawn KAS
Chkd KJD

De Beers Canada Inc.

Snap Lake Outflow Dissolved Concentrations

FIGURE VI-1f



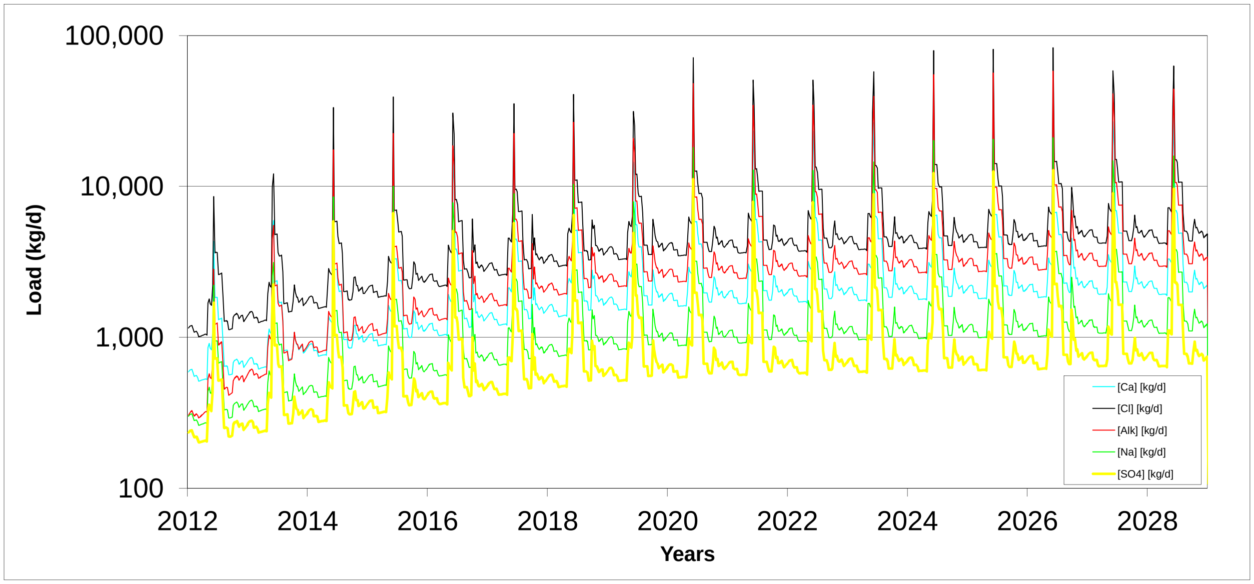
Date: December 2013
Project: 12-1337-0001

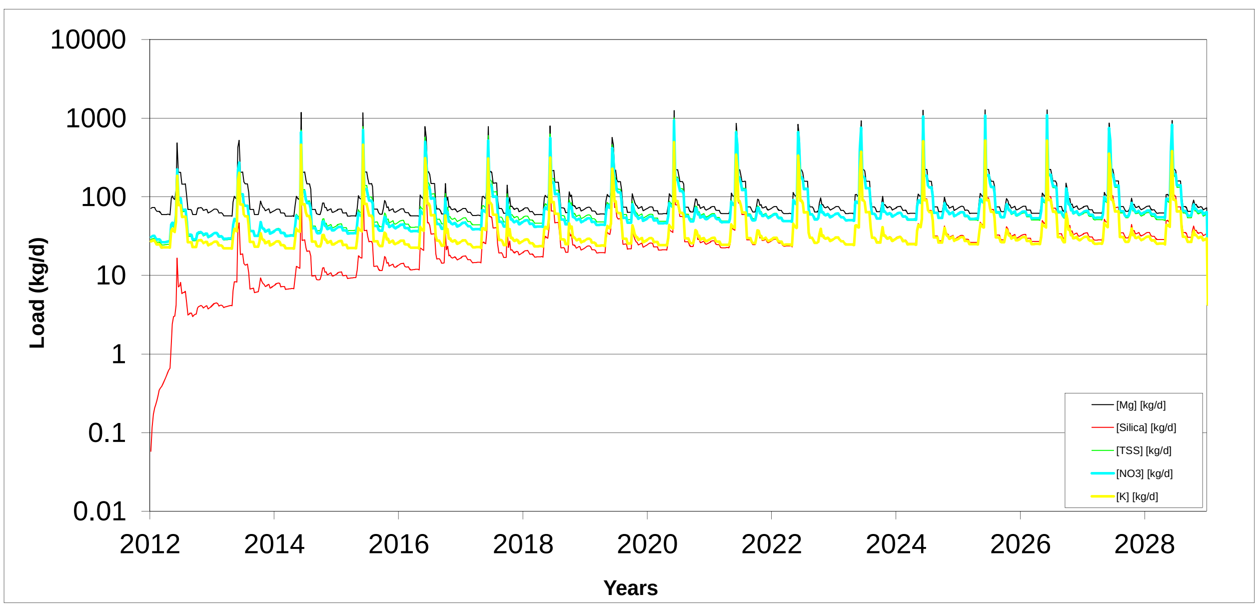
Drawn KAS
Chkd KJD

De Beers Canada Inc.

Snap Lake Outflow Dissolved Load

FIGURE VI-2a



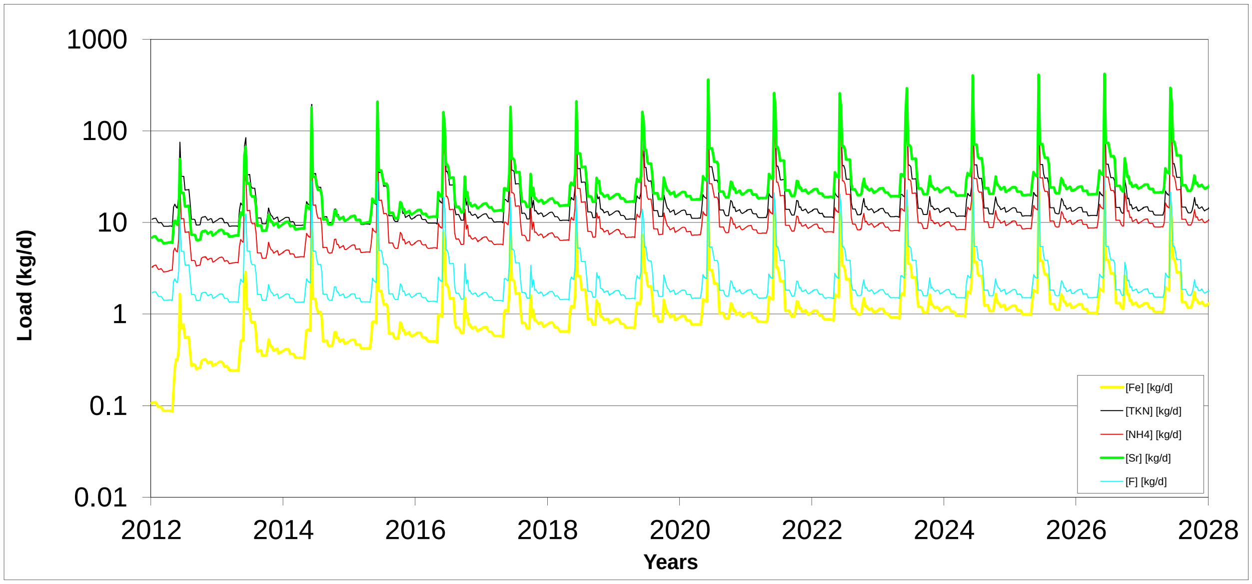


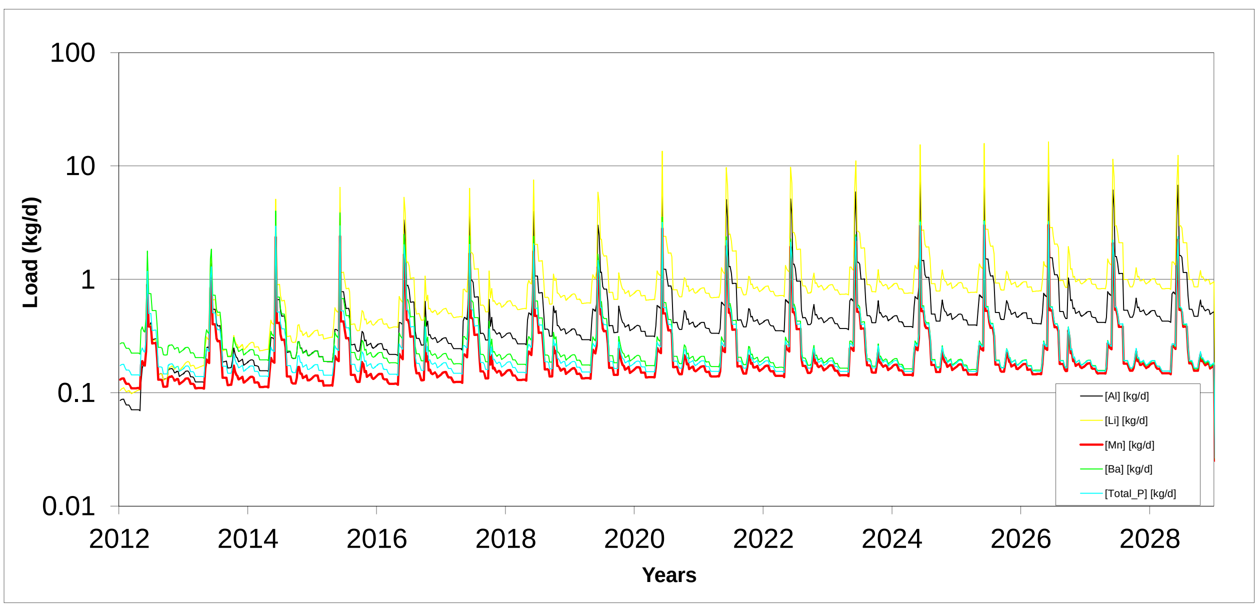
Date: December 2013
Project: 12-1337-0001

Drawn KAS
Chkd KJD

De Beers Canada Inc.

Snap Lake Outflow Dissolved Load	FIGURE VI-2b





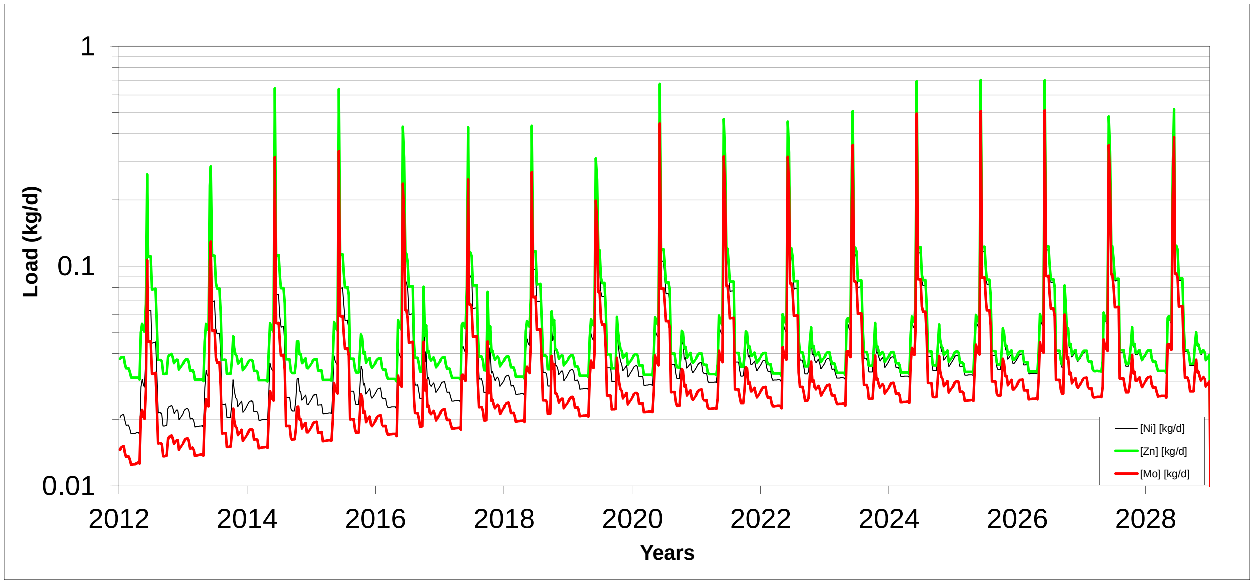
Date: December 2013
Project: 12-1337-0001

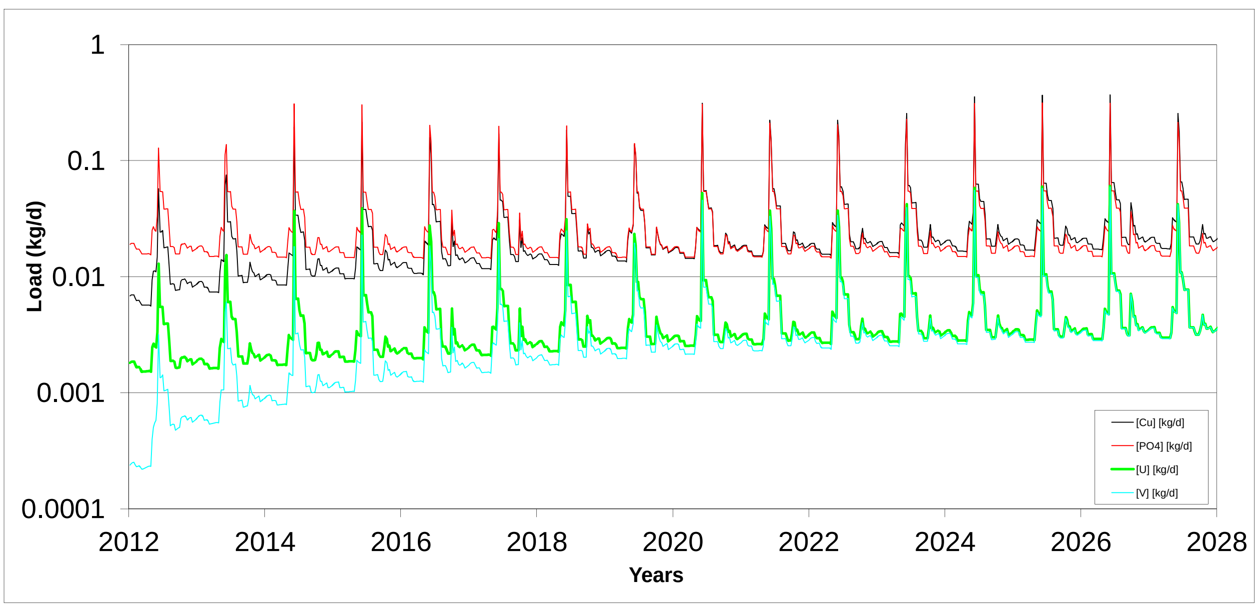
Drawn KAS
Chkd KJD

De Beers Canada Inc.

Snap Lake Outflow Dissolved Load

FIGURE VI-2c





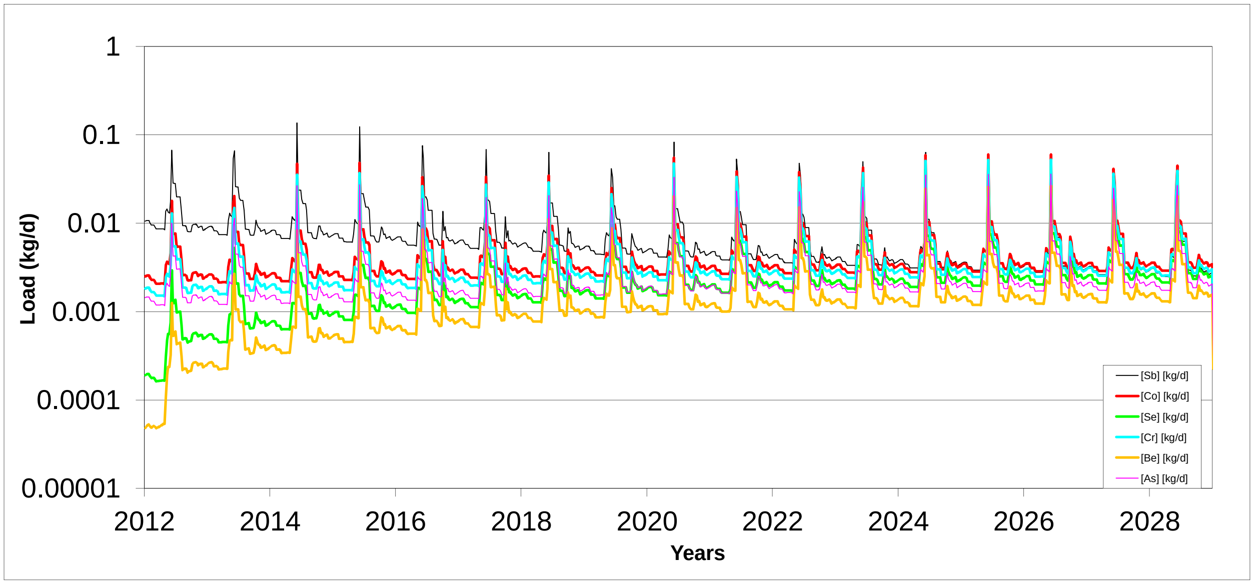
Date: December 2013
Project: 12-1337-0001

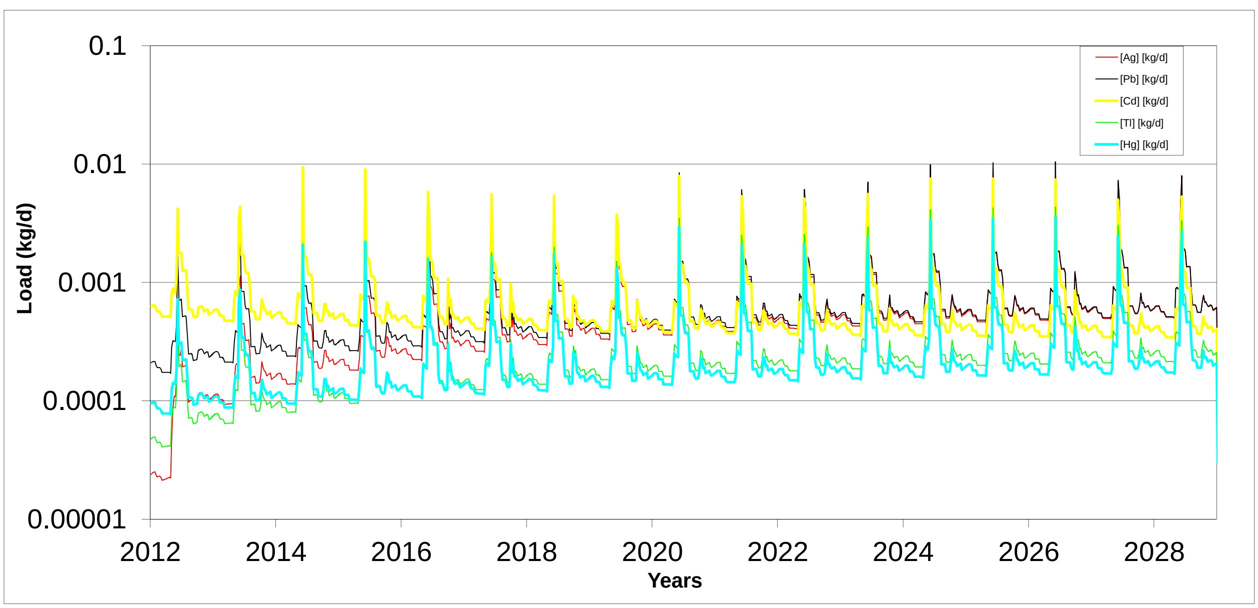
Drawn KAS
Chkd KJD

De Beers Canada Inc.

Snap Lake Outflow Dissolved Load

FIGURE VI-2d





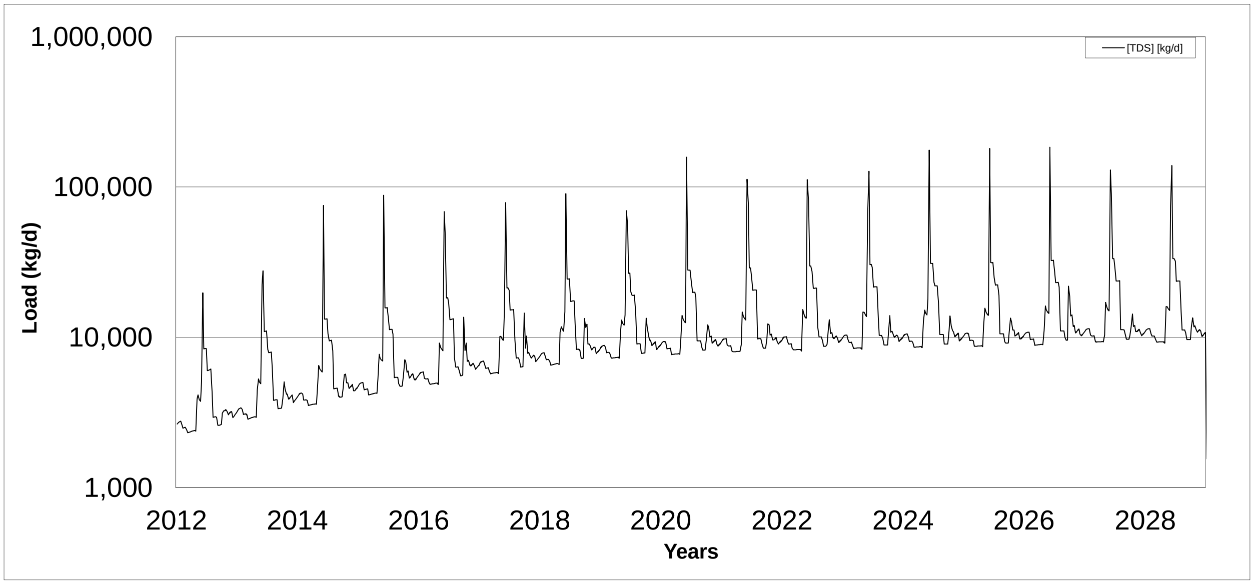
Date: December 2013
Project: 12-1337-0001

Drawn KAS
Chkd KJD

De Beers Canada Inc.

Snap Lake Outflow Dissolved Load

FIGURE VI-2e

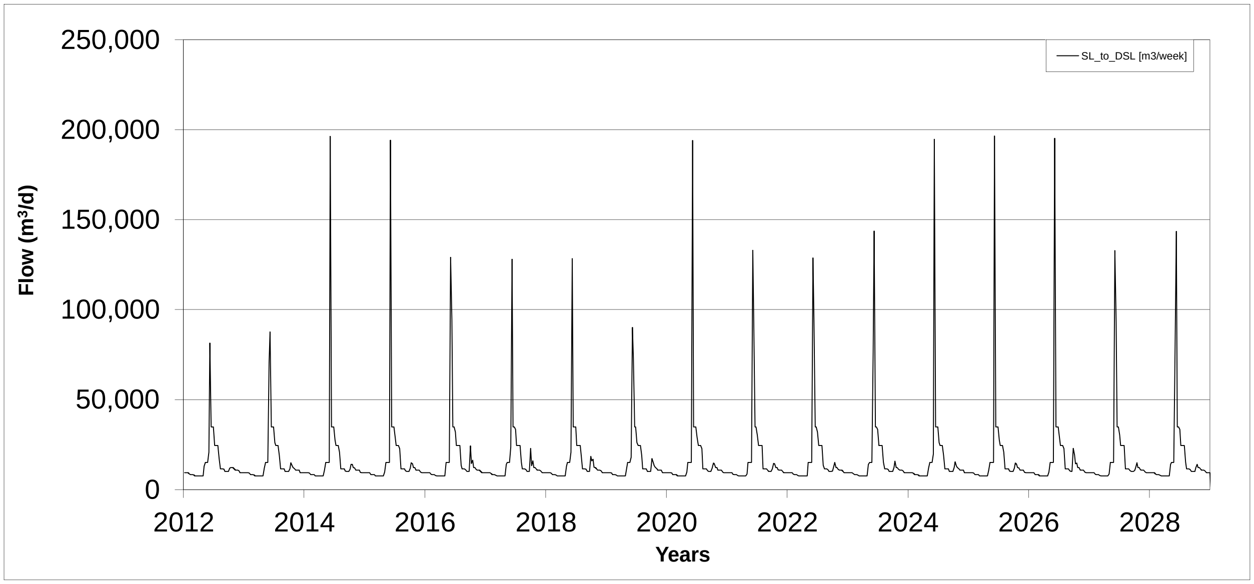


Date: December 2013
Project: 12-1337-0001

Drawn KAS
Chkd KJD

De Beers Canada Inc.

Snap Lake Outflow Dissolved Load FLOW	FIGURE VI-2f



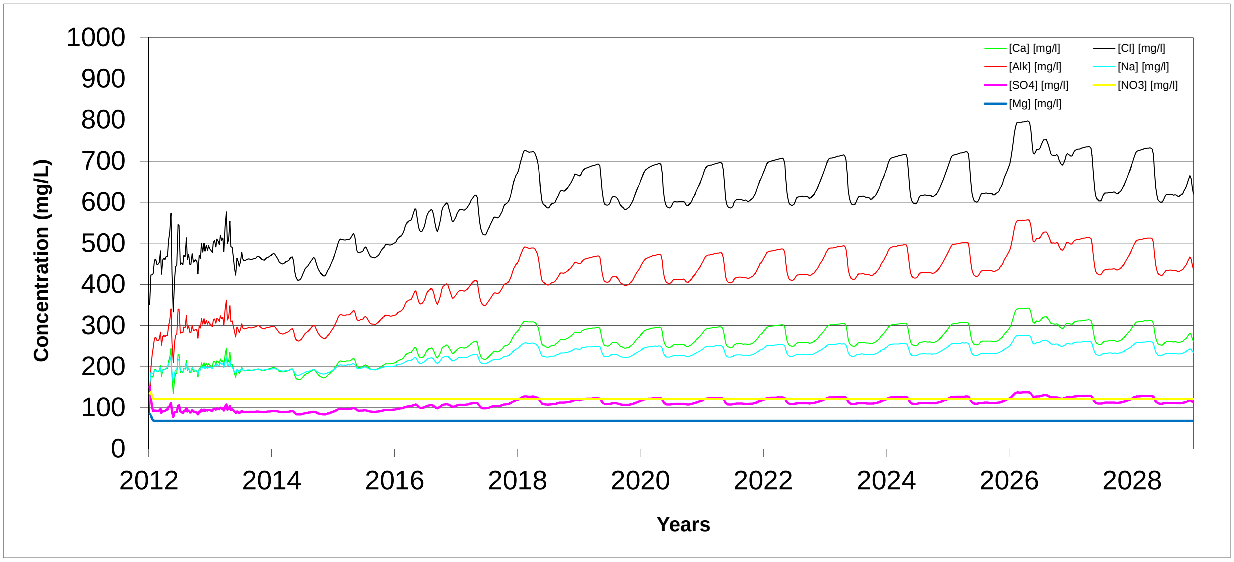
Date: December 2013
Project: 12-1337-0001

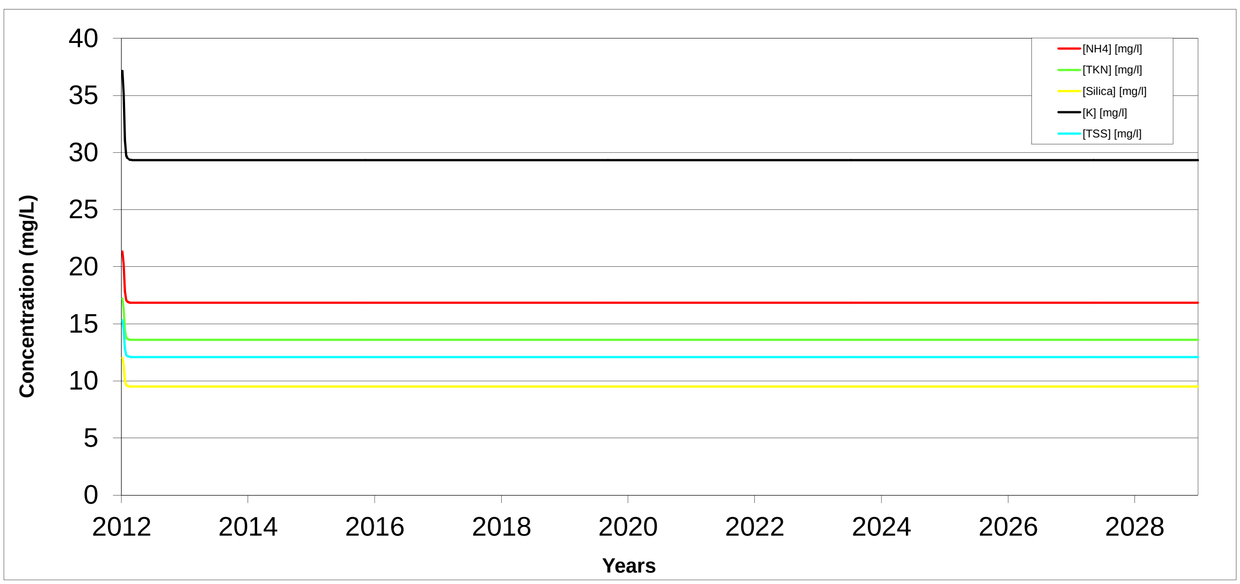
Drawn KAS
Chkd KJD

De Beers Canada Inc.

Process Water Dissolved Concentrations

FIGURE VI-3a



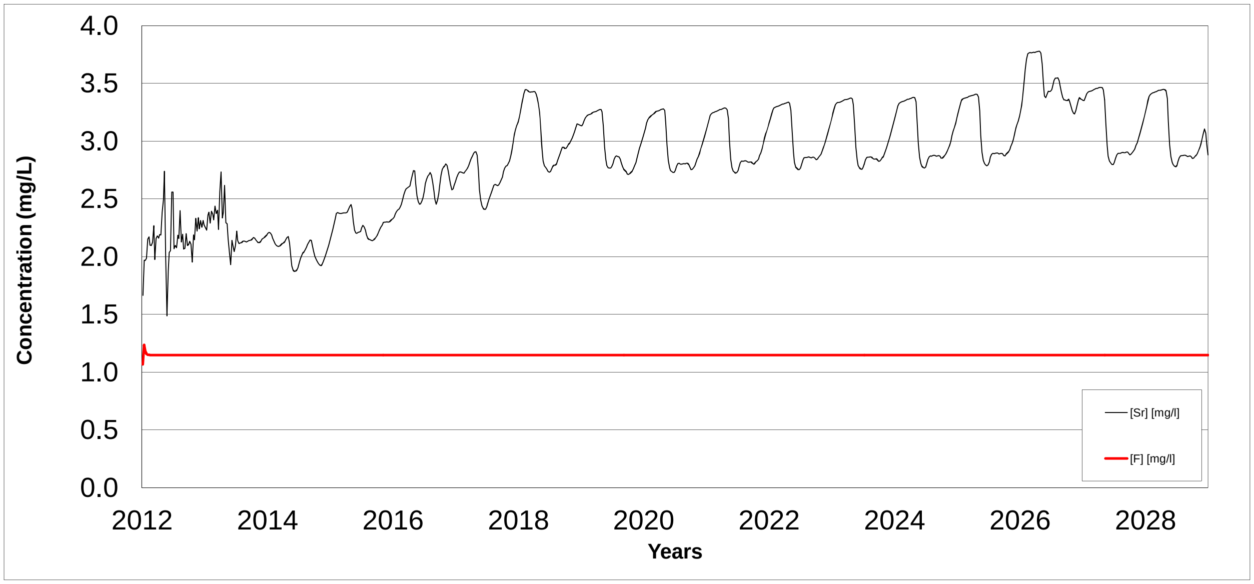


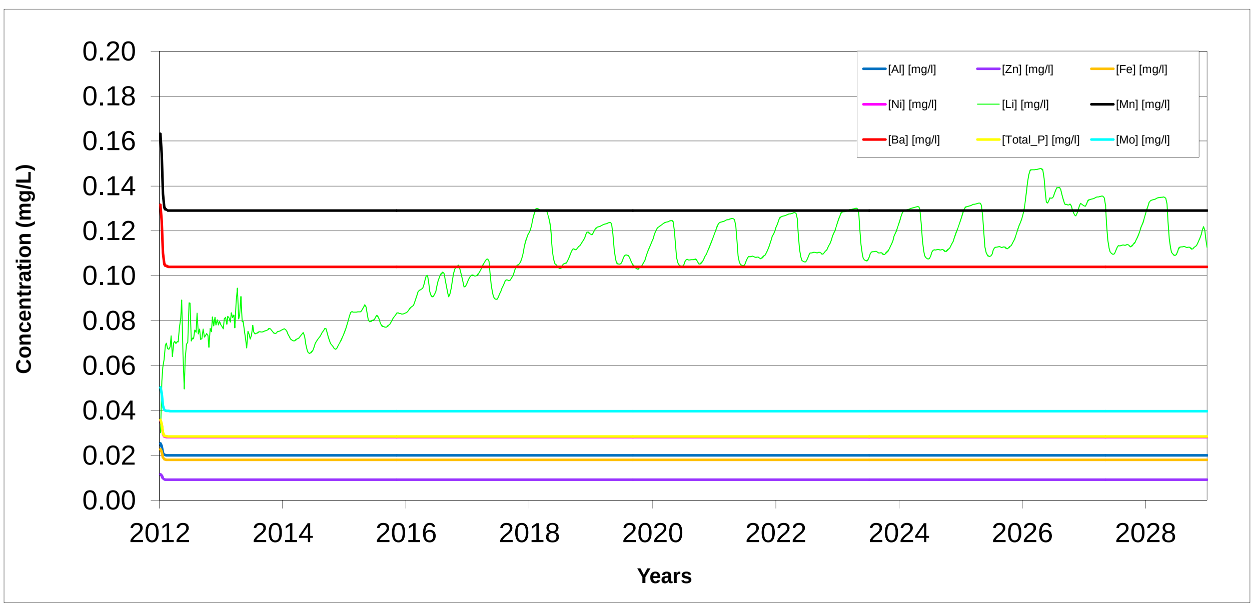
Date: December 2013
Project: 12-1337-0001

Drawn KAS
Chkd KJD

De Beers Canada Inc.

Process Water Dissolved Concentrations	FIGURE VI-3b





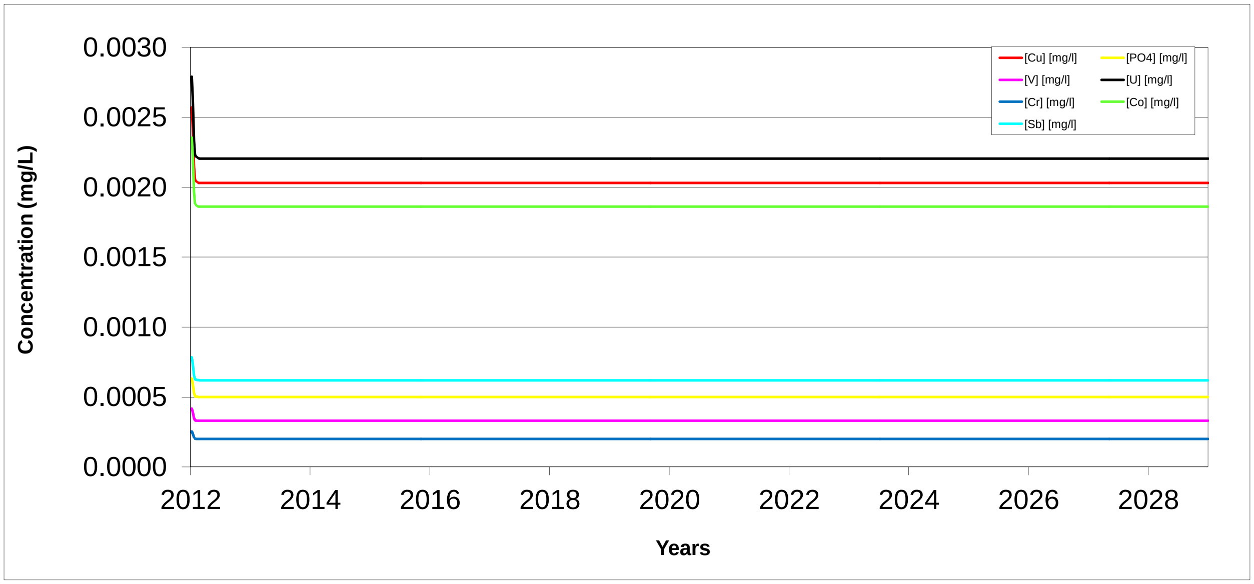
Date: December 2013
Project: 12-1337-0001

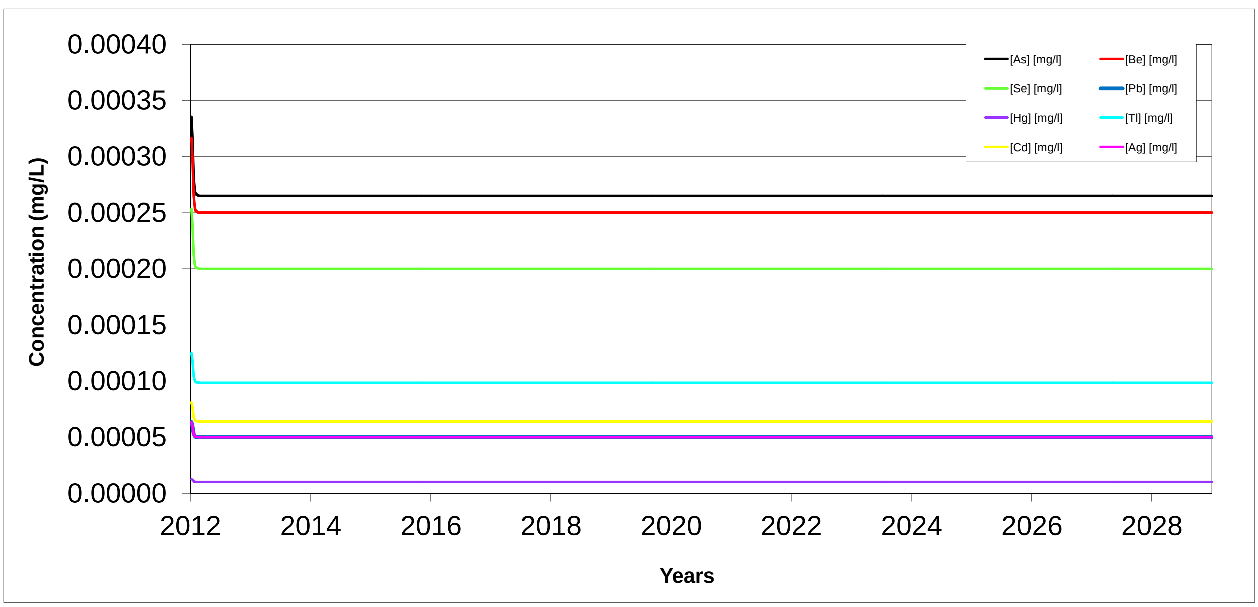
Drawn KAS
Chkd KJD

De Beers Canada Inc.

Process Water Dissolved Concentrations

FIGURE VI-3c





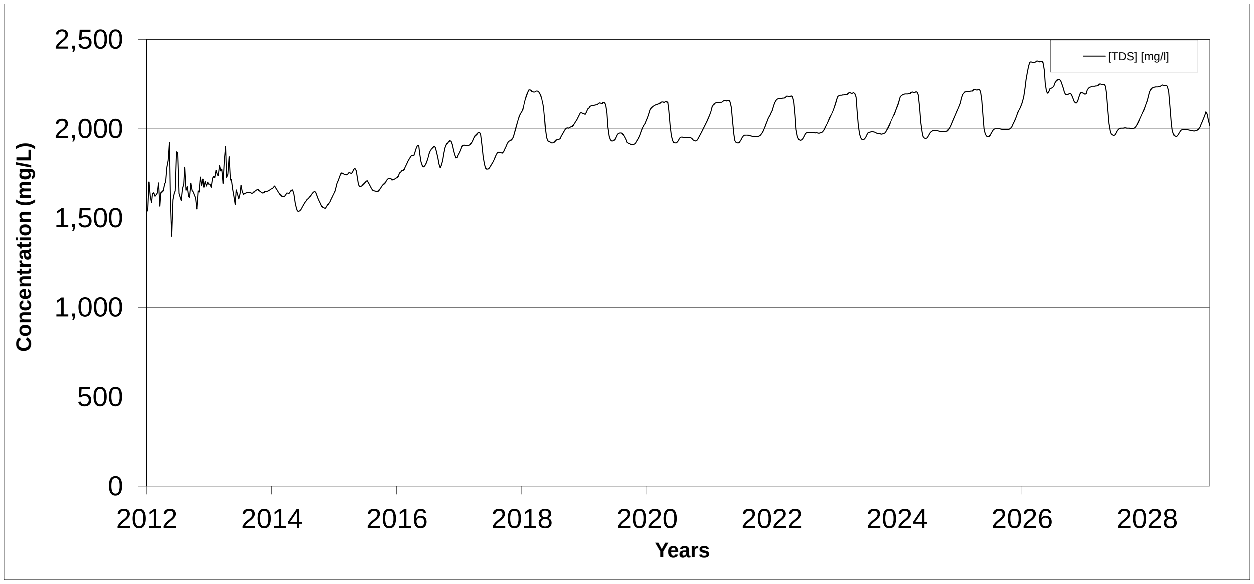
Date: December 2013
Project: 12-1337-0001

Drawn KAS
Chkd KJD

De Beers Canada Inc.

Process Water Dissolved Concentrations

FIGURE VI-3d



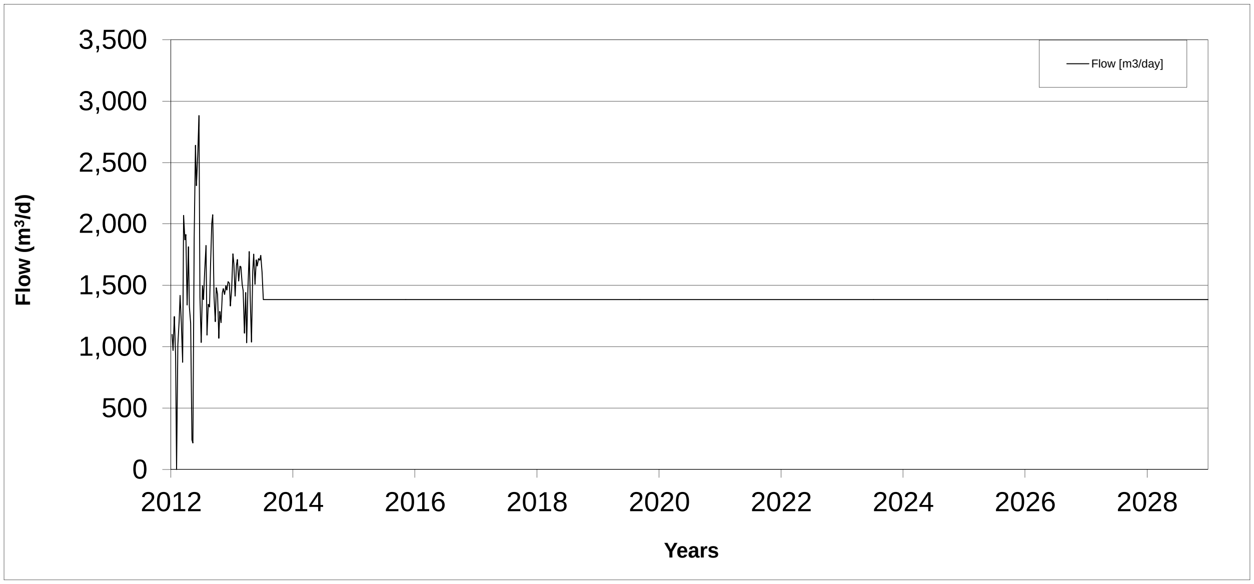
Date: December 2013
Project: 12-1337-0001

De Beers Canada Inc.

Drawn KAS
Chkd KJD

Process Water Dissolved Concentrations

FIGURE VI-3e



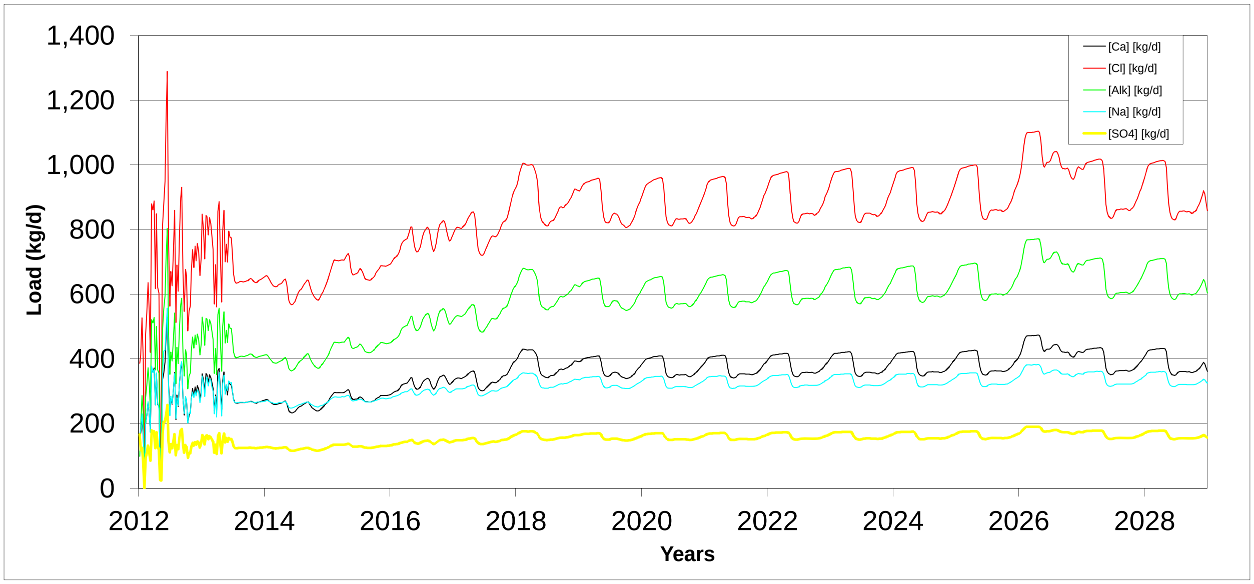
Date: December 2013
Project: 12-1337-0001

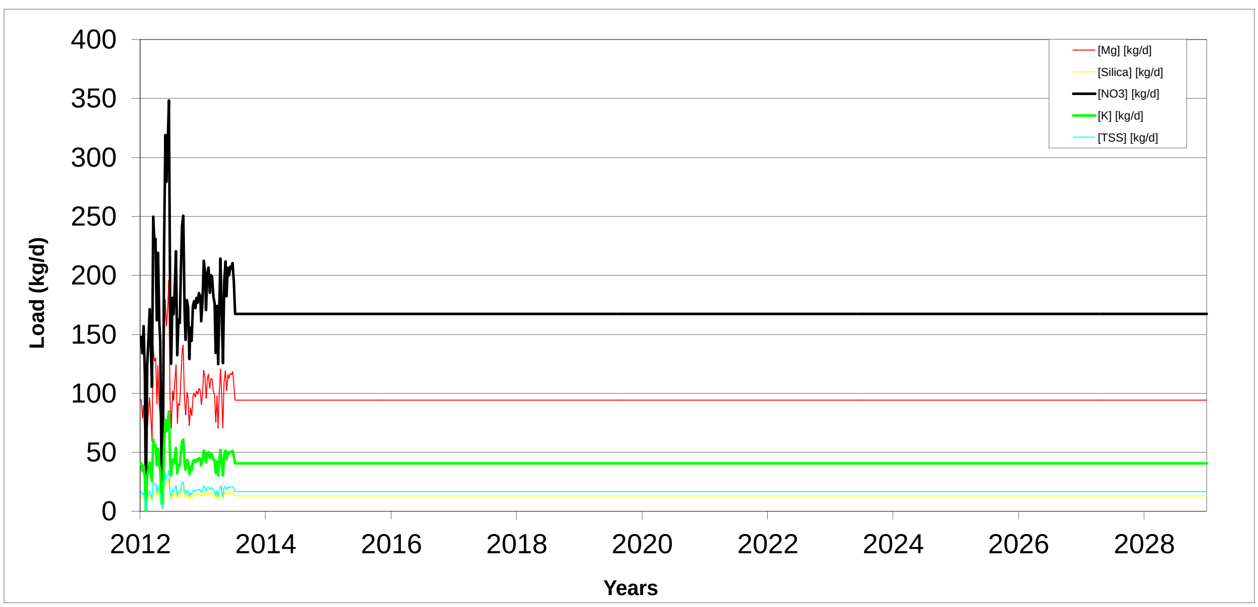
De Beers Canada Inc.

Drawn KAS
Chkd KJD

Process Water Dissolved Load

FIGURE VI-4a





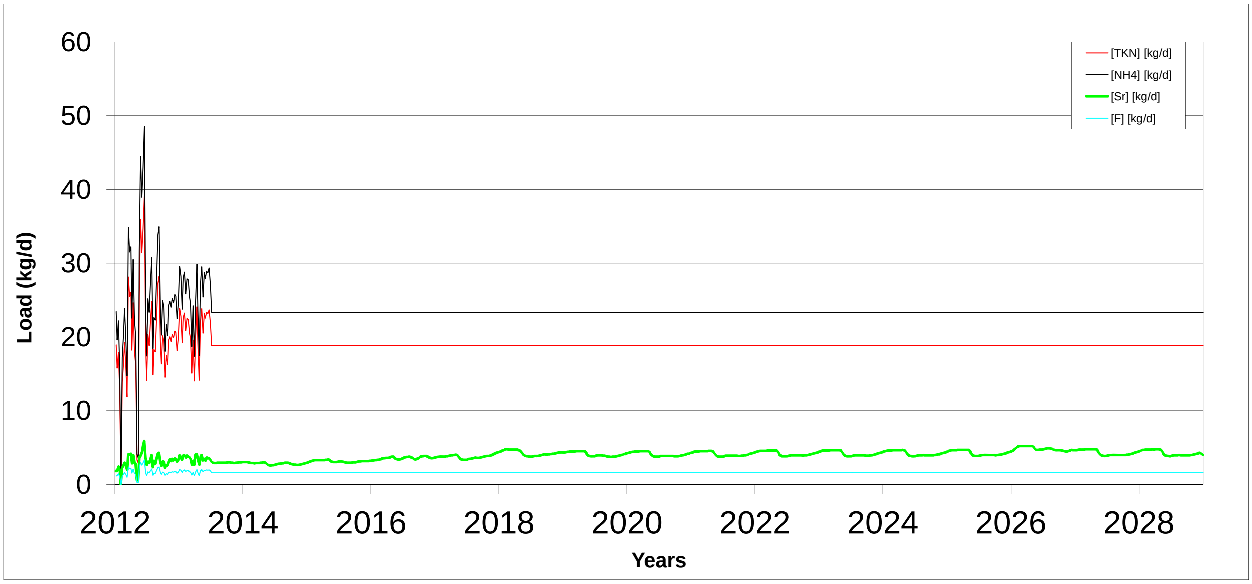
Date: December 2013
Project: 12-1337-0001

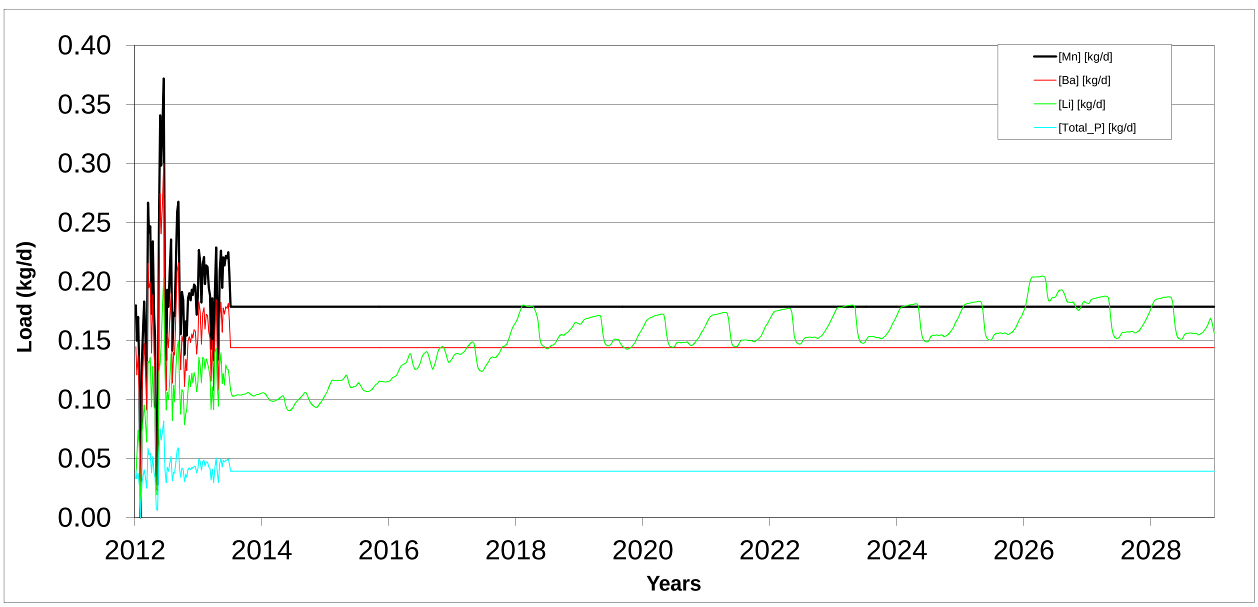
Drawn KAS
Chkd KJD

De Beers Canada Inc.

Process Water Dissolved Load

FIGURE VI-4b





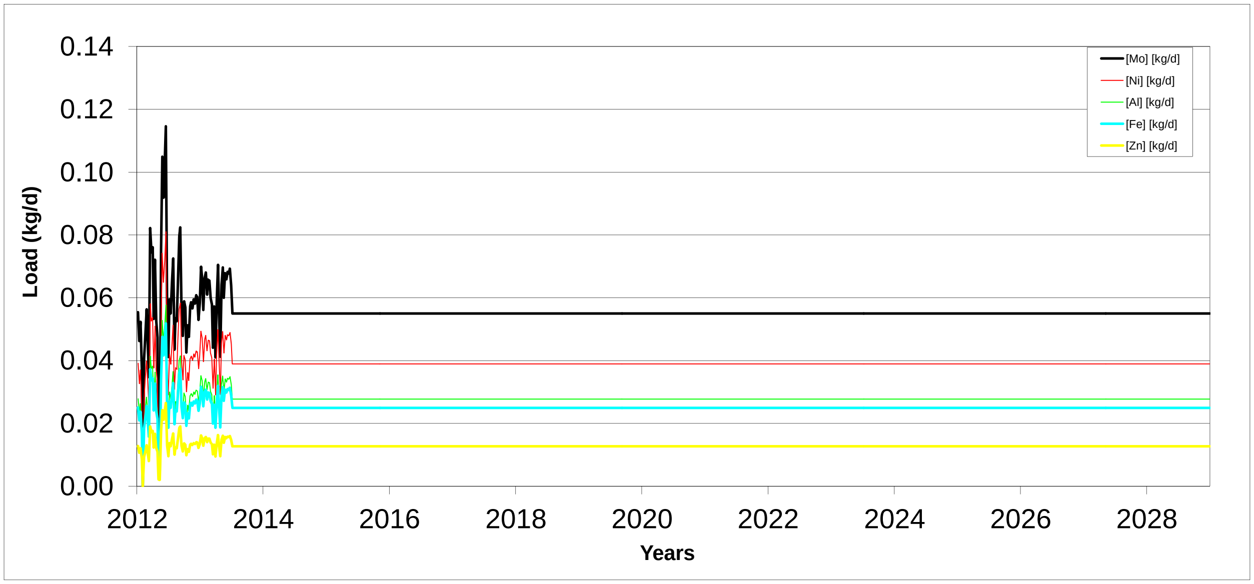
Date: December 2013
Project: 12-1337-0001

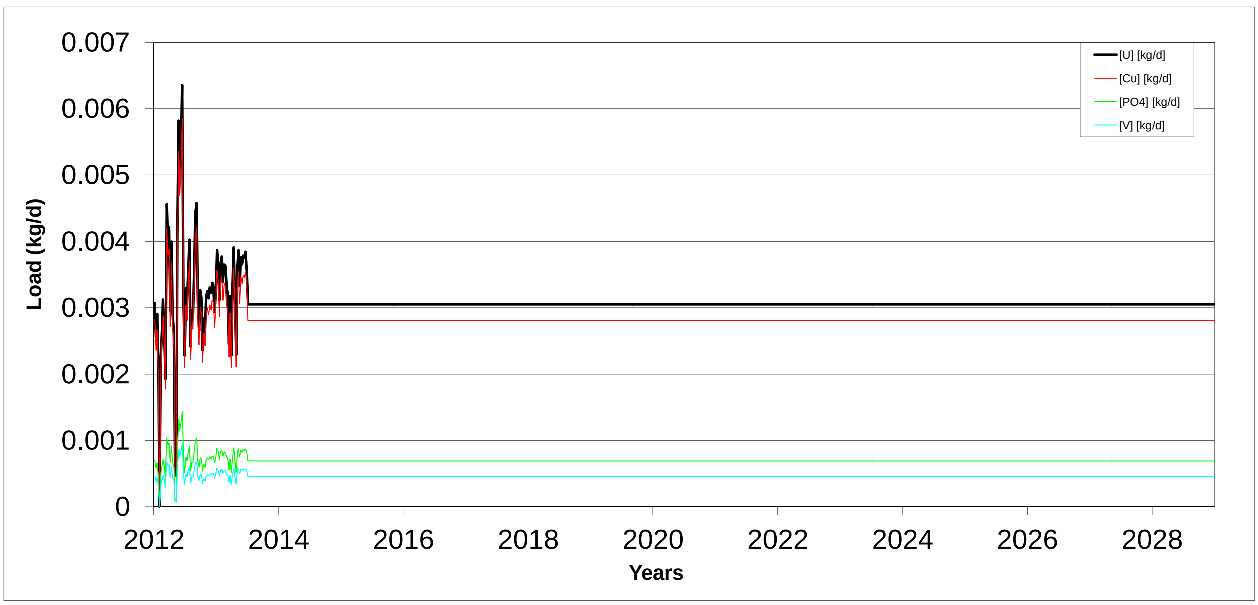
Drawn KAS
Chkd KJD

De Beers Canada Inc.

Process Water Dissolved Load

FIGURE VI-4c





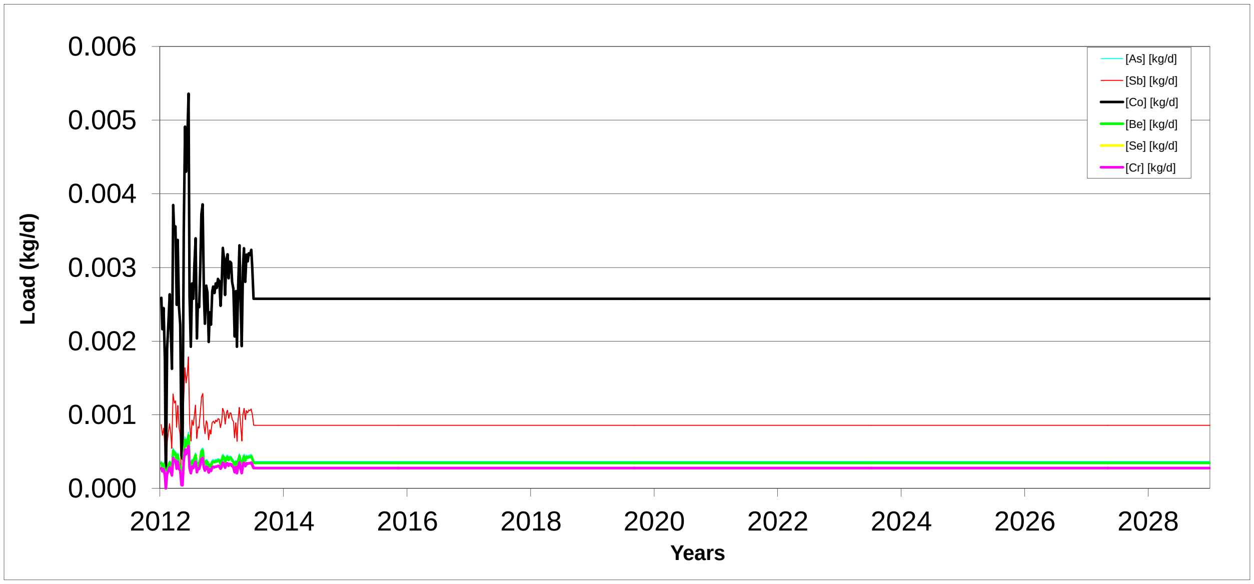
Date: December 2013
Project: 12-1337-0001

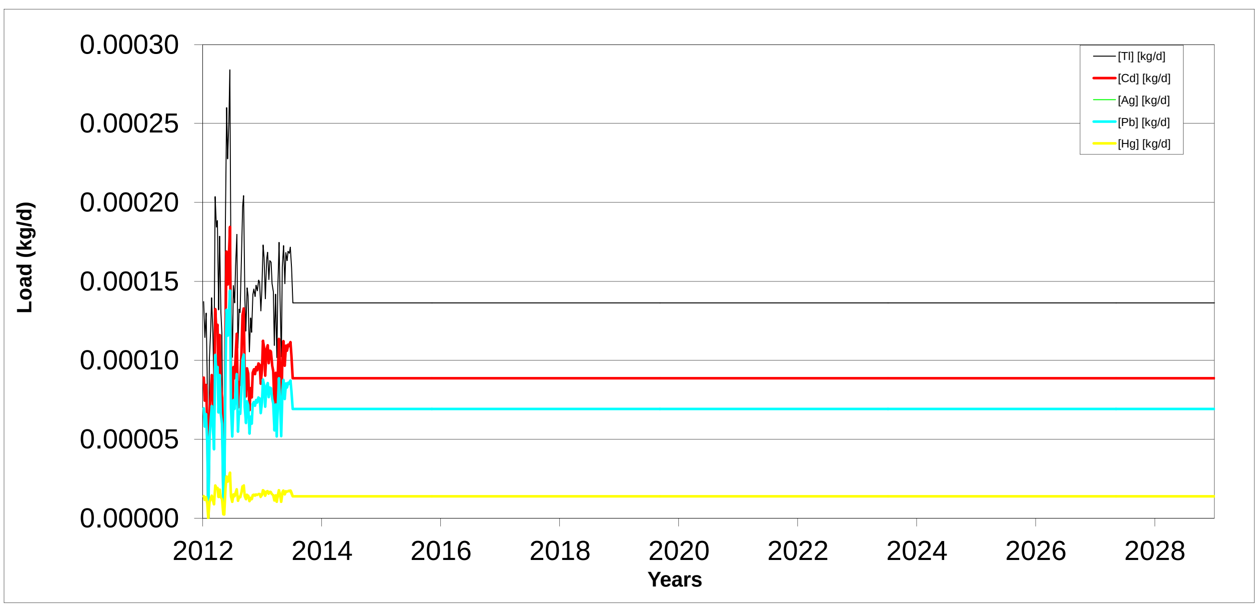
Drawn KAS
Chkd KJD

De Beers Canada Inc.

Process Water Dissolved Load

FIGURE VI-4d





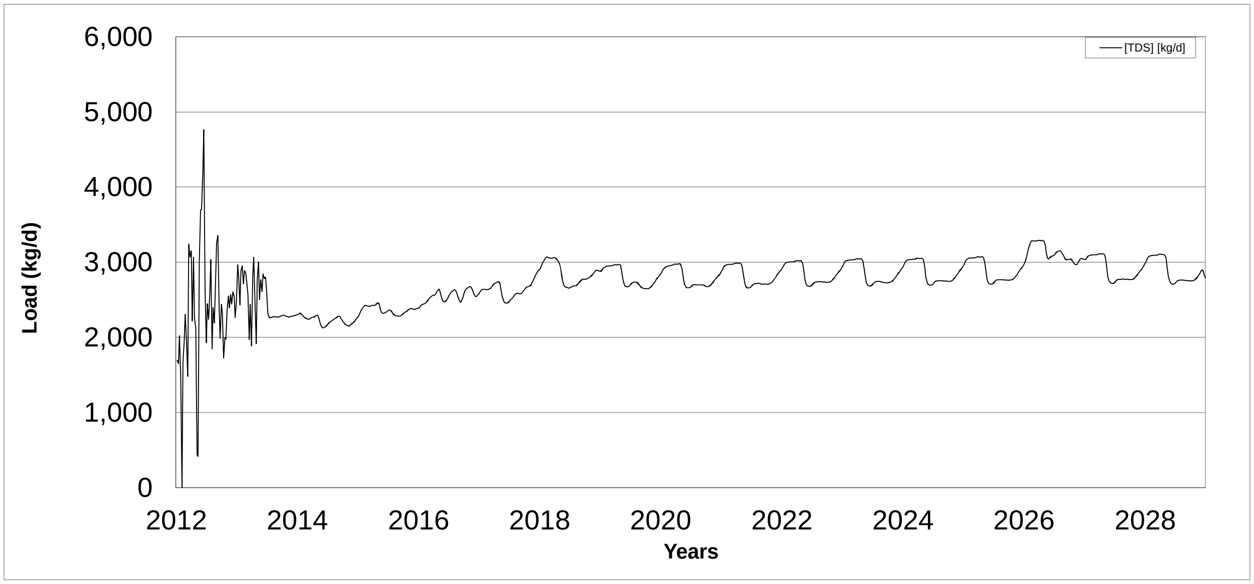
Date: December 2013
Project: 12-1337-0001

Drawn KAS
Chkd KJD

De Beers Canada Inc.

Process Water Dissolved Load

FIGURE VI-4e

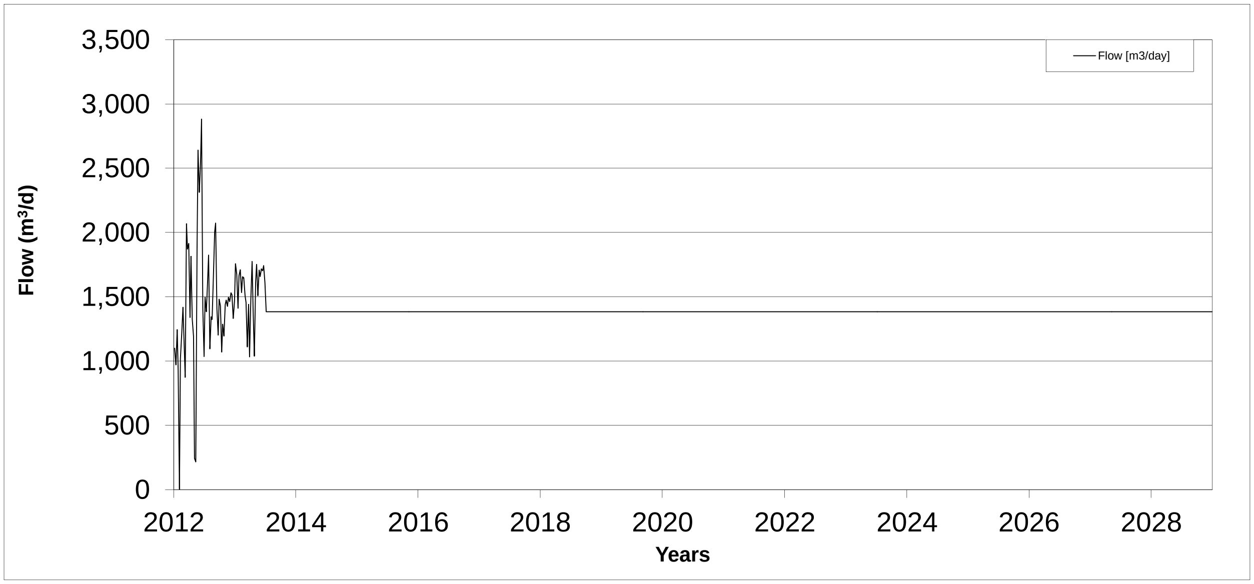


Date: December 2013
Project: 12-1337-0001

Drawn KAS
Chkd KJD

De Beers Canada Inc.

Process Water Dissolved Load FLOW	FIGURE VI-4f

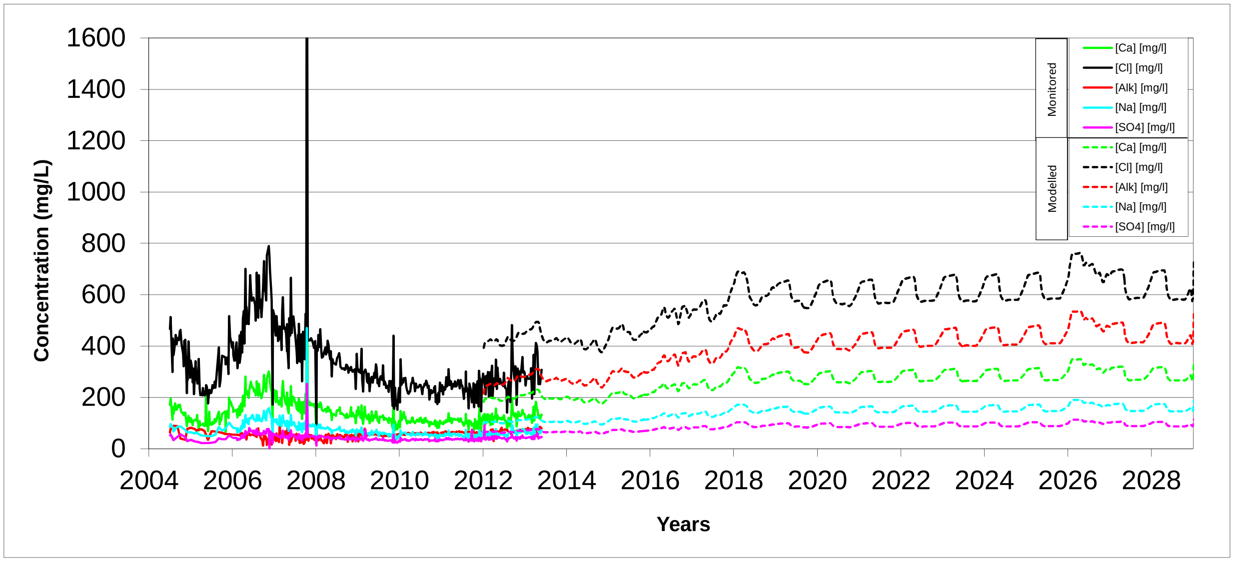


Date: December 2013
Project: 12-1337-0001

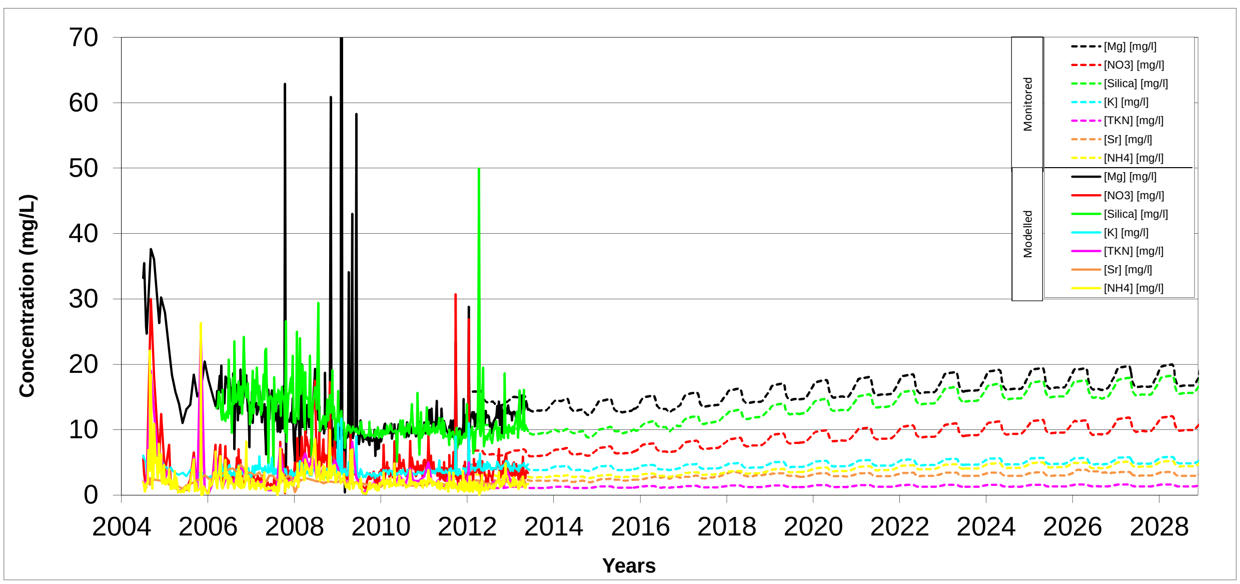
Drawn KAS
Chkd KJD

De Beers Canada Inc.

Mine Water (SNP 02-01) Dissolved Concentrations	FIGURE VI-5a



Note: Monitoring values above 1600 mg/L are not shown.



Note: Monitoring values above 70 mg/L are not shown.

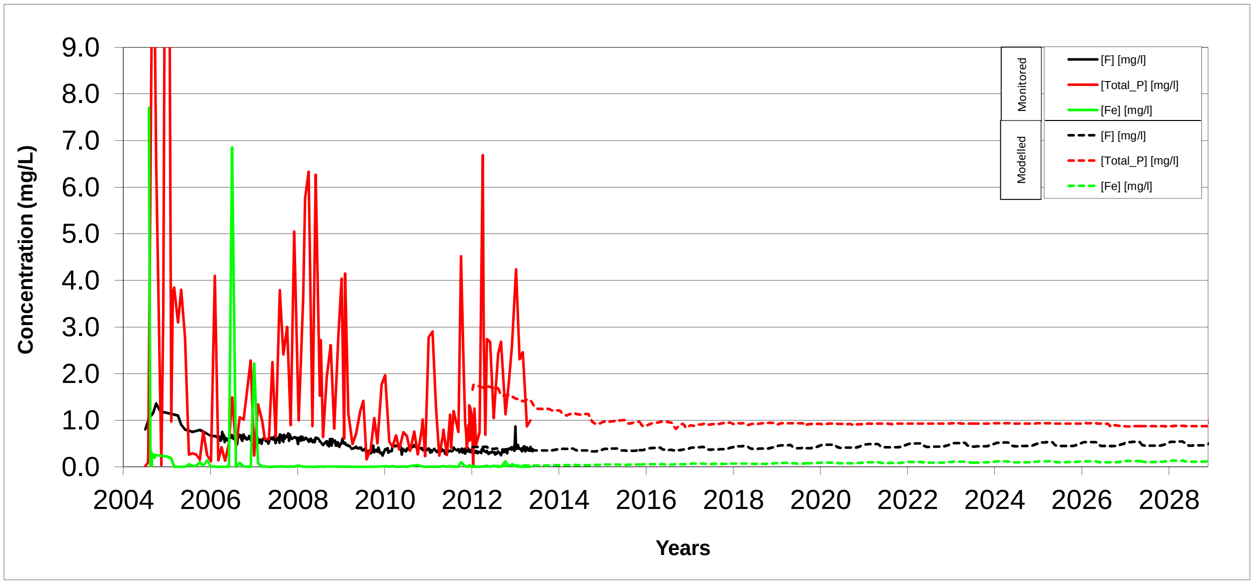
Date: December 2013
Project: 12-1337-0001

Drawn KAS
Chkd KJD

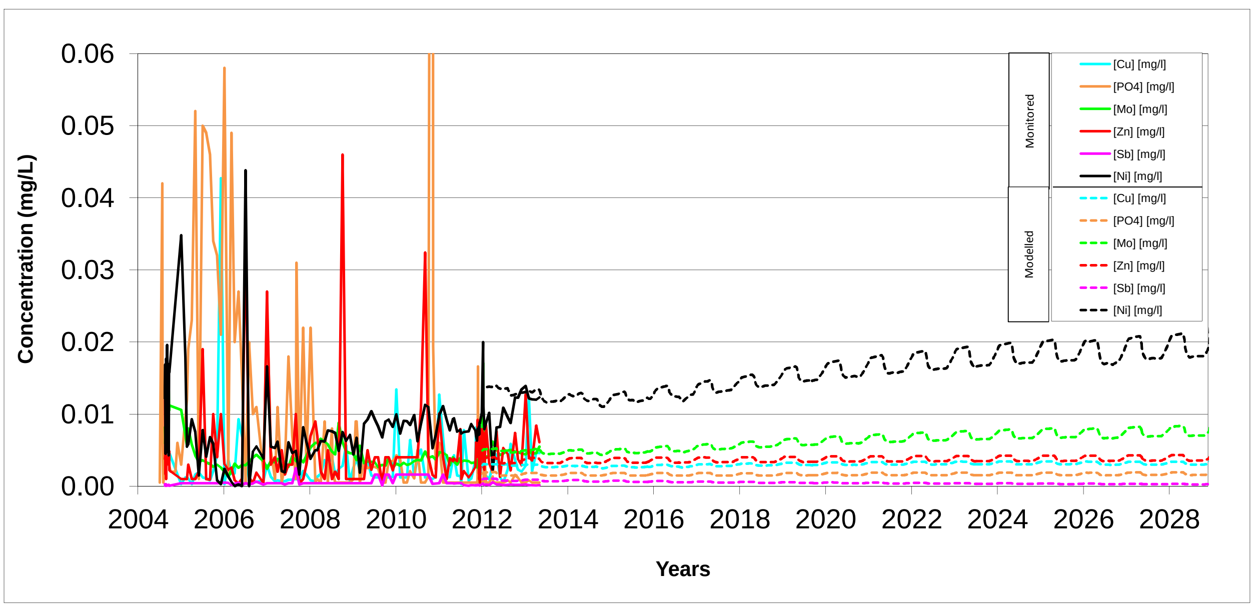
De Beers Canada Inc.

Mine Water (SNP 02-01) Dissolved Concentrations

FIGURE VI-5b



Note: Monitored values above 9.0 mg/L are not shown.



Note: Monitoring values above 0.06 mg/L are not shown.

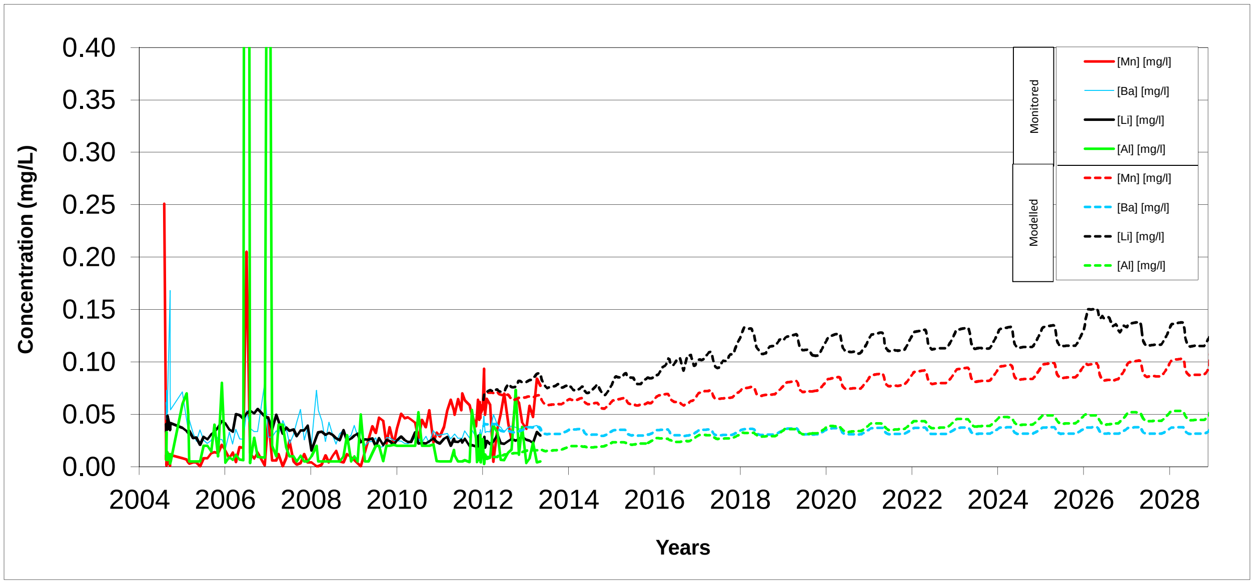
Date: December 2013
Project: 12-1337-0001

Drawn KAS
Chkd KJD

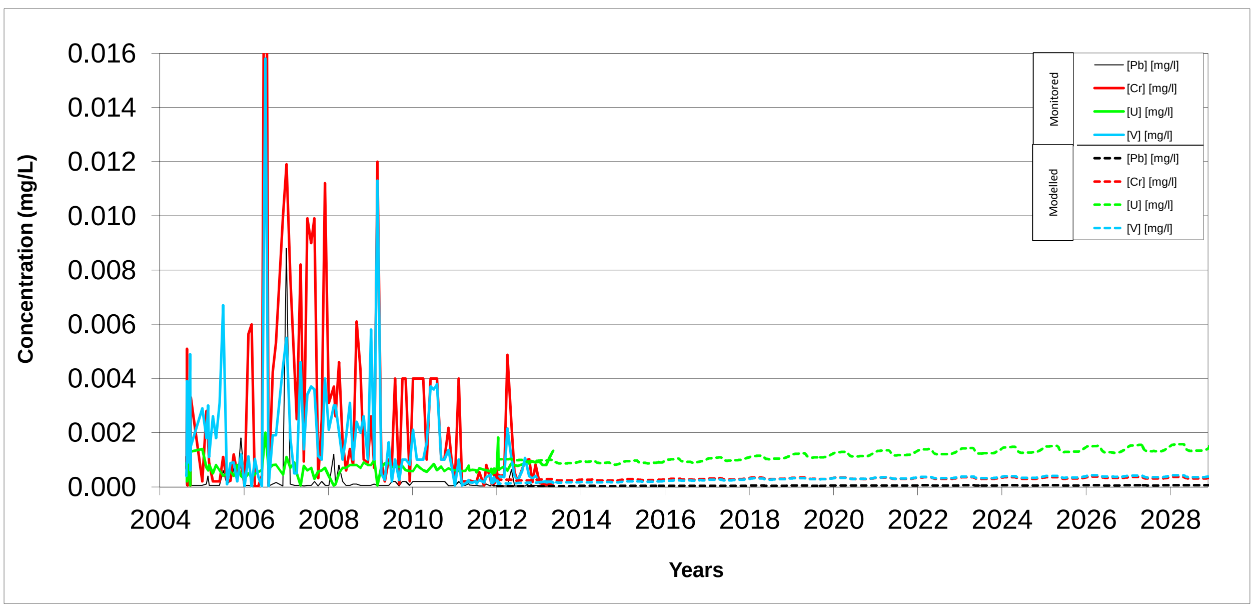
De Beers Canada Inc.

Mine Water (SNP 02-01) Dissolved Concentrations

FIGURE VI-5c



Note: Monitored values above 0.40 mg/L are not shown.



Note: Monitored values above 0.016 mg/L are not shown.

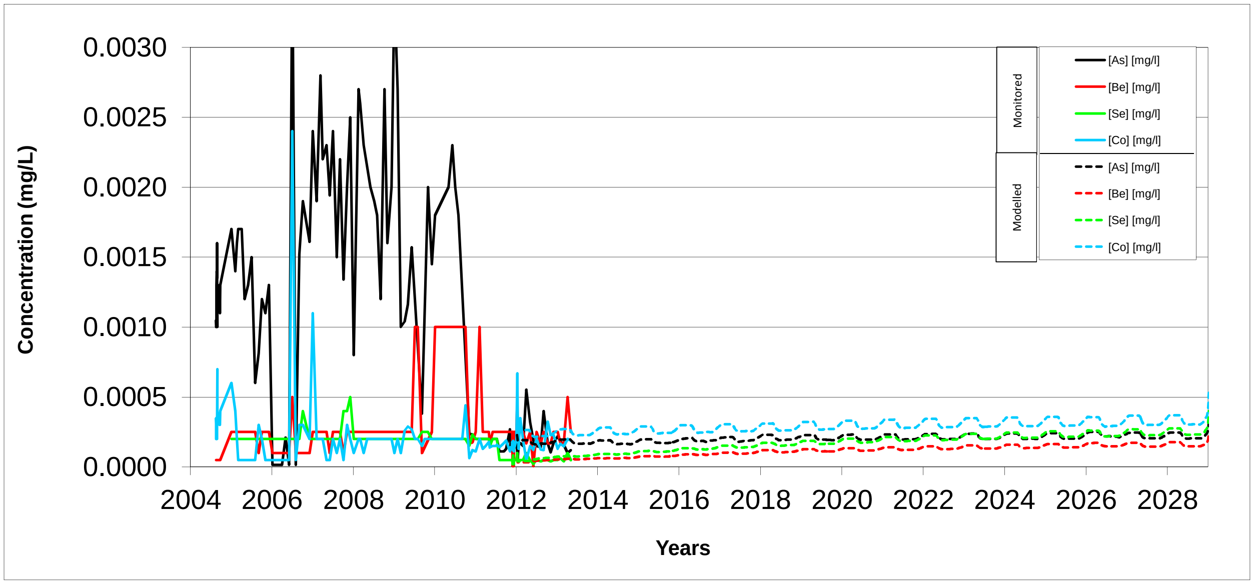
Date: December 2013
Project: 12-1337-0001

Drawn KAS
Chkd KJD

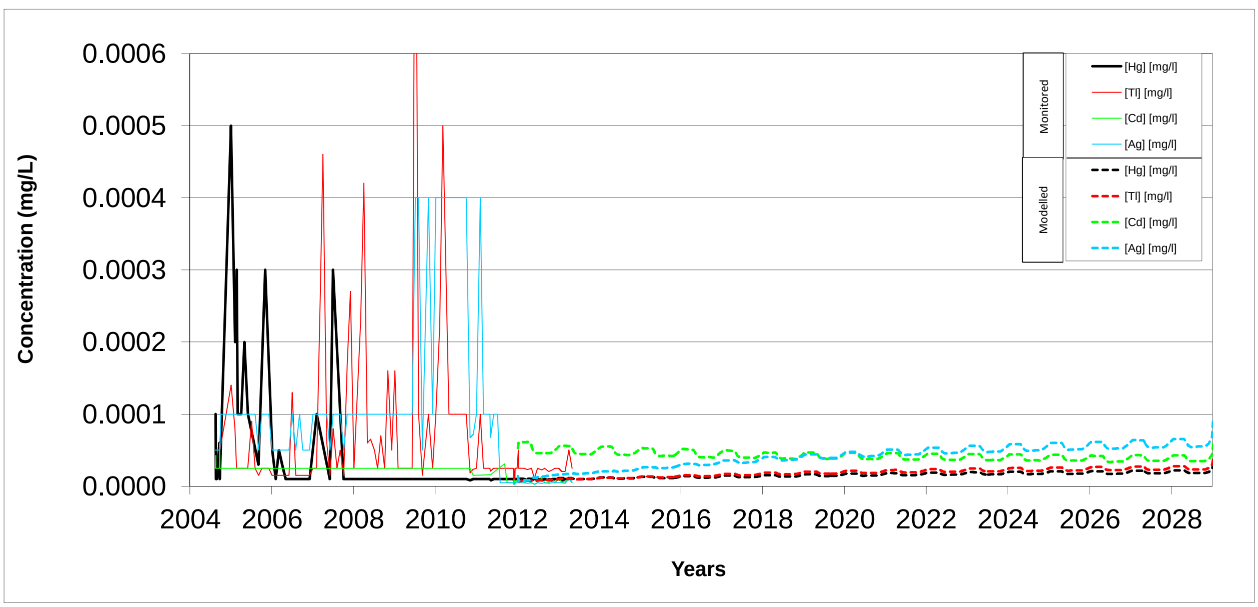
De Beers Canada Inc.

Mine Water (SNP 02-01) Dissolved Concentrations

FIGURE VI-5d



Note: Monitored values above 0.0030 mg/L are not shown.



Note: Monitored values above 0.0006 mg/L are not shown.

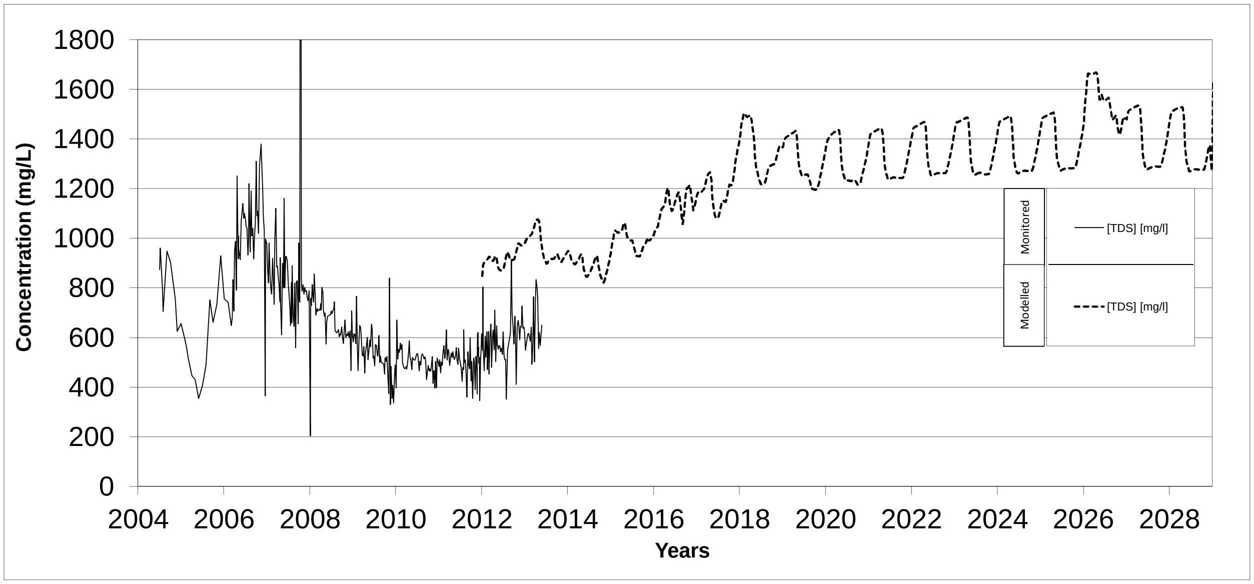
Date: December 2013
Project: 12-1337-0001

Drawn KAS
Chkd KJD

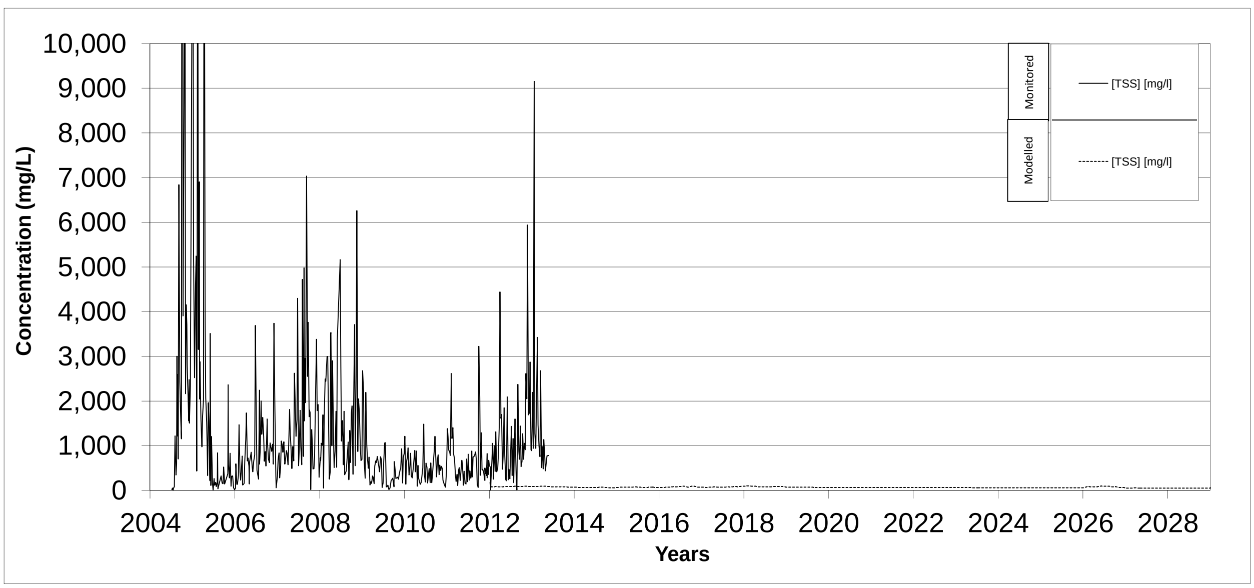
De Beers Canada Inc.

Mine Water (SNP 02-01) Dissolved Concentrations

FIGURE VI-5e



Note: Monitored values above 1800 mg/L are not shown.



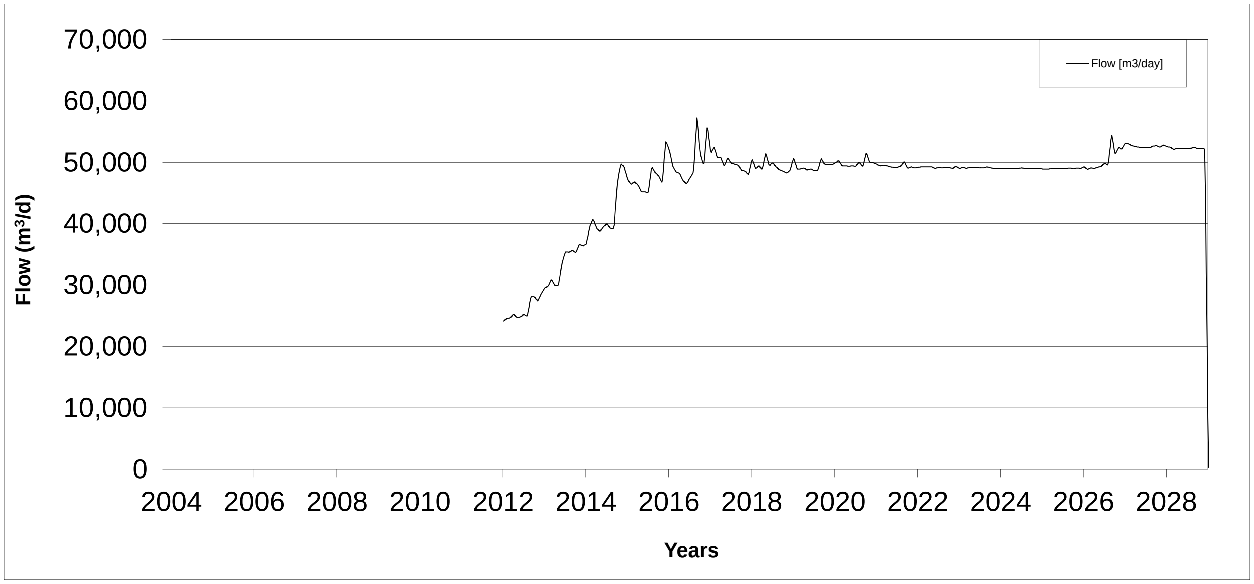
Note: Monitored values above 10,000 mg/L are not shown.

Date: December 2013
Project: 12-1337-0001

Drawn KAS
Chkd KJD

De Beers Canada Inc.

Mine Water (SNP 02-01) Dissolved Concentrations	FIGURE VI-5f



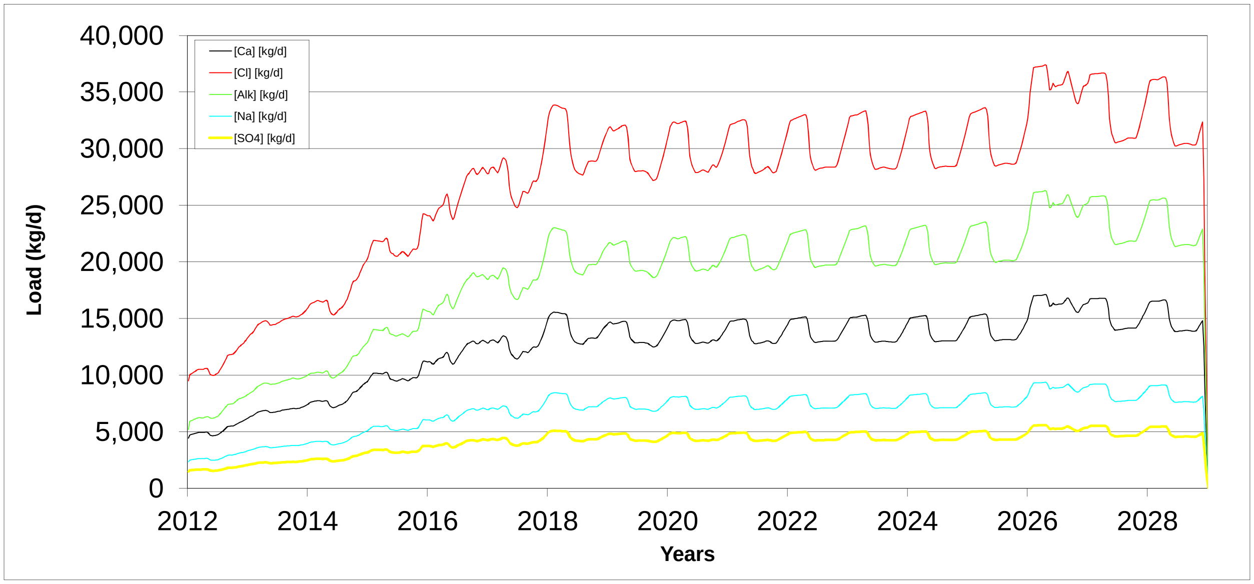
Date: December 2013
Project: 12-1337-0001

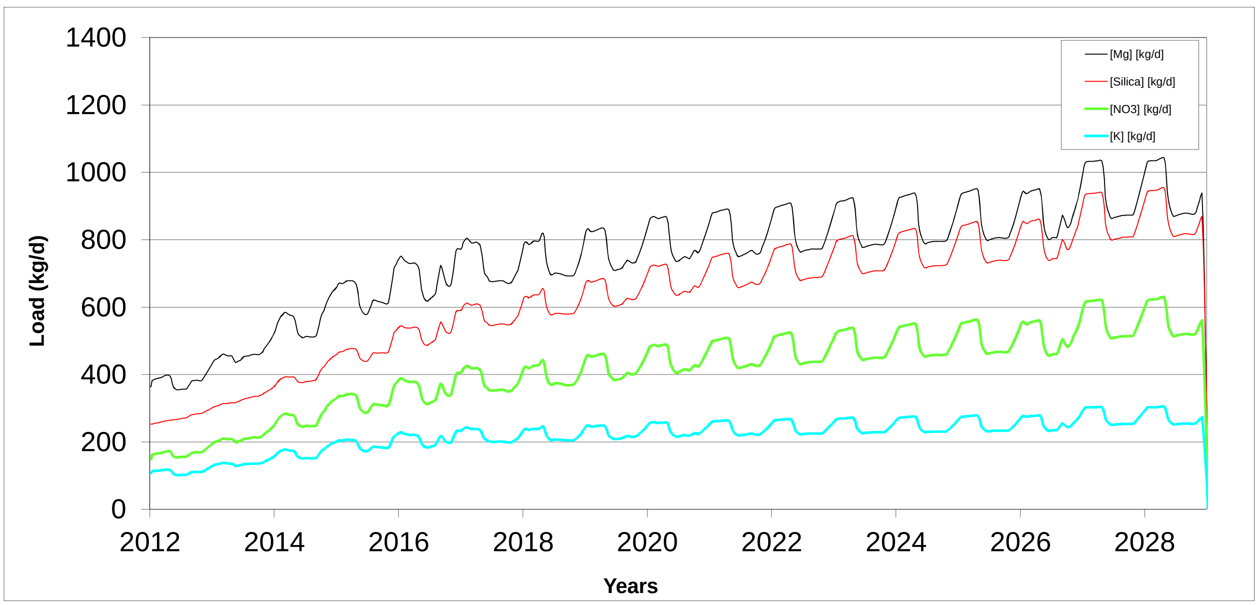
Drawn KAS
Chkd KJD

De Beers Canada Inc.

Mine Water (SNP 02-01) Dissolved Load

FIGURE VI-6a



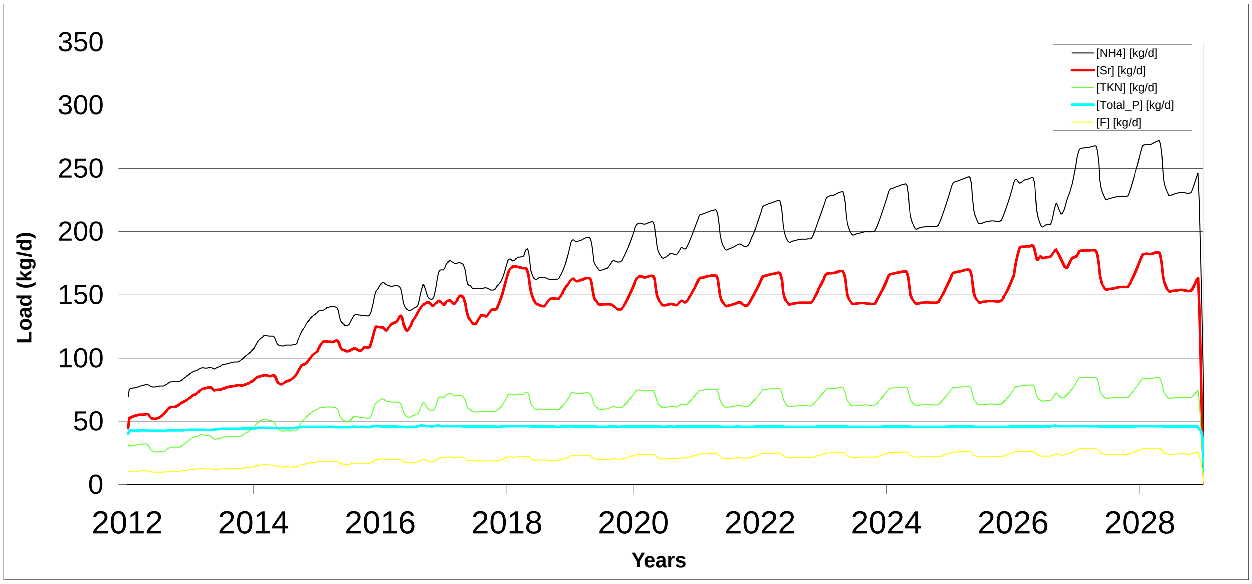


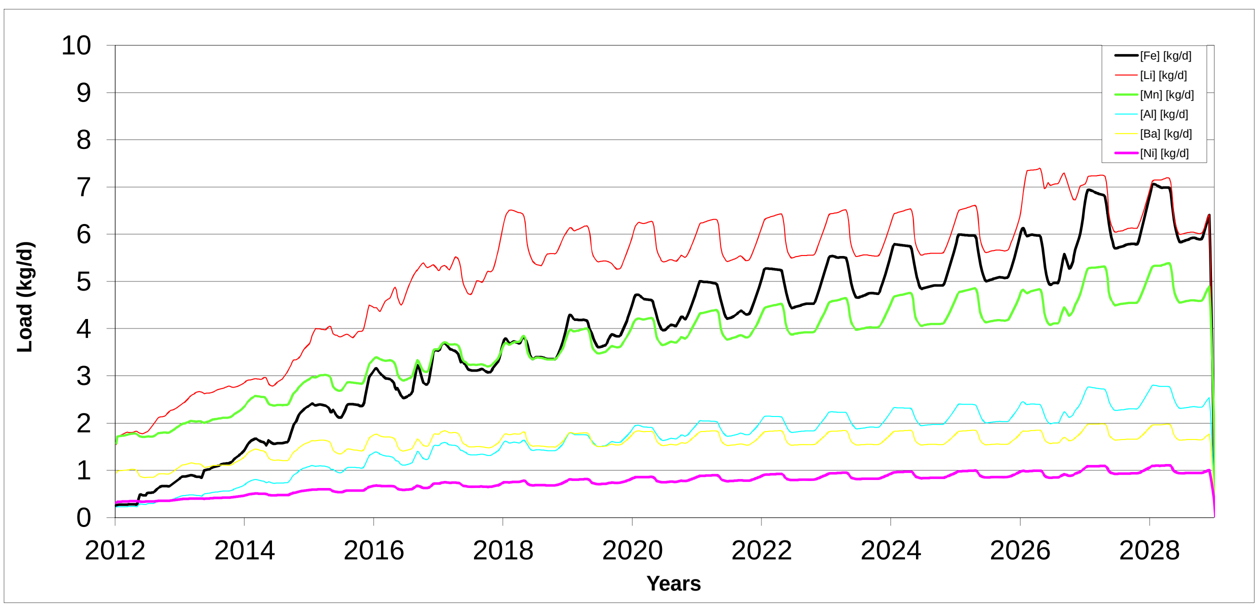
Date: December 2013
Project: 12-1337-0001

Drawn KAS
Chkd KJD

De Beers Canada Inc.

Mine Water (SNP 02-01) Dissolved Load	FIGURE VI-6b



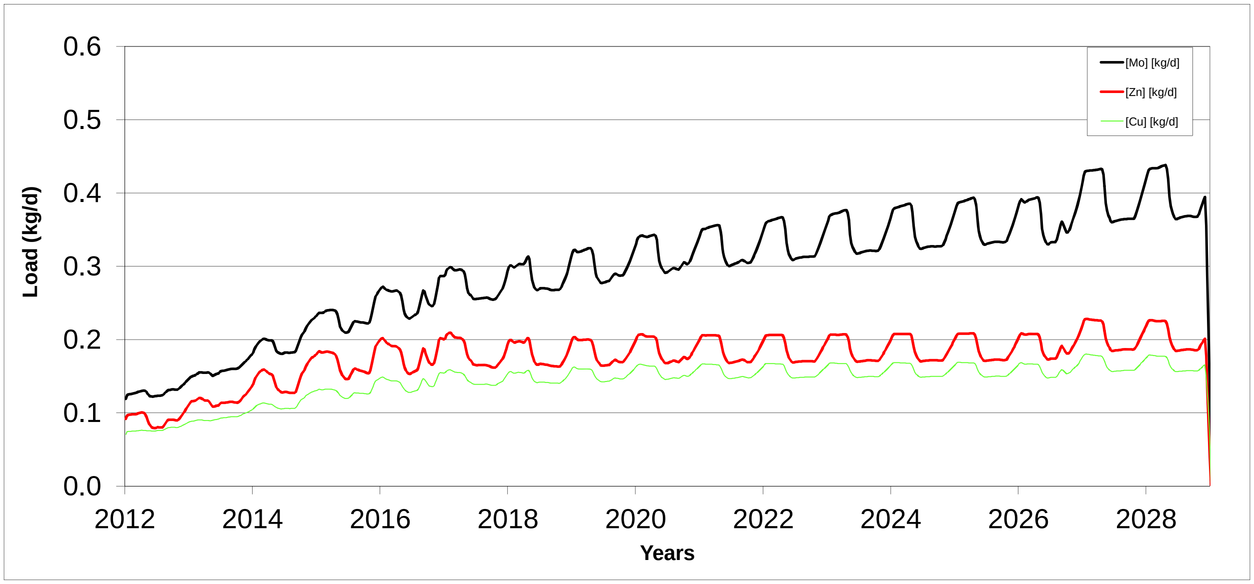


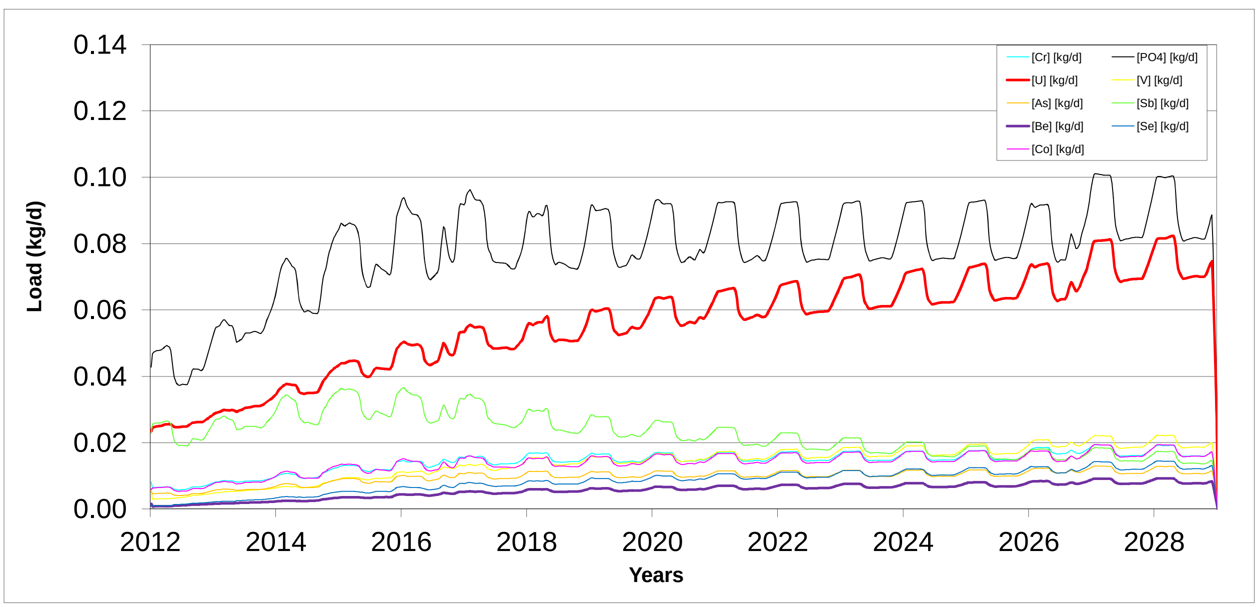
Date: December 2013
Project: 12-1337-0001

Drawn KAS
Chkd KJD

De Beers Canada Inc.

Mine Water (SNP 02-01) Dissolved Load	FIGURE VI-6c



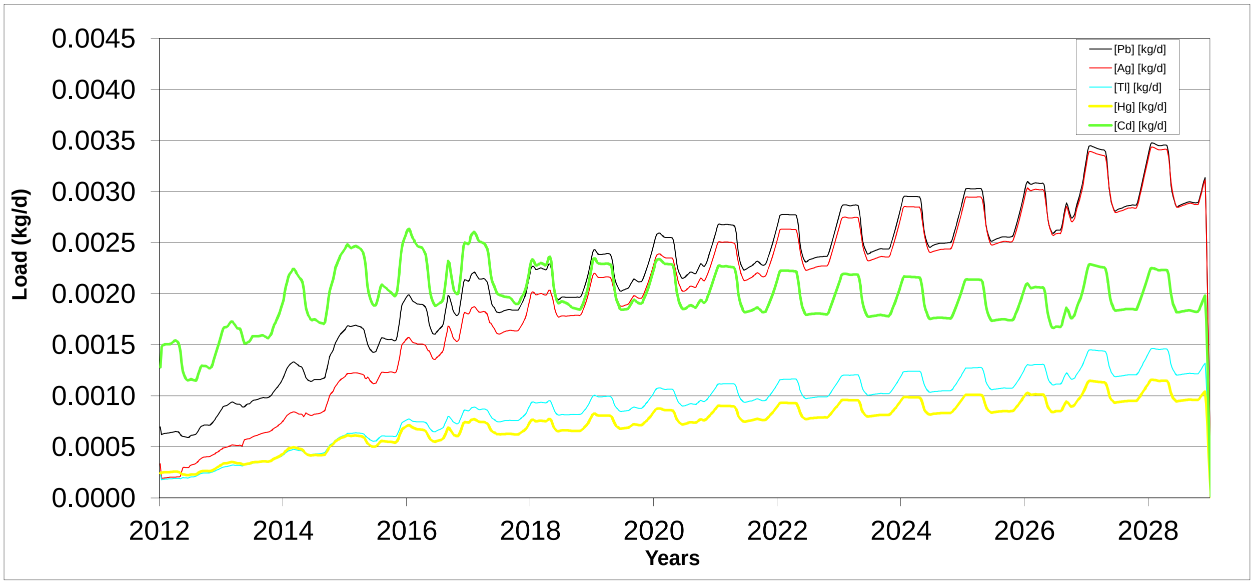


Date: December 2013
Project: 12-1337-0001

Drawn KAS
Chkd KJD

De Beers Canada Inc.

Mine Water (SNP 02-01) Dissolved Load	FIGURE VI-6d



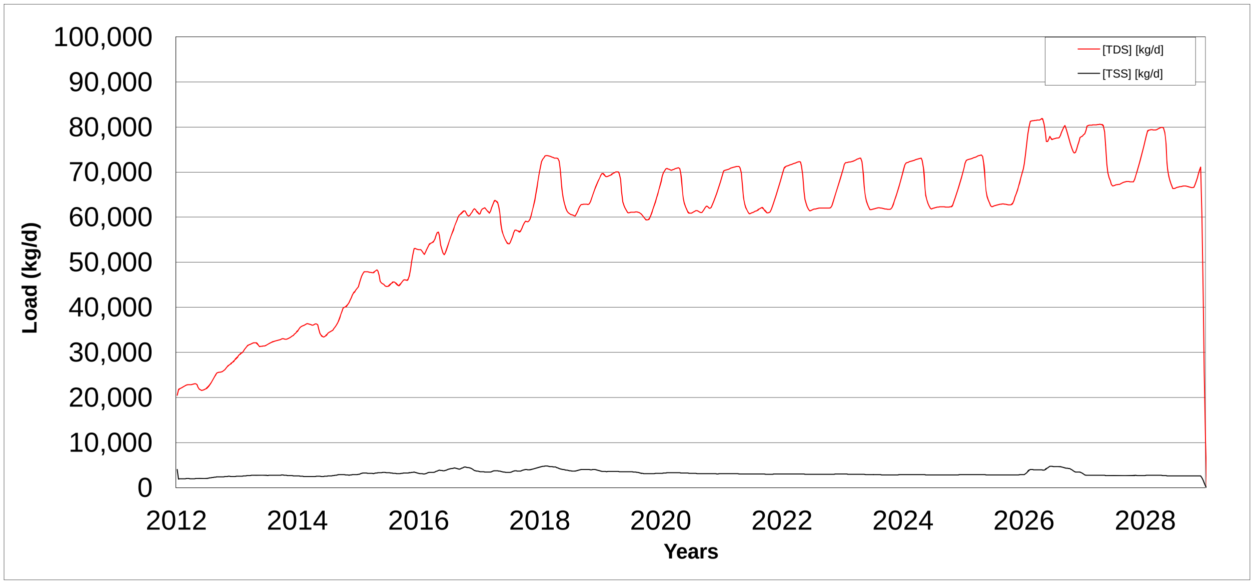
Date: December 2013
Project: 12-1337-0001

Drawn KAS
Chkd KJD

De Beers Canada Inc.

Mine Water (SNP 02-01) Dissolved Load

FIGURE VI-6e

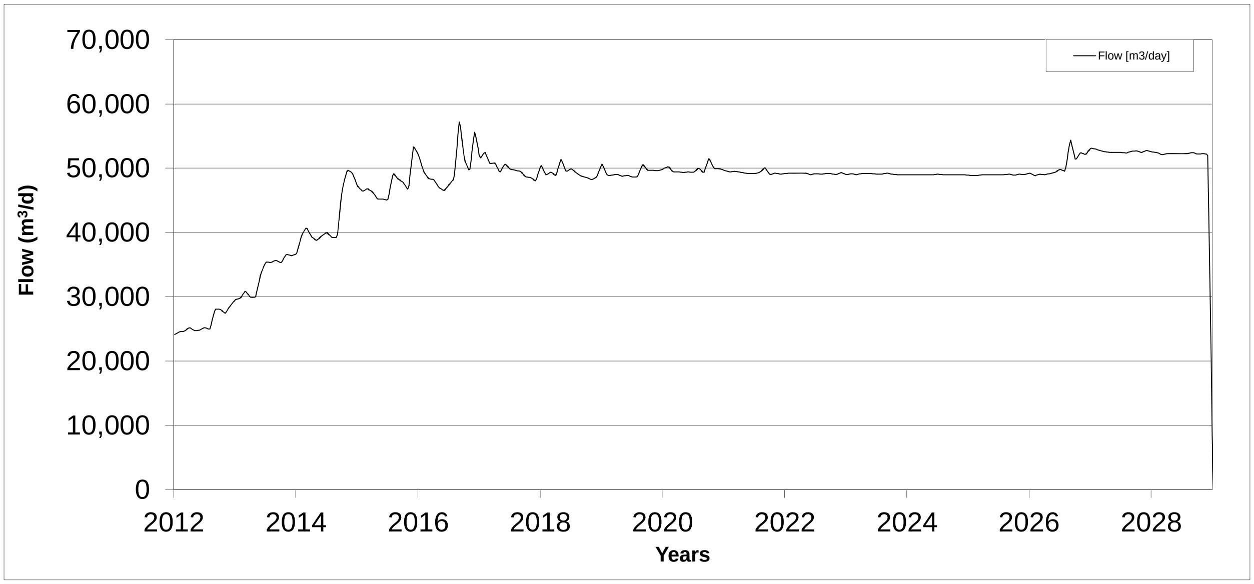


Date: December 2013
Project: 12-1337-0001

Drawn KAS
Chkd KJD

De Beers Canada Inc.

Mine Water (SNP 02-01) Dissolved Load FLOW	FIGURE VI-6f



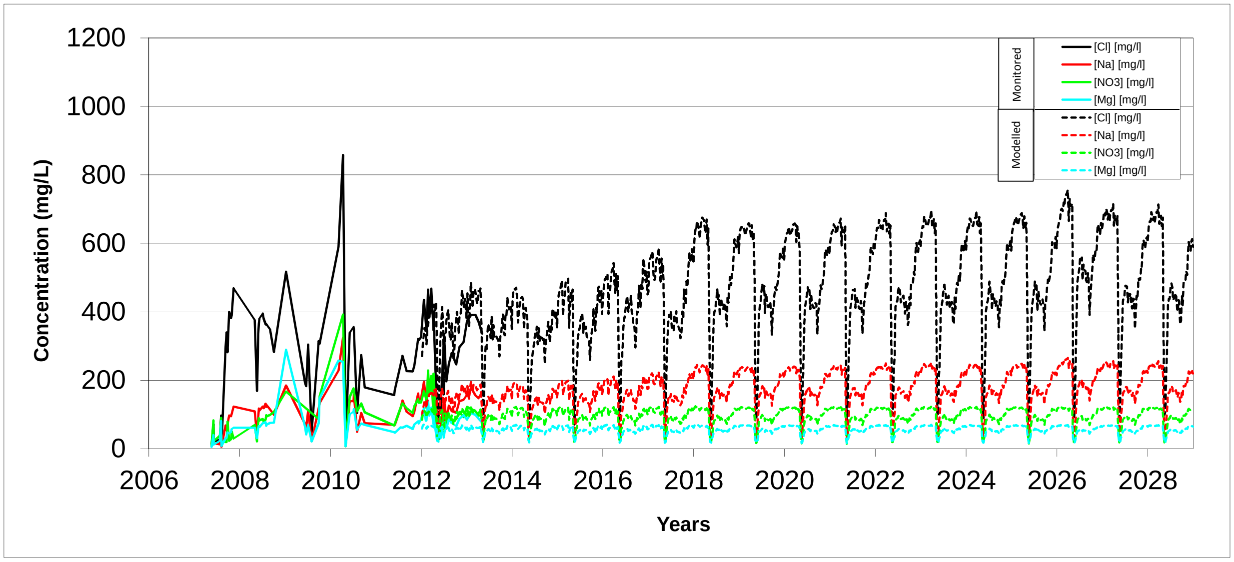
Date: December 2013
Project: 12-1337-0001

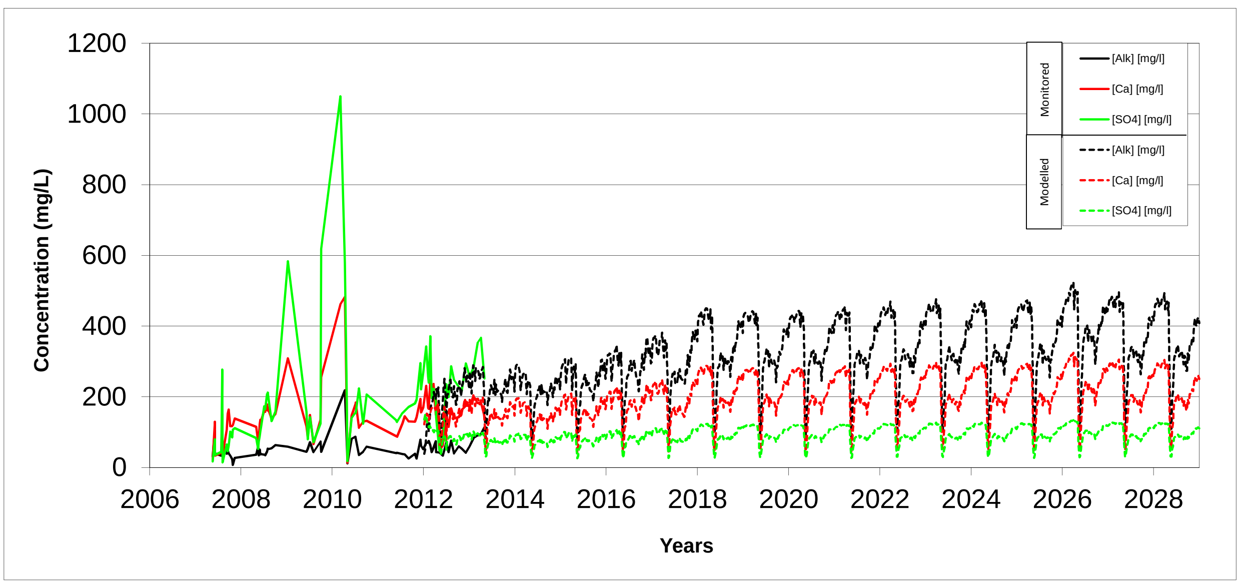
Drawn KAS
Chkd KJD

De Beers Canada Inc.

North Pile Discharge (SNP 02-02) Dissolved Concentrations

FIGURE VI-7a





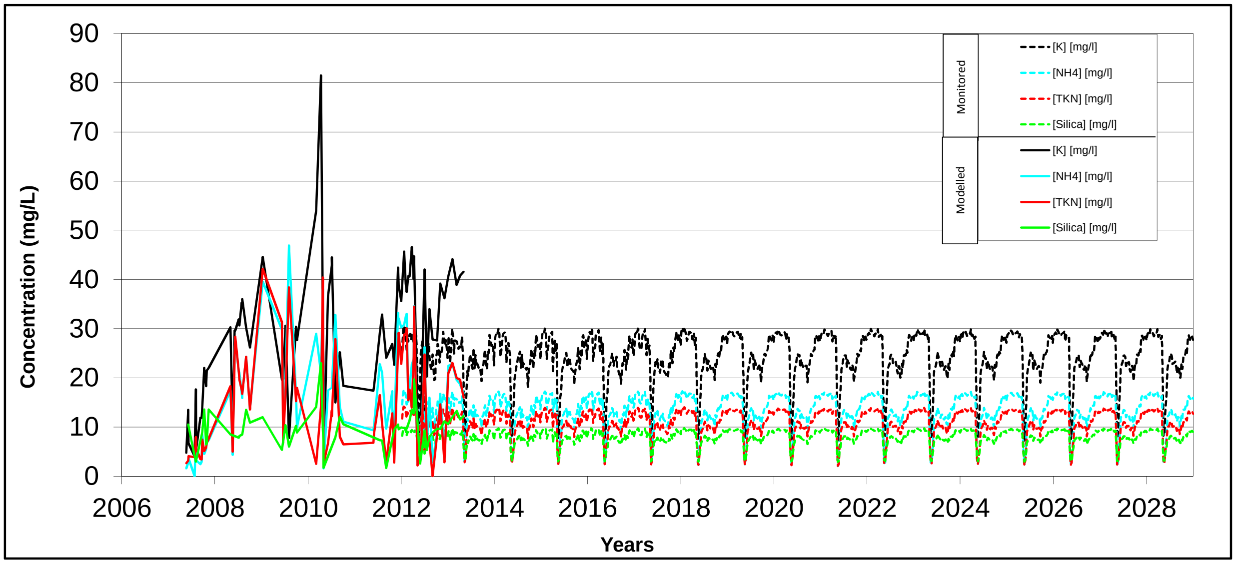
Date: December 2013
Project: 12-1337-0001

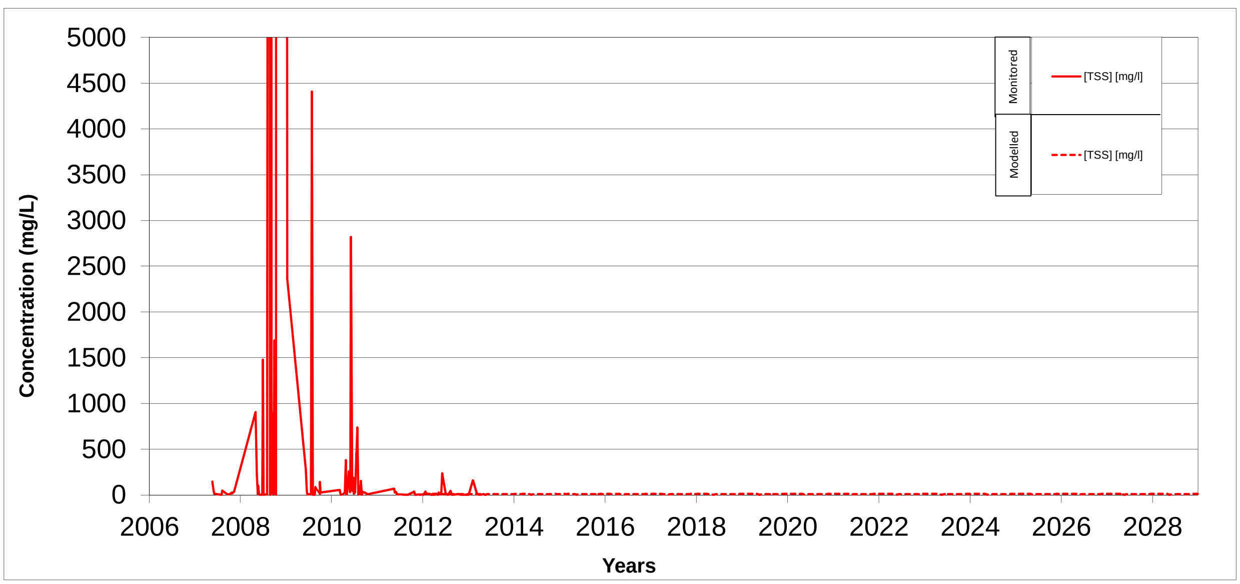
Drawn KAS
Chkd KJD

De Beers Canada Inc.

North Pile Discharge (SNP 02-02) Dissolved Concentrations

FIGURE VI-7b





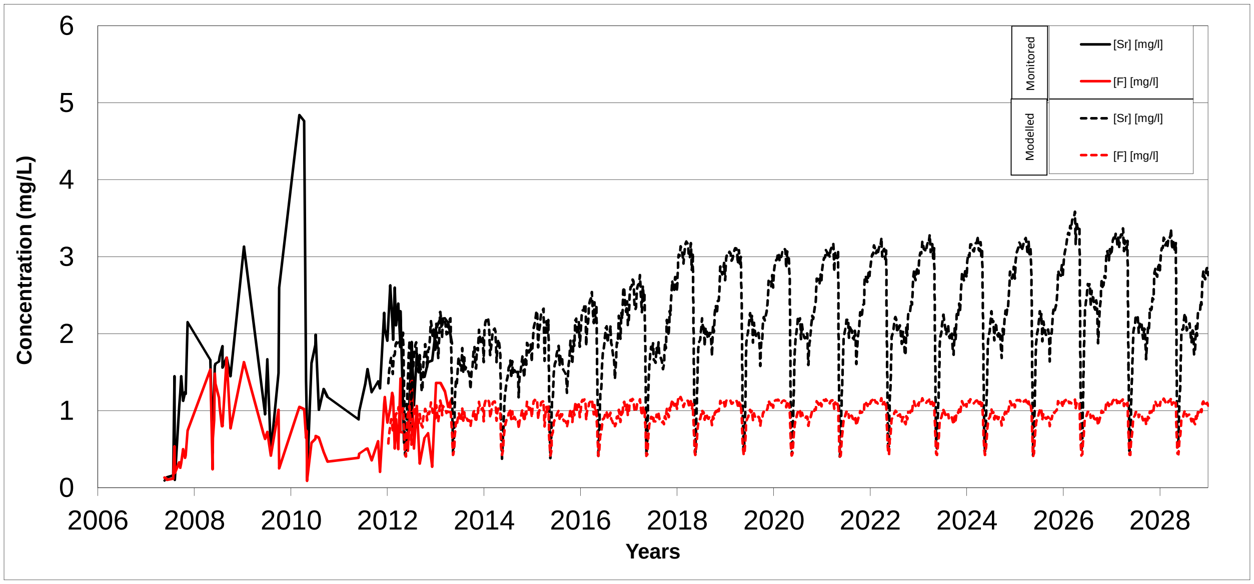
Note: Monitoring values above 5000 mg/L are not shown.

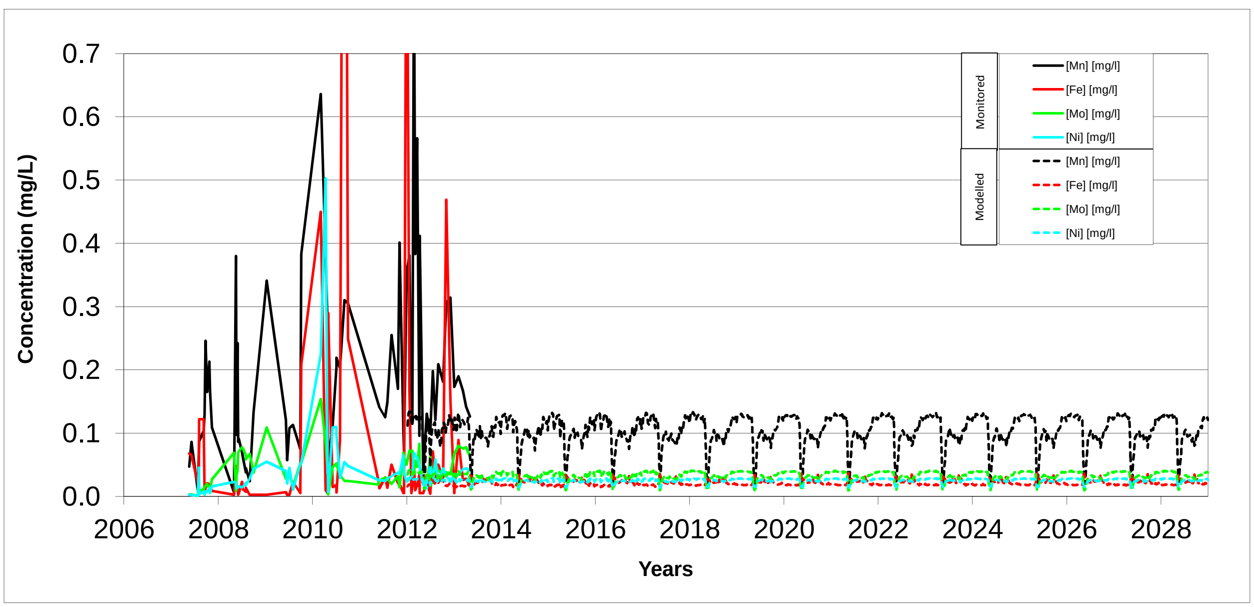
Date: December 2013
Project: 12-1337-0001

Drawn KAS
Chkd KJD

De Beers Canada Inc.

North Pile Discharge (SNP 02-02) Dissolved Concentrations	FIGURE VI-7c





Note: Monitoring values above 0.7 mg/L are not shown.

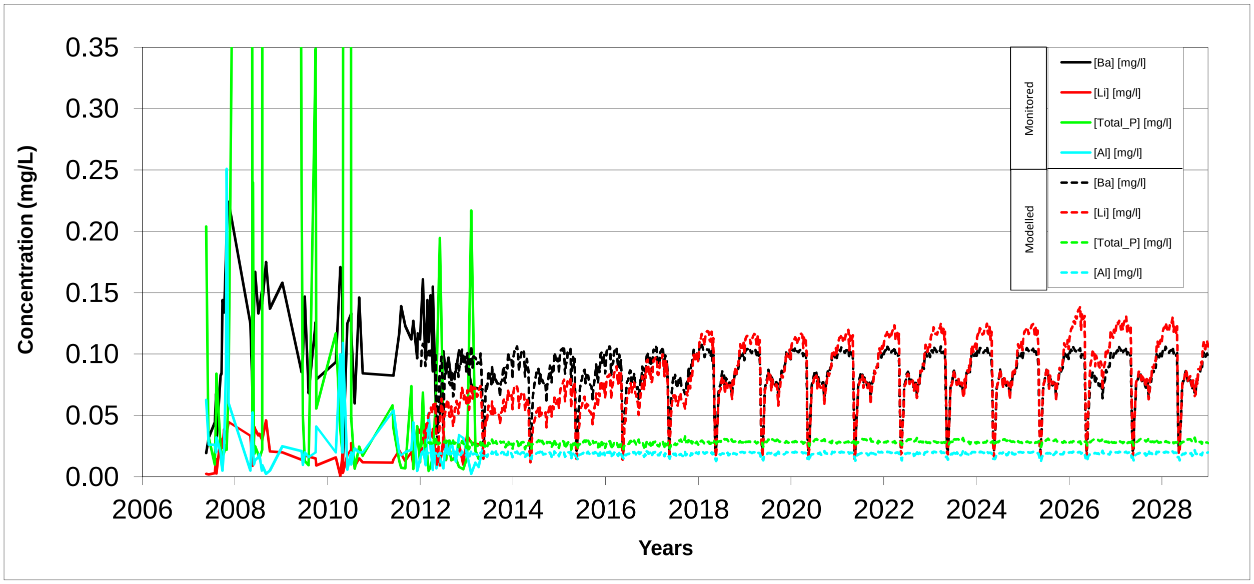
Date: December 2013
Project: 12-1337-0001

Drawn KAS
Chkd KJD

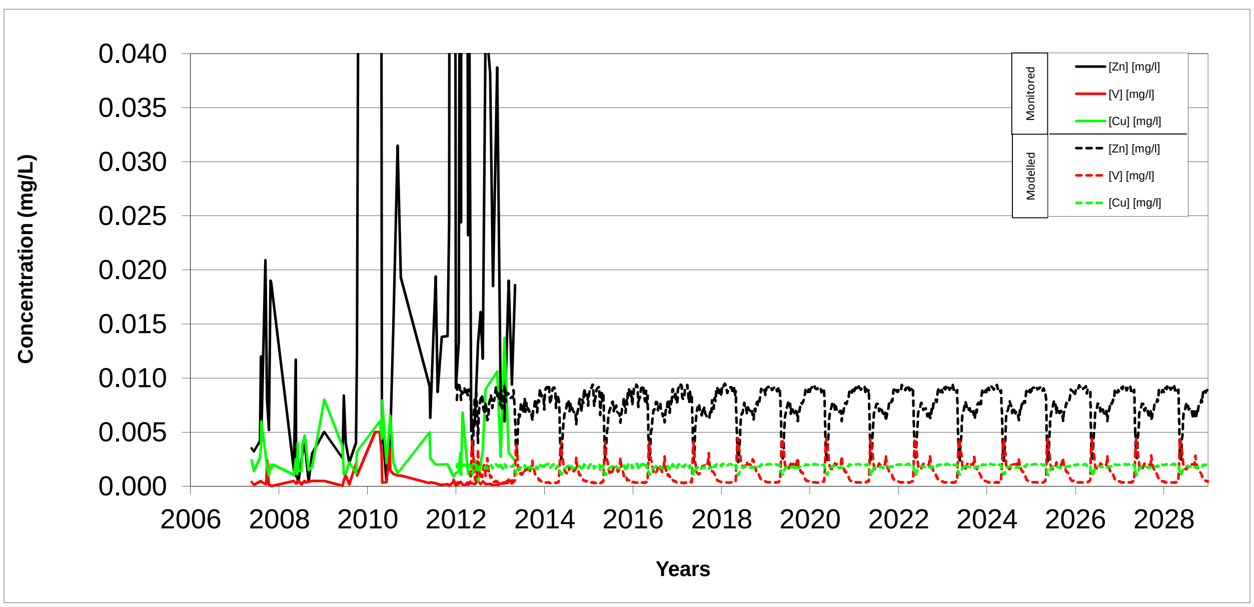
De Beers Canada Inc.

North Pile Discharge (SNP 02-02) Dissolved Concentrations

FIGURE VI-7d



Note: Monitoring values above 0.35 mg/L are not shown.



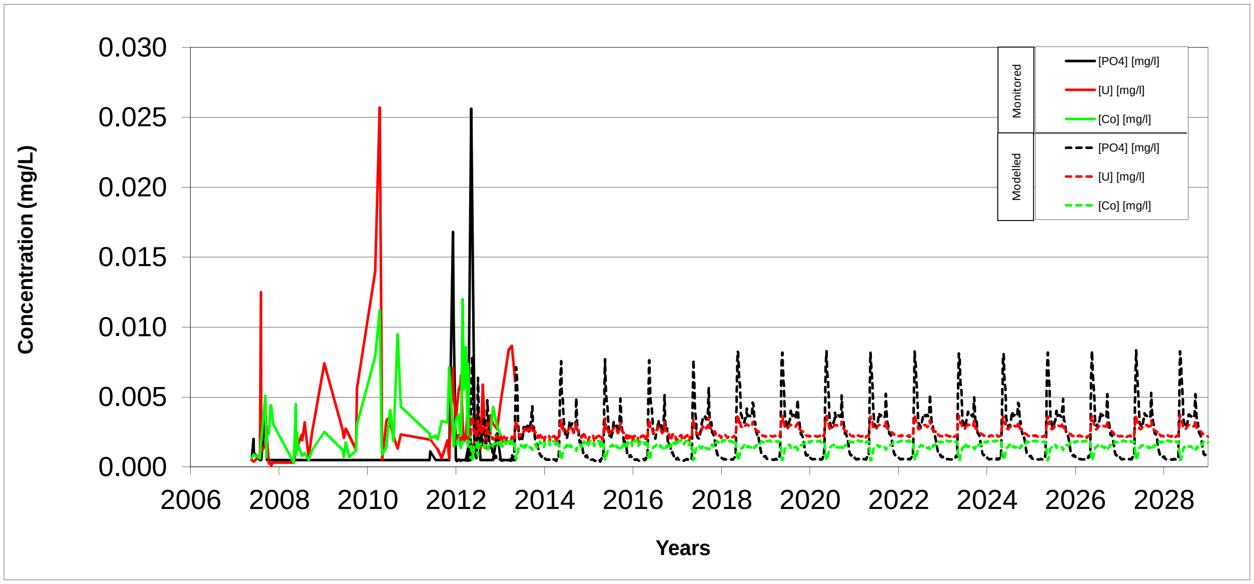
Note: Monitoring values above 0.40 mg/L are not shown.

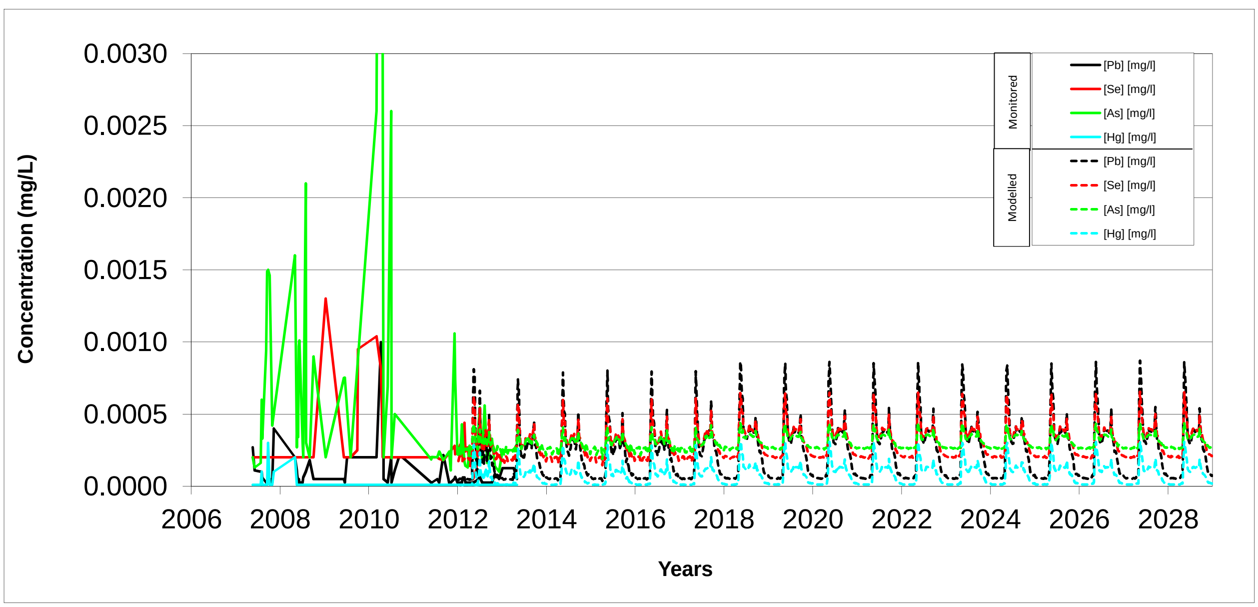
Date: December 2013
Project: 12-1337-0001

Drawn KAS
Chkd KJD

De Beers Canada Inc.

North Pile Discharge (SNP 02-02) Dissolved Concentrations	FIGURE VI-7e





Note: Monitoring values above 0.0030 mg/L are not shown.

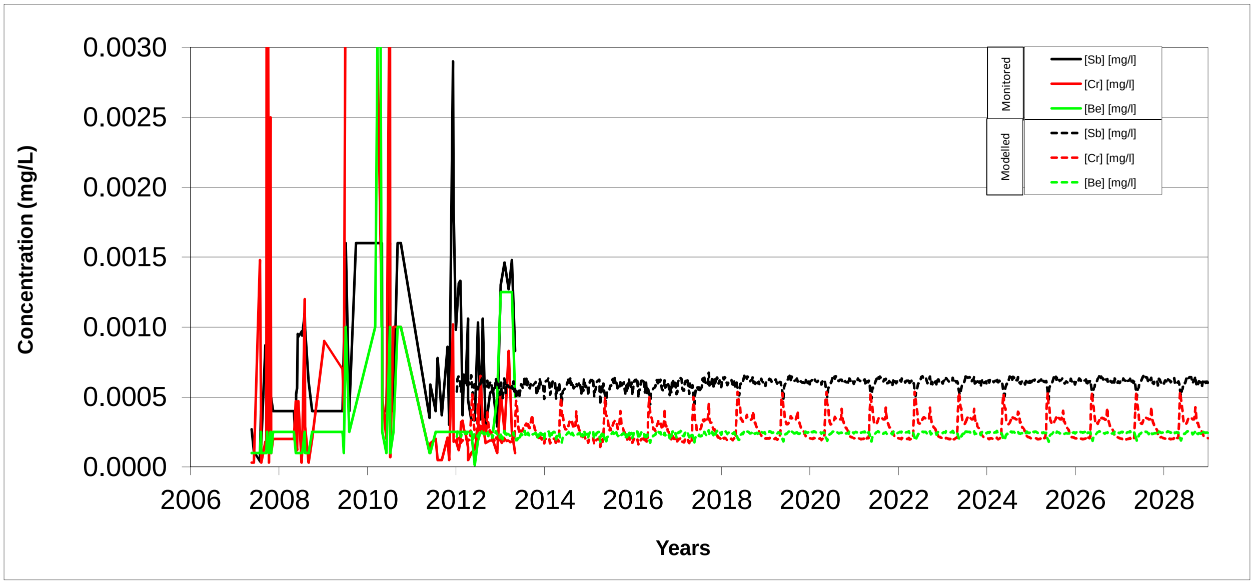
Date: December 2013
Project: 12-1337-0001

Drawn KAS
Chkd KJD

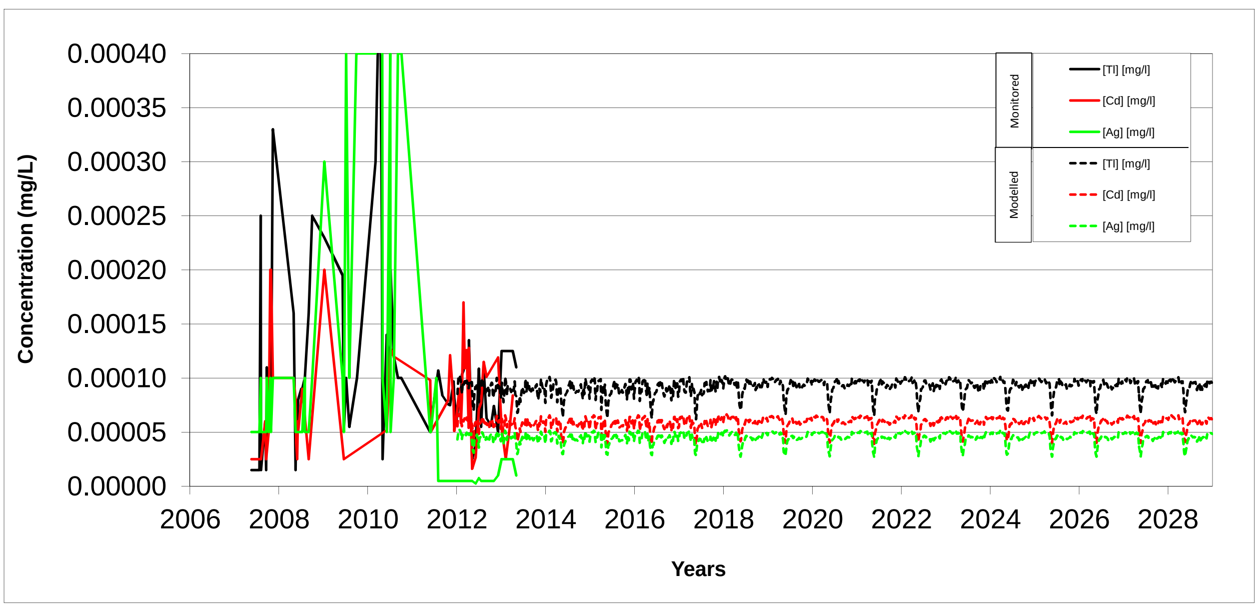
De Beers Canada Inc.

North Pile Discharge (SNP 02-02) Dissolved Concentrations

FIGURE VI-7f



Note: Monitoring values above 0.0030 mg/L are not shown.



Note: Monitoring values above 0.00040 mg/L are not shown.

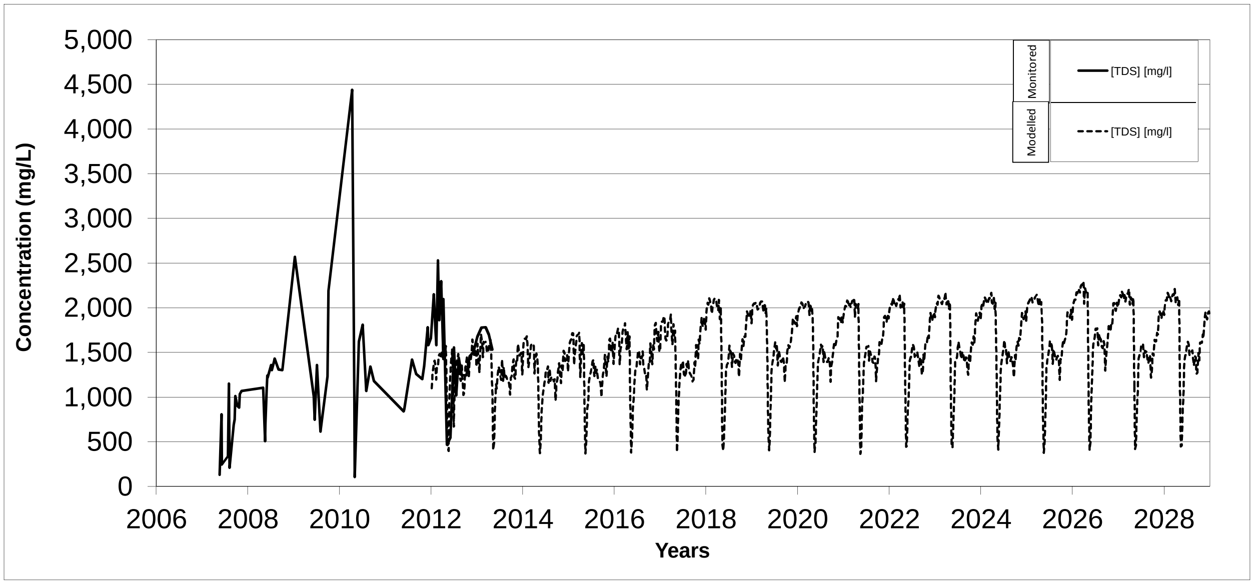
Date: December 2013
Project: 12-1337-0001

Drawn KAS
Chkd KJD

De Beers Canada Inc.

North Pile Discharge (SNP 02-02) Dissolved Concentrations

FIGURE VI-7g

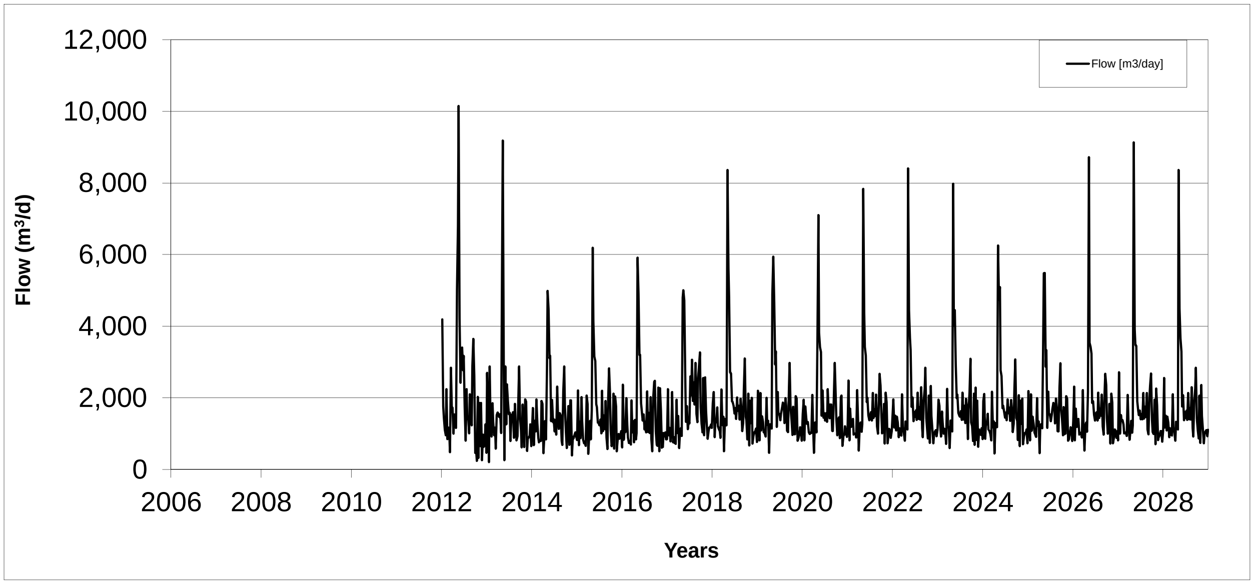


Date: December 2013
Project: 12-1337-0001

Drawn KAS
Chkd KJD

De Beers Canada Inc.

North Pile Discharge (SNP 02-02) Dissolved Concentrations	FIGURE VI-7h

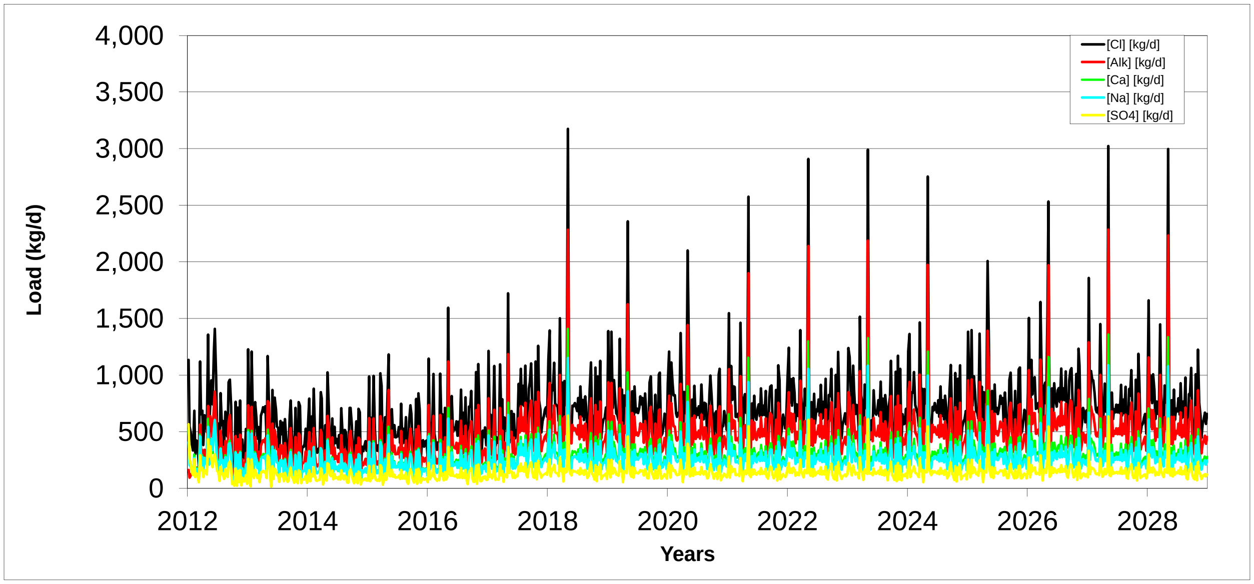


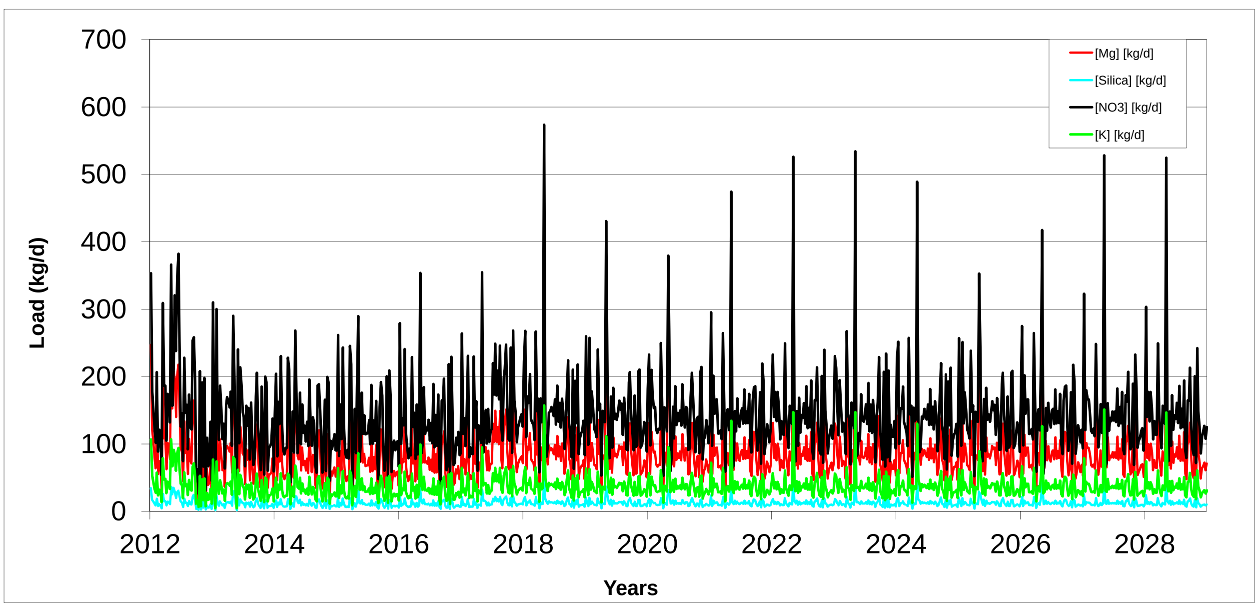
Date: December 2013
Project: 12-1337-0001

Drawn KAS
Chkd KJD

De Beers Canada Inc.

North Pile Discharge (SNP 02-02) Dissolved Load	FIGURE VI-8a



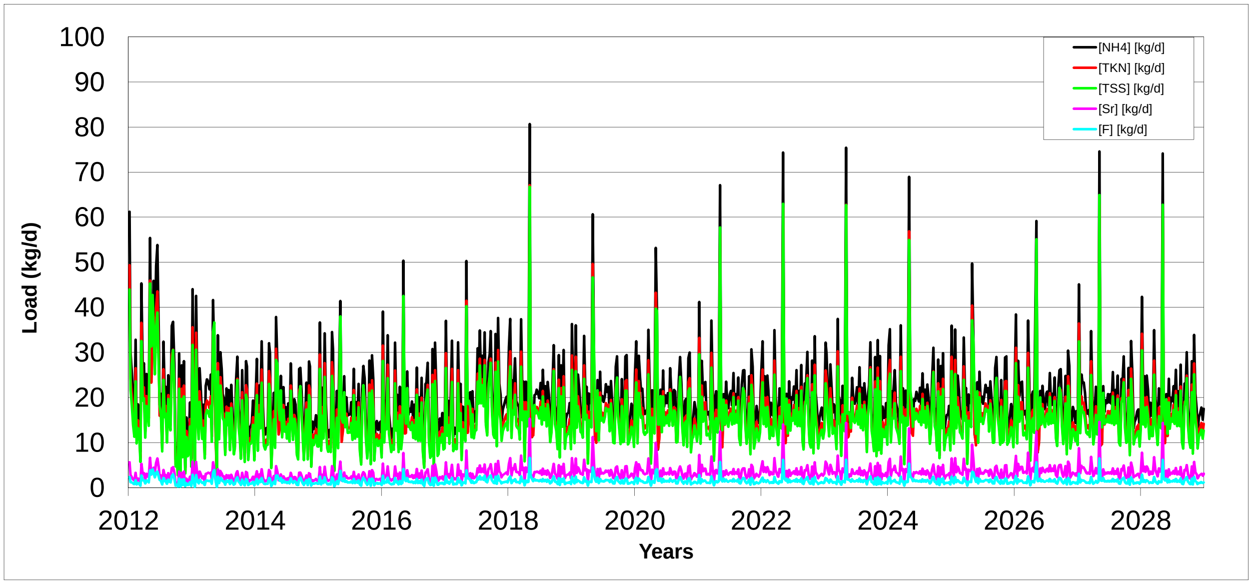


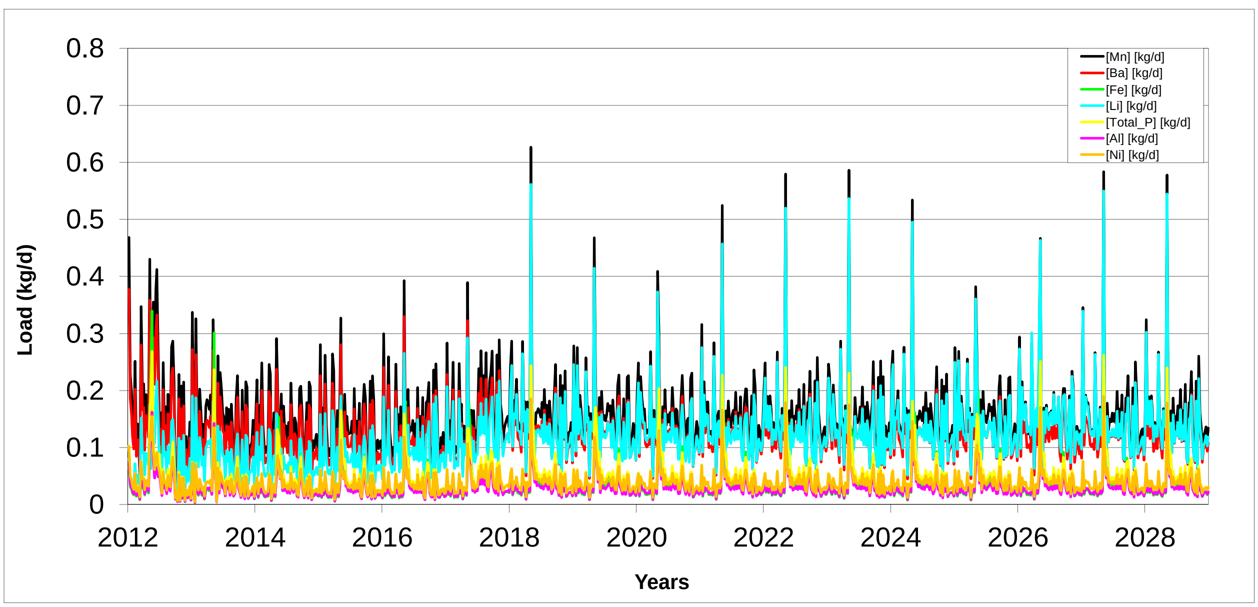
Date: December 2013
Project: 12-1337-0001

Drawn KAS
Chkd KJD

De Beers Canada Inc.

North Pile Discharge (SNP 02-02) Dissolved Load	FIGURE VI-8b



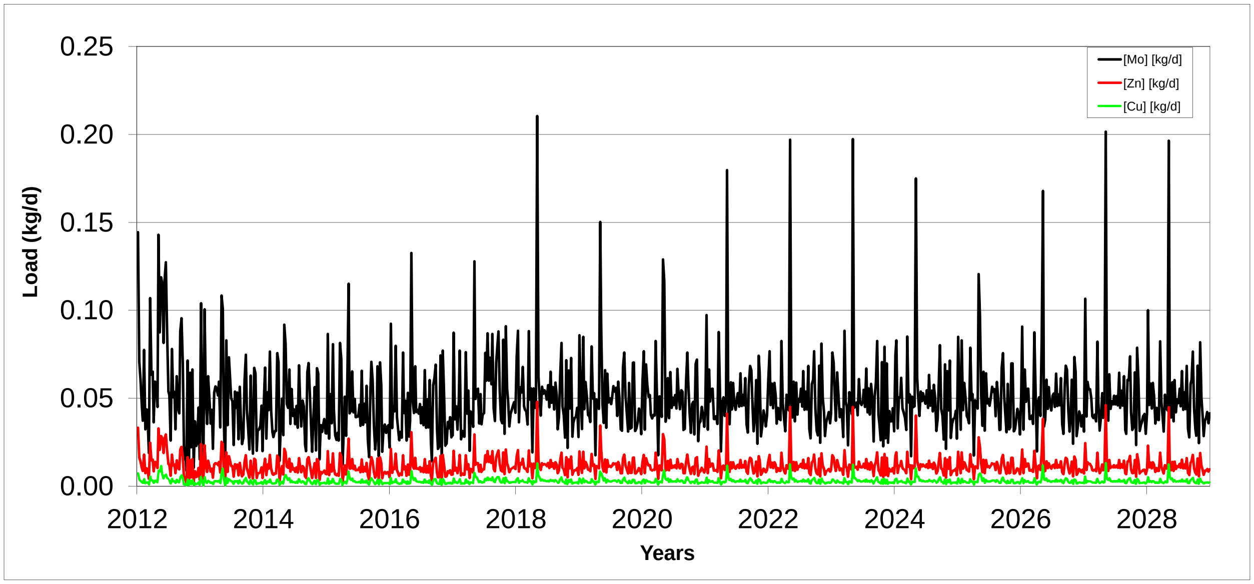


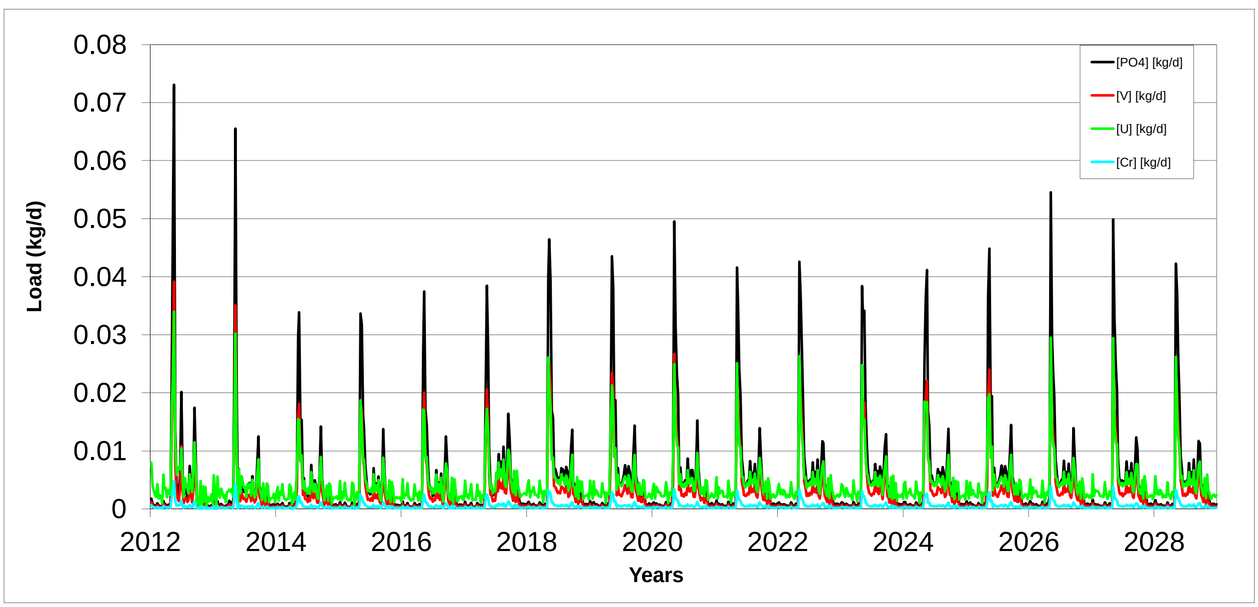
Date: December 2013
Project: 12-1337-0001

Drawn KAS
Chkd KJD

De Beers Canada Inc.

North Pile Discharge (SNP 02-02) Dissolved Load	FIGURE VI-8c





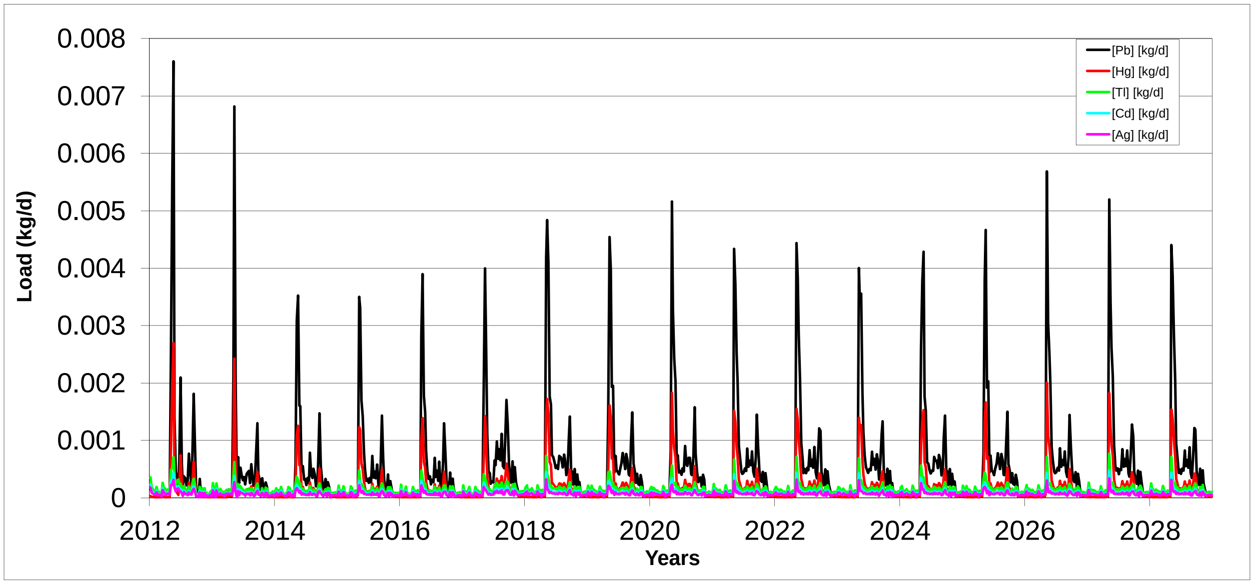
Date: December 2013
Project: 12-1337-0001

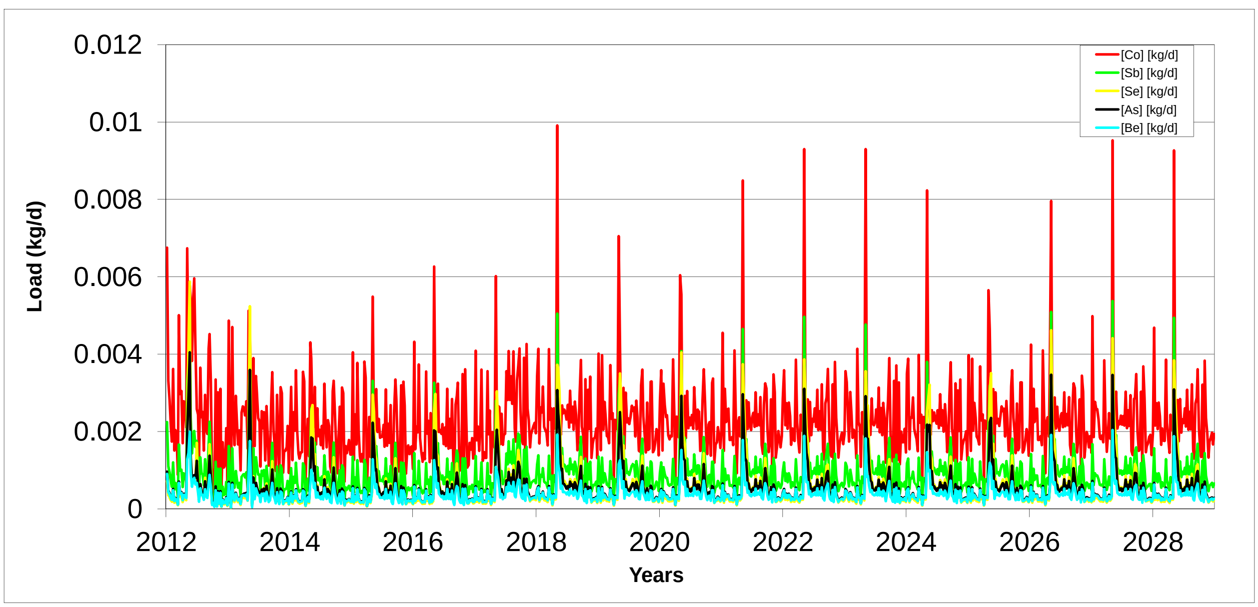
Drawn KAS
Chkd KJD

De Beers Canada Inc.

North Pile Discharge (SNP 02-02) Dissolved Load

FIGURE VI-8d





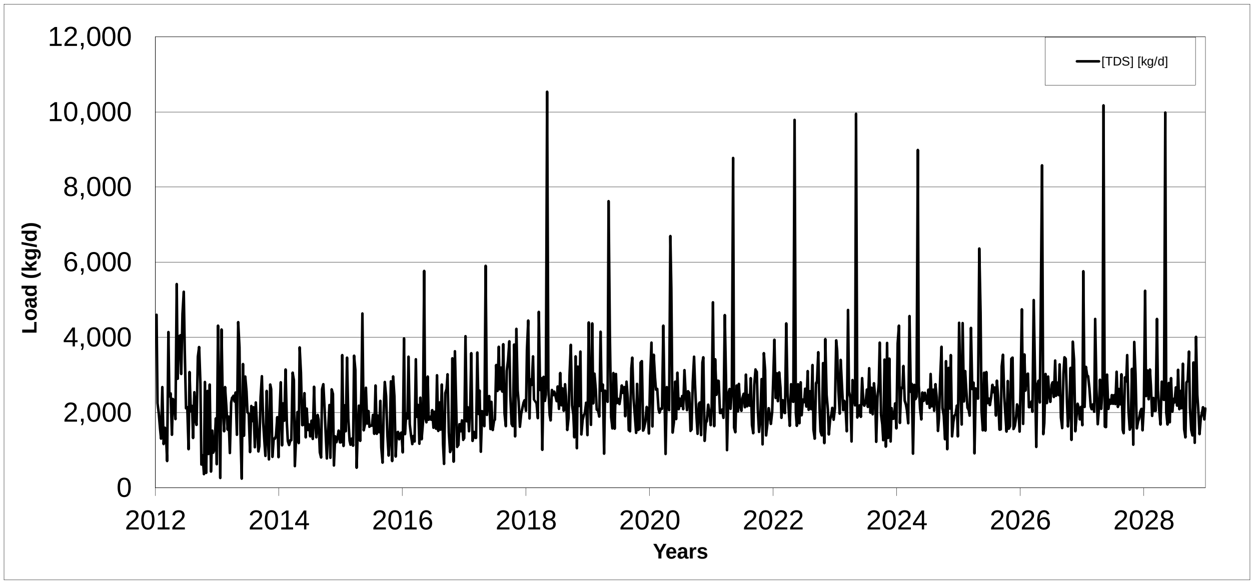
Date: December 2013
Project: 12-1337-0001

Drawn KAS
Chkd KJD

De Beers Canada Inc.

AppVI_Fig8.xls-AppVI-8d

North Pile Discharge (SNP 02-02) Dissolved Load	FIGURE VI-8e



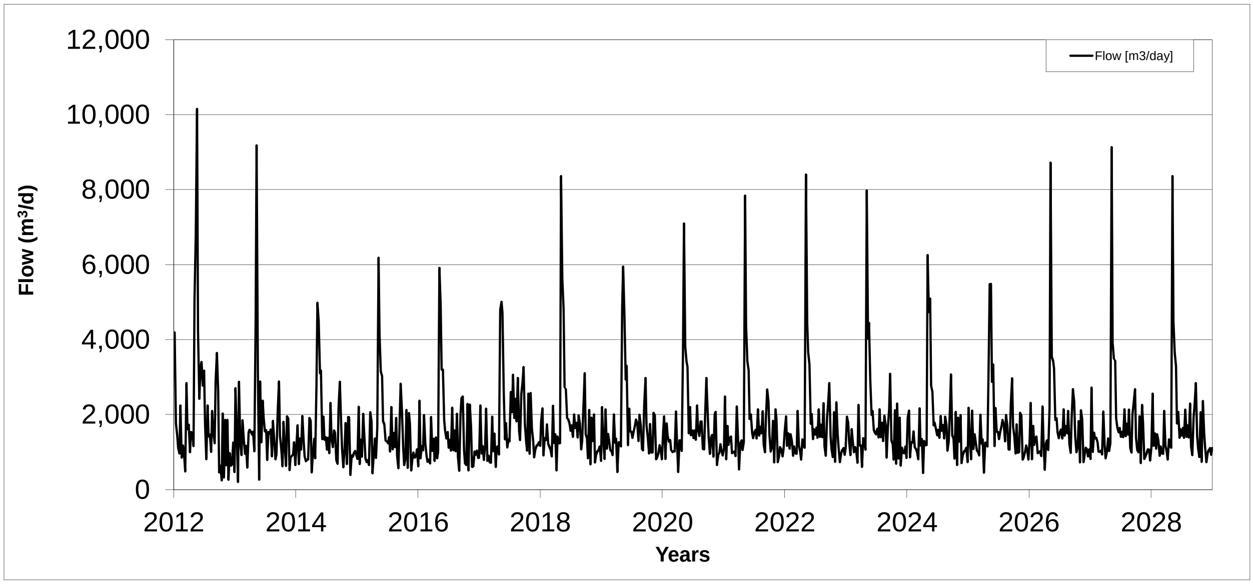
Date: December 2013
Project: 12-1337-0001

Drawn KAS
Chkd KJD

De Beers Canada Inc.

North Pile Discharge (SNP 02-02) Dissolved Load FLOW

FIGURE VI-8f



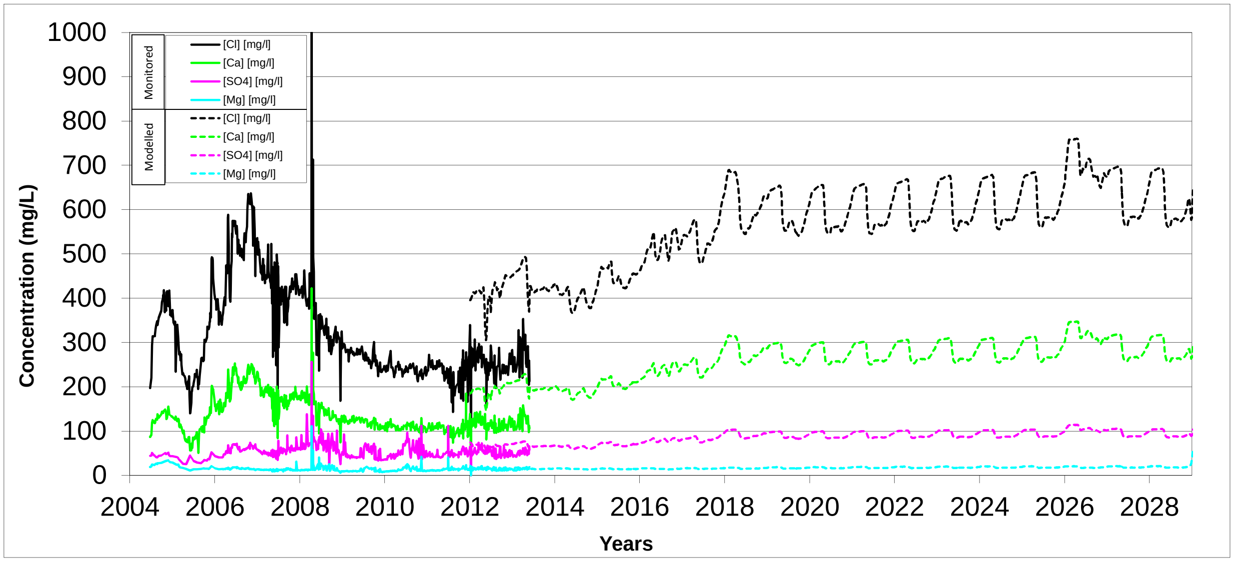
Date: December 2013
Project: 12-1337-0001

Drawn KAS
Chkd KJD

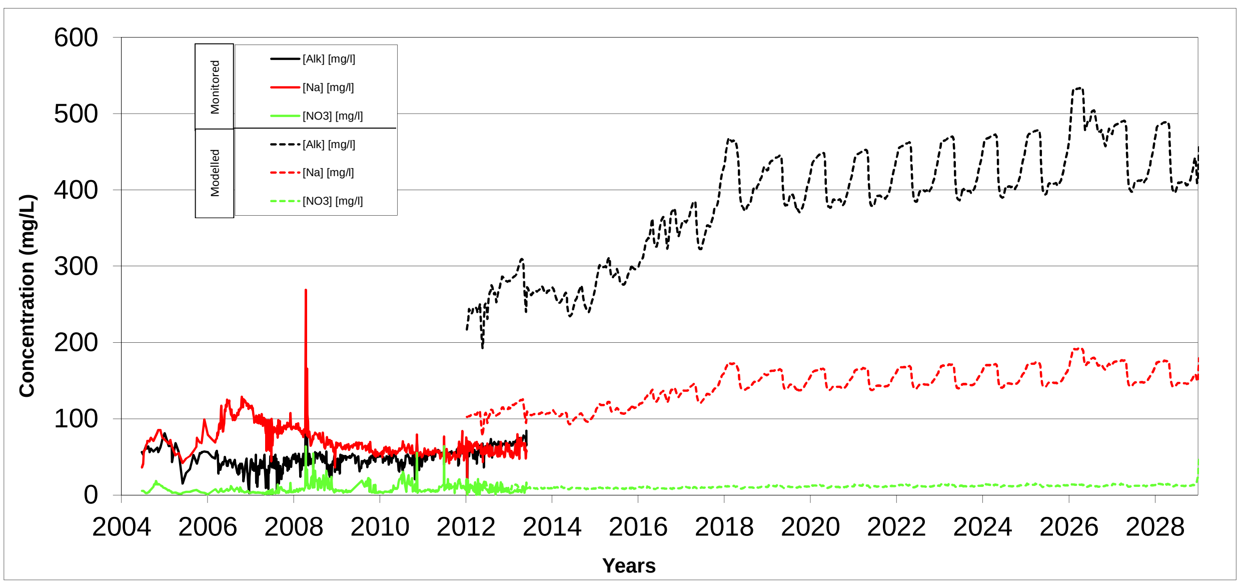
De Beers Canada Inc.

Final Discharge (SNP 02-17B) Dissolved Concentrations

FIGURE VI-9a



Note: Monitored values above 1000 mg/L are not shown.

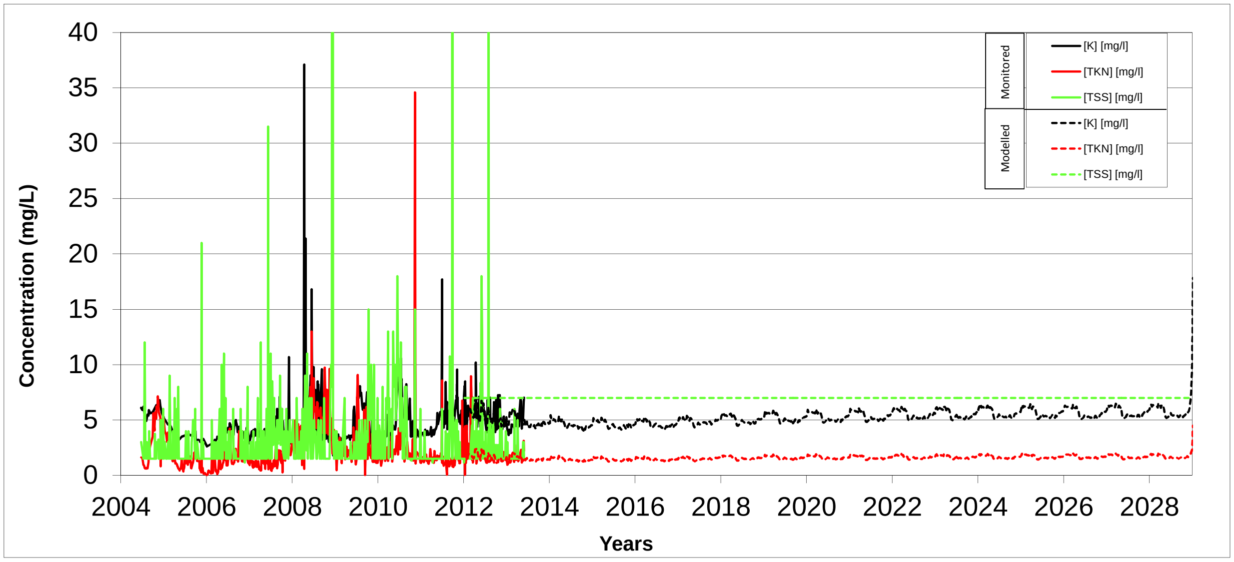


Date: December 2013
Project: 12-1337-0001

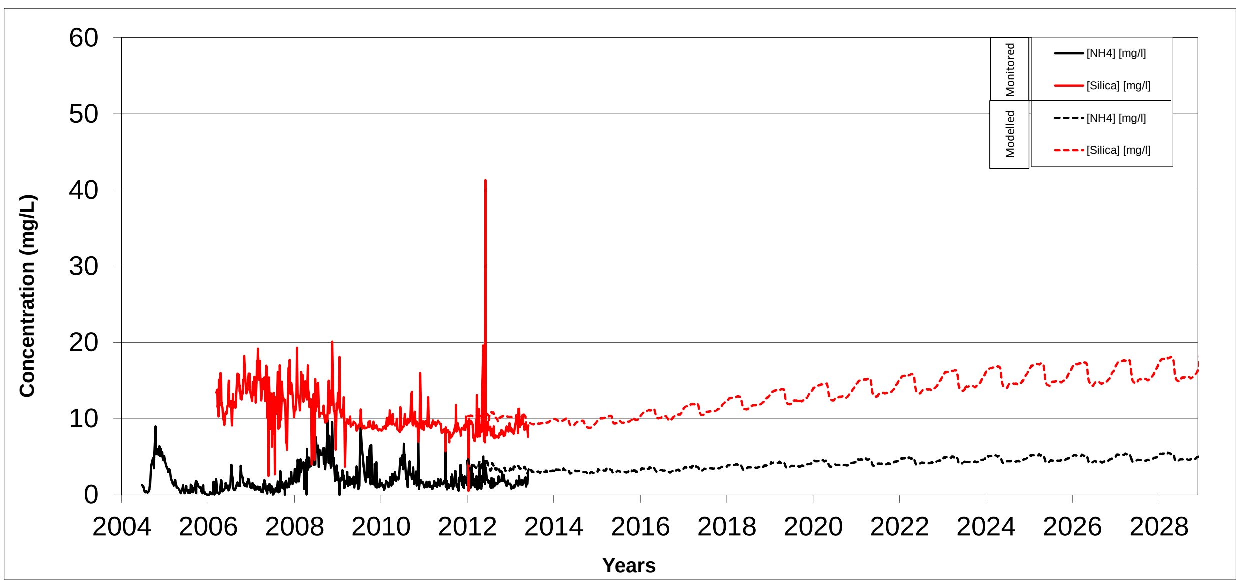
Drawn KAS
Chkd KJD

De Beers Canada Inc.

Final Discharge (SNP 02-17B) Dissolved Concentrations	FIGURE VI-9b



Note: Monitored values above 40 mg/L are not shown.

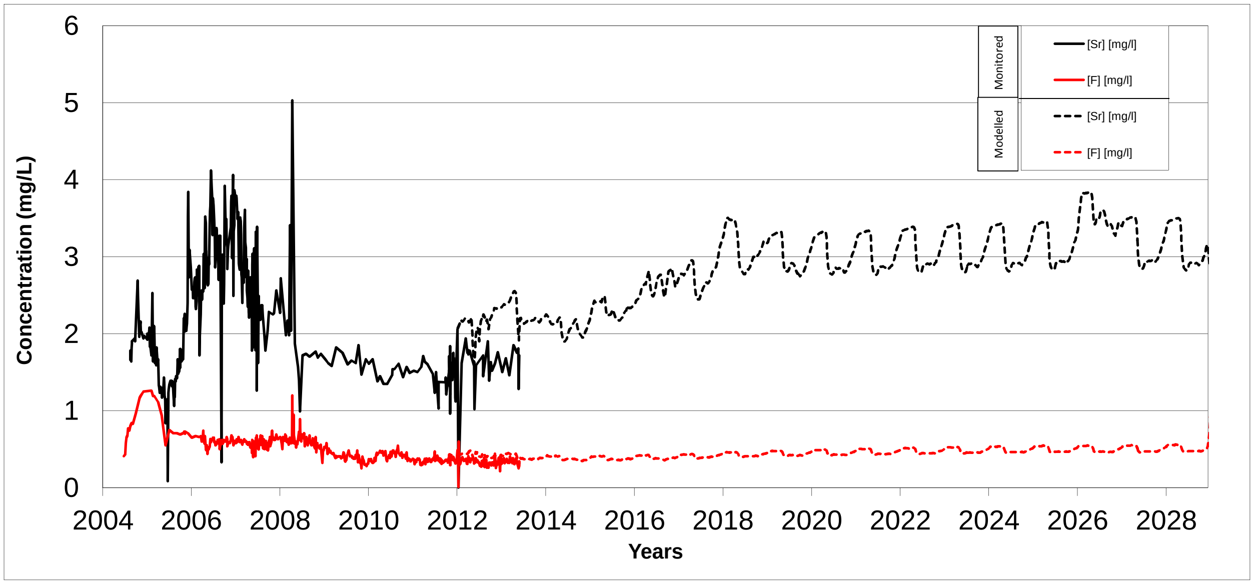


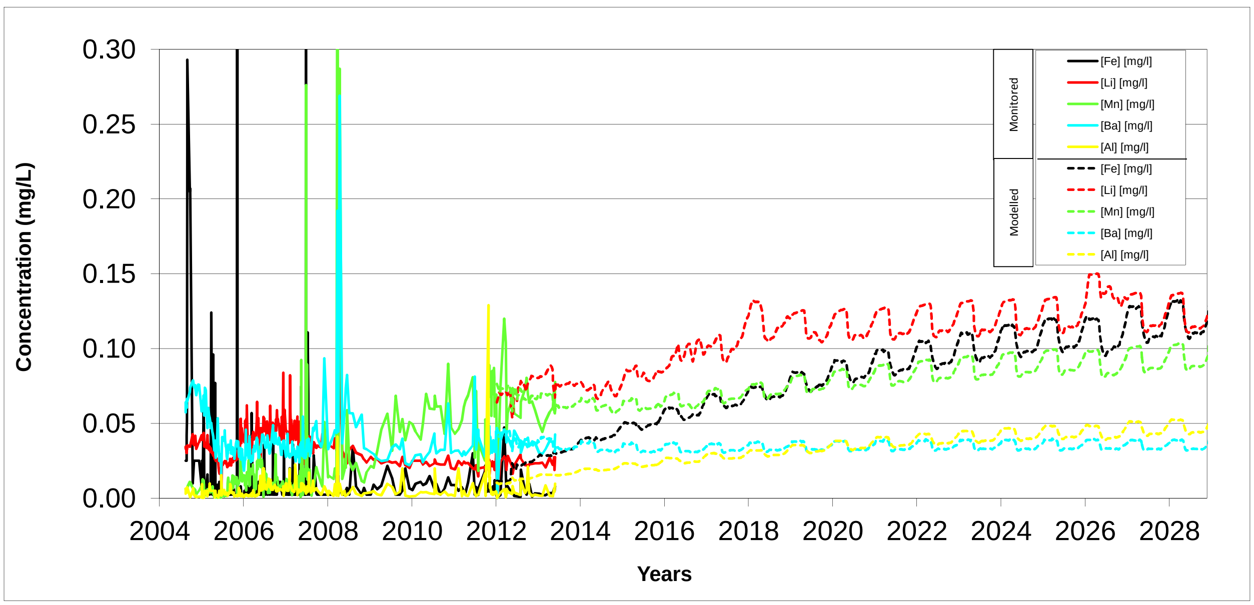
Date: December 2013
Project: 12-1337-0001

Drawn KAS
Chkd KJD

De Beers Canada Inc.

Final Discharge (SNP 02-17B) Dissolved Concentrations	**FIGURE VI-9c**





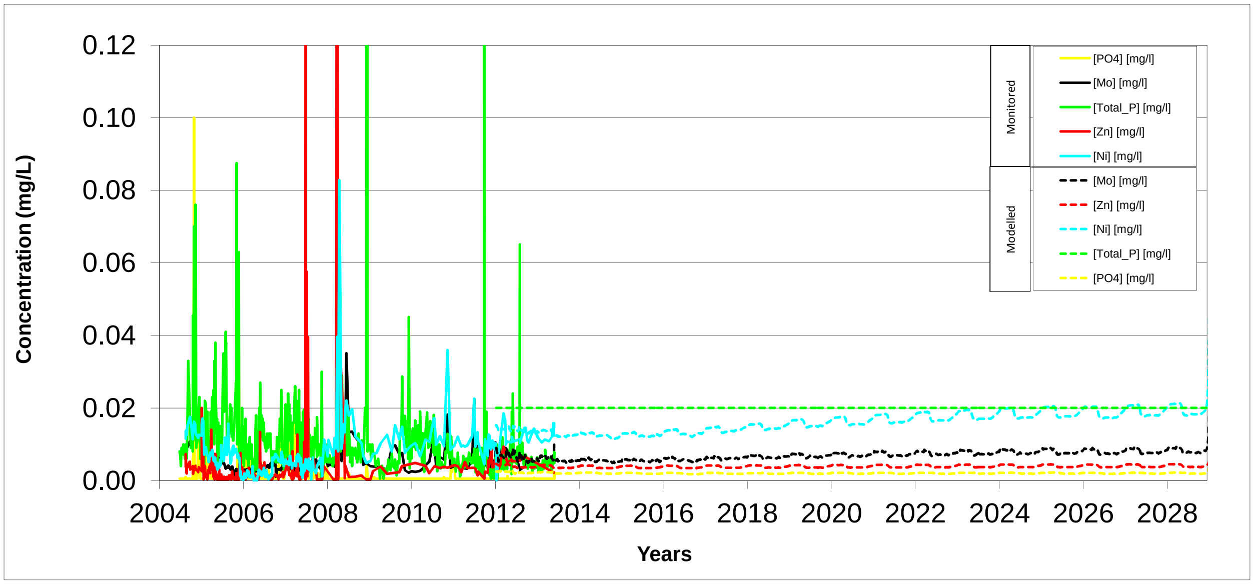
Note: Monitored values above 0.3 mg/L are not shown.

Date: December 2013
Project: 12-1337-0001

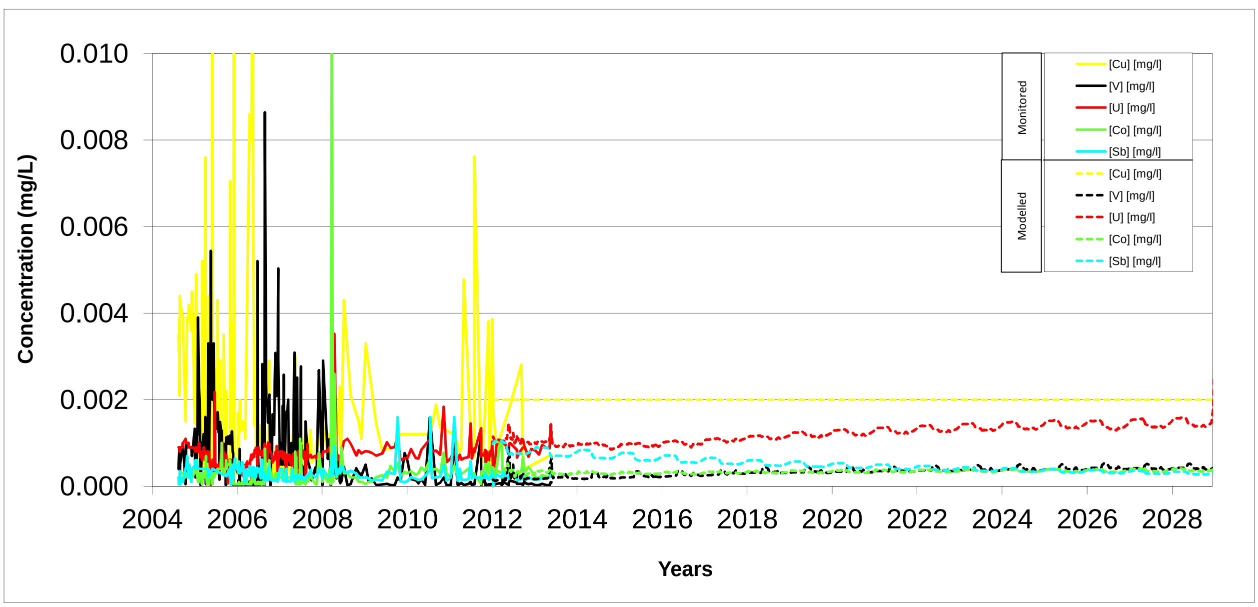
Drawn KAS
Chkd KJD

De Beers Canada Inc.

Final Discharge (SNP 02-17B) Dissolved Concentrations	FIGURE VI-9d



Note: Monitored values above 0.12 mg/L are not shown.



Note: Monitored values above 0.01 mg/L are not shown.

Date: December 2013
Project: 12-1337-0001

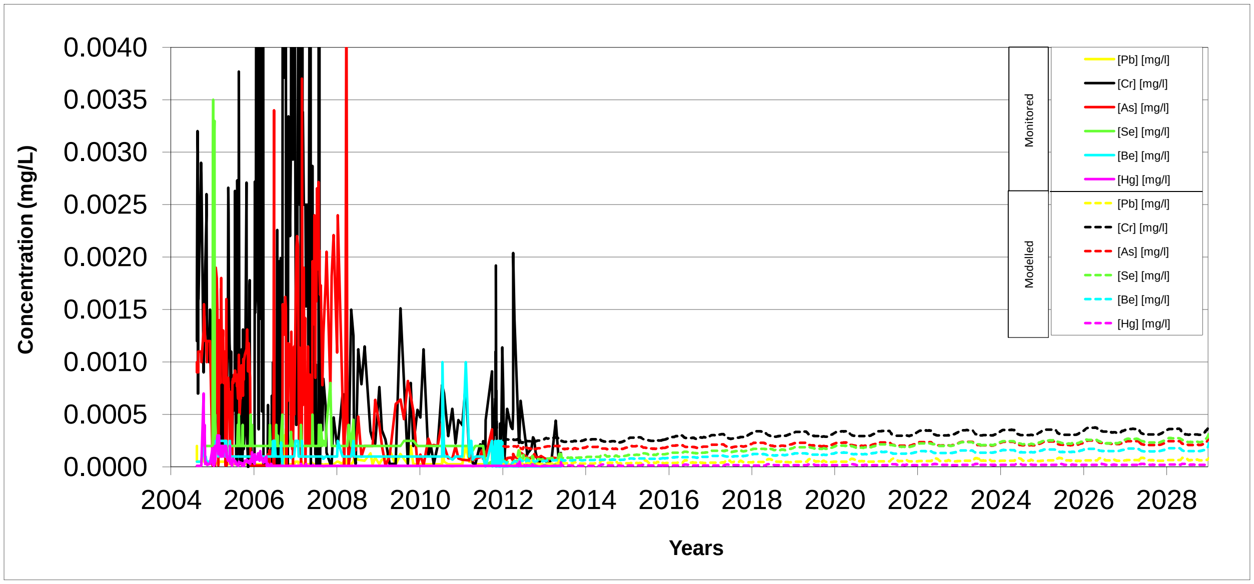
Drawn KAS
Chkd KJD

De Beers Canada Inc.

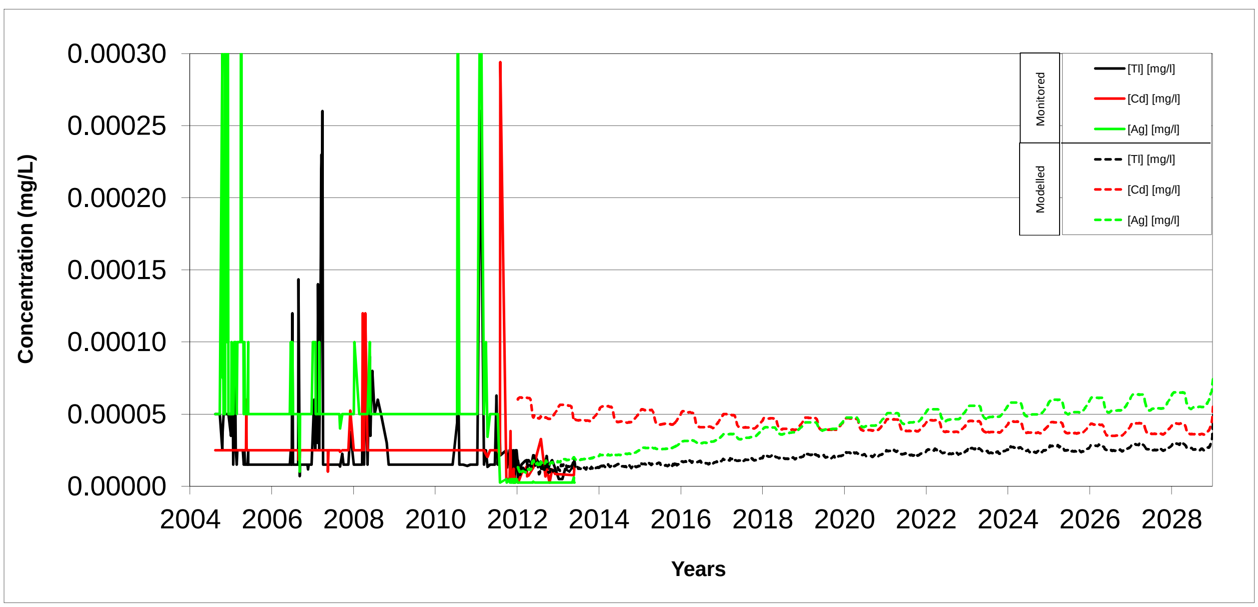
AppVI_Fig9.xls-App VI-9d

Final Discharge (SNP 02-17B) Dissolved Concentrations

FIGURE VI-9e



Note: Monitored values above 0.0040 mg/L are not shown.



Note: Monitored values above 0.00030 mg/L are not shown.

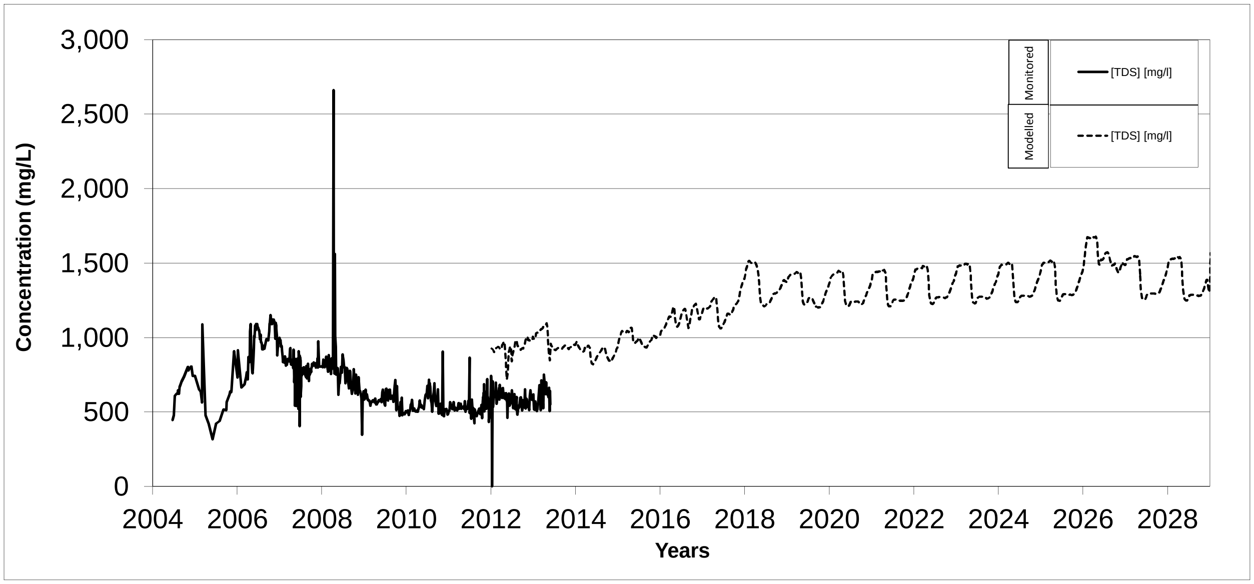
Date: December 2013
Project: 12-1337-0001

Drawn KAS
Chkd KJD

De Beers Canada Inc.

Final Discharge (SNP 02-17B) Dissolved Concentrations

FIGURE VI-9f



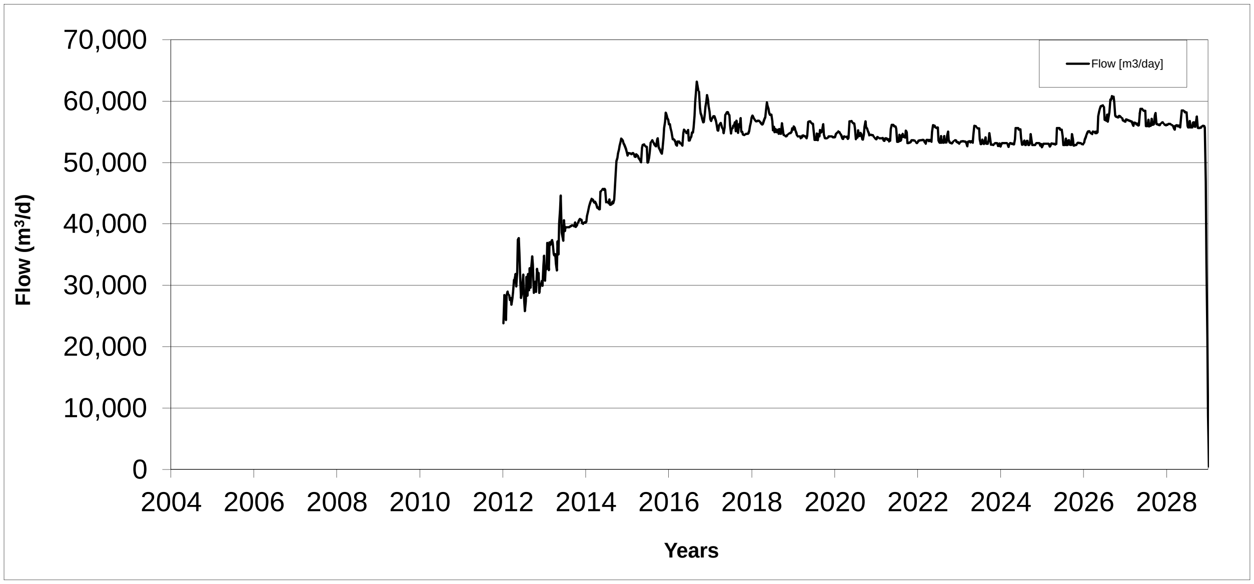
Date: December 2013
Project: 12-1337-0001

Drawn KAS
Chkd KJD

De Beers Canada Inc.

Final Discharge (SNP 02-17B) Dissolved Concentrations

FIGURE VI-9g



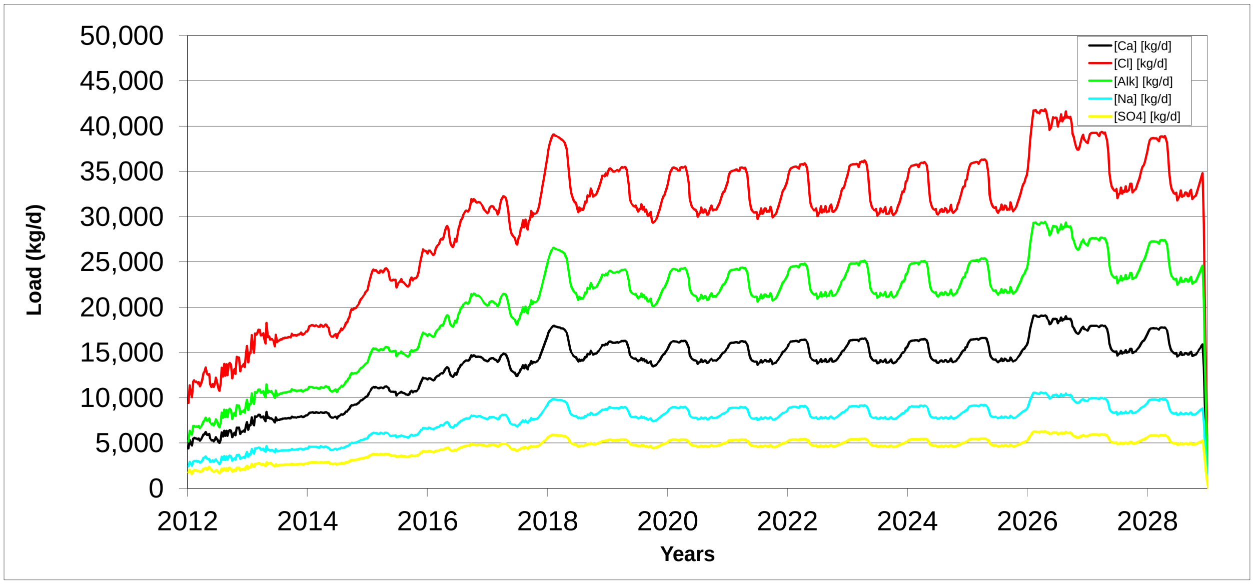
Date: December 2013
Project: 12-1337-0001

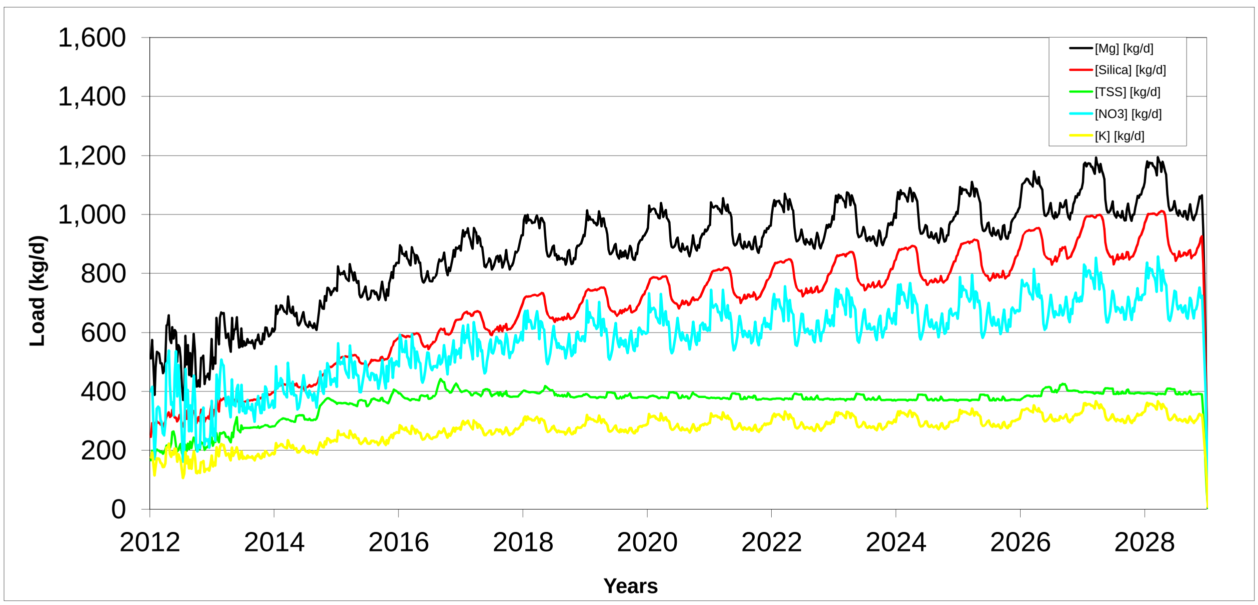
Drawn KAS
Chkd KJD

De Beers Canada Inc.

Final Discharge (SNP 02-17B) Dissolved Load

FIGURE VI-10a





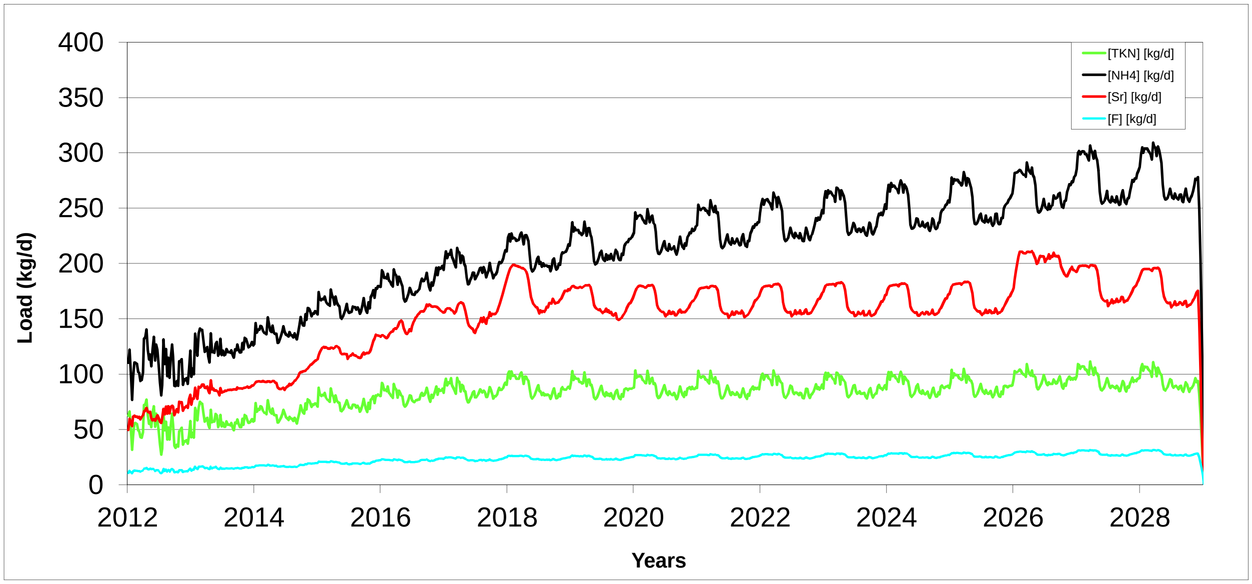
Date: December 2013
Project: 12-1337-0001

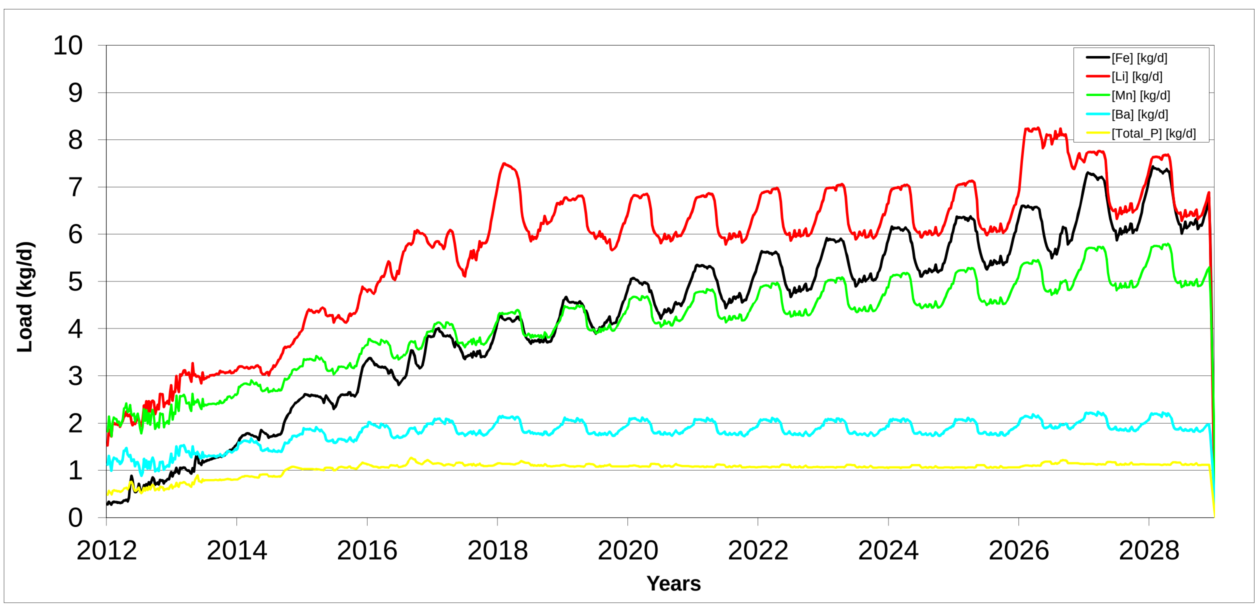
Drawn KAS
Chkd KJD

De Beers Canada Inc.

Final Discharge (SNP 02-17B) Dissolved Load

FIGURE VI-10b



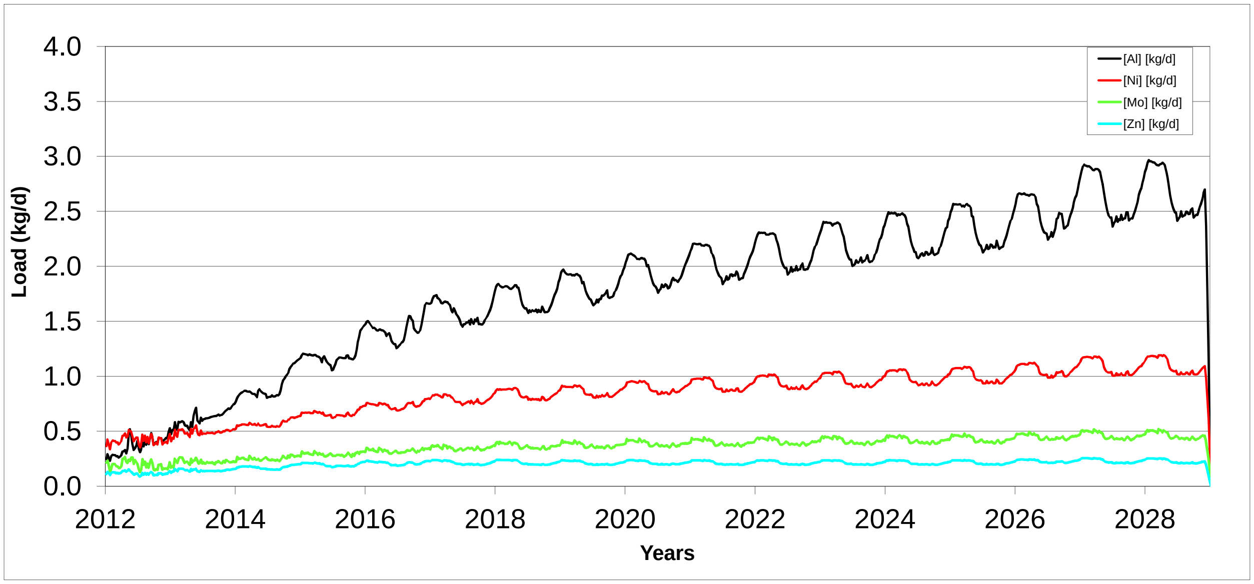


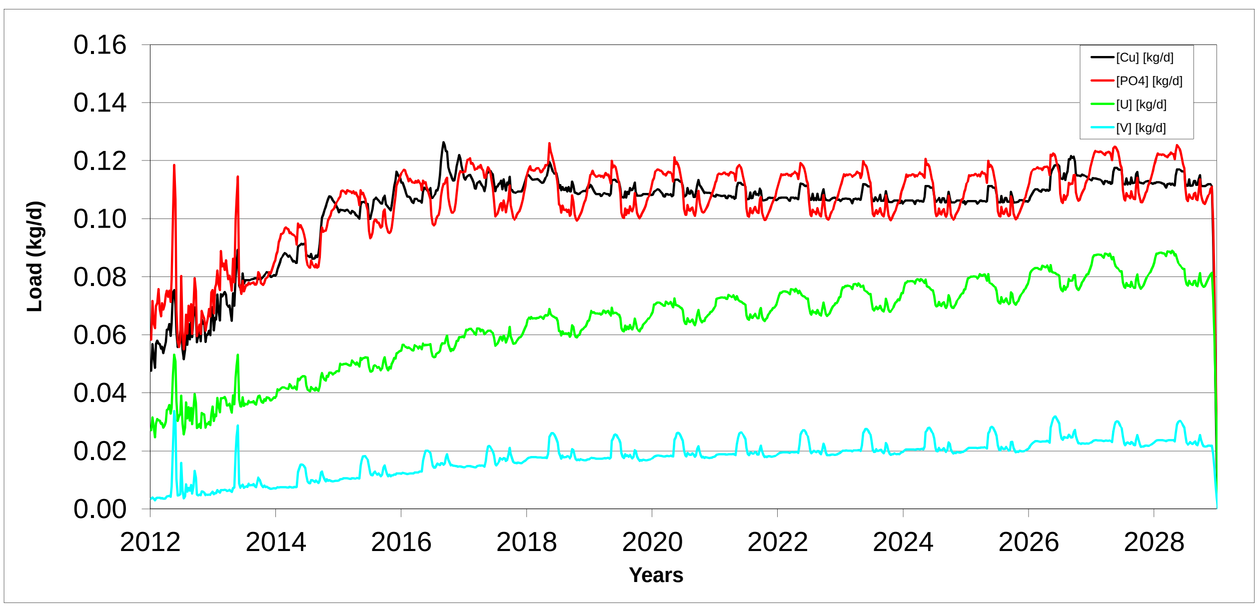
Date: December 2013
Project: 12-1337-0001

Drawn KAS
Chkd KJD

De Beers Canada Inc.

Final Discharge (SNP 02-17B) Dissolved Load	FIGURE VI-10c





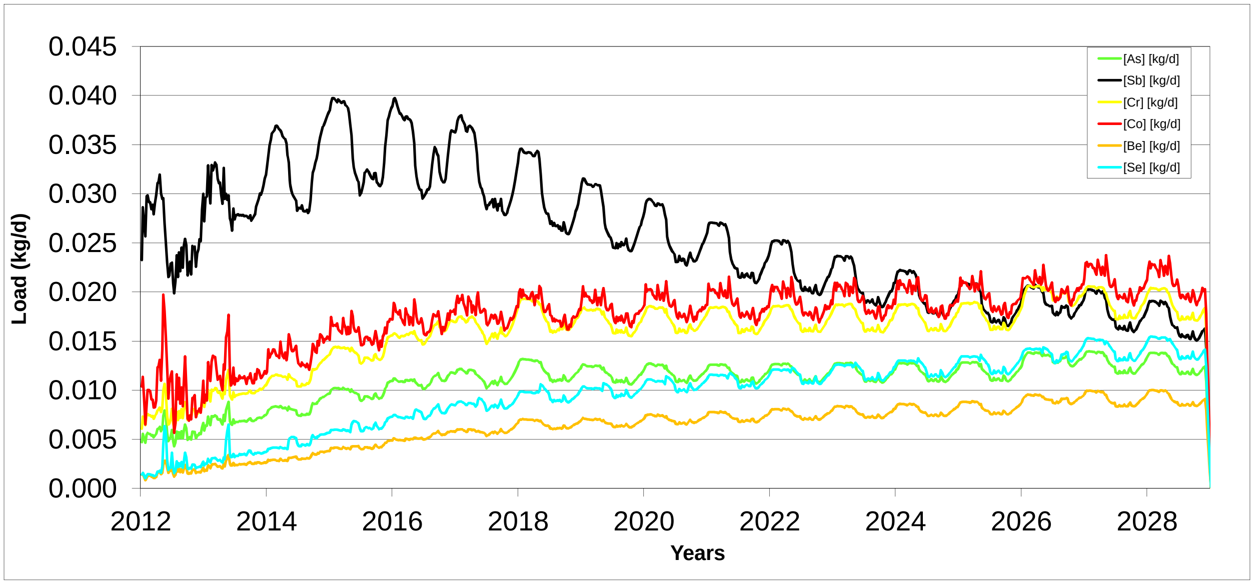
Date: December 2013
Project: 12-1337-0001

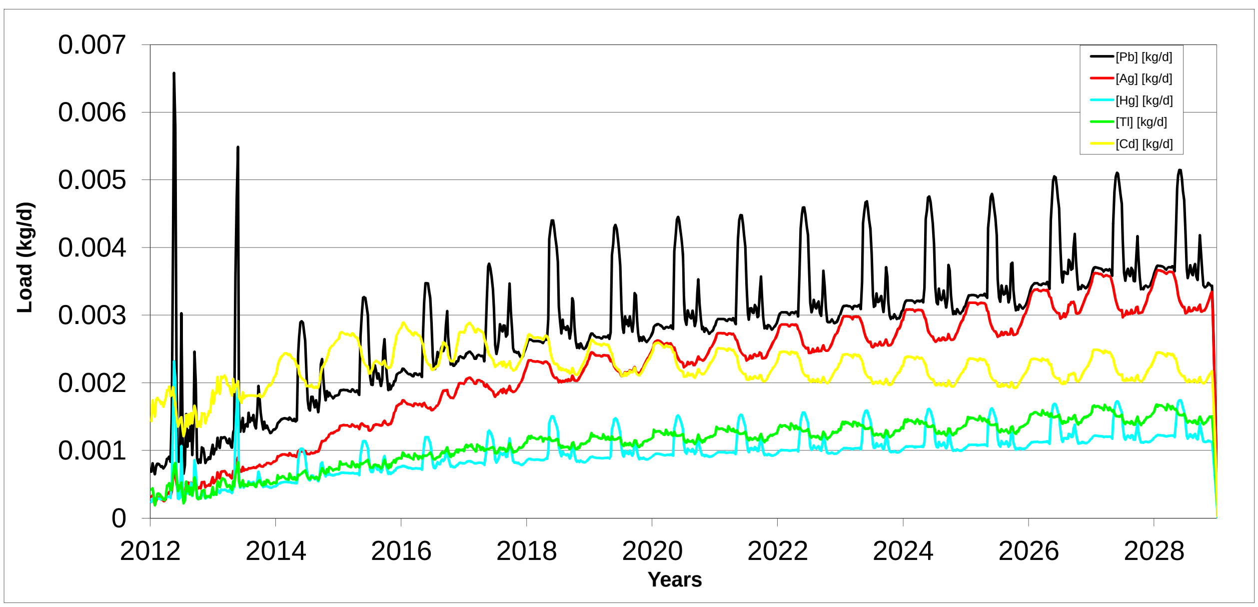
Drawn KAS
Chkd KJD

De Beers Canada Inc.

Final Discharge (SNP 02-17B) Dissolved Load

FIGURE VI-10d



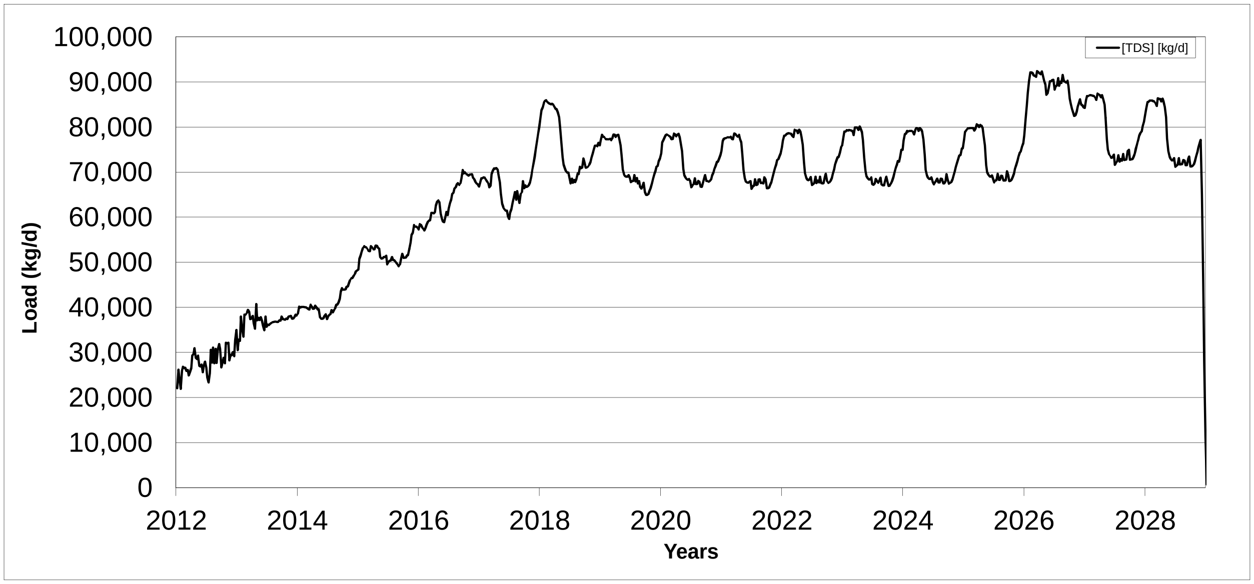


Date: December 2013
Project: 12-1337-0001

Drawn KAS
Chkd KJD

De Beers Canada Inc.

Final Discharge (SNP 02-17B) Dissolved Load	FIGURE VI-10e



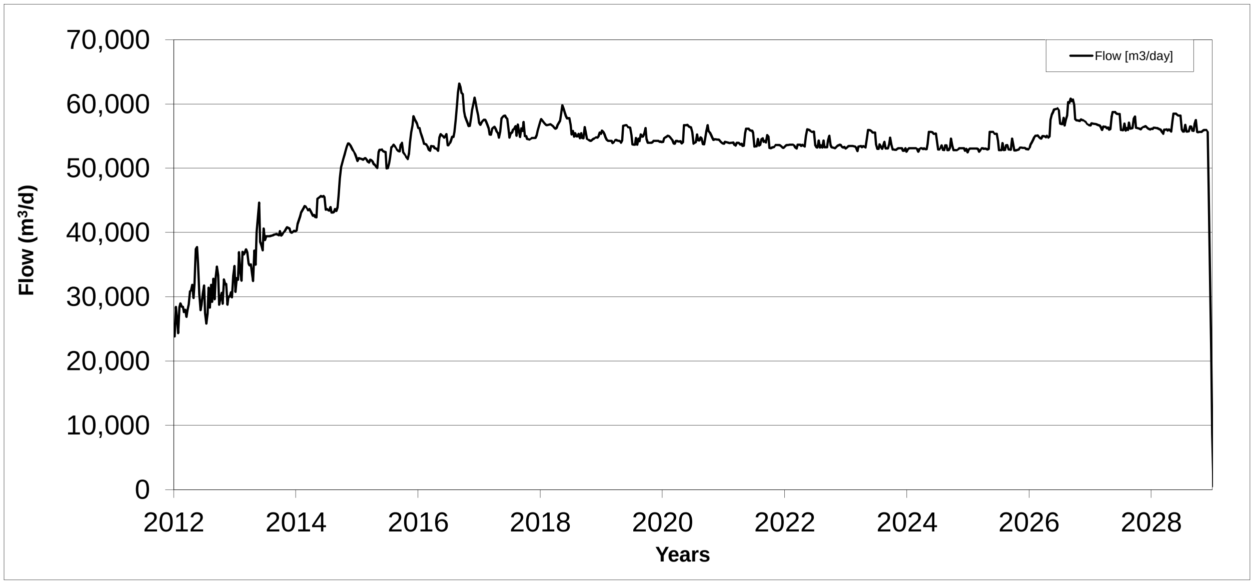
Date: December 2013
Project: 12-1337-0001

Drawn KAS
Chkd KJD

De Beers Canada Inc.

Final Discharge (SNP 02-17B) Dissolved Load FLOW

FIGURE VI-10f



Date: December 2013
Project: 12-1337-0001

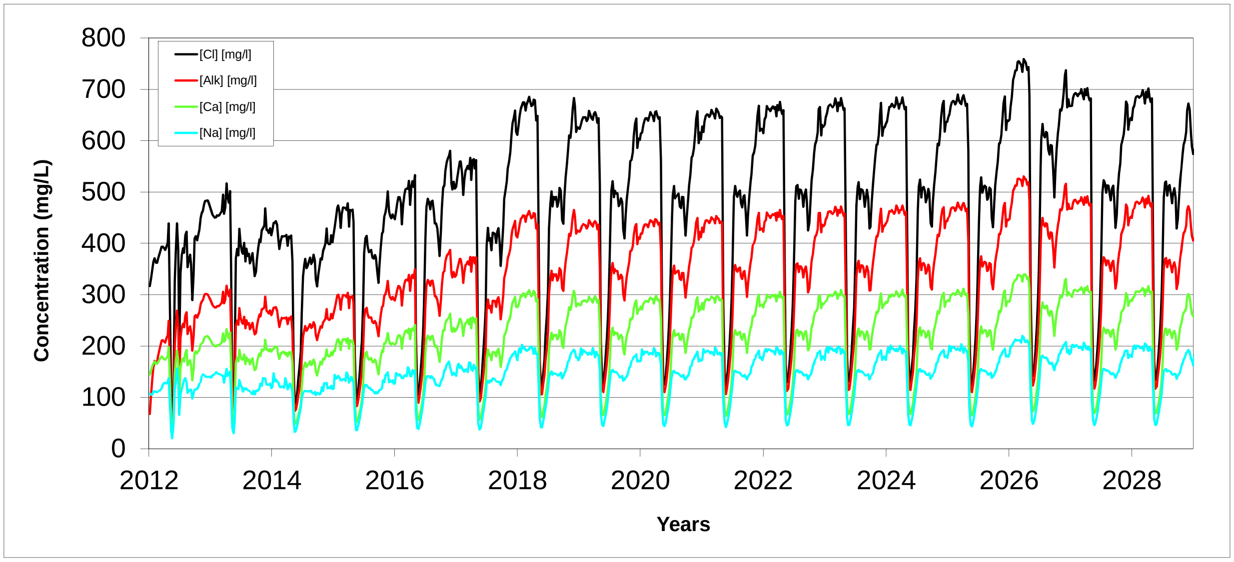
Drawn KAS
Chkd KJD

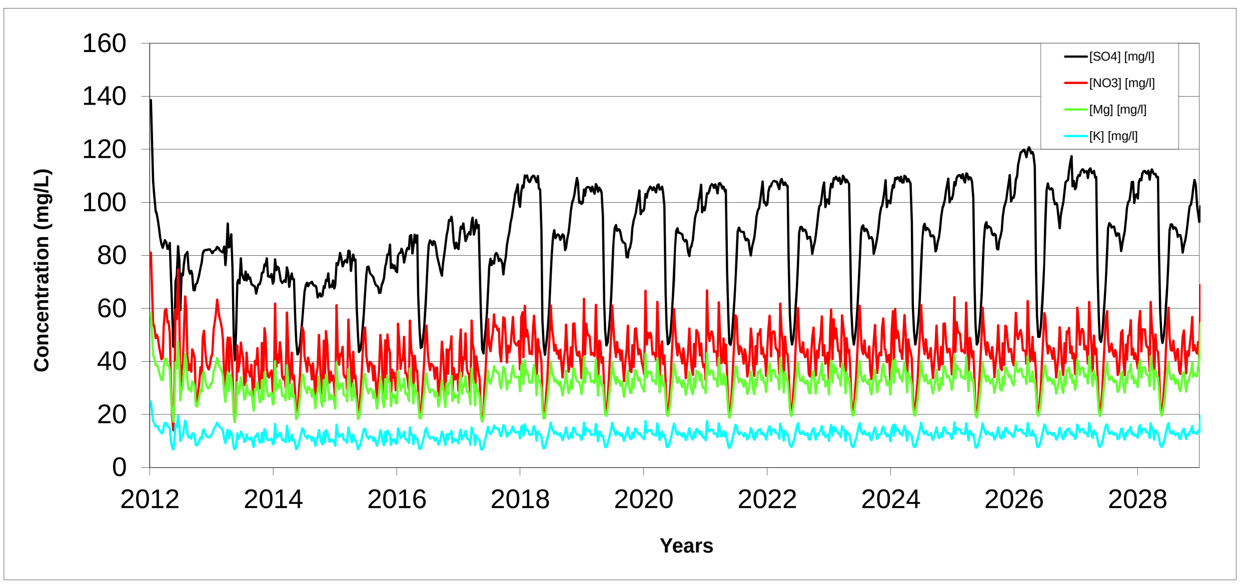
De Beers Canada Inc.

AppVI_Fig10.xls-App VI-10f

Water Management Pond Seepage Dissolved Concentrations

FIGURE VI-11a



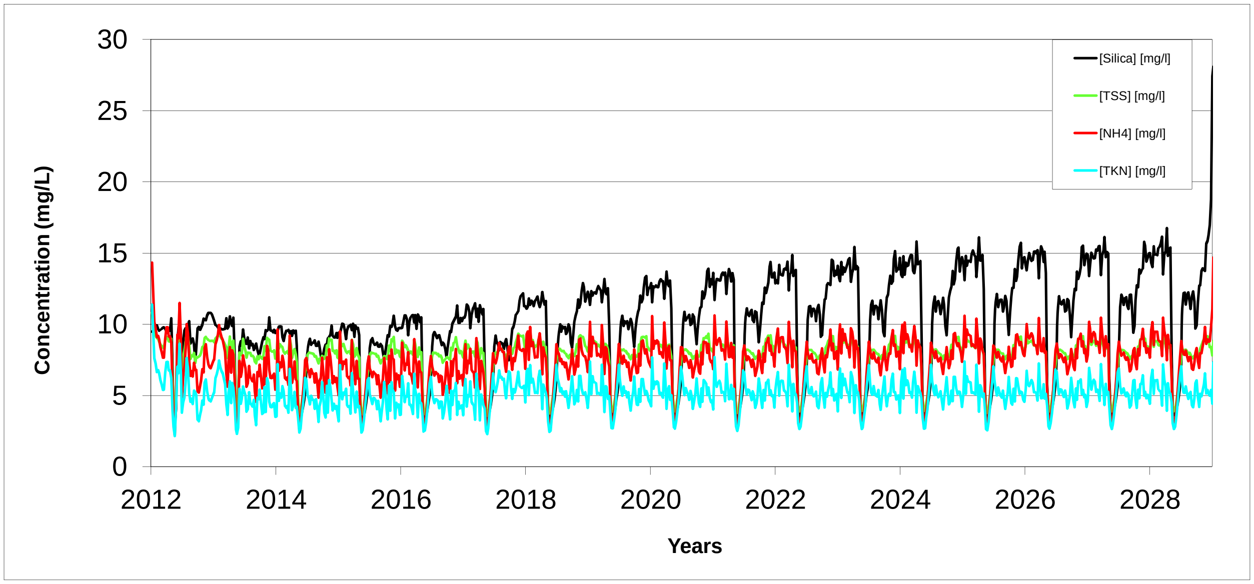


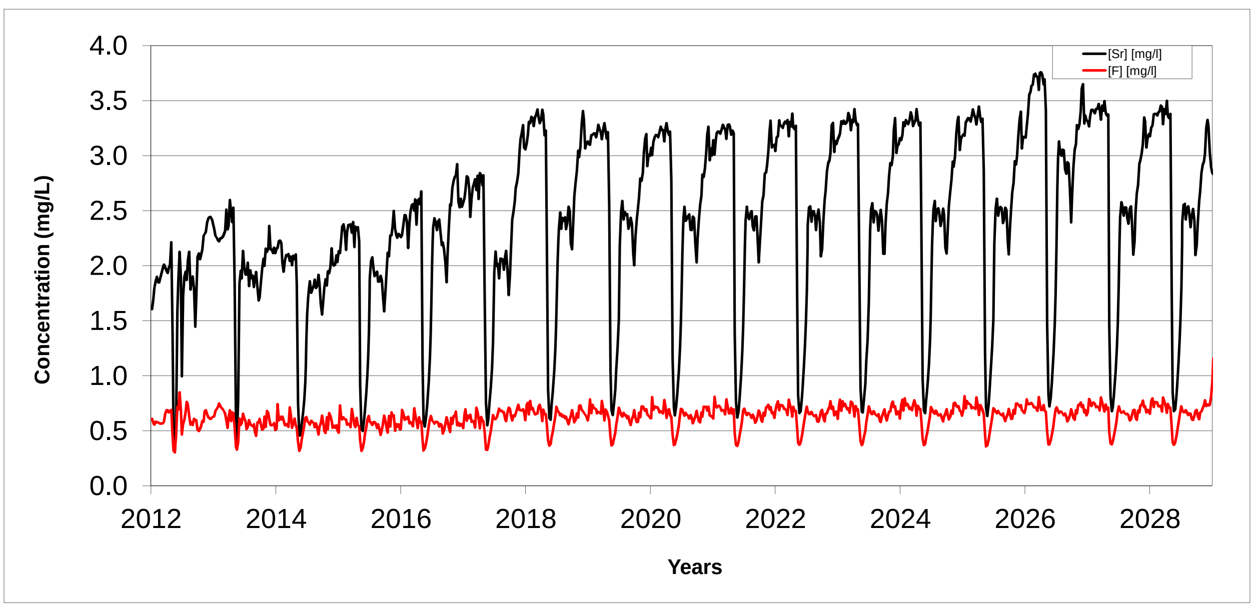
Date: December 2013
Project: 12-1337-0001

Drawn KAS
Chkd KJD

De Beers Canada Inc.

Water Management Pond Seepage Dissolved Concentrations	FIGURE VI-11b





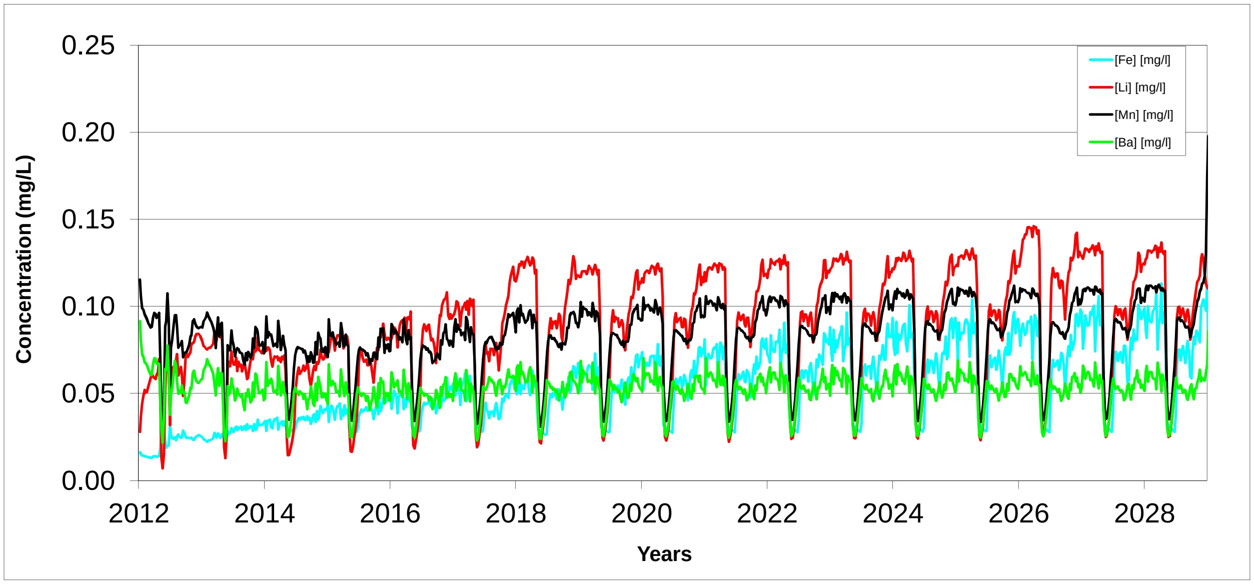
Date: December 2013
Project: 12-1337-0001

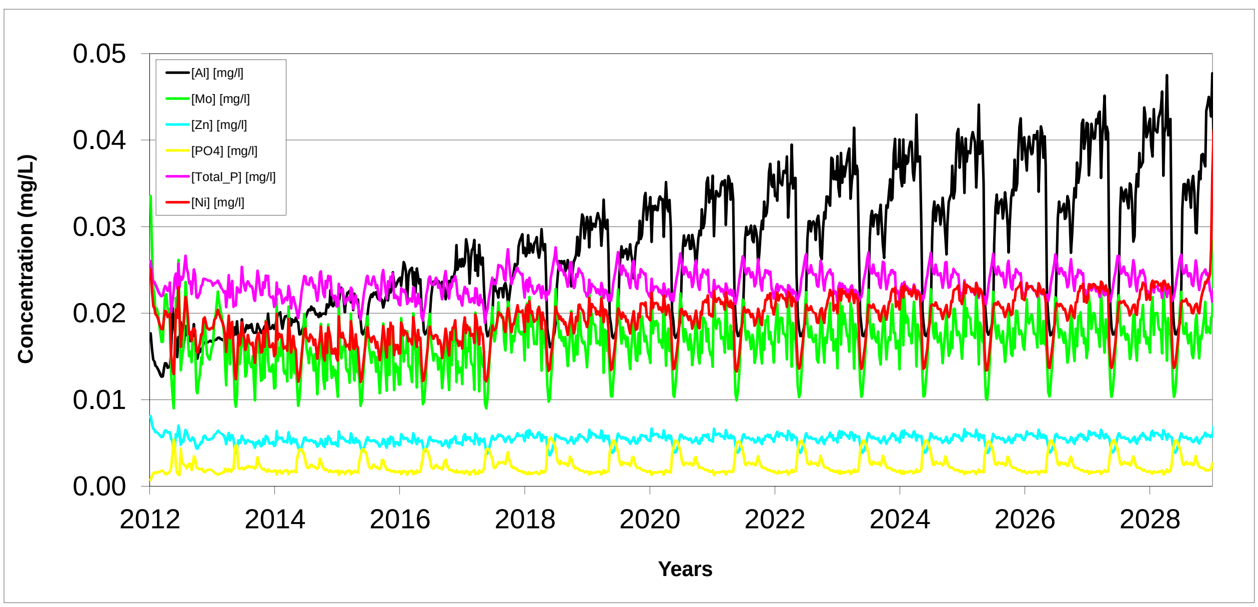
Drawn KAS
Chkd KJD

De Beers Canada Inc.

Water Management Pond Seepage Dissolved Concentrations

FIGURE VI-11c





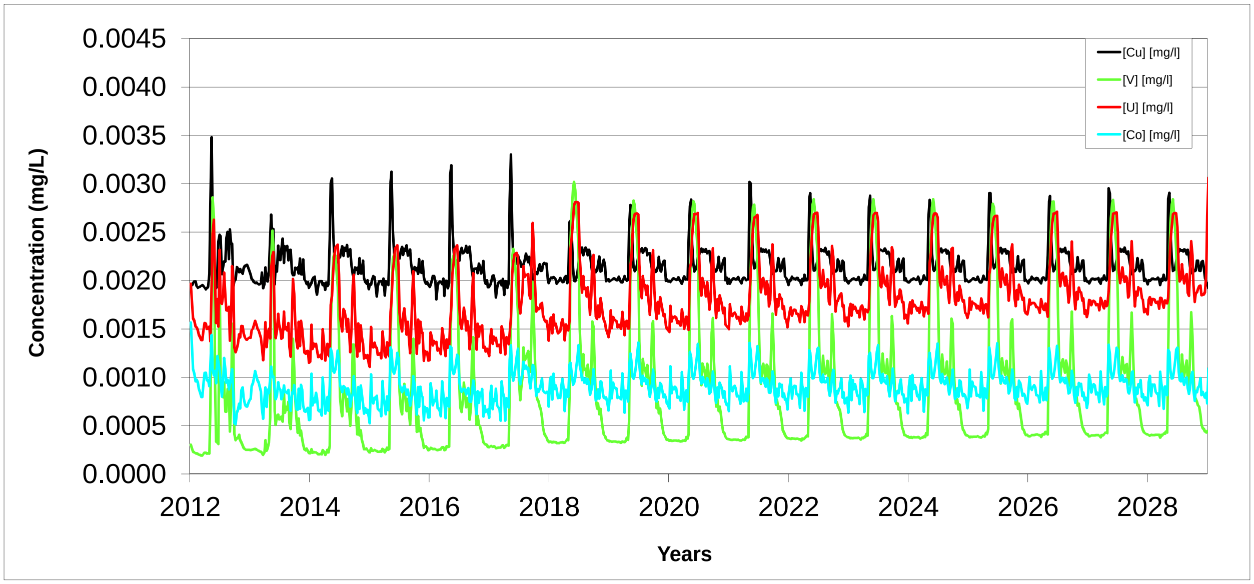
Date: December 2013
Project: 12-1337-0001

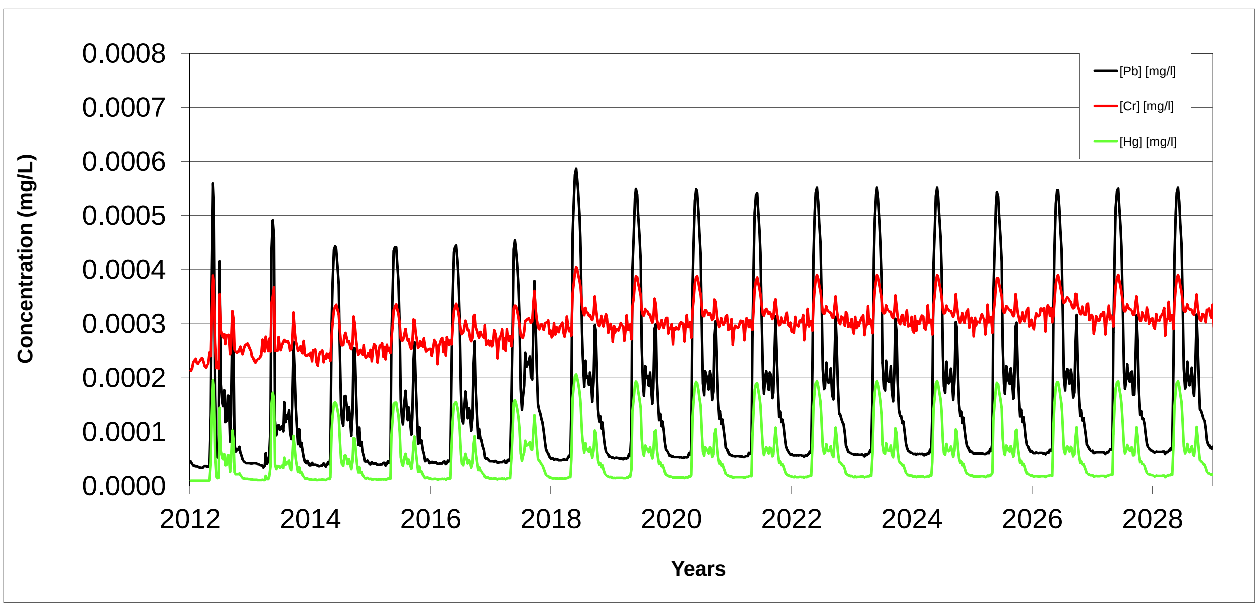
Drawn KAS
Chkd KJD

De Beers Canada Inc.

Water Management Pond Seepage Dissolved Concentrations

FIGURE VI-11d



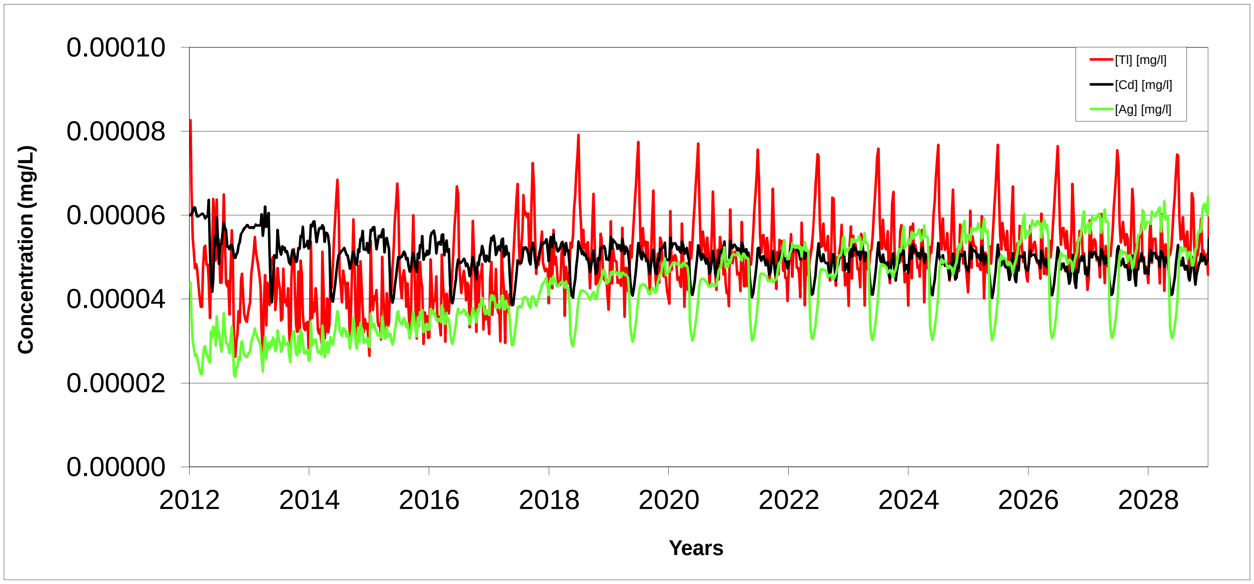


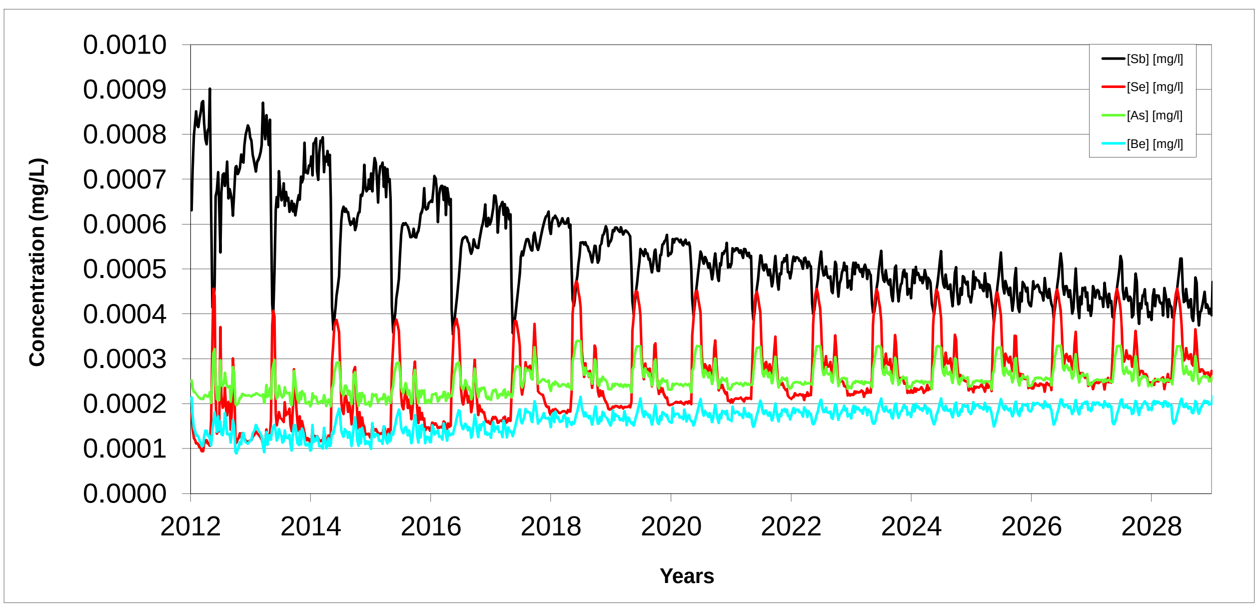
Date: December 2013
Project: 12-1337-0001

Drawn KAS
Chkd KJD

De Beers Canada Inc.

Water Management Pond Seepage Dissolved Concentrations	FIGURE VI-11e



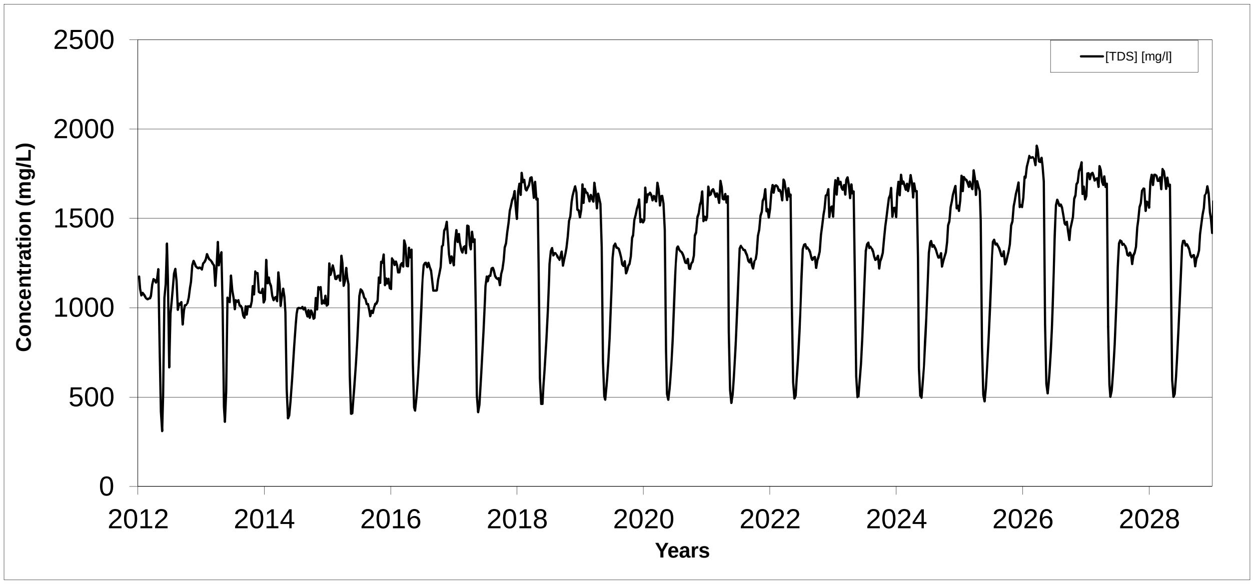


Date: December 2013
Project: 12-1337-0001

Drawn KAS
Chkd KJD

De Beers Canada Inc.

Water Management Pond Seepage Dissolved Concentrations	FIGURE VI-11f

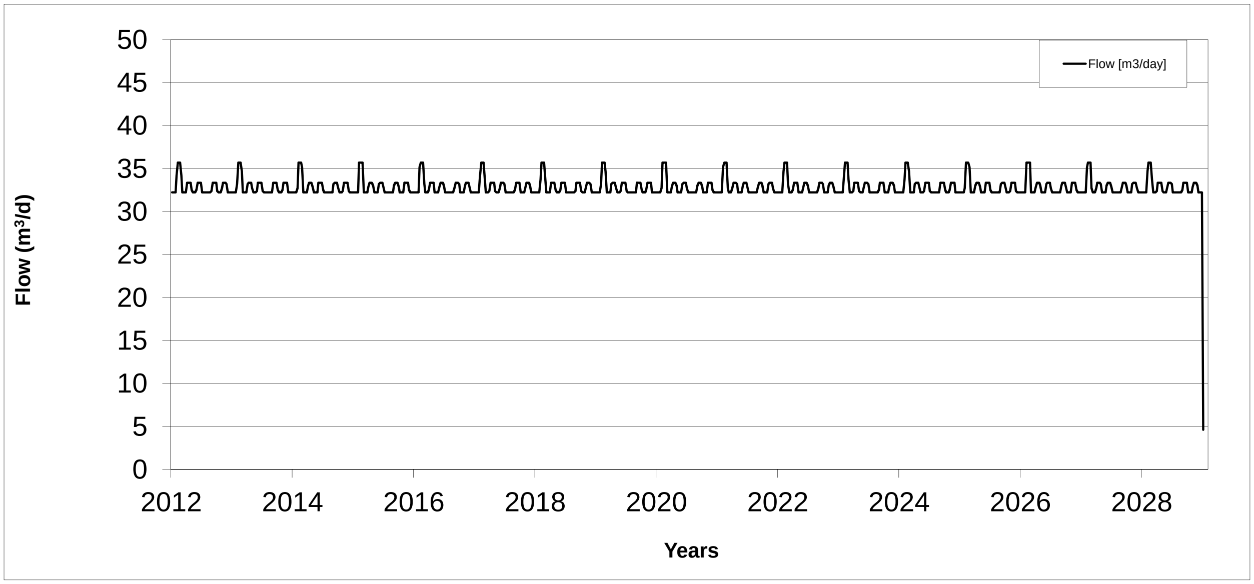


Date: December 2013
Project: 12-1337-0001

Drawn KAS
Chkd KJD

De Beers Canada Inc.

Water Management Pond Seepage Dissolved Concentrations	FIGURE VI-11g



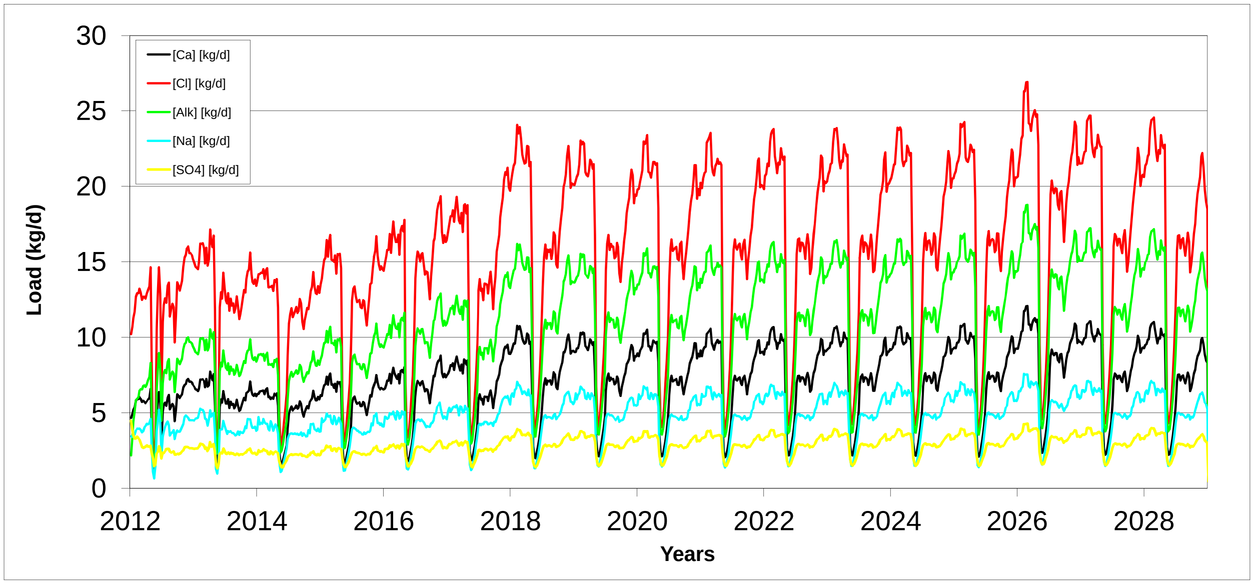
Date: December 2013
Project: 12-1337-0001

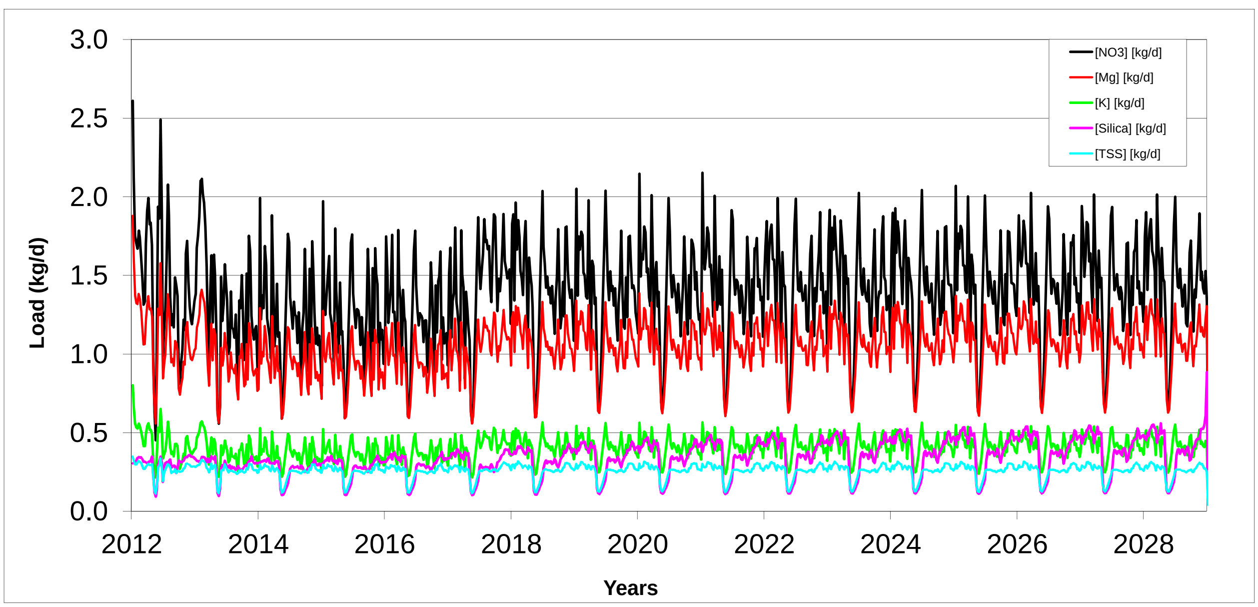
Drawn KAS
Chkd KJD

De Beers Canada Inc.

Water Management Pond Seepage Dissolved Load

FIGURE VI-12a



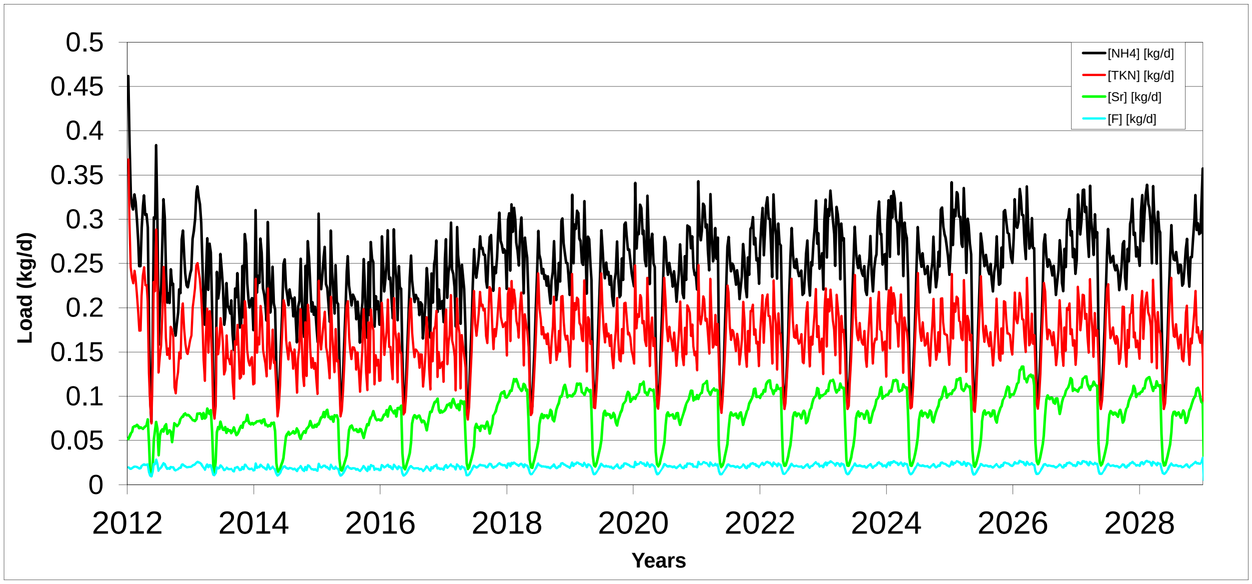


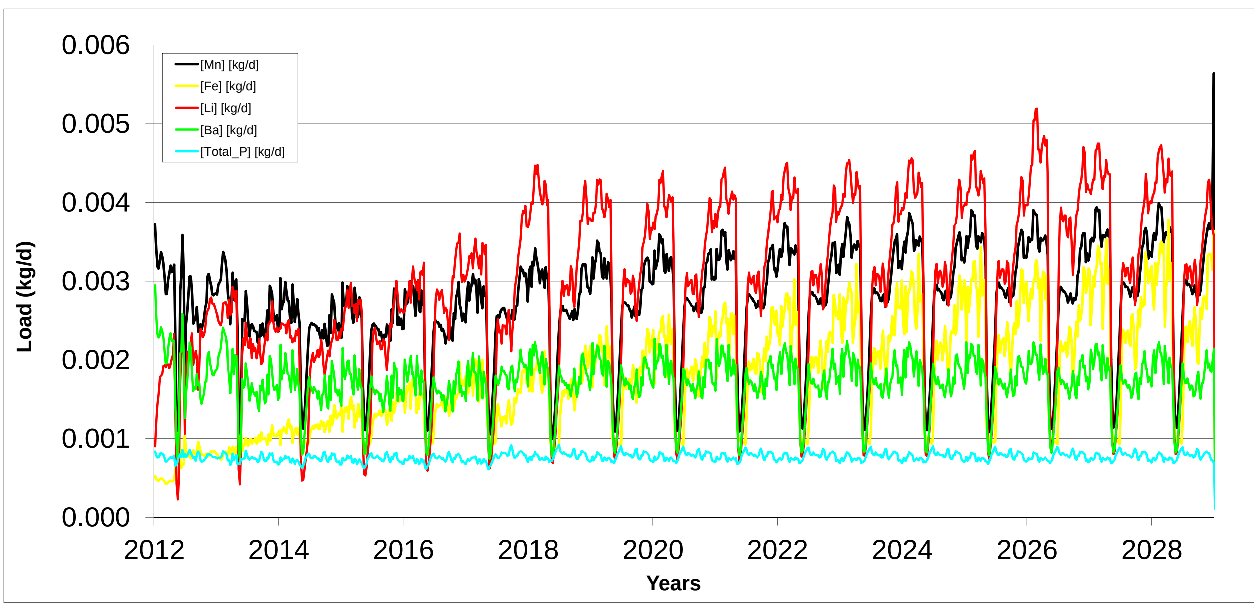
Date: December 2013
Project: 12-1337-0001

Drawn KAS
Chkd KJD

De Beers Canada Inc.

Water Management Pond Seepage Dissolved Load	FIGURE VI-12b





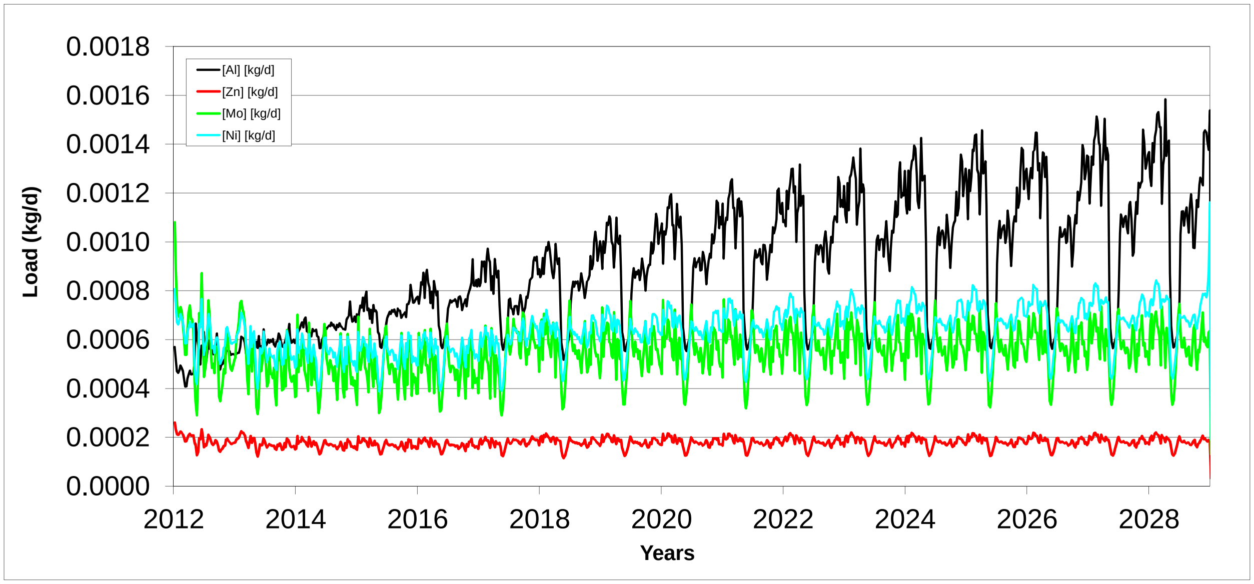
Date: December 2013
Project: 12-1337-0001

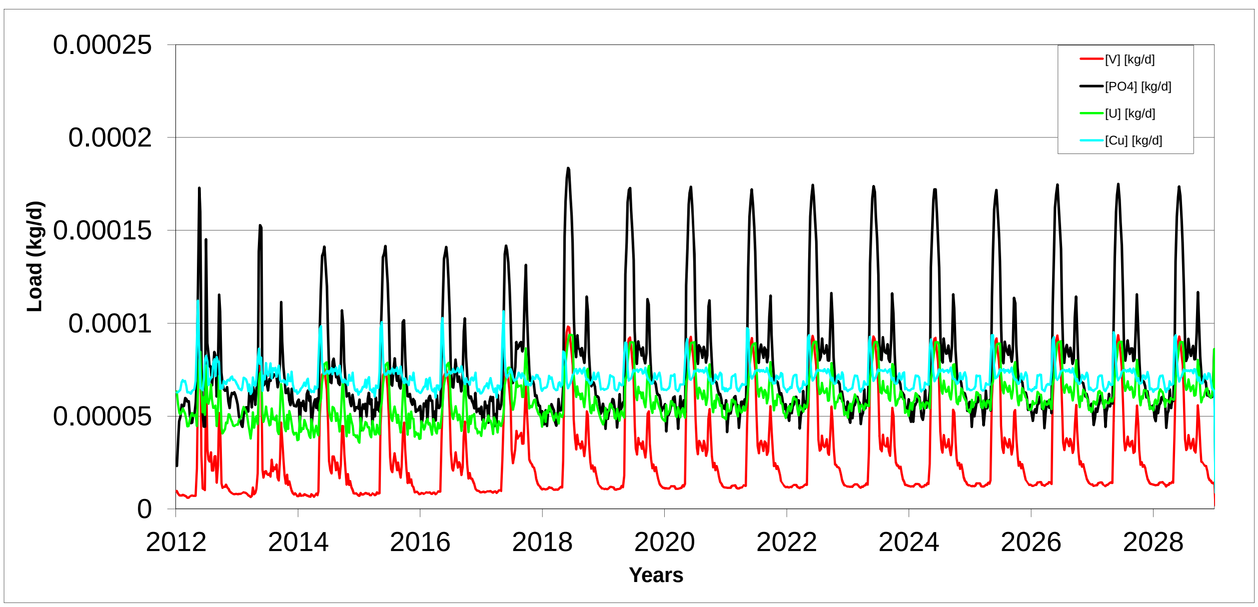
Drawn KAS
Chkd KJD

De Beers Canada Inc.

Water Management Pond Seepage Dissolved Load

FIGURE VI-12c



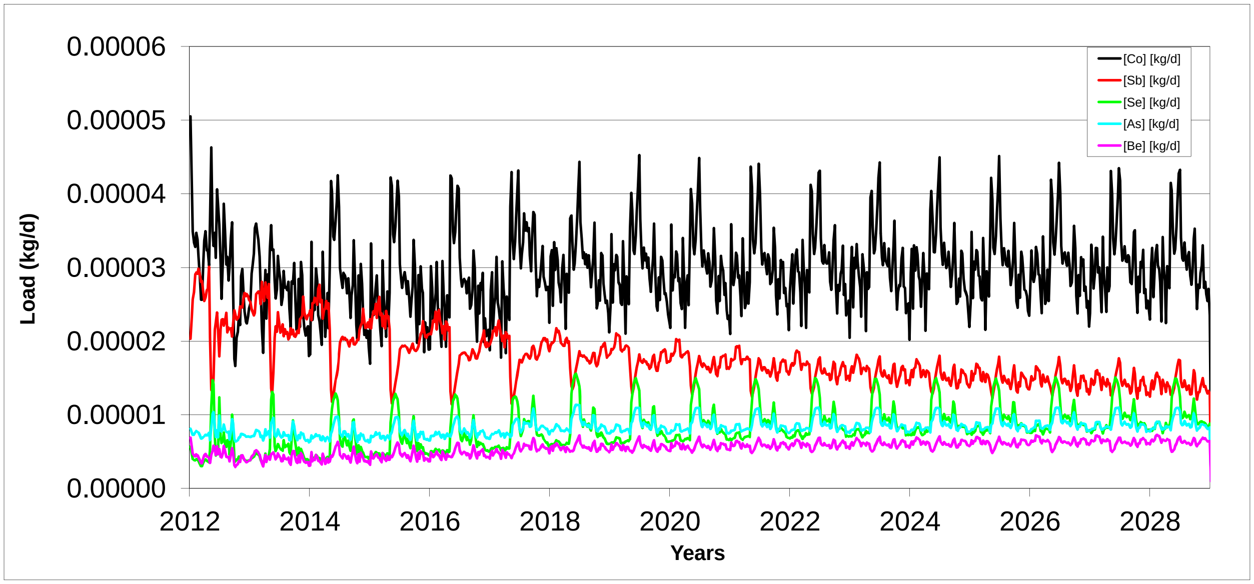


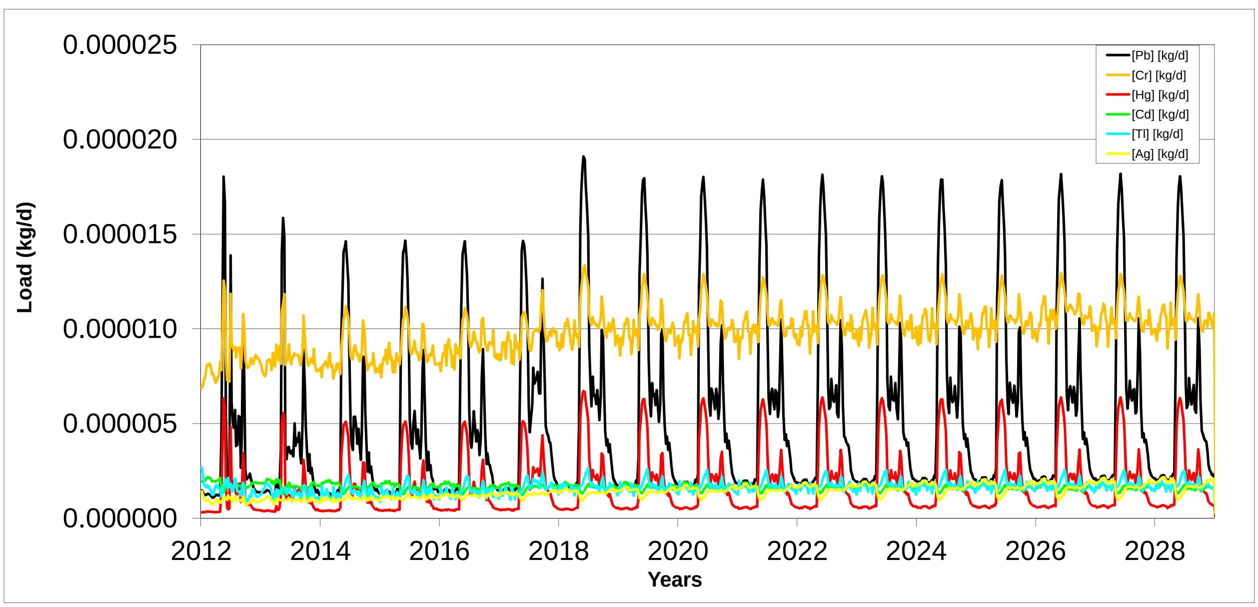
Date: December 2013
Project: 12-1337-0001

Drawn KAS
Chkd KJD

De Beers Canada Inc.

Water Management Pond Seepage Dissolved Load	FIGURE VI-12d





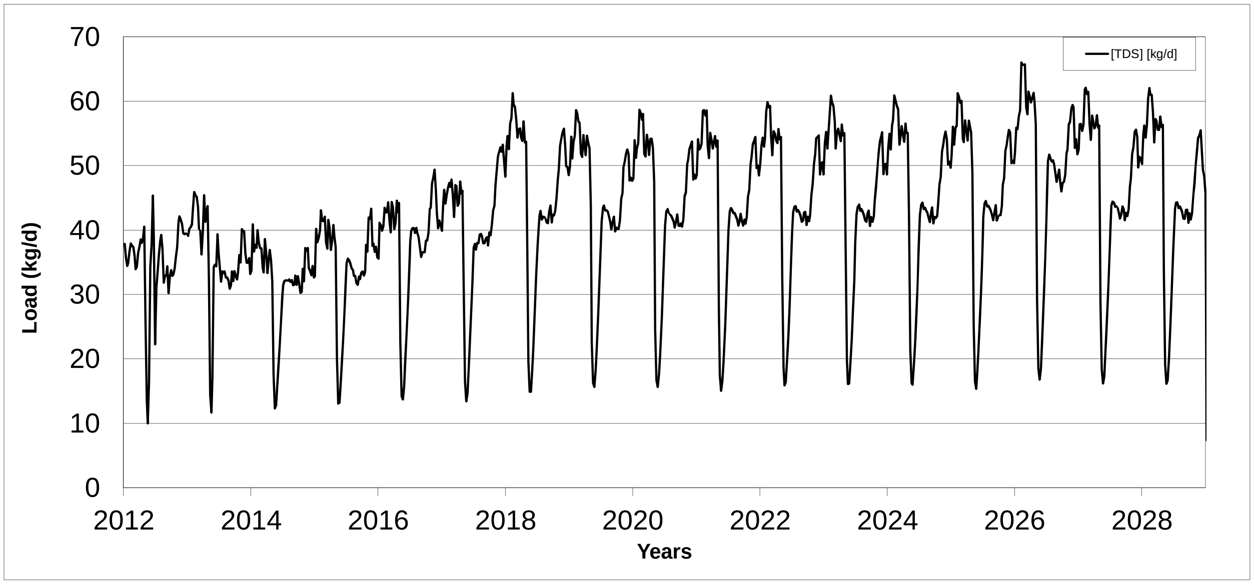
Date: December 2013
Project: 12-1337-0001

Drawn KAS
Chkd KJD

De Beers Canada Inc.

Water Management Pond Seepage Dissolved Load

FIGURE VI-12e

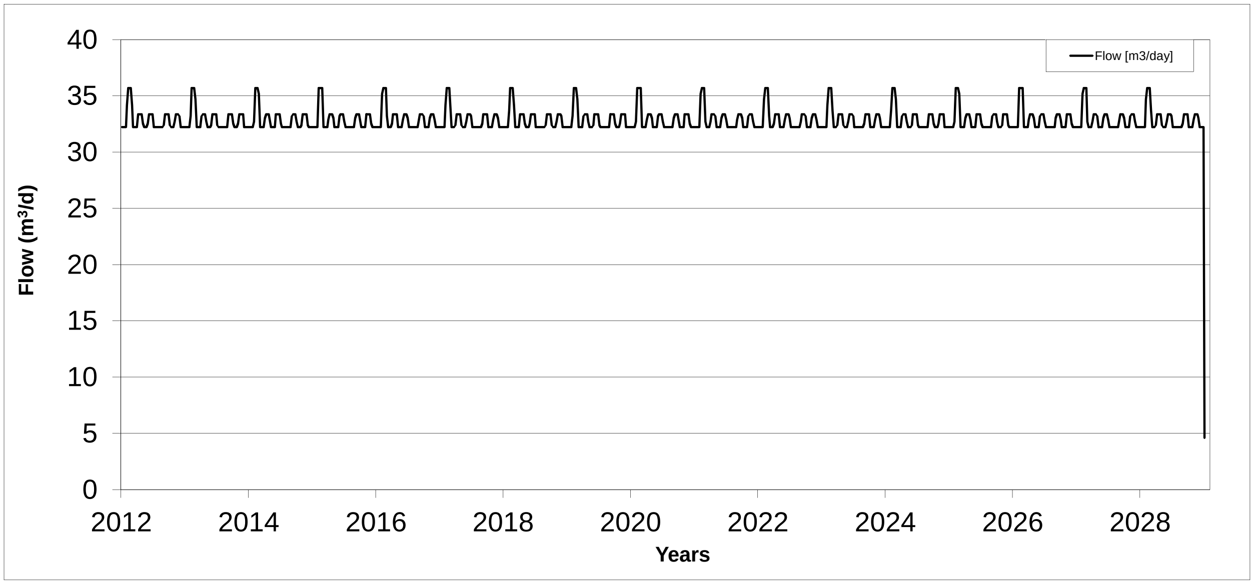


Date: December 2013
Project: 12-1337-0001

Drawn KAS
Chkd KJD

De Beers Canada Inc.

Water Management Pond Seepage Dissolved Load FLOW	FIGURE VI-12f



Date: December 2013
Project: 12-1337-0001

Drawn KAS
Chkd KJD

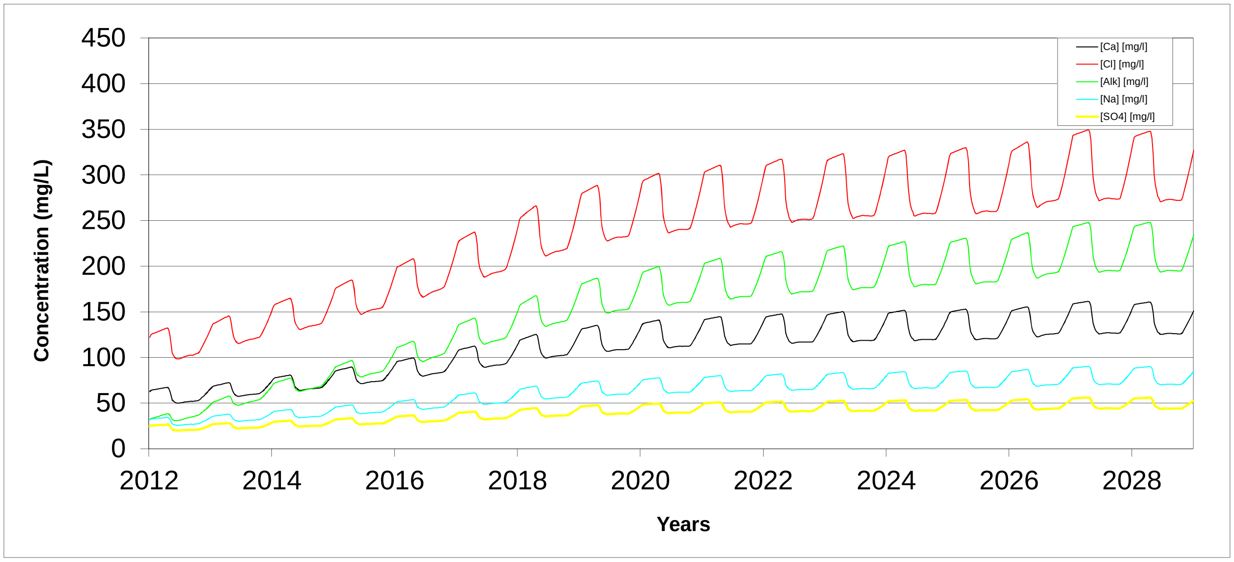
De Beers Canada Inc.

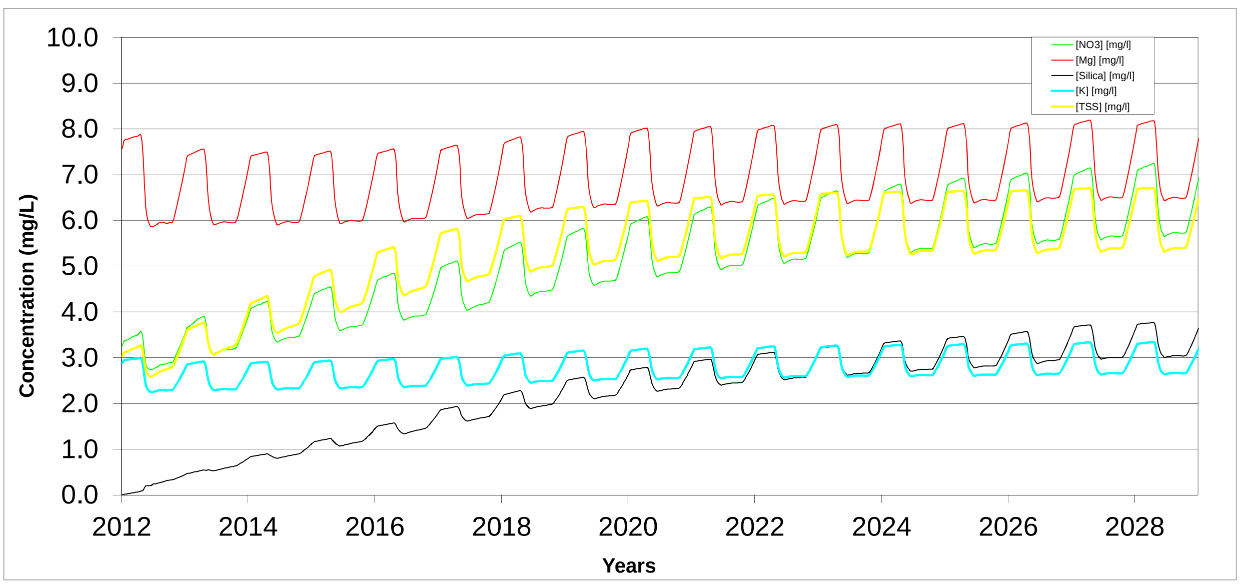
APPENDIX VII

LOWER BOUND SCENARIO B

December 2013

Snap Lake Outflow Dissolved Concentrations	FIGURE VII-1a





Date: December, 2013
Project: 12-1337-0001

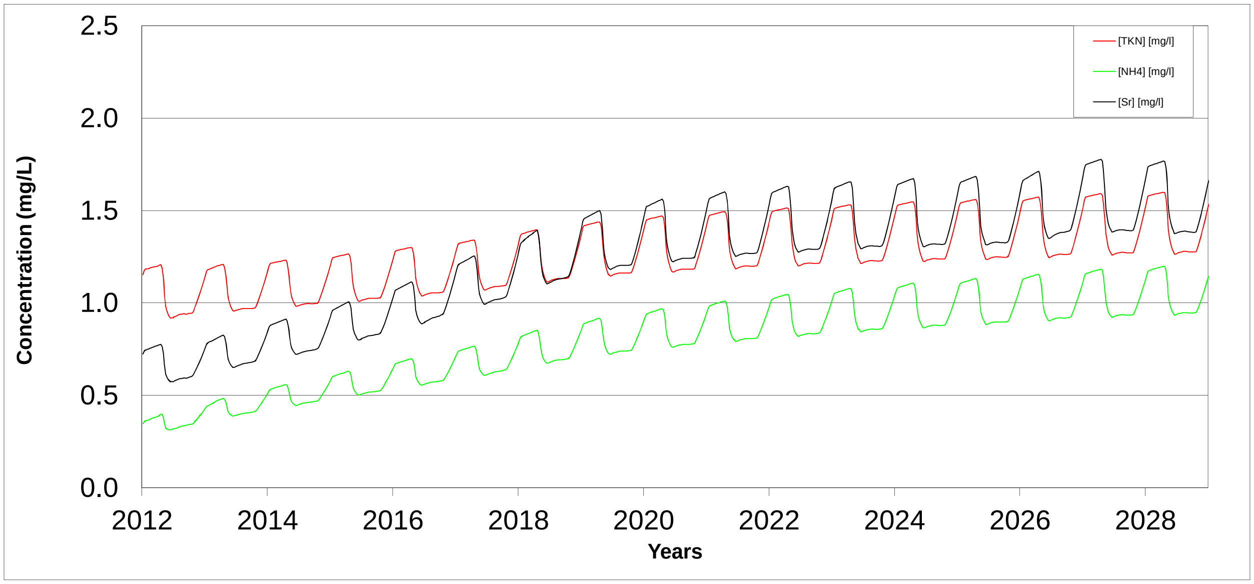
Drawn KAS
Chkd KJD

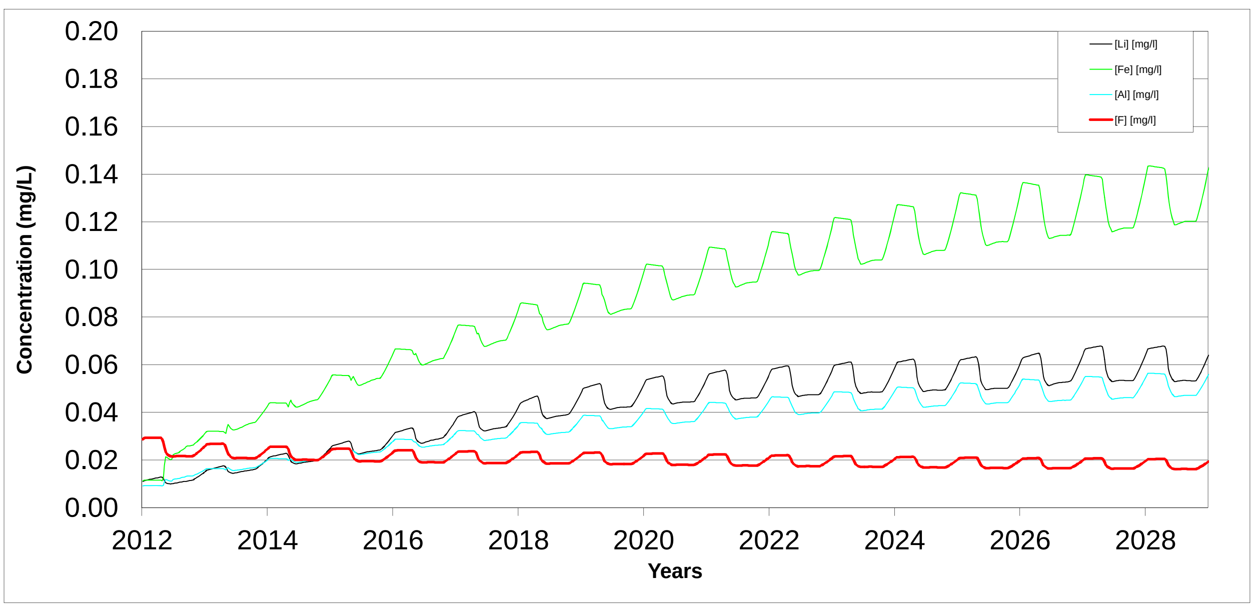
De Beers Canada Inc.

AppVII_Fig1.xls-App VII-1a

Snap Lake Outflow Dissolved Concentrations

FIGURE VII-1b





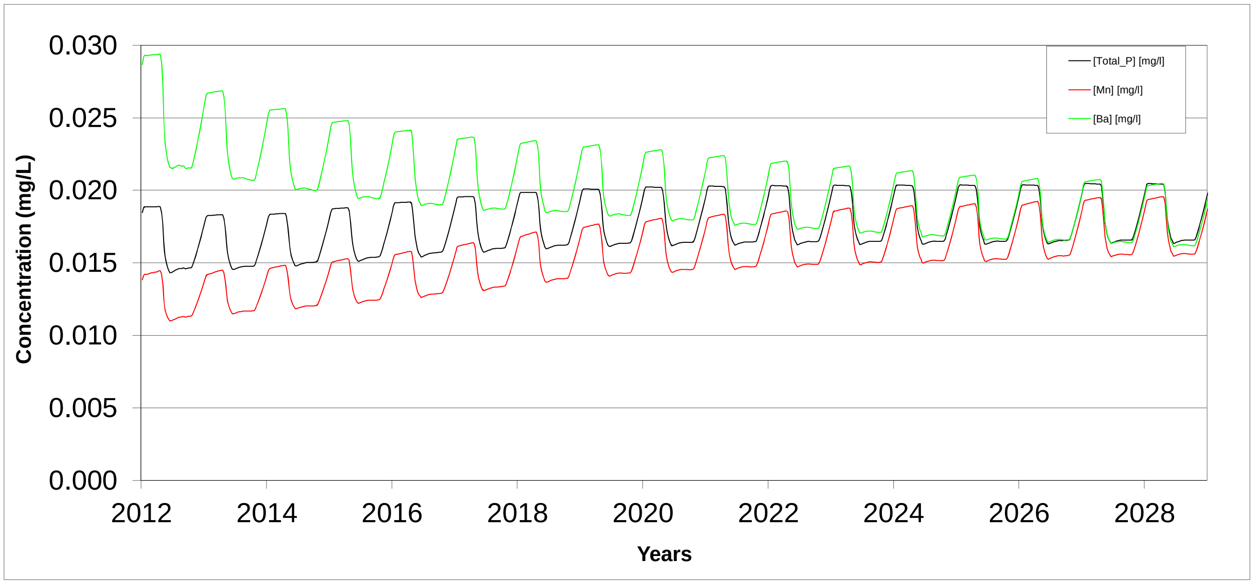
Date: December, 2013
Project: 12-1337-0001

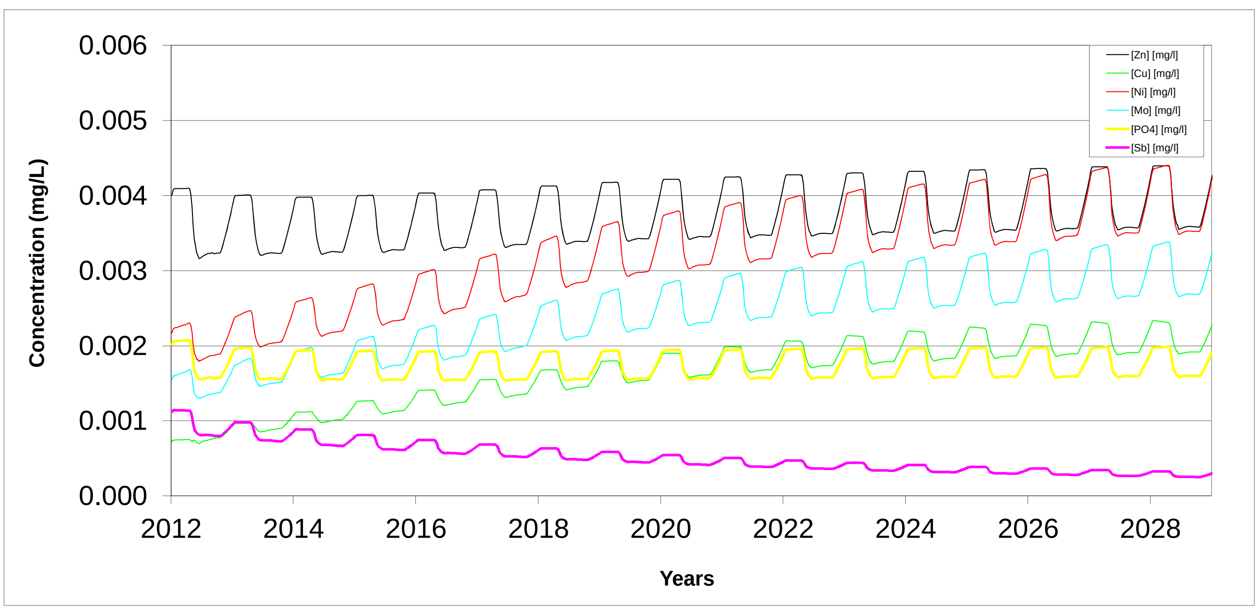
Drawn KAS
Chkd KJD

De Beers Canada Inc.

Snap Lake Outflow Dissolved Concentrations

FIGURE VII-1c



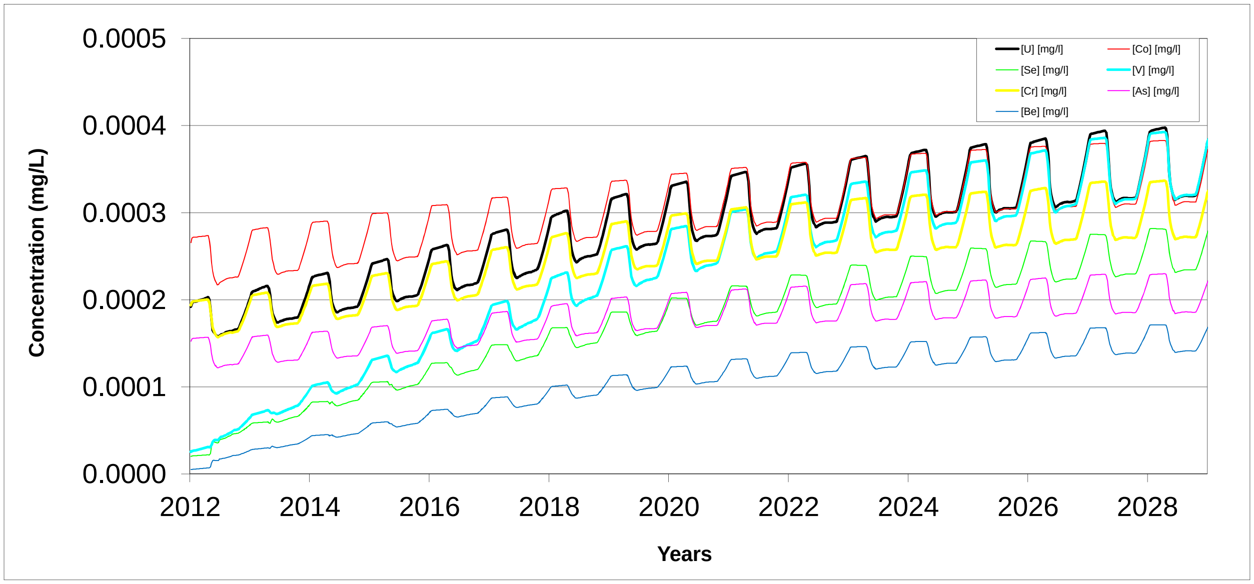


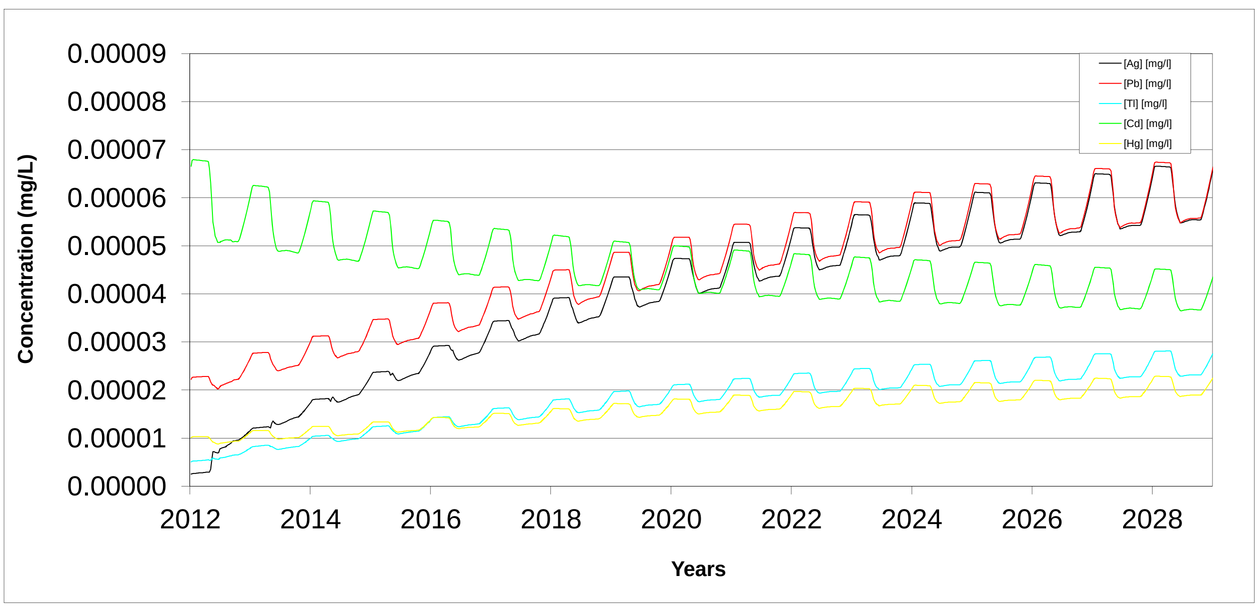
Date: December, 2013
Project: 12-1337-0001

Drawn KAS
Chkd KJD

De Beers Canada Inc.

Snap Lake Outflow Dissolved Concentrations	FIGURE VII-1d





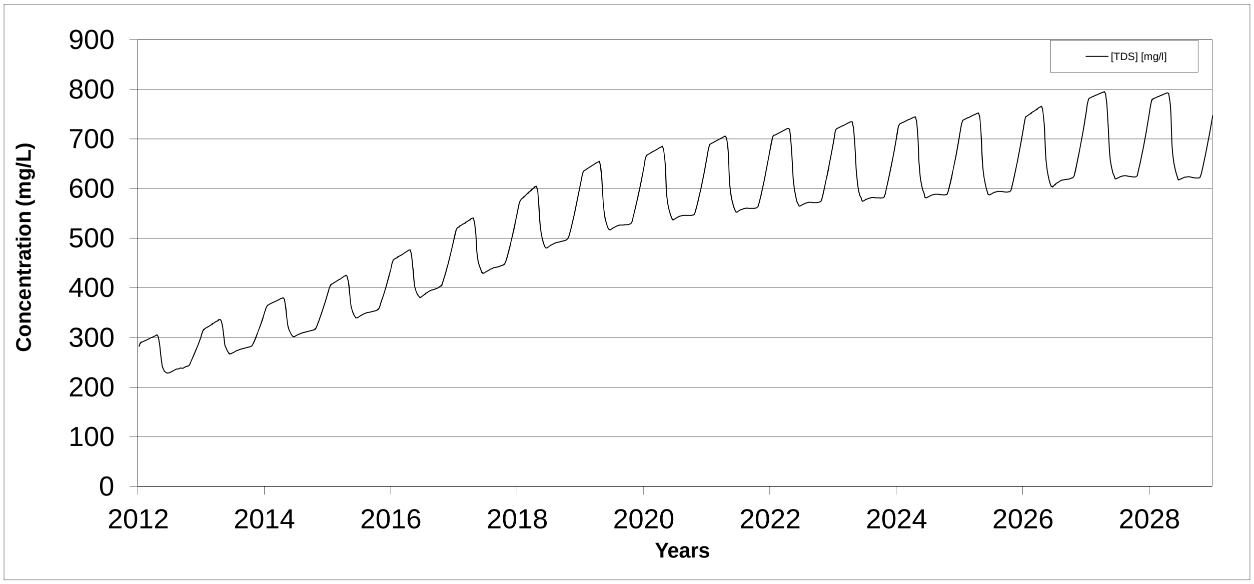
Date: December, 2013
Project: 12-1337-0001

Drawn KAS
Chkd KJD

De Beers Canada Inc.

Snap Lake Outflow Dissolved Concentrations

FIGURE VII-1e



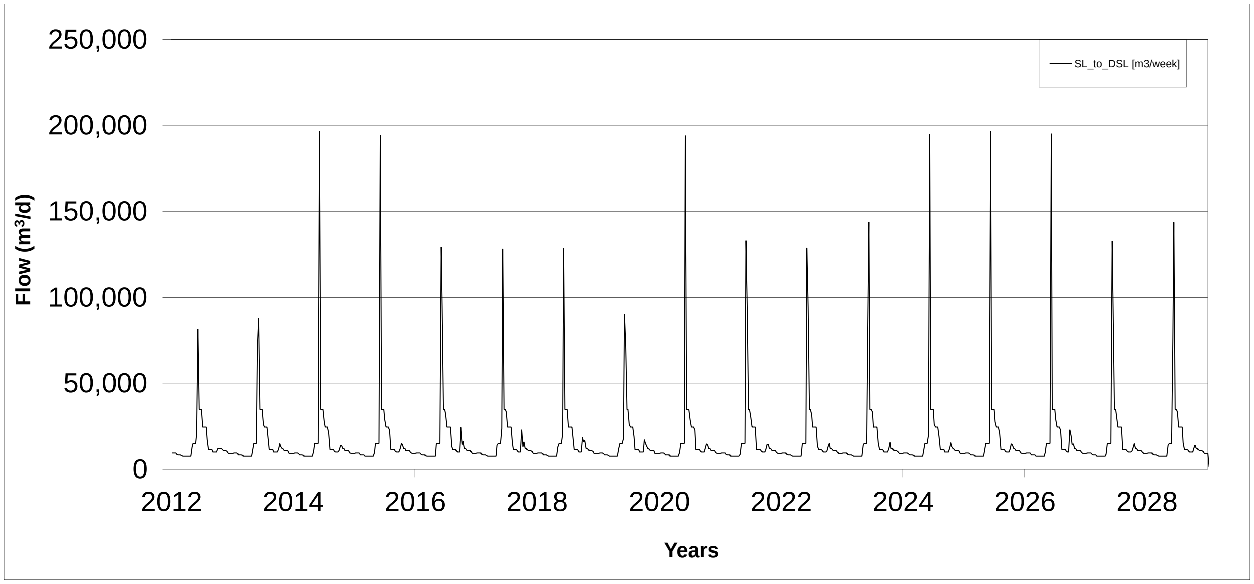
Date: December, 2013
Project: 12-1337-0001

Drawn KAS
Chkd KJD

De Beers Canada Inc.

Snap Lake Outflow Dissolved Concentrations

FIGURE VII-1f

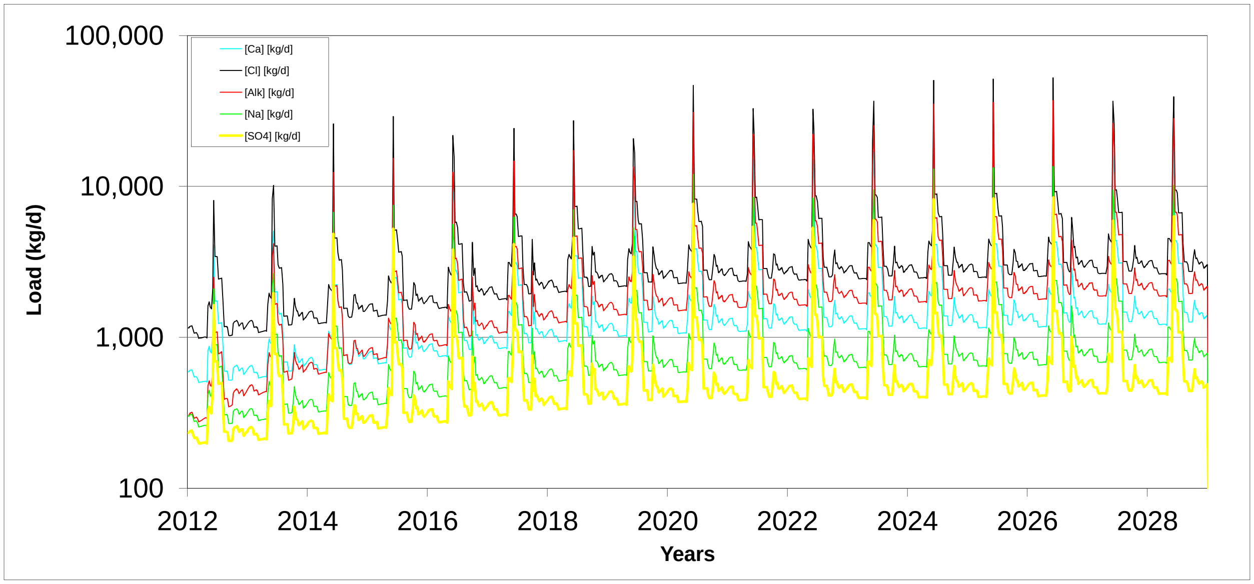


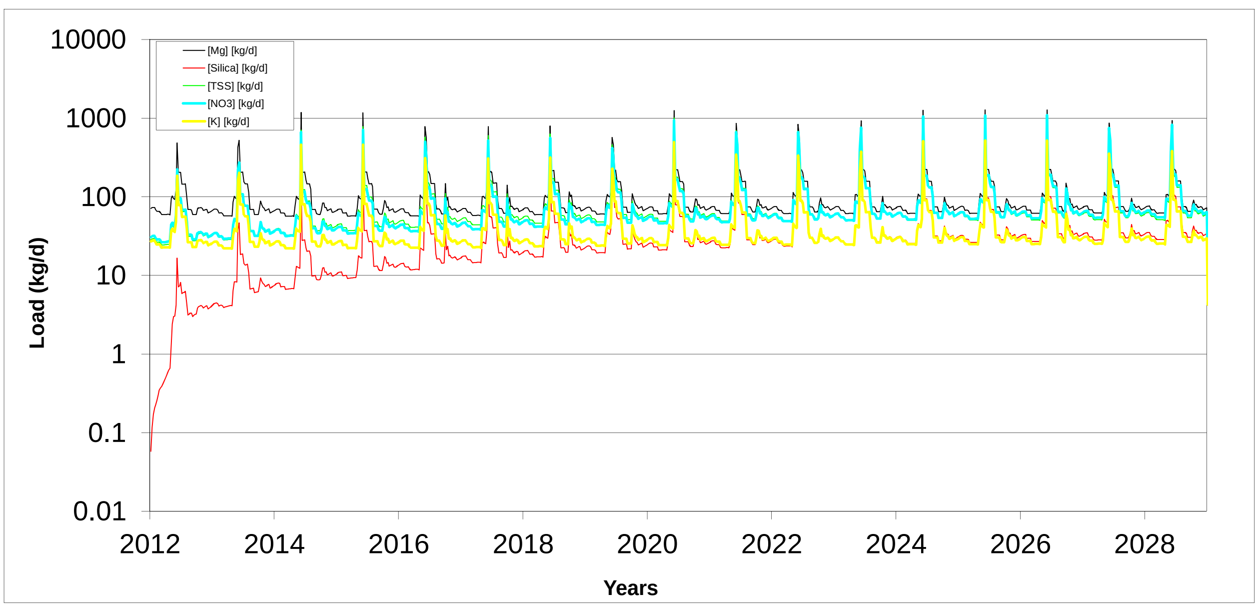
Date: December, 2013
Project: 12-1337-0001

Drawn KAS
Chkd KJD

De Beers Canada Inc.

Snap Lake Outflow Dissolved Load	FIGURE VII-2a



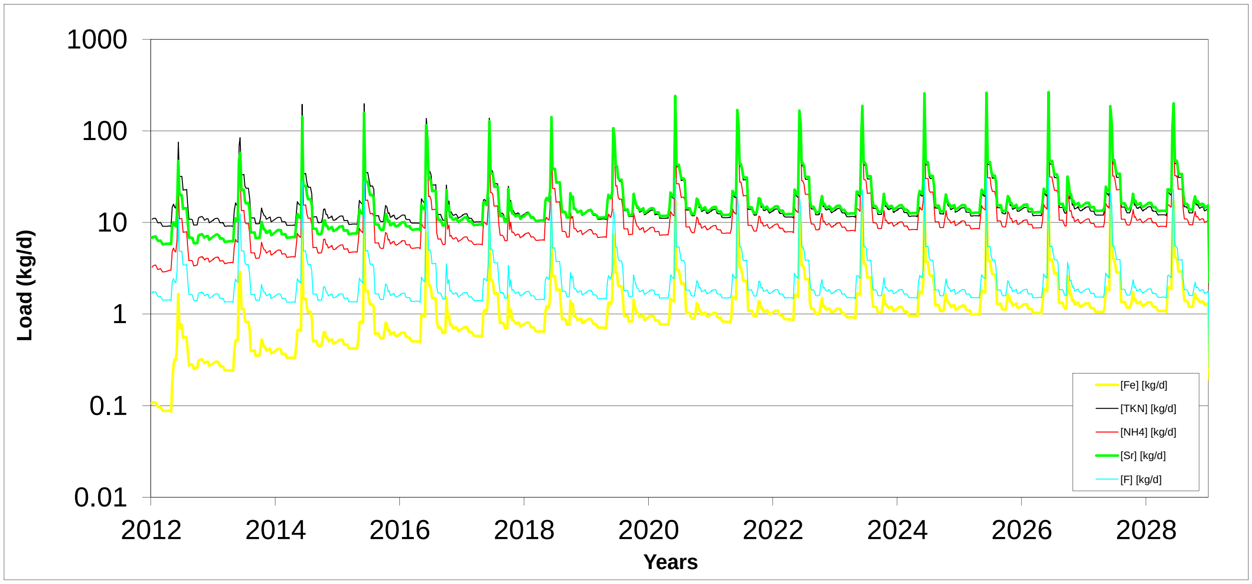


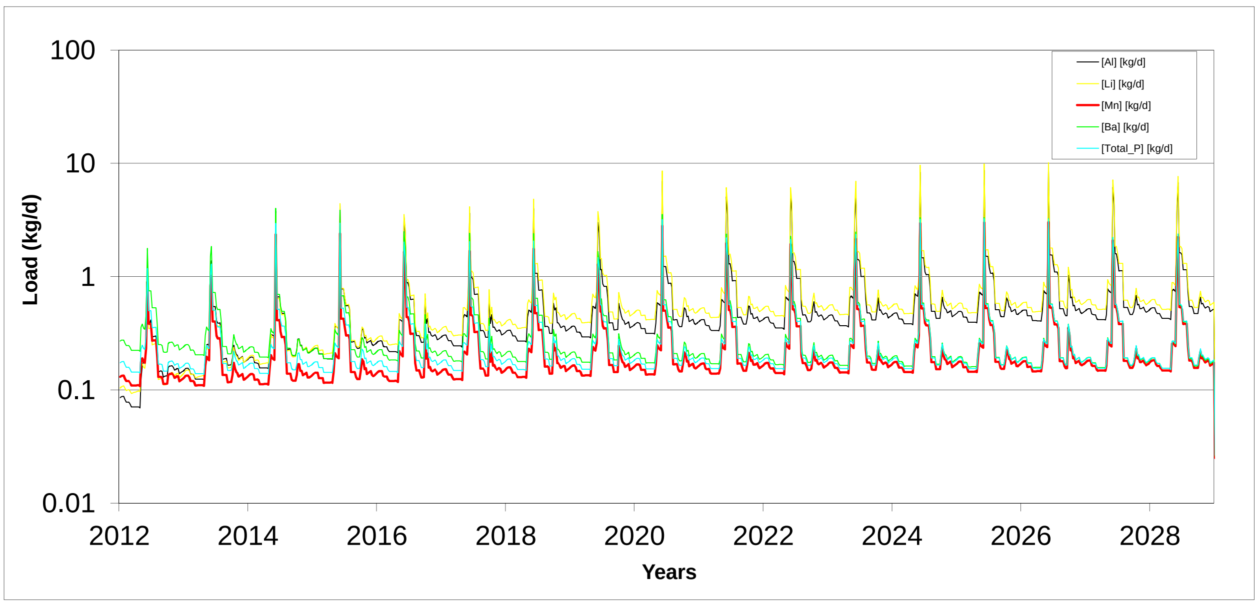
Date: December, 2013
Project: 12-1337-0001

Drawn KAS
Chkd KJD

De Beers Canada Inc.

Snap Lake Outflow Dissolved Load	FIGURE VII-2b



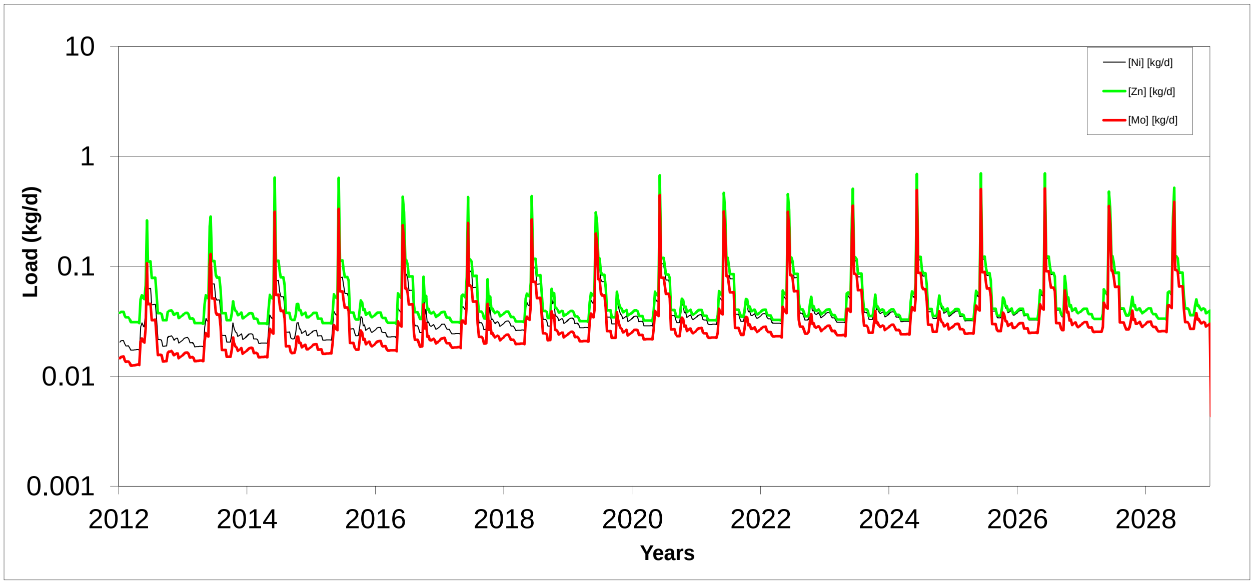


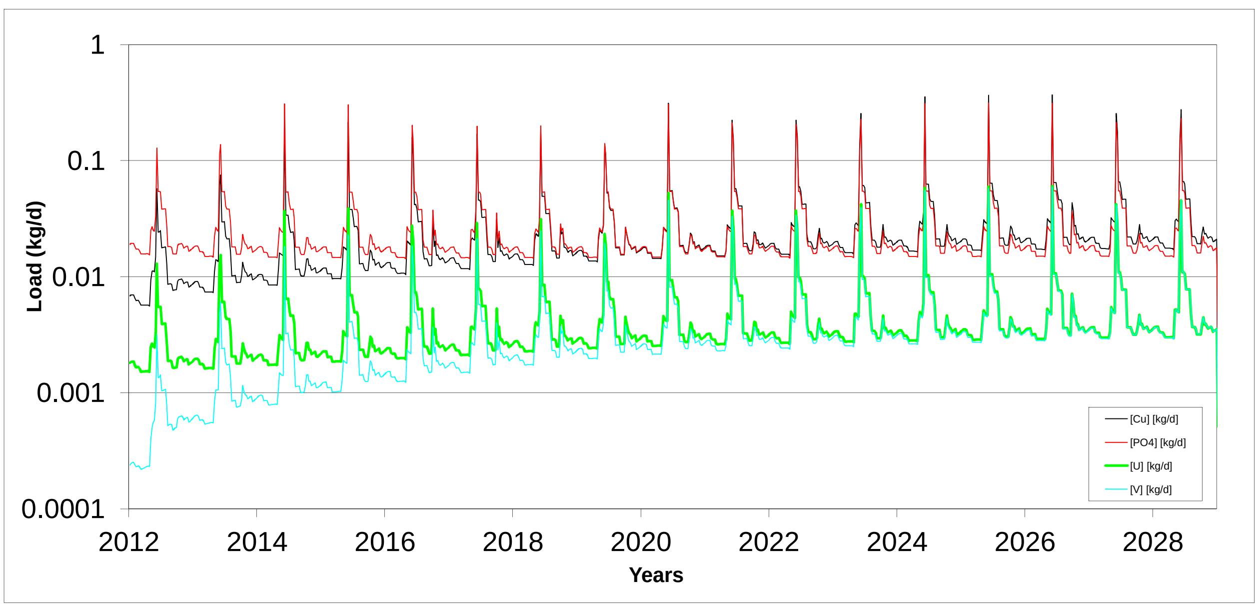
Date: December, 2013
Project: 12-1337-0001

Drawn KAS
Chkd KJD

De Beers Canada Inc.

Snap Lake Outflow Dissolved Load	FIGURE VII-2c





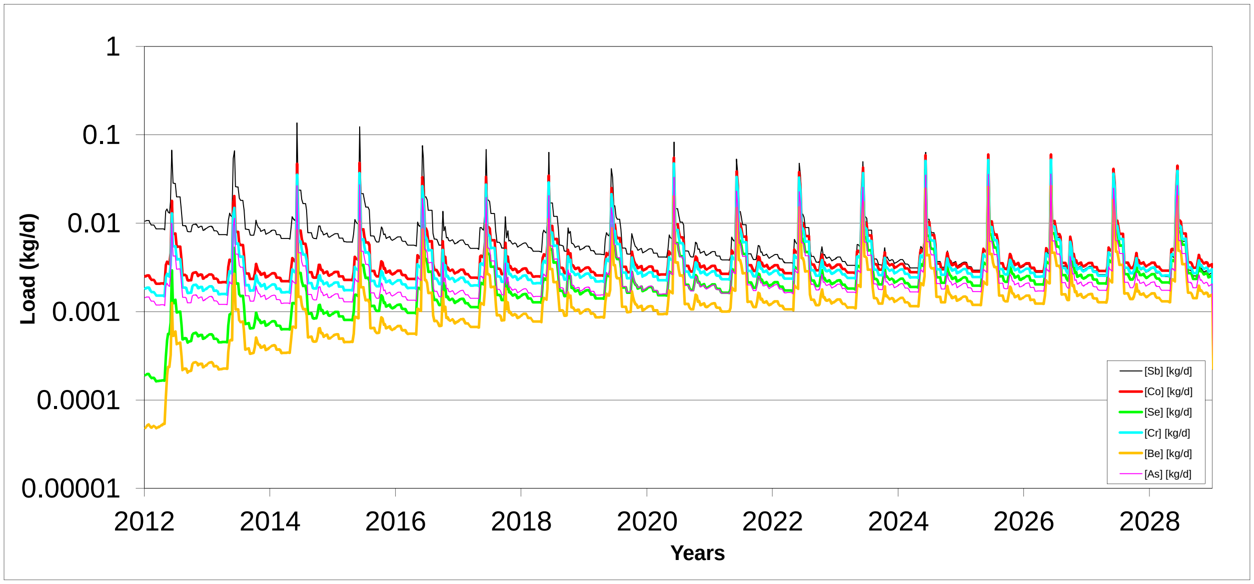
Date: December, 2013
Project: 12-1337-0001

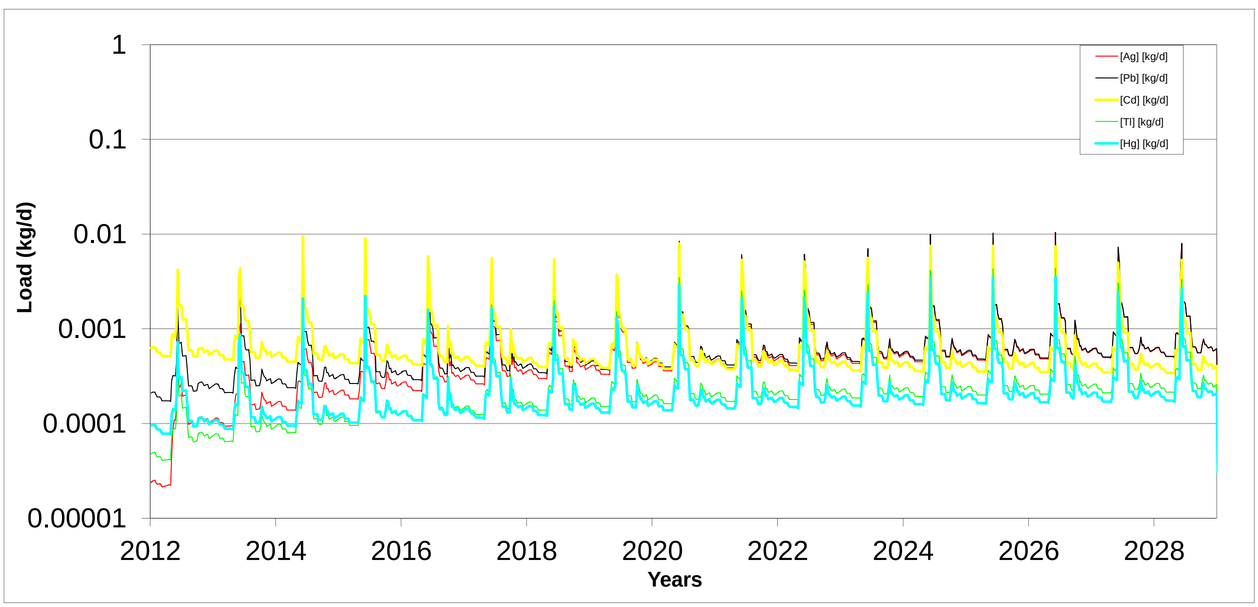
Drawn KAS
Chkd KJD

De Beers Canada Inc.

Snap Lake Outflow Dissolved Load

FIGURE VII-2d



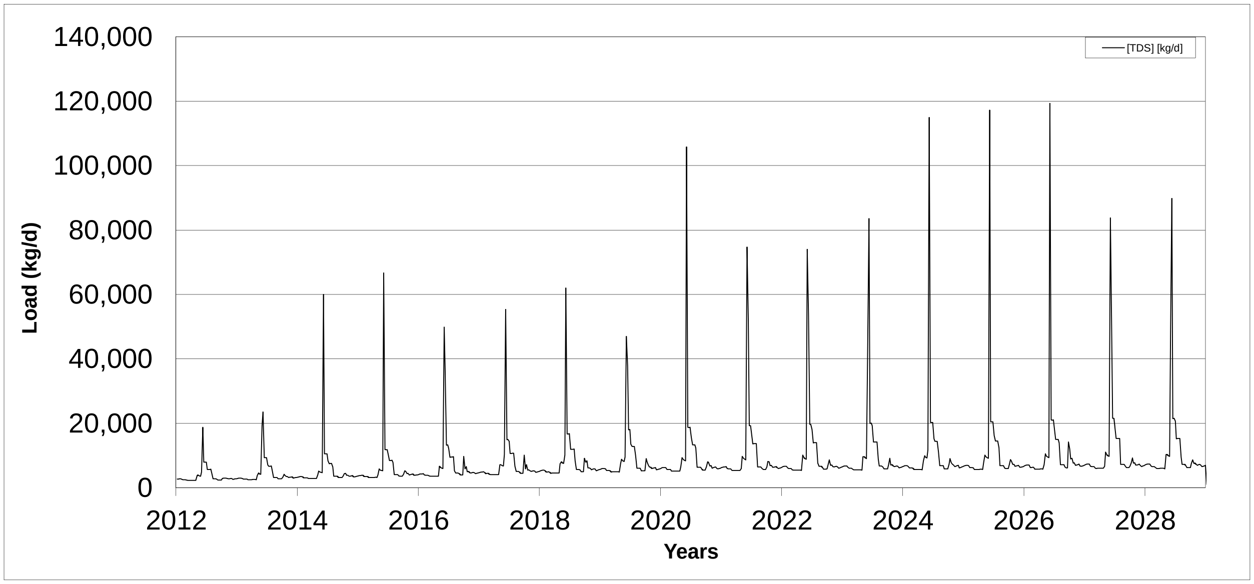


Date: December, 2013
Project: 12-1337-0001

Drawn KAS
Chkd KJD

De Beers Canada Inc.

Snap Lake Outflow Dissolved Load	FIGURE VII-2e



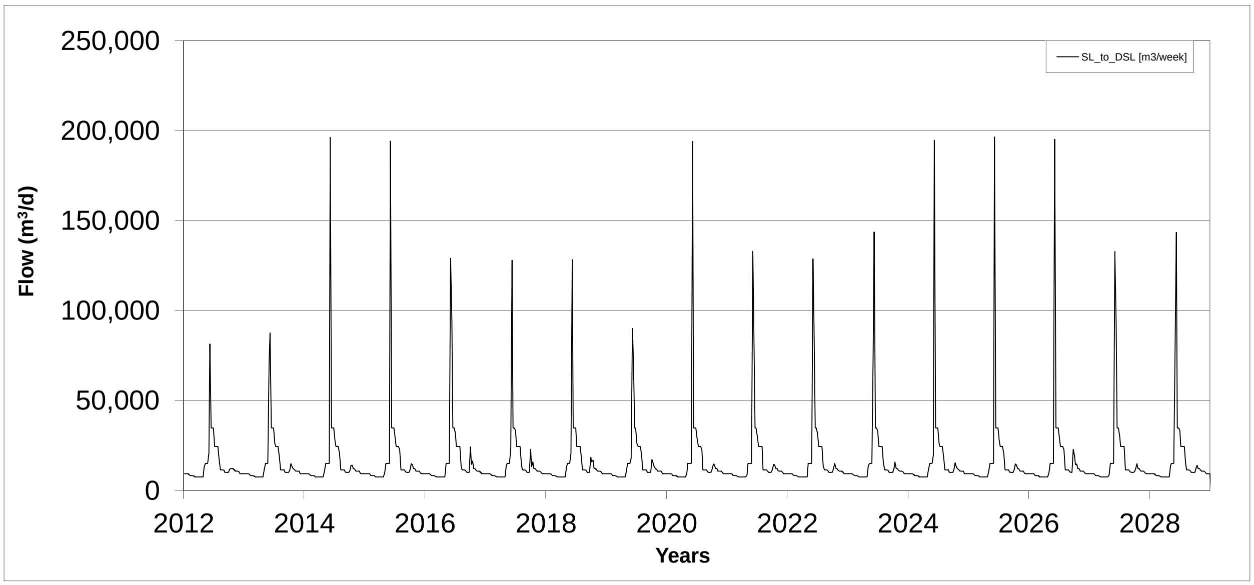
Date: December, 2013
Project: 12-1337-0001

Drawn KAS
Chkd KJD

De Beers Canada Inc.

Snap Lake Outflow Dissolved Load FLOW

FIGURE VII-2f

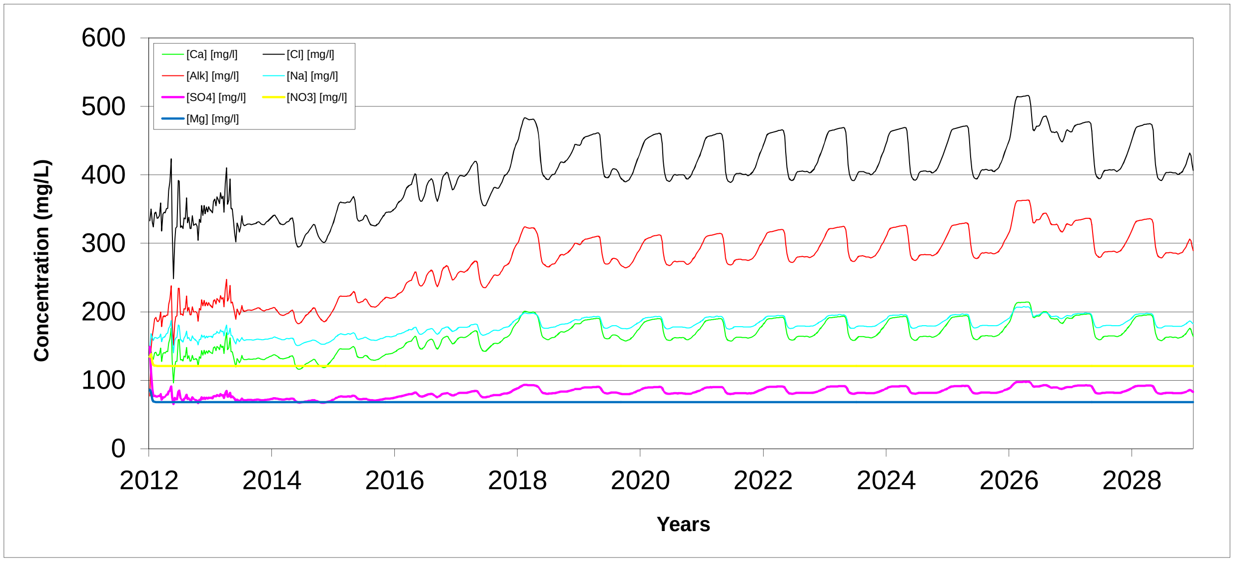


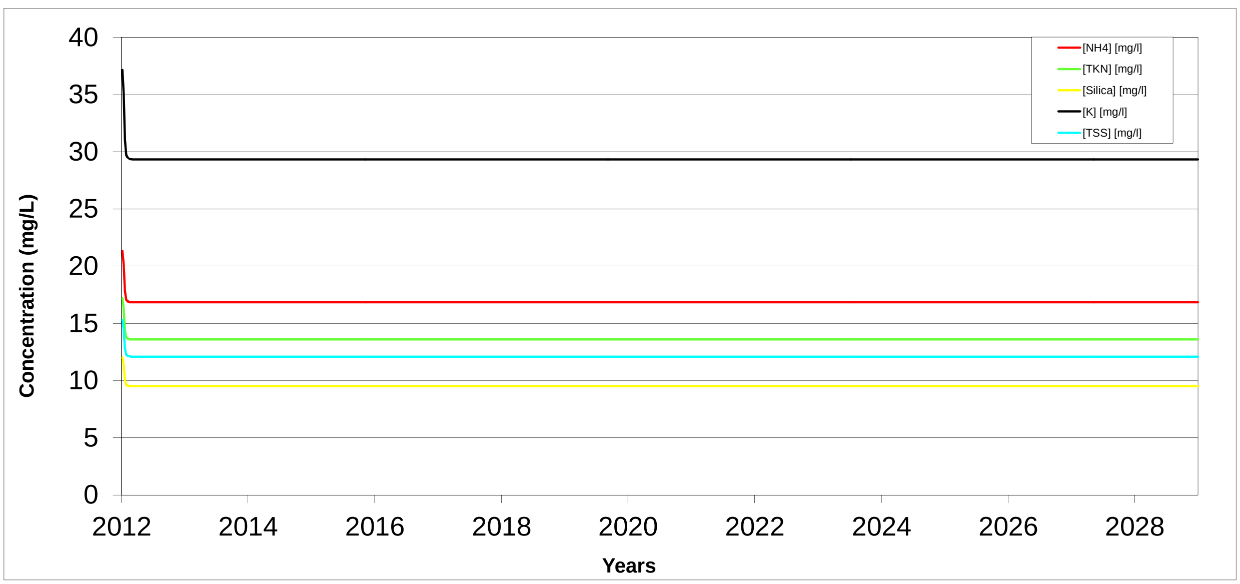
Date: December, 2013
Project: 12-1337-0001

Drawn KAS
Chkd KJD

De Beers Canada Inc.

Process Water Dissolved Concentrations	FIGURE VII-3a





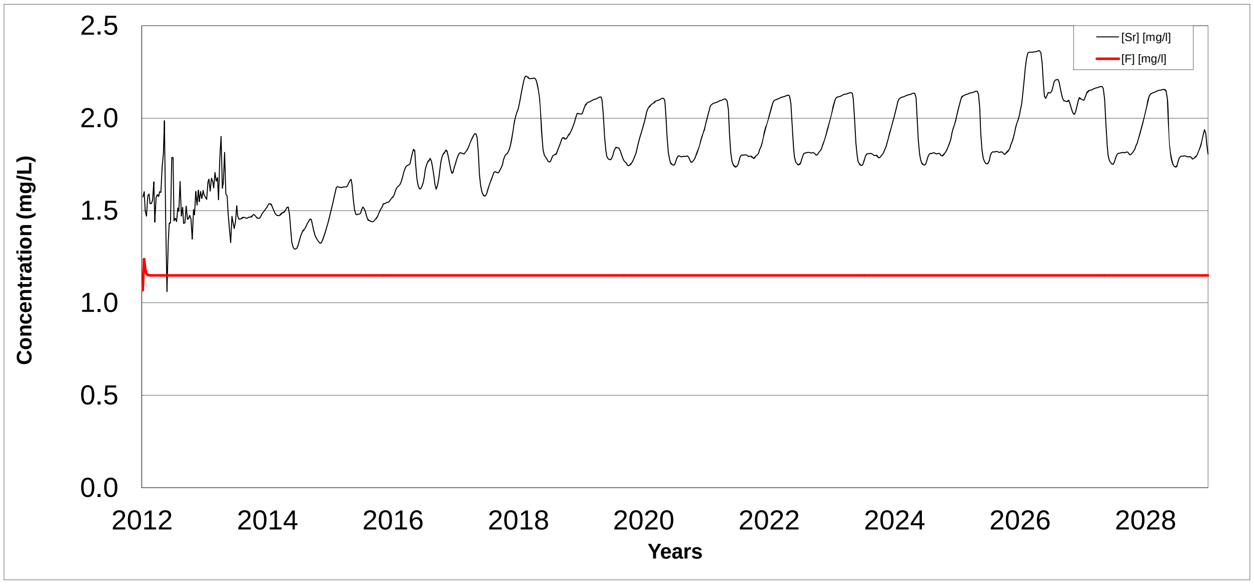
Date: December, 2013
Project: 12-1337-0001

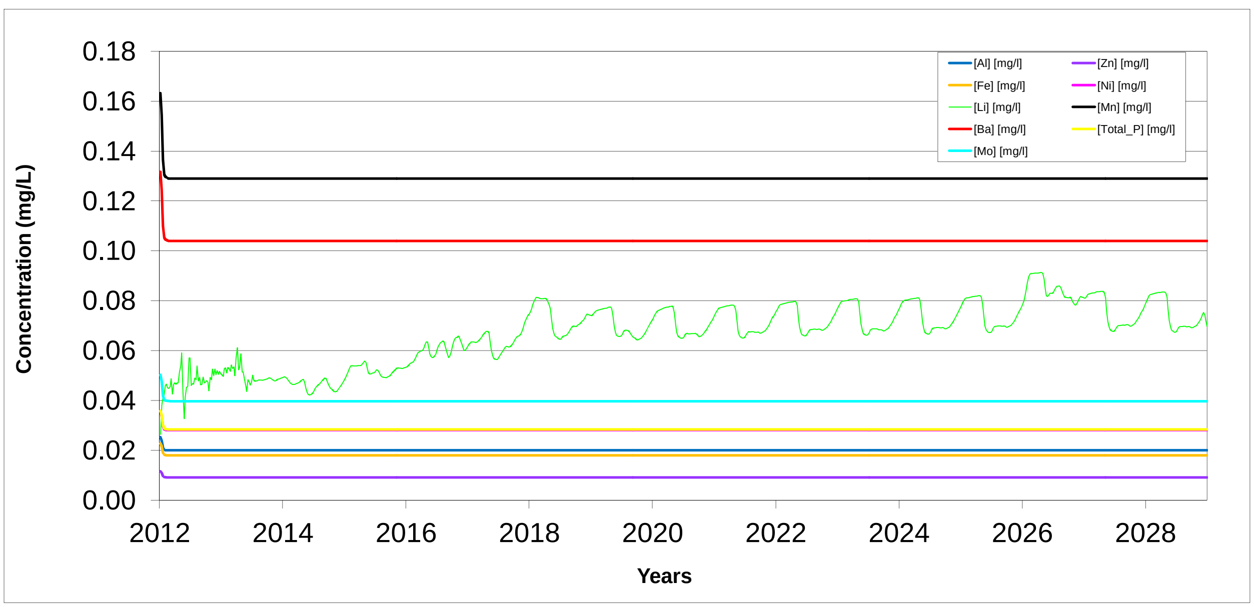
Drawn KAS
Chkd KJD

De Beers Canada Inc.

Process Water Dissolved Concentrations

FIGURE VII-3b





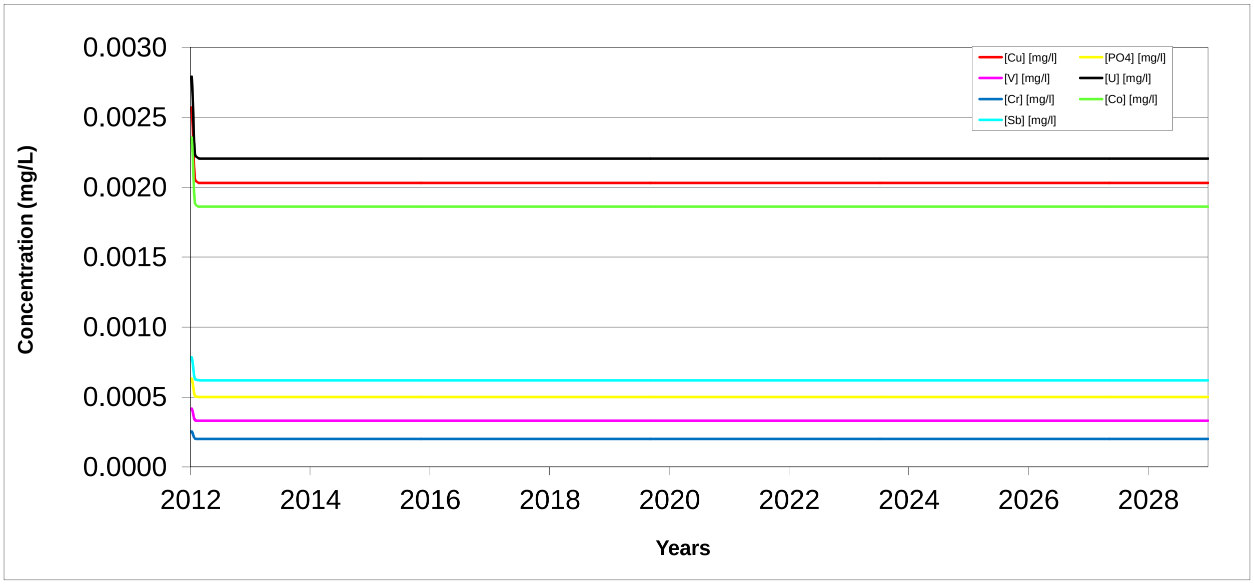
Date: December, 2013
Project: 12-1337-0001

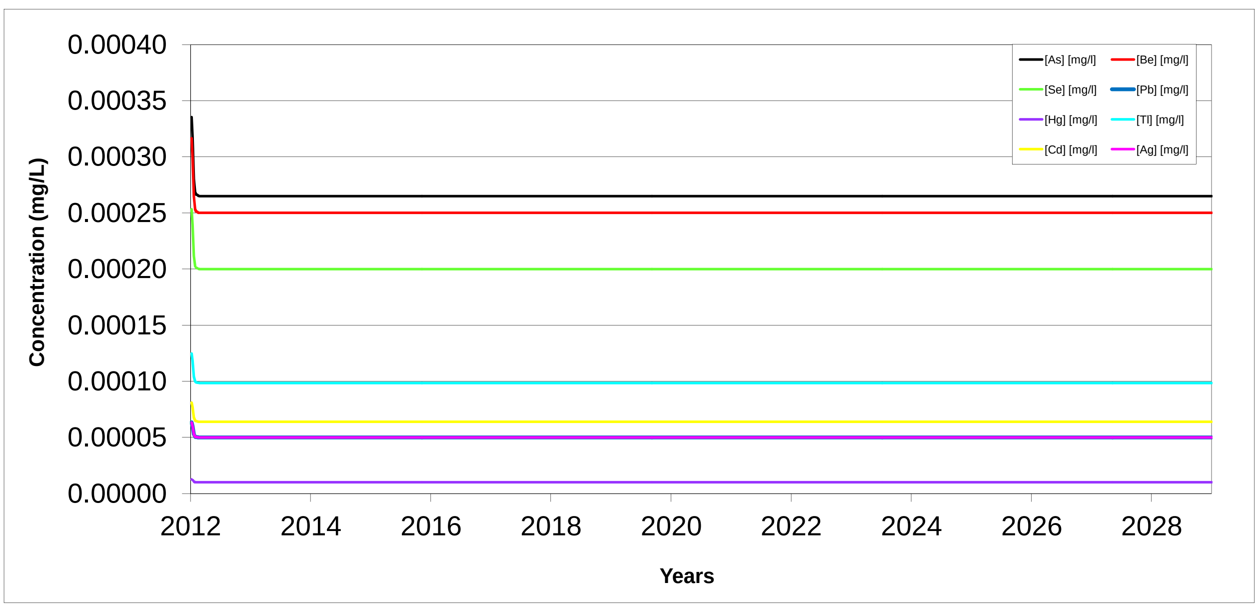
Drawn KAS
Chkd KJD

De Beers Canada Inc.

Process Water Dissolved Concentrations

FIGURE VII-3c





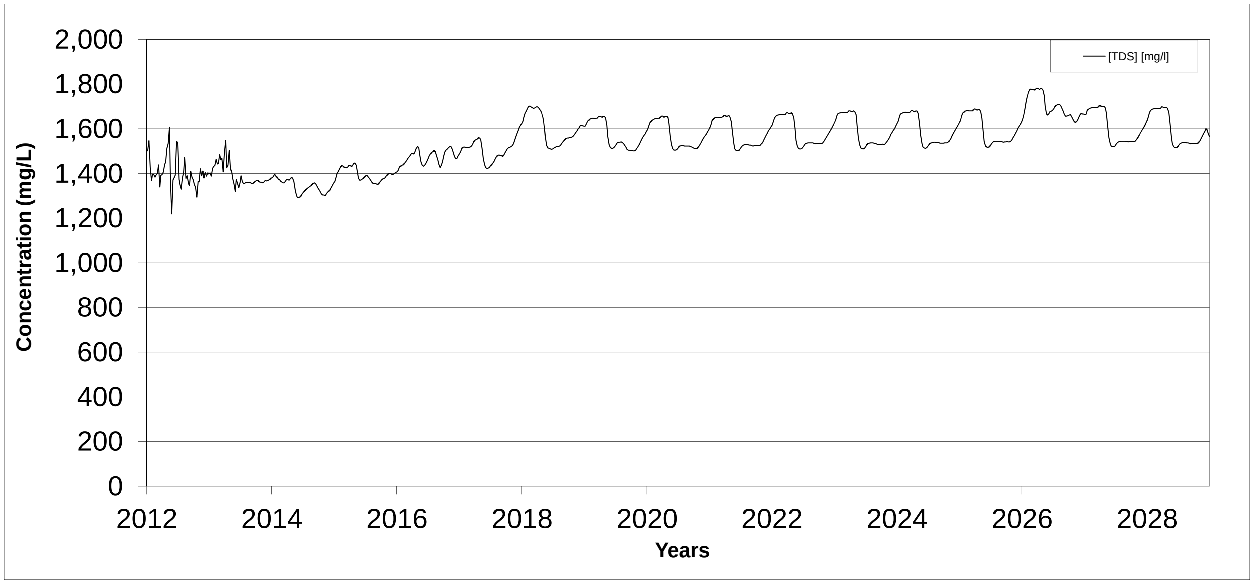
Date: December, 2013
Project: 12-1337-0001

Drawn KAS
Chkd KJD

De Beers Canada Inc.

Process Water Dissolved Concentrations

FIGURE VII-3d



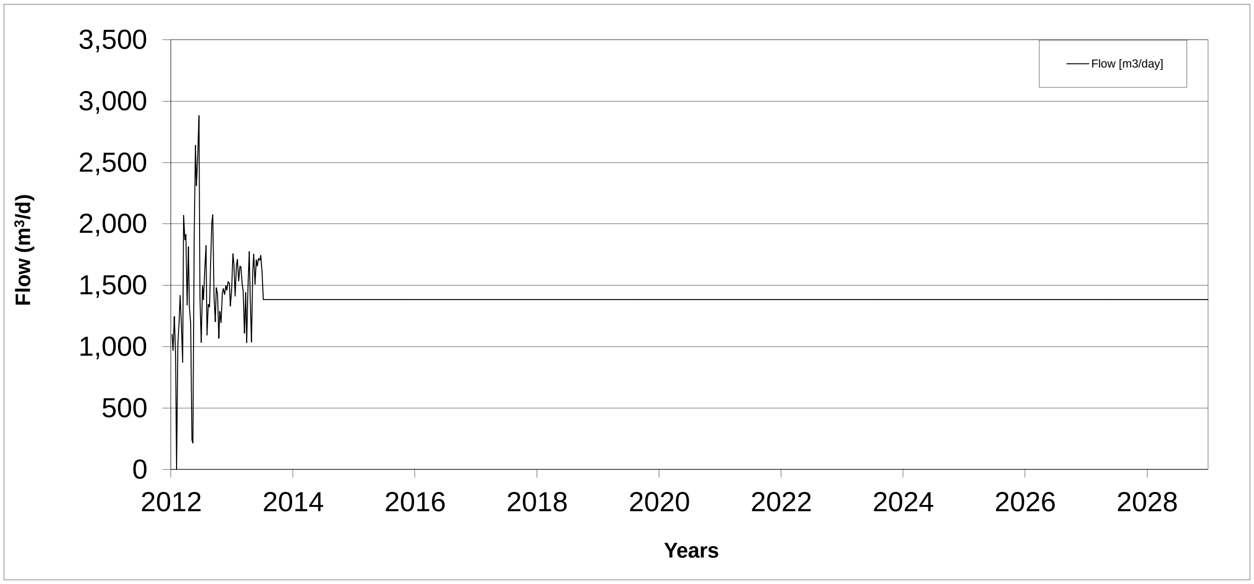
Date: December, 2013
Project: 12-1337-0001

Drawn KAS
Chkd KJD

De Beers Canada Inc.

Process Water Dissolved Concentrations

FIGURE VII-3e



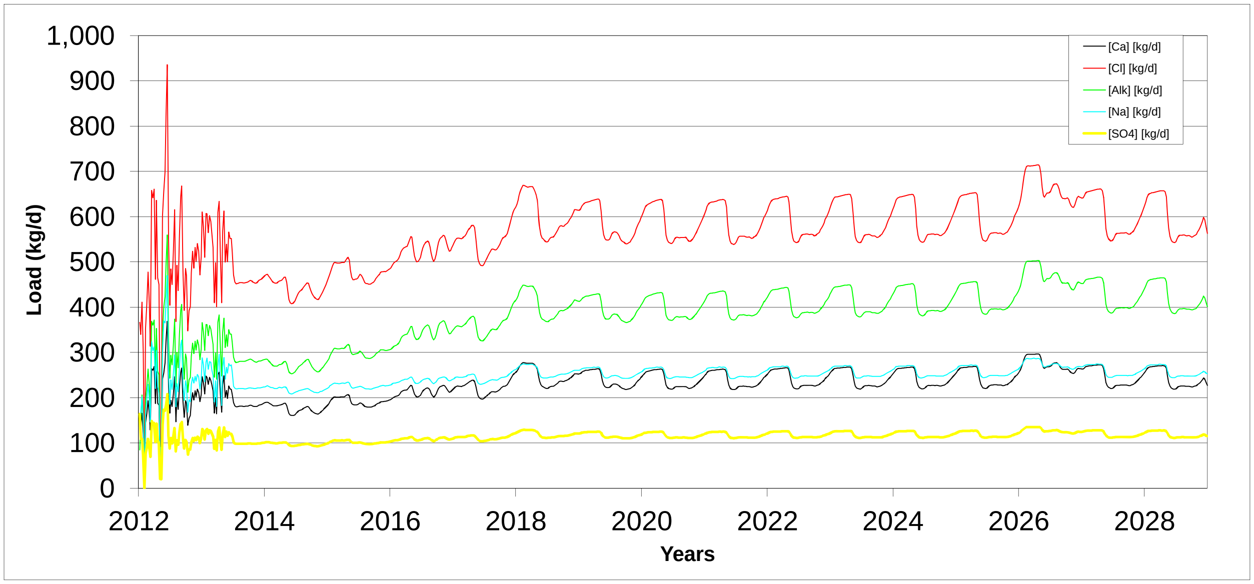
Date: December, 2013
Project: 12-1337-0001

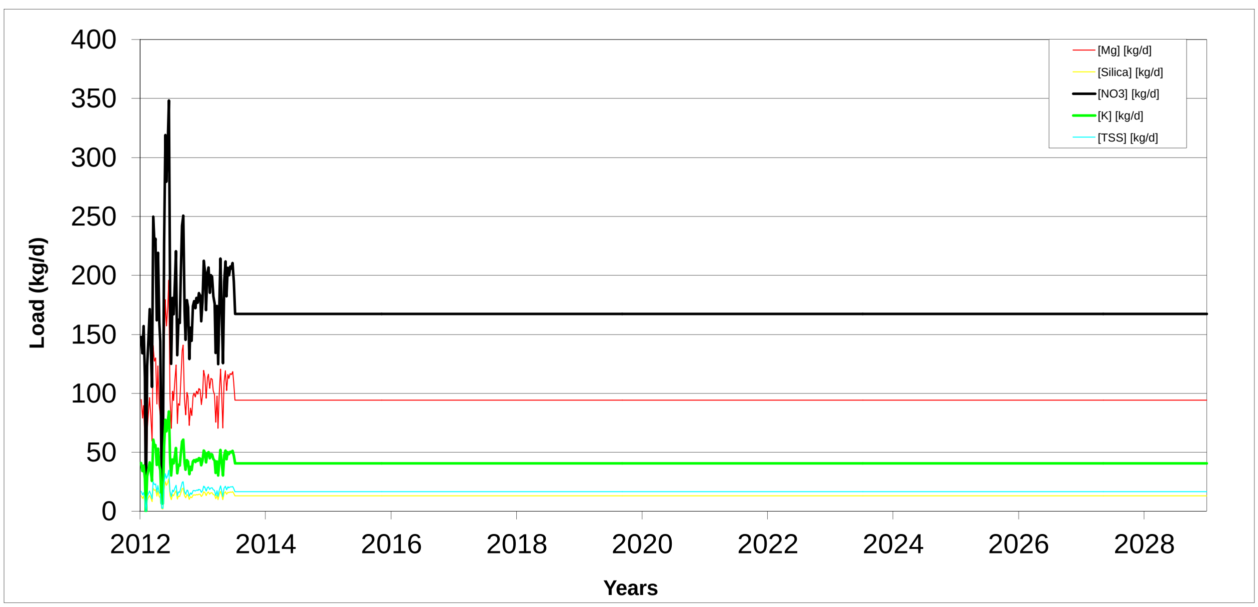
Drawn KAS
Chkd KJD

De Beers Canada Inc.

Process Water Dissolved Load

FIGURE VII-4a





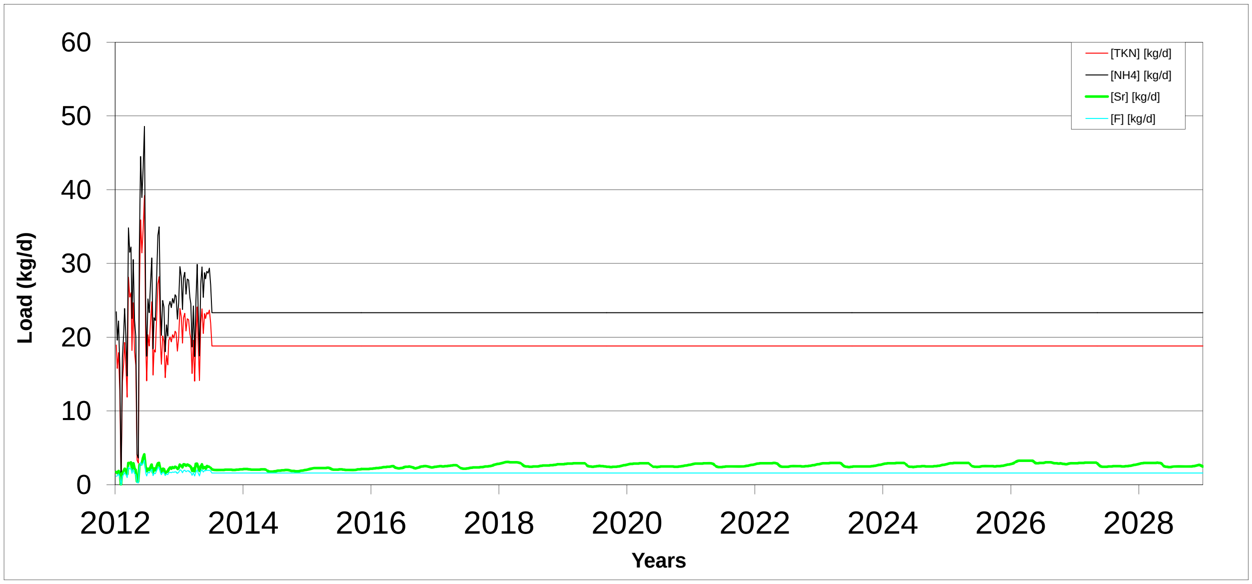
Date: December, 2013
Project: 12-1337-0001

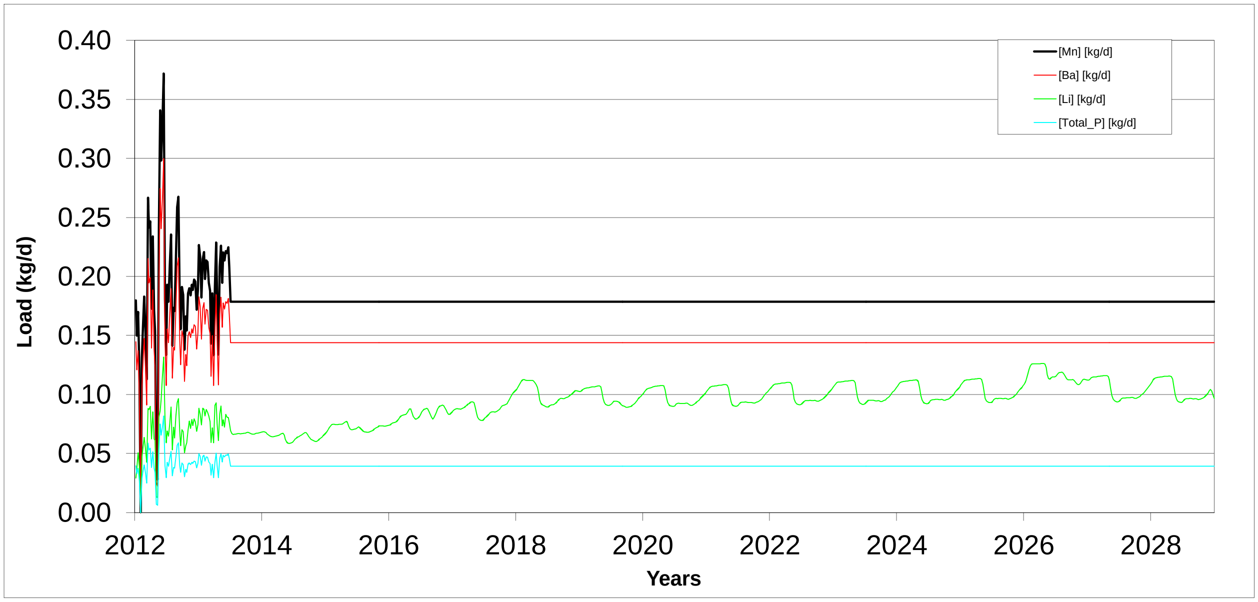
Drawn KAS
Chkd KJD

De Beers Canada Inc.

Process Water Dissolved Load

FIGURE VII-4b



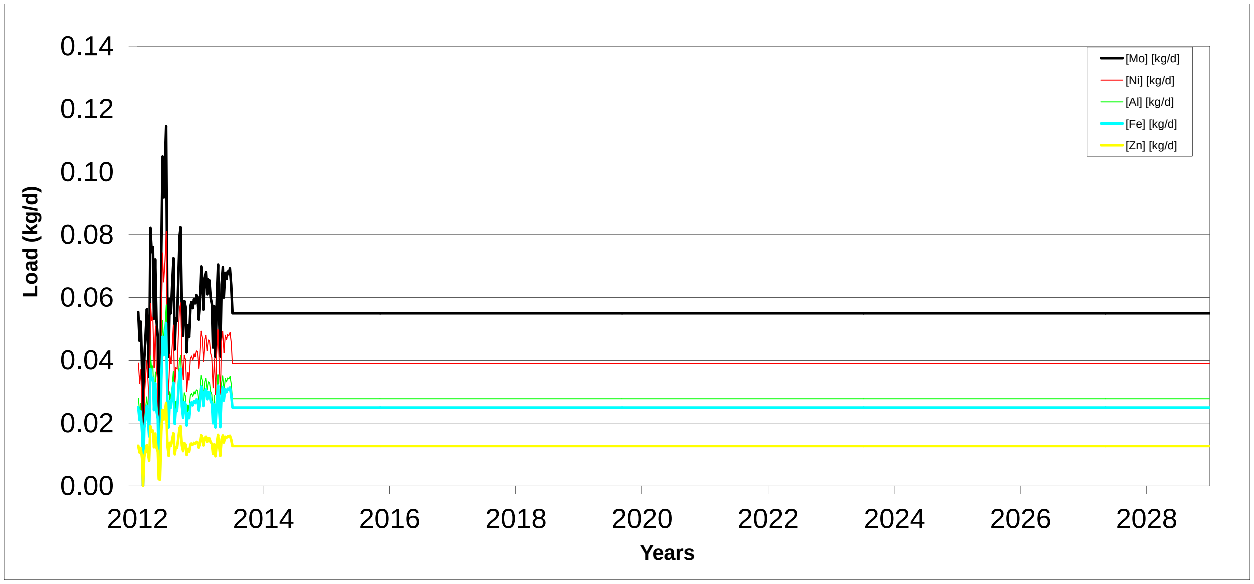


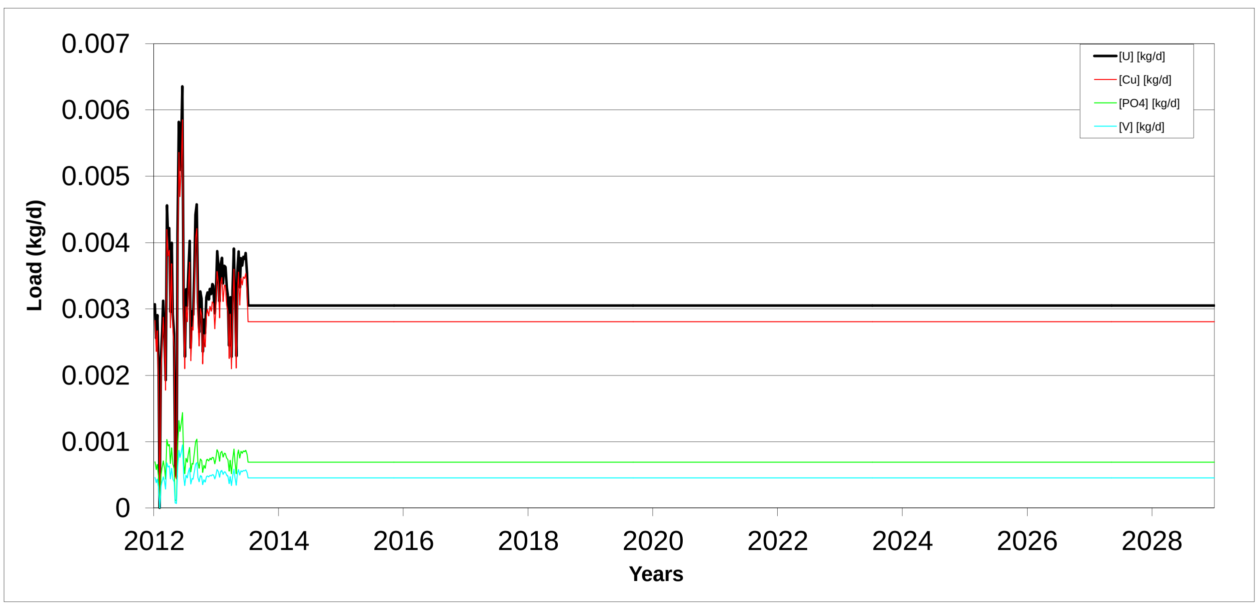
Date: December, 2013
Project: 12-1337-0001

Drawn KAS
Chkd KJD

De Beers Canada Inc.

Process Water Dissolved Load	FIGURE VII-4c



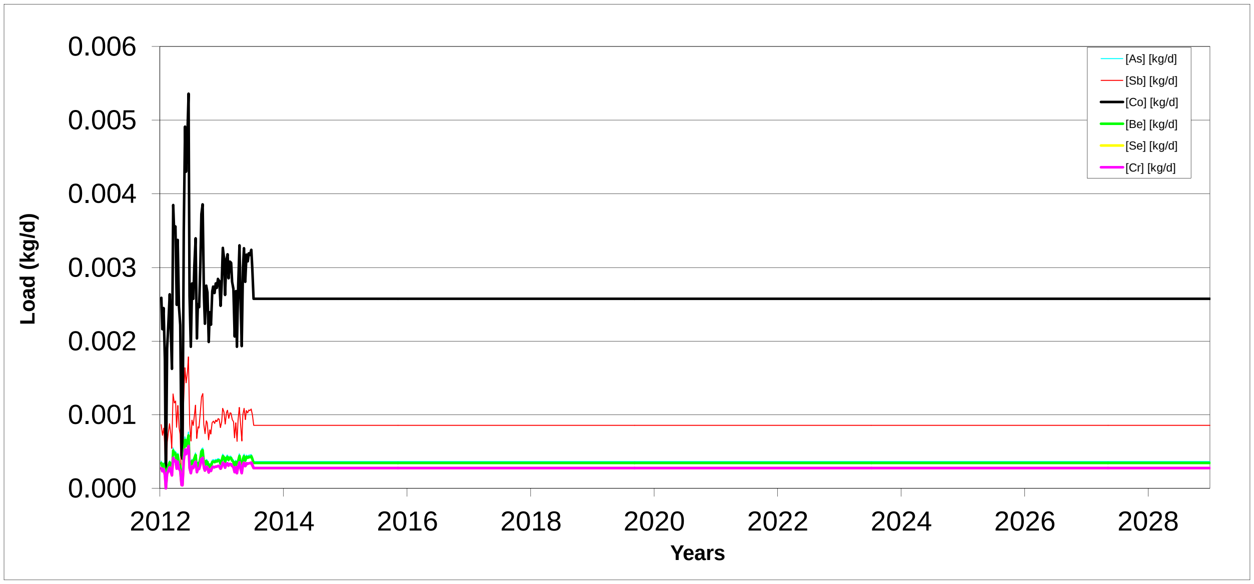


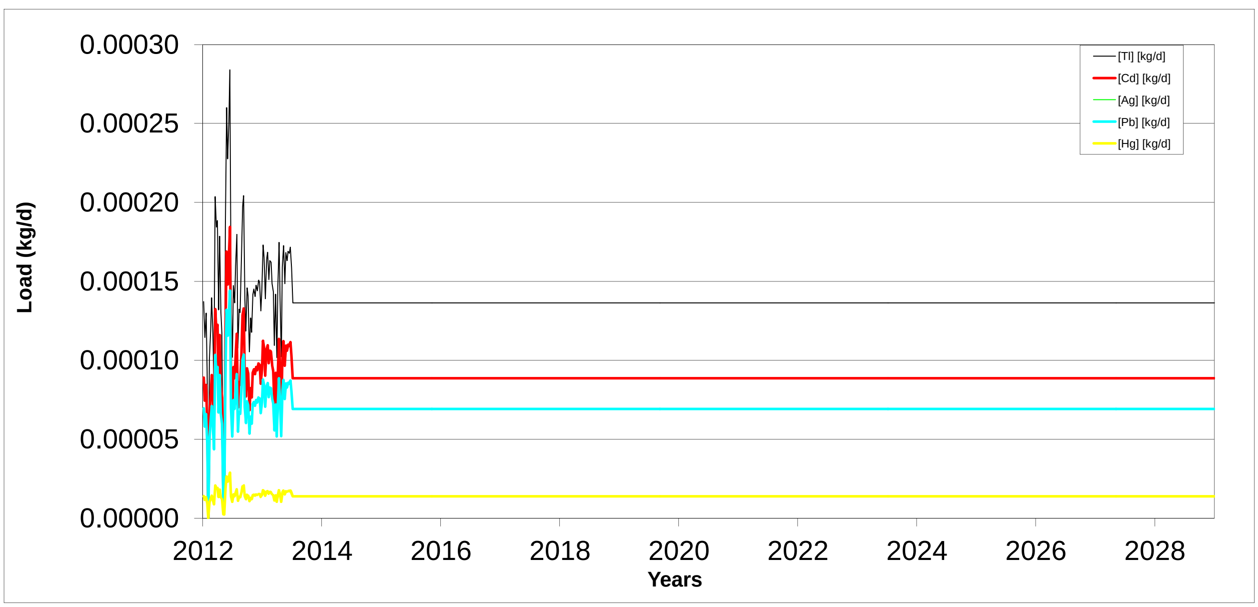
Date: December, 2013
Project: 12-1337-0001

Drawn KAS
Chkd KJD

De Beers Canada Inc.

Process Water Dissolved Load	FIGURE VII-4d



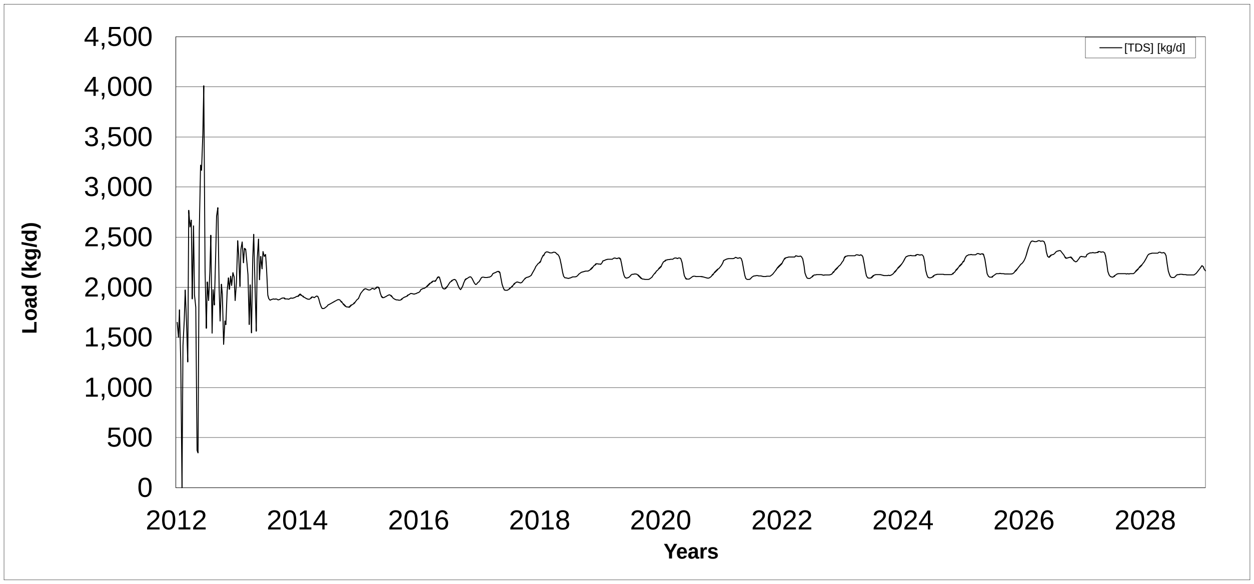


Date: December, 2013
Project: 12-1337-0001

Drawn KAS
Chkd KJD

De Beers Canada Inc.

Process Water Dissolved Load	FIGURE VII-4e

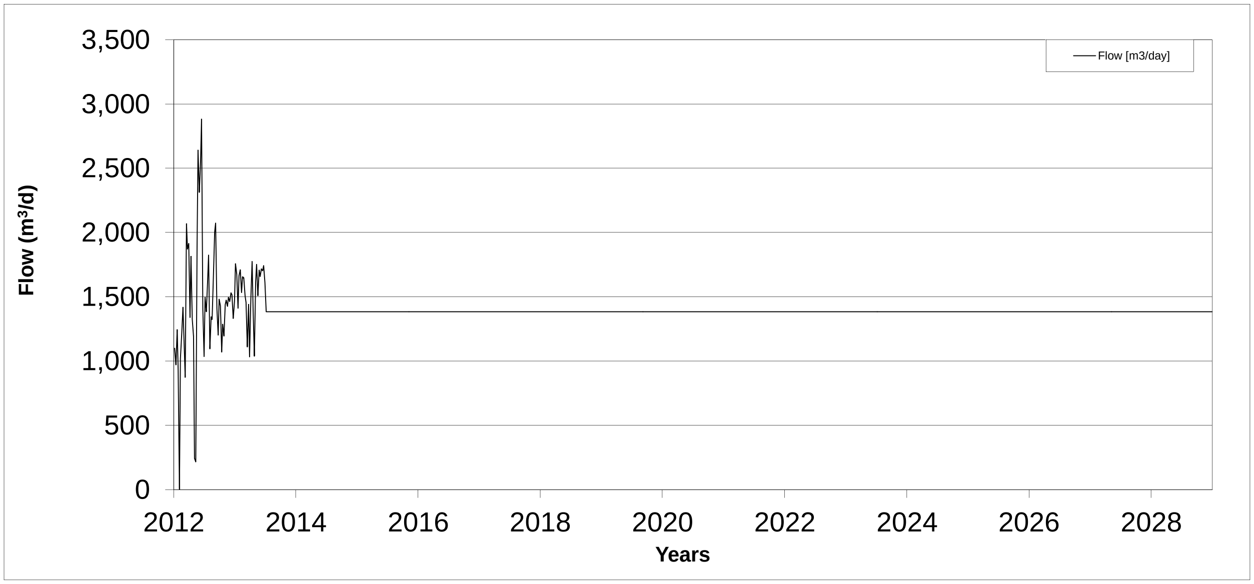


Date: December, 2013
Project: 12-1337-0001

Drawn KAS
Chkd KJD

De Beers Canada Inc.

Process Water Dissolved Load FLOW	FIGURE VII-4f



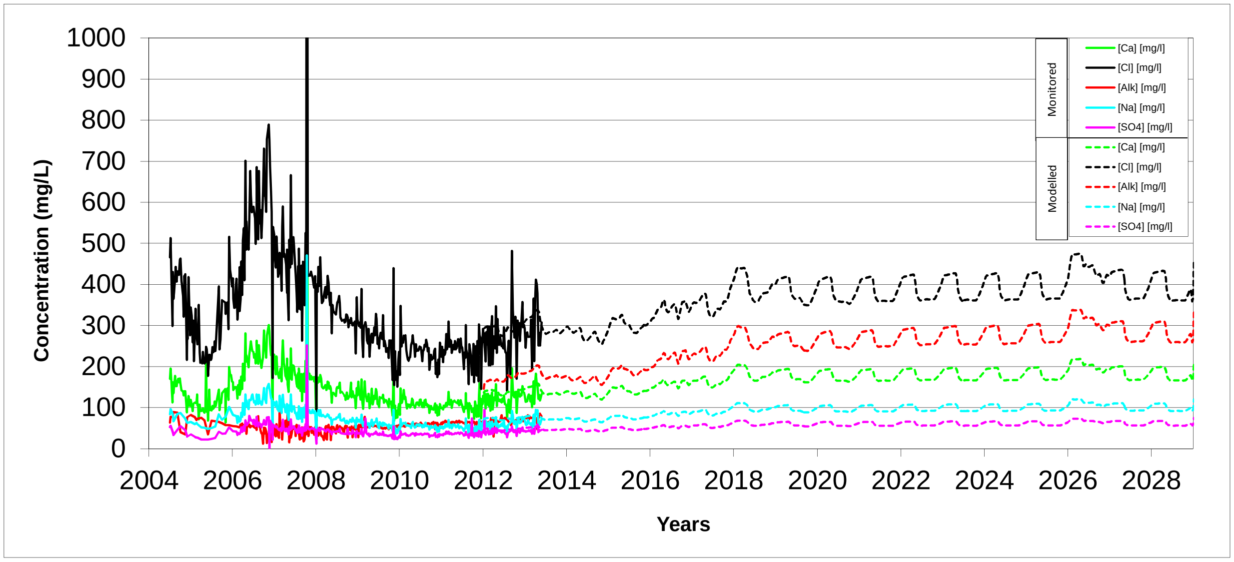
Date: December, 2013
Project: 12-1337-0001

Drawn KAS
Chkd KJD

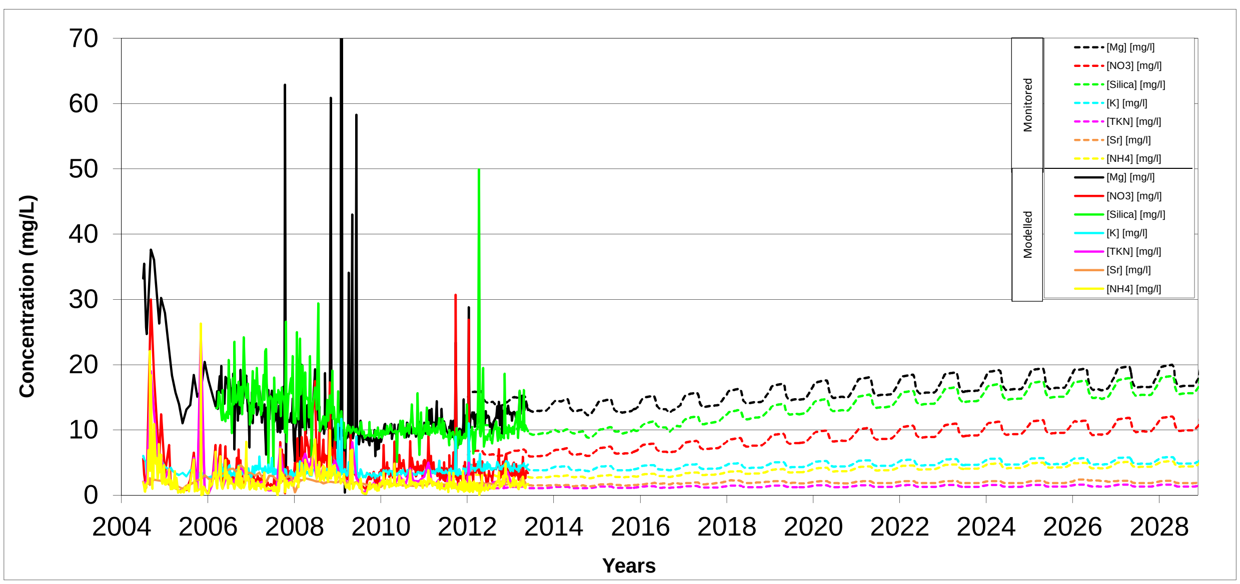
De Beers Canada Inc.

Mine Water (SNP 02-01) Dissolved Concentrations

FIGURE VII-5a



Note: Monitoring values above 1000 mg/L are not shown.



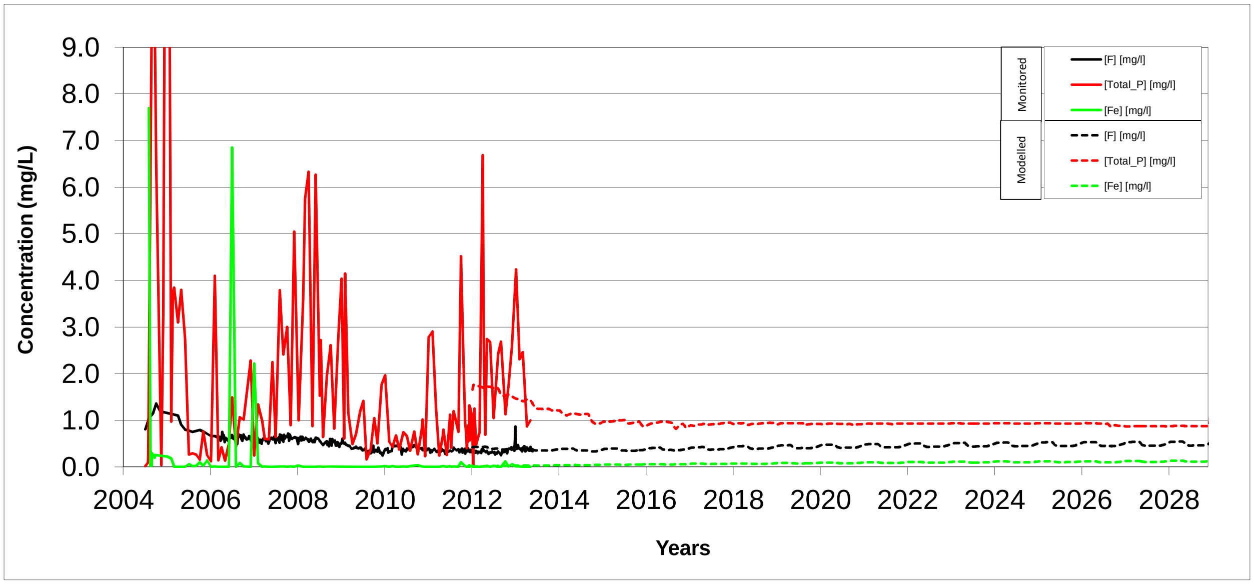
Note: Monitoring values above 70 mg/L are not shown.

Date: December, 2013
Project: 12-1337-0001

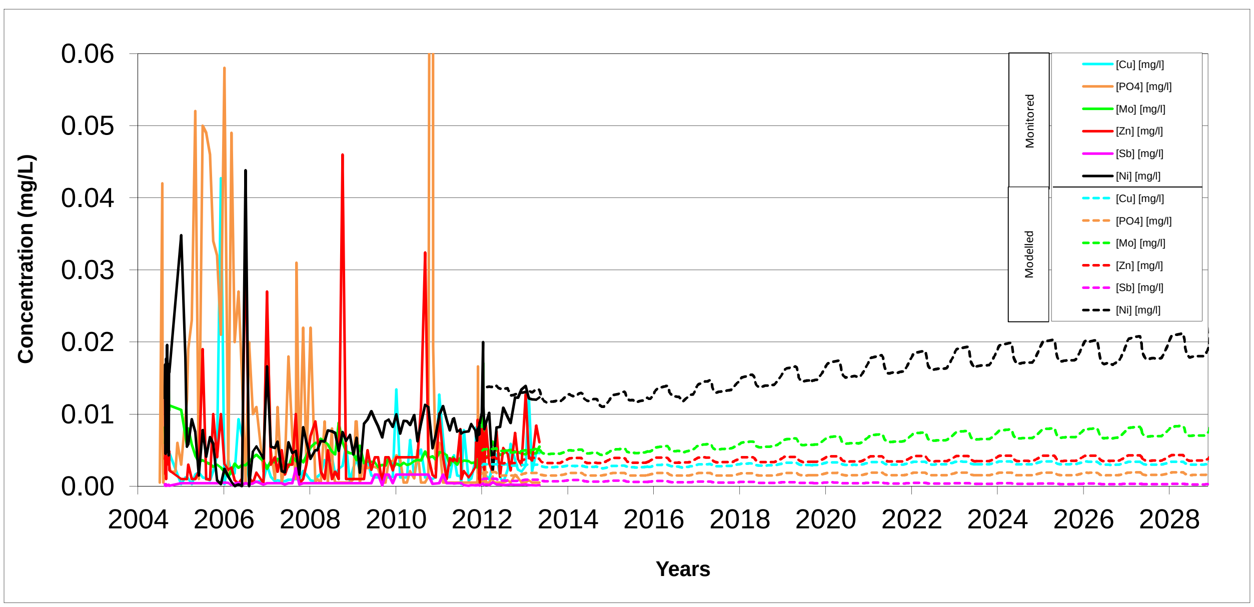
Drawn KAS
Chkd KJD

De Beers Canada Inc.

Mine Water (SNP 02-01) Dissolved Concentrations	FIGURE VII-5b



Note: Monitored values above 9.0 mg/L are not shown.



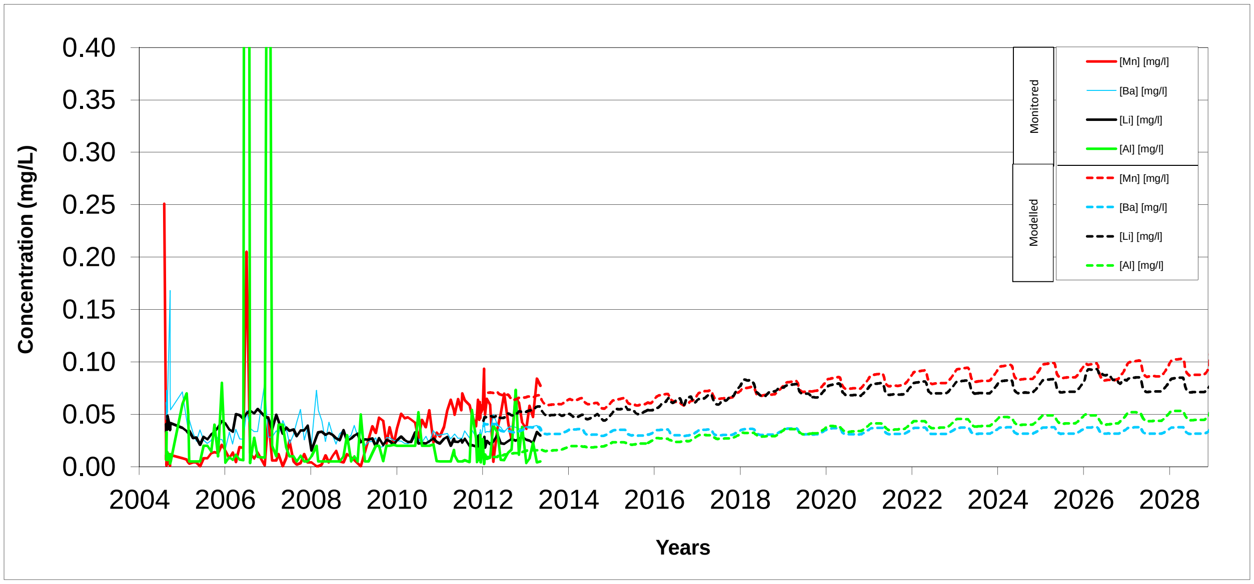
Note: Monitoring values above 0.06 mg/L are not shown.

Date: December, 2013
Project: 12-1337-0001

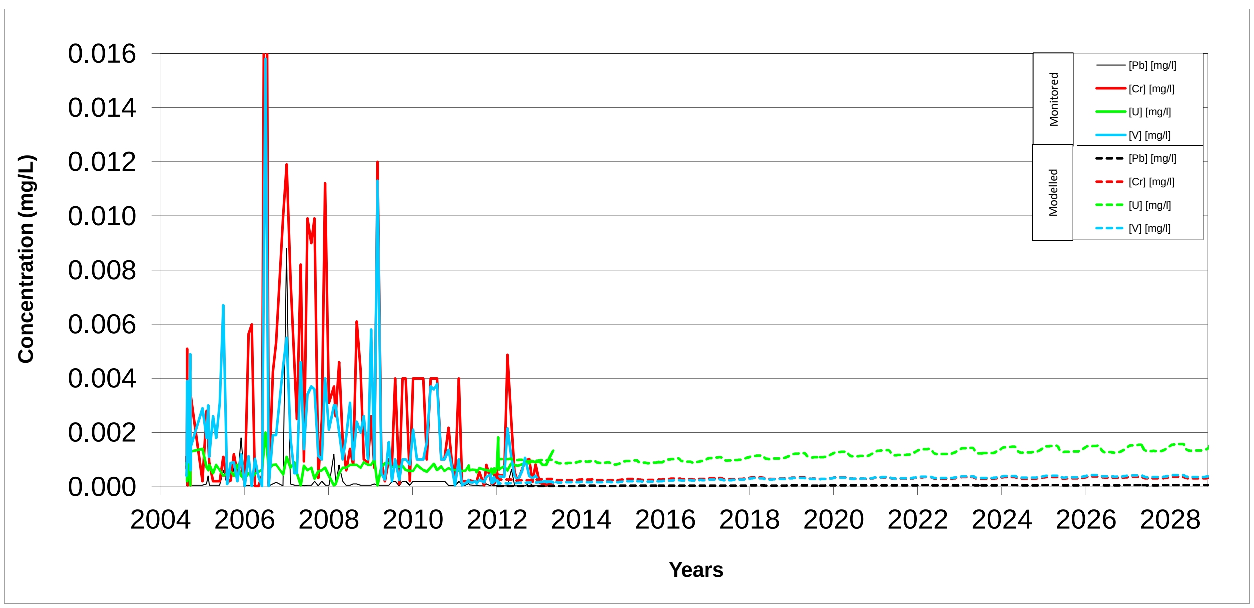
Drawn KAS
Chkd KJD

De Beers Canada Inc.

Mine Water (SNP 02-01) Dissolved Concentrations	FIGURE VII-5c



Note: Monitored values above 0.40 mg/L are not shown.



Note: Monitored values above 0.016 mg/L are not shown.

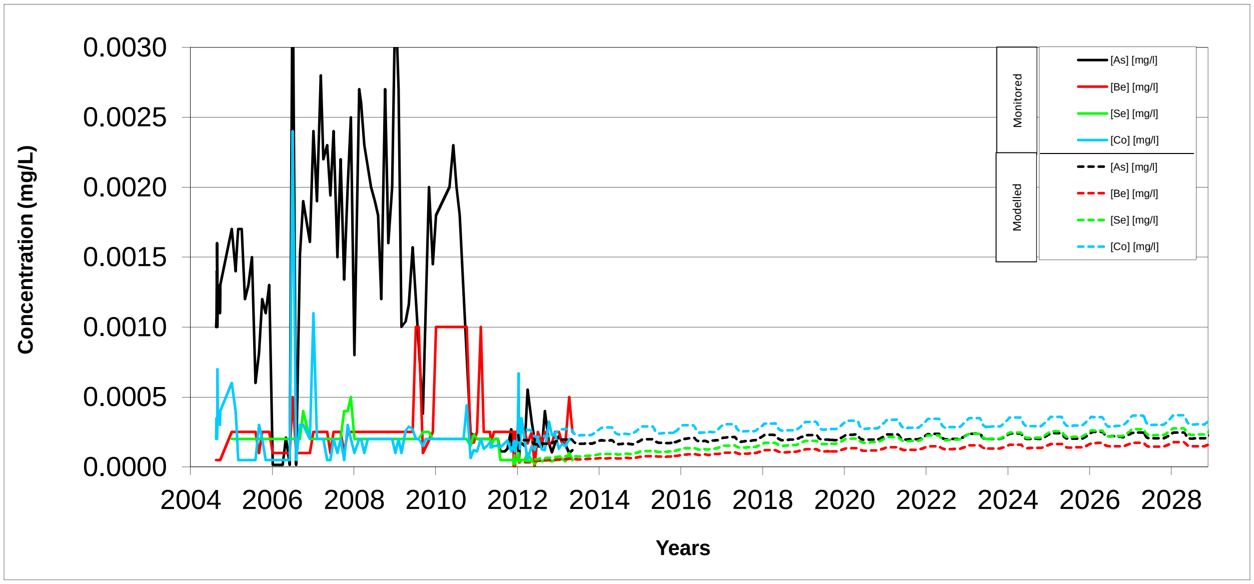
Date: December, 2013
Project: 12-1337-0001

Drawn KAS
Chkd KJD

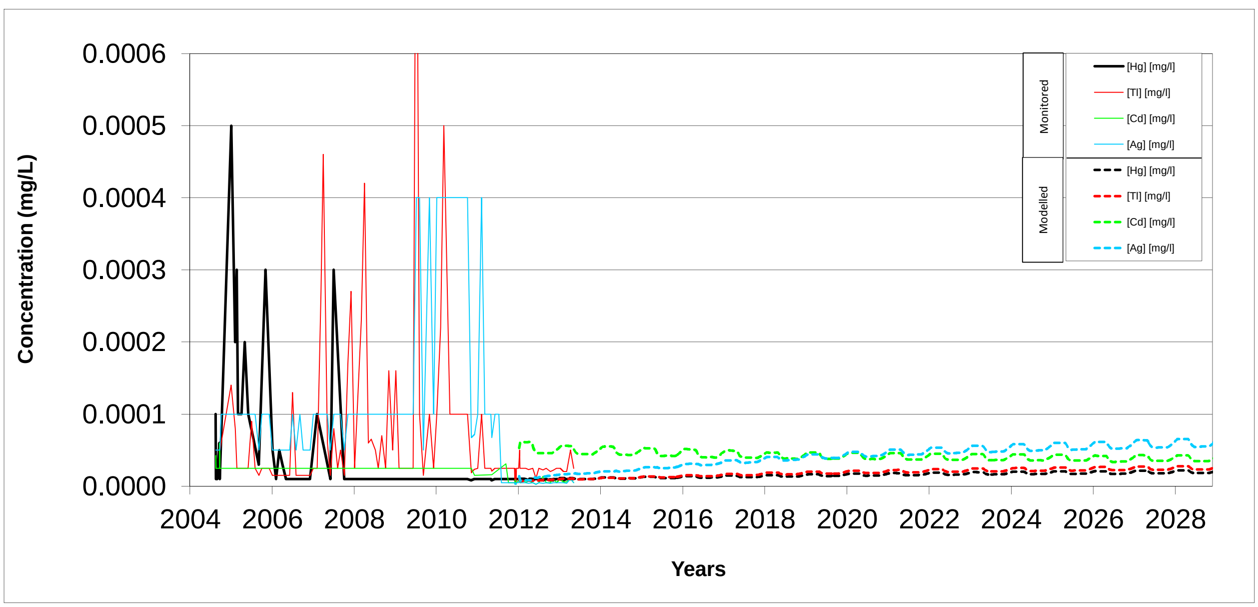
De Beers Canada Inc.

Mine Water (SNP 02-01) Dissolved Concentrations

FIGURE VII-5d



Note: Monitored values above 0.0030 mg/L are not shown.



Note: Monitored values above 0.0006 mg/L are not shown.

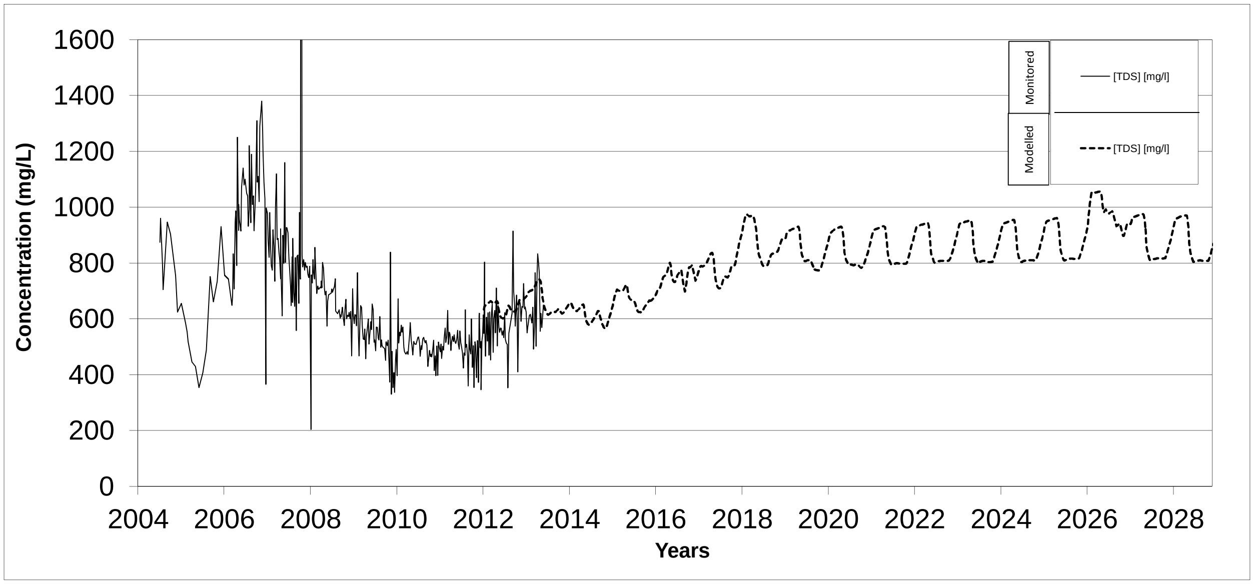
Date: December, 2013
Project: 12-1337-0001

Drawn KAS
Chkd KJD

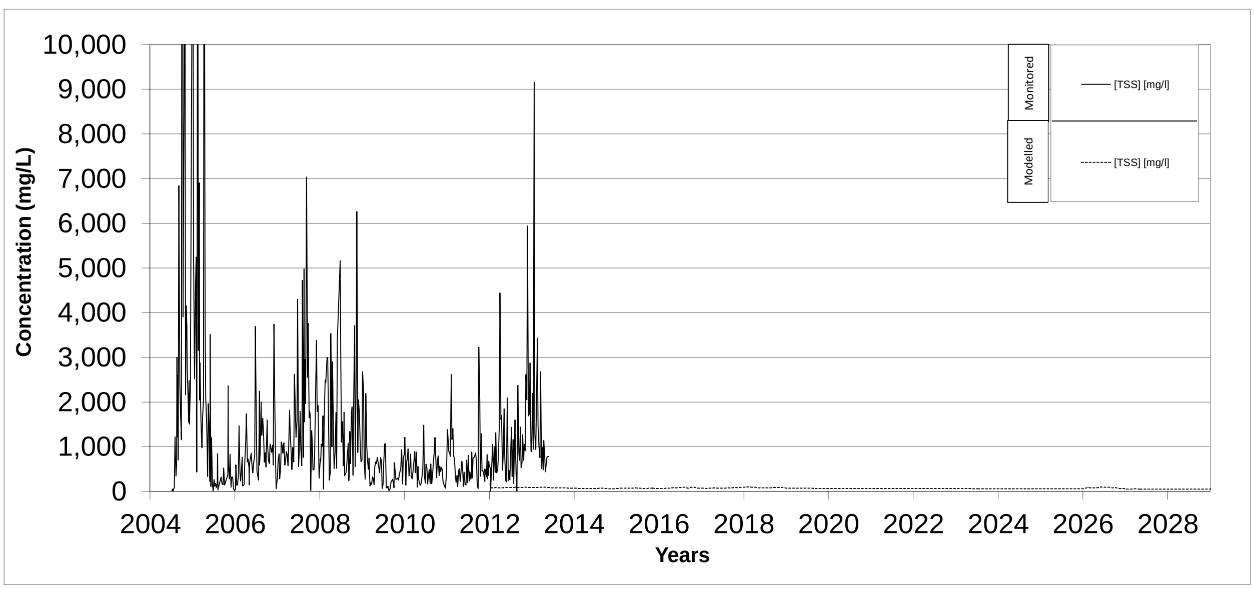
De Beers Canada Inc.

Mine Water (SNP 02-01) Dissolved Concentrations

FIGURE VII-5e



Note: Monitored values above 1600 mg/L are not shown.



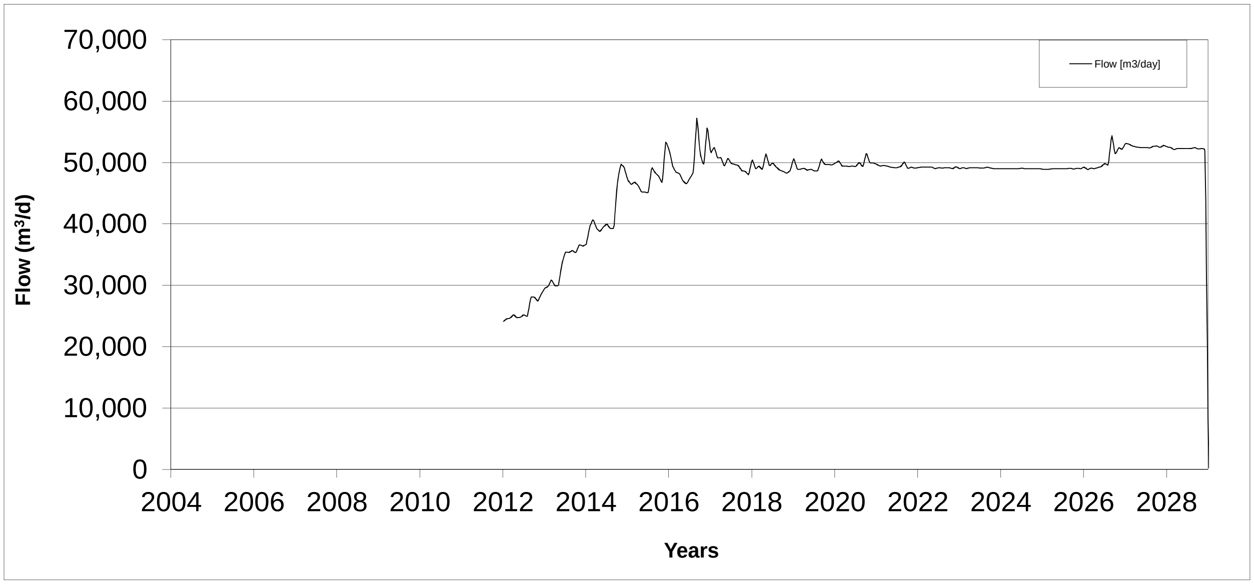
Note: Monitored values above 10,000 mg/L are not shown.

Date: December, 2013
Project: 12-1337-0001

Drawn KAS
Chkd KJD

De Beers Canada Inc.

Mine Water (SNP 02-01) Dissolved Concentrations	FIGURE VII-5f

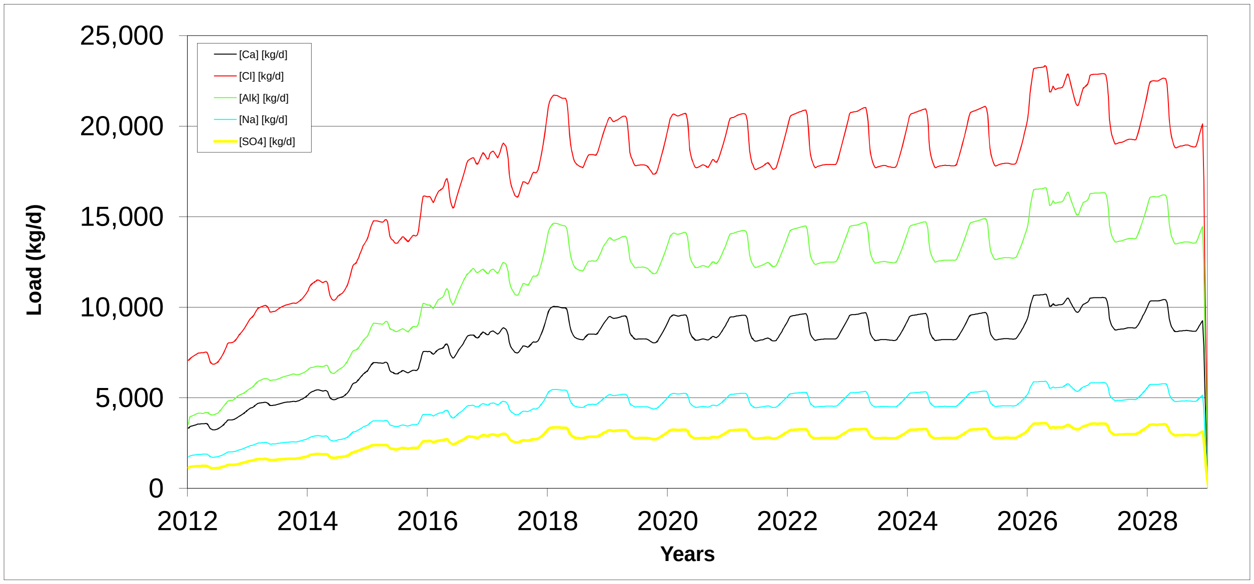


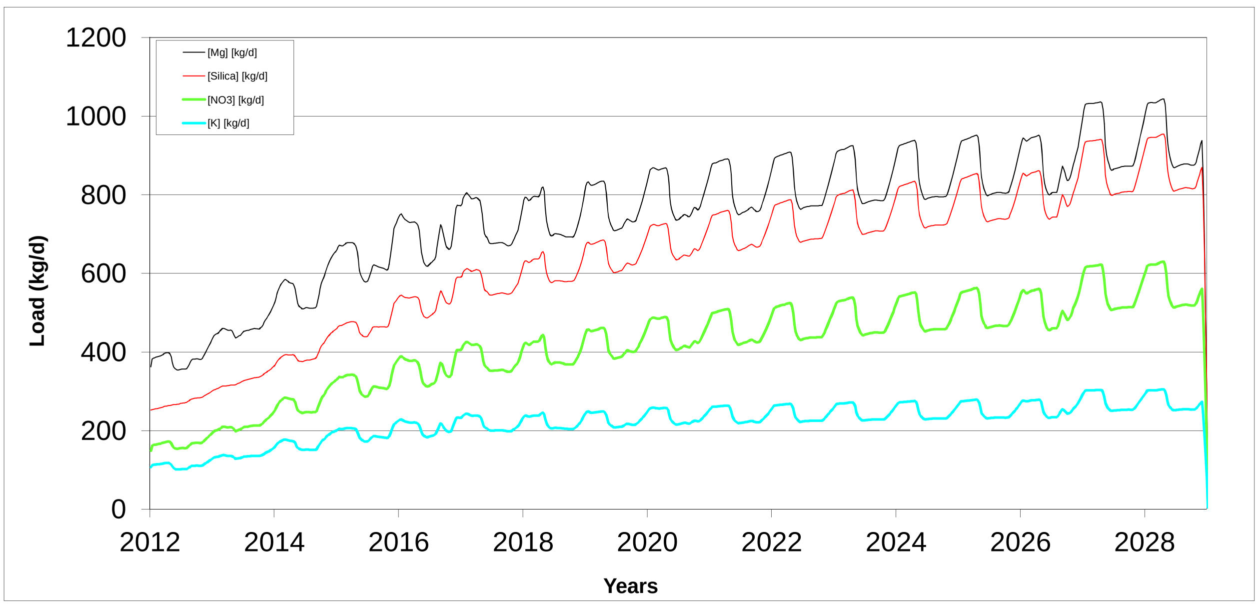
Date: December, 2013
Project: 12-1337-0001

Drawn KAS
Chkd KJD

De Beers Canada Inc.

Mine Water (SNP 02-01) Dissolved Load	FIGURE VII-6a



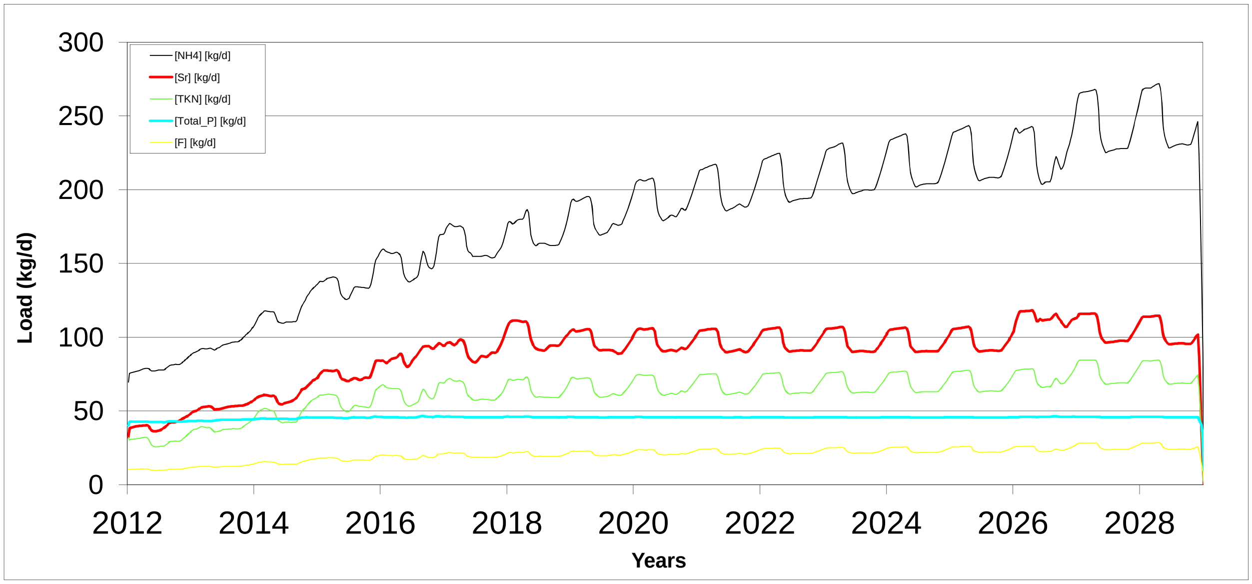


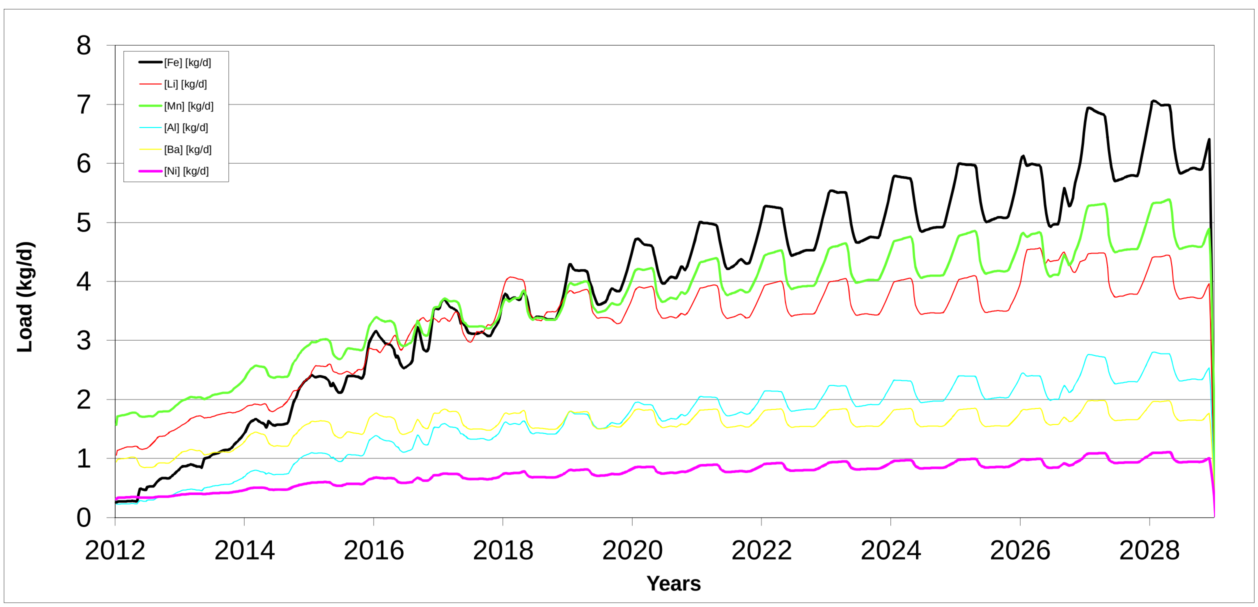
Date: December, 2013
Project: 12-1337-0001

Drawn KAS
Chkd KJD

De Beers Canada Inc.

Mine Water (SNP 02-01) Dissolved Load	FIGURE VII-6b



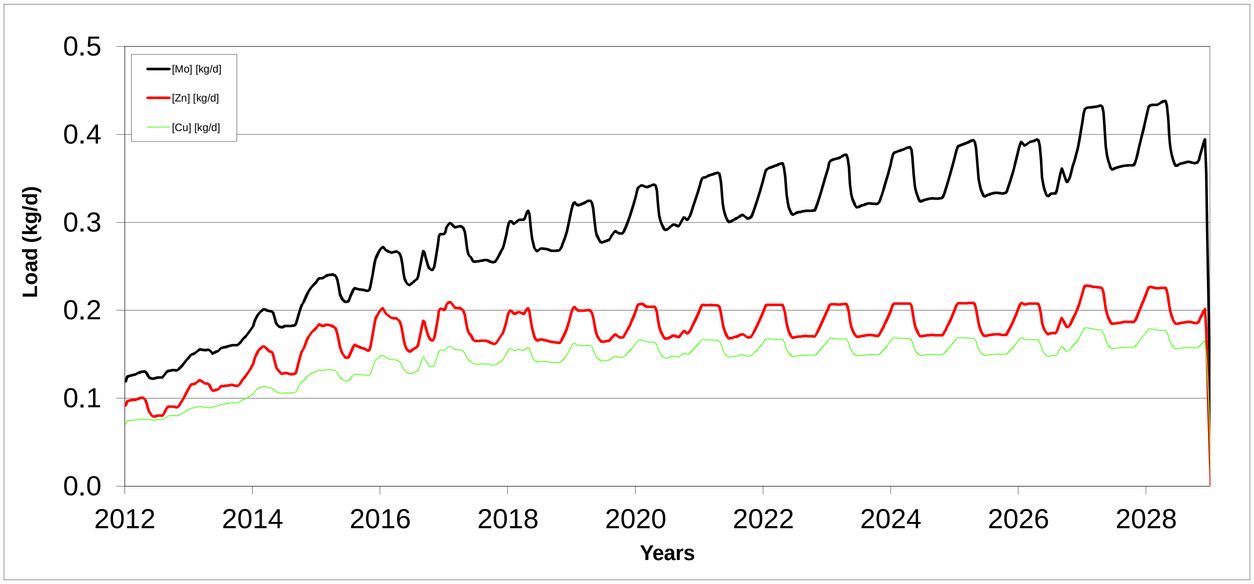


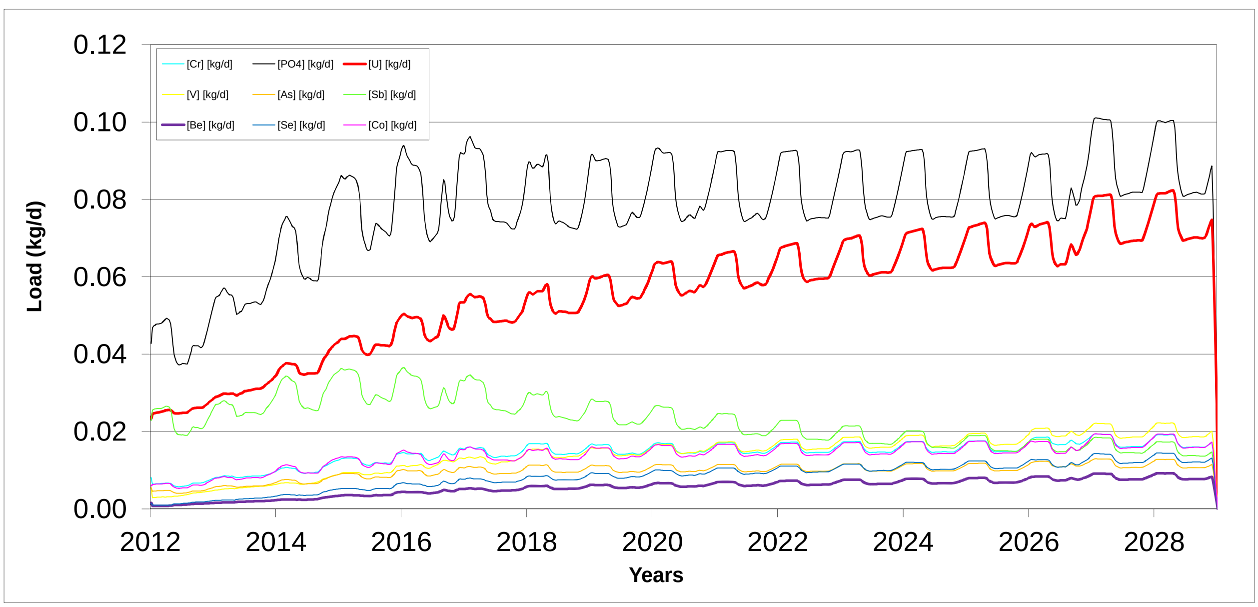
Date: December, 2013
Project: 12-1337-0001

Drawn KAS
Chkd KJD

De Beers Canada Inc.

Mine Water (SNP 02-01) Dissolved Load	FIGURE VII-6c





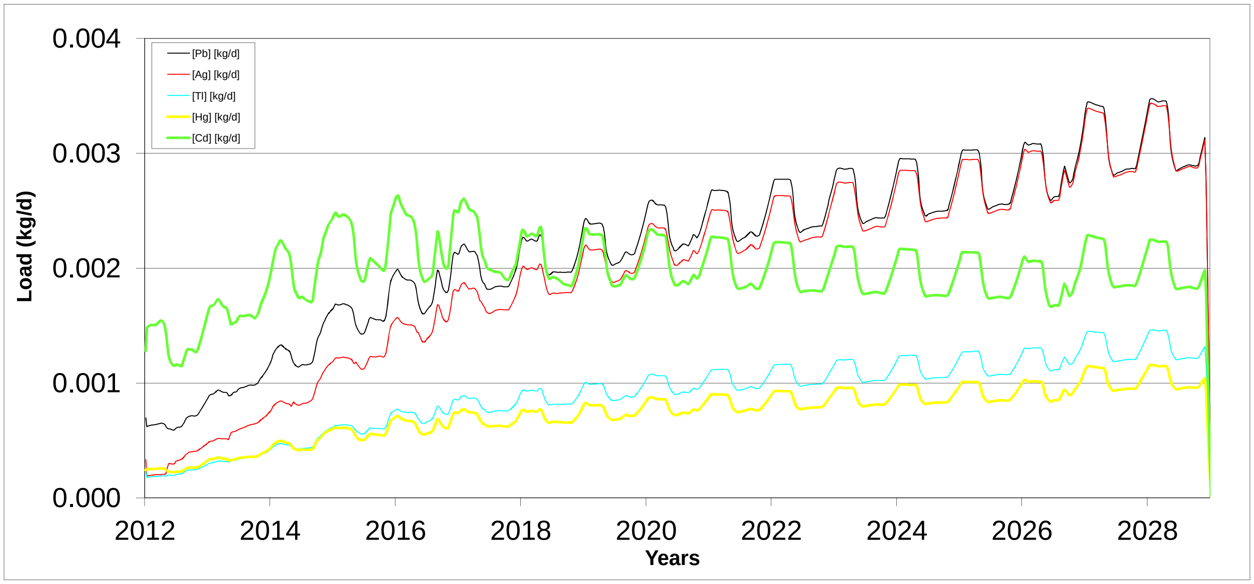
Date: December, 2013
Project: 12-1337-0001

Drawn KAS
Chkd KJD

De Beers Canada Inc.

Mine Water (SNP 02-01) Dissolved Load

FIGURE VII-6d

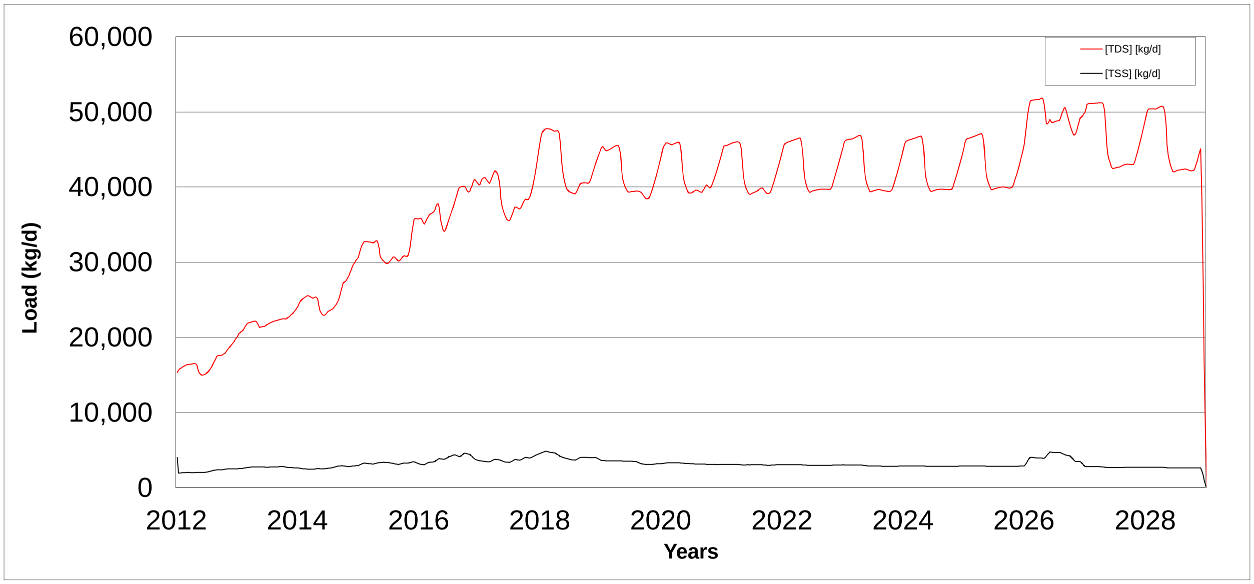


Date: December, 2013
Project: 12-1337-0001

Drawn KAS
Chkd KJD

De Beers Canada Inc.

Mine Water (SNP 02-01) Dissolved Load	FIGURE VII-6e

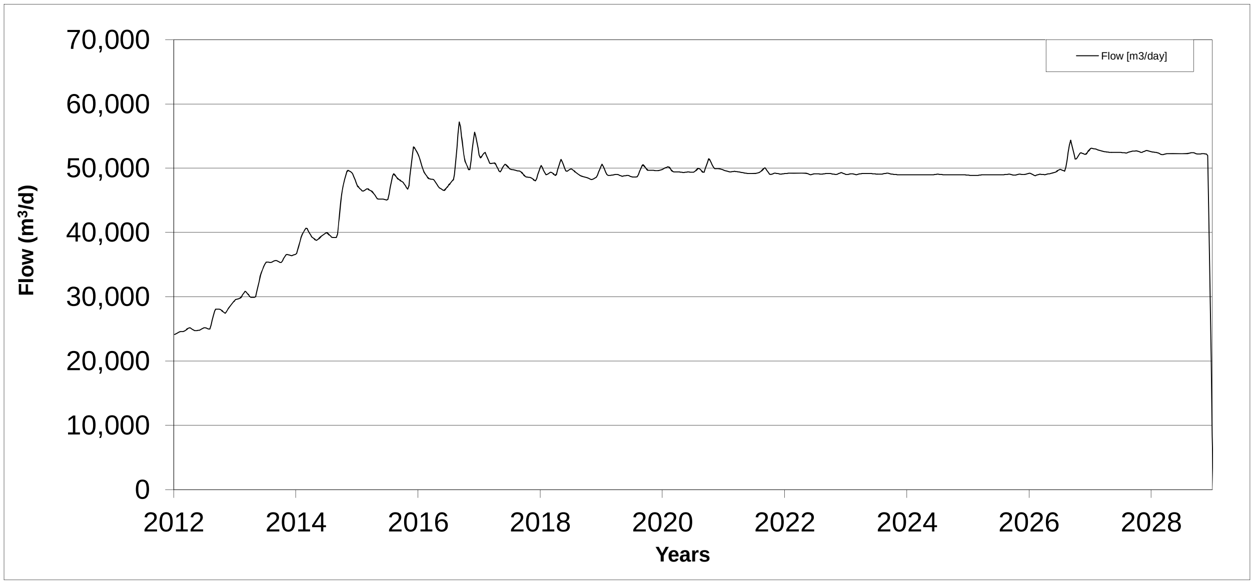


Date: December, 2013
Project: 12-1337-0001

Drawn KAS
Chkd KJD

De Beers Canada Inc.

Mine Water (SNP 02-01) Dissolved Load FLOW	FIGURE VII-6f



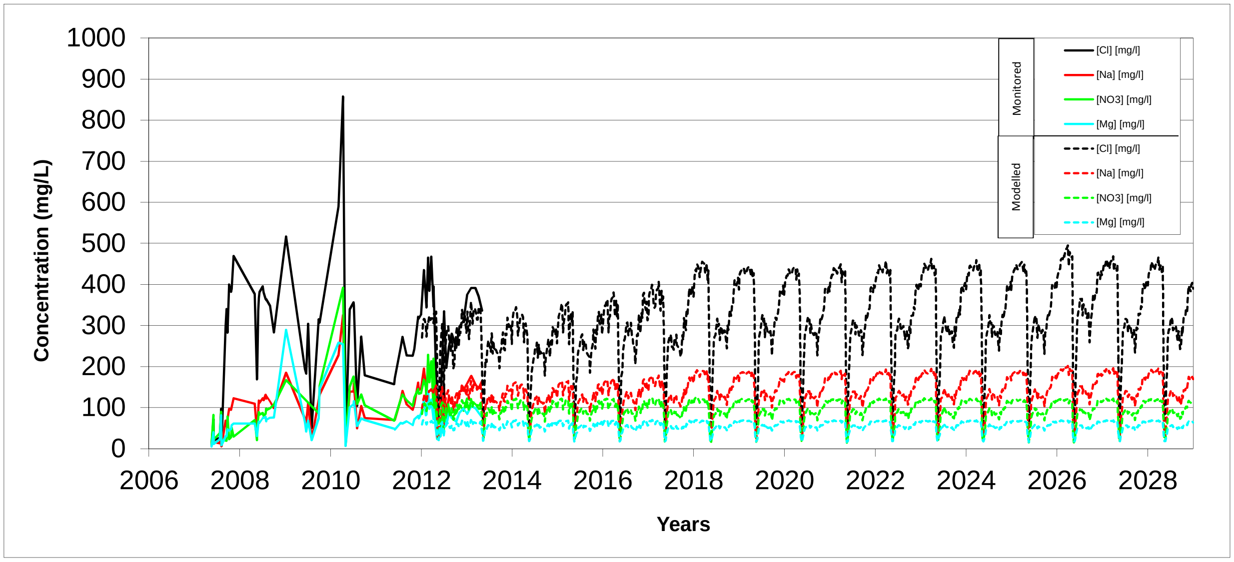
Date: December, 2013
Project: 12-1337-0001

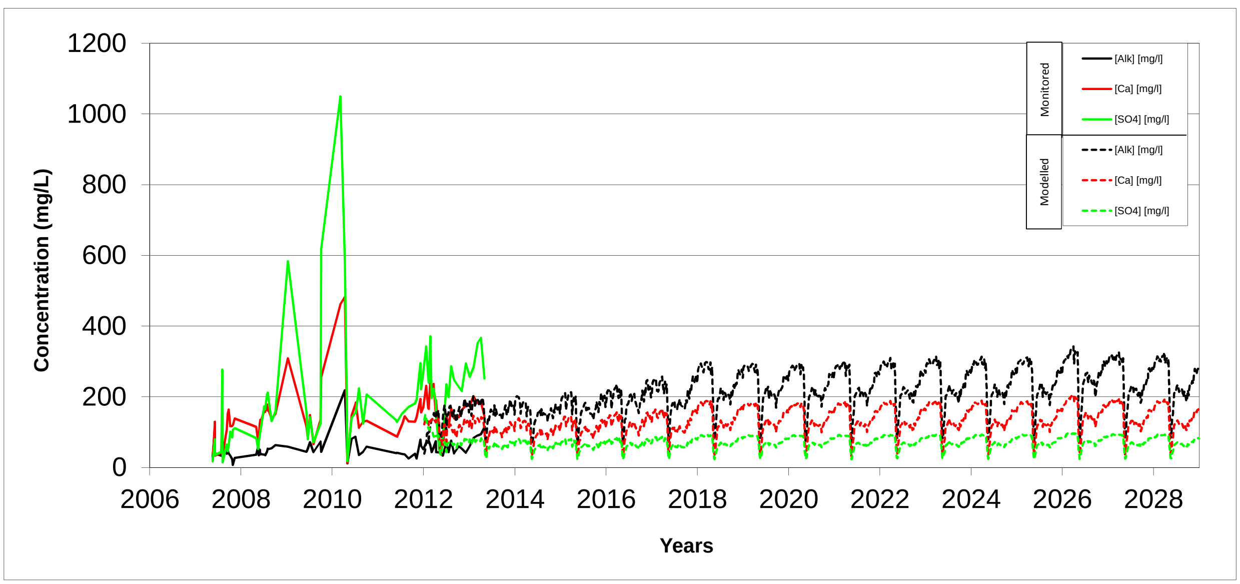
Drawn KAS
Chkd KJD

De Beers Canada Inc.

North Pile Discharge (SNP 02-02) Dissolved Concentrations

FIGURE VII-7a



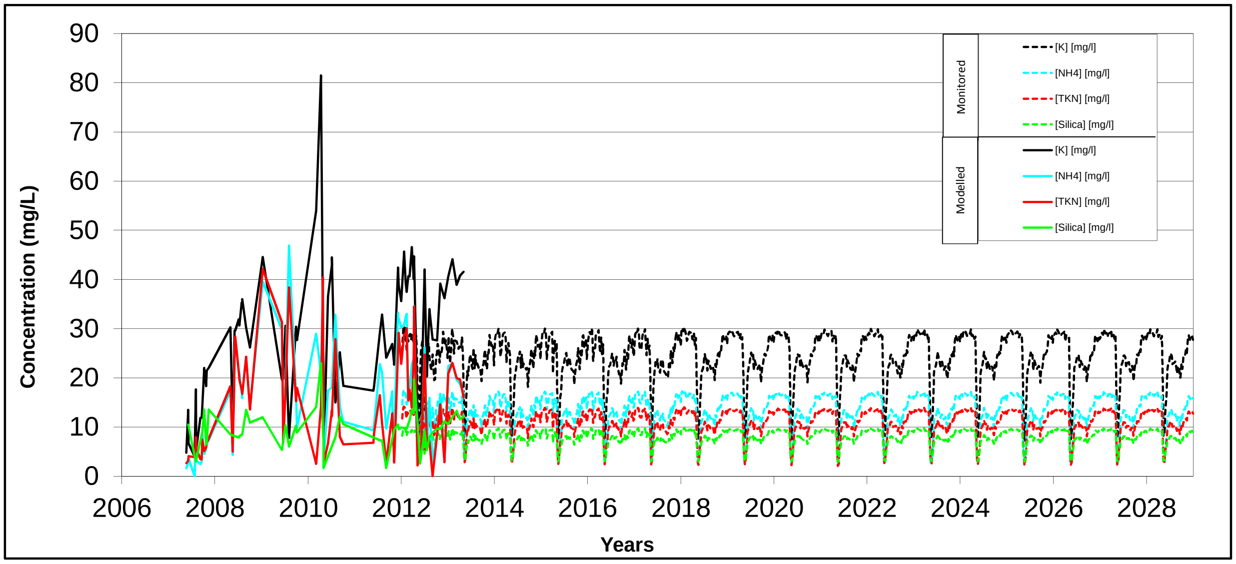


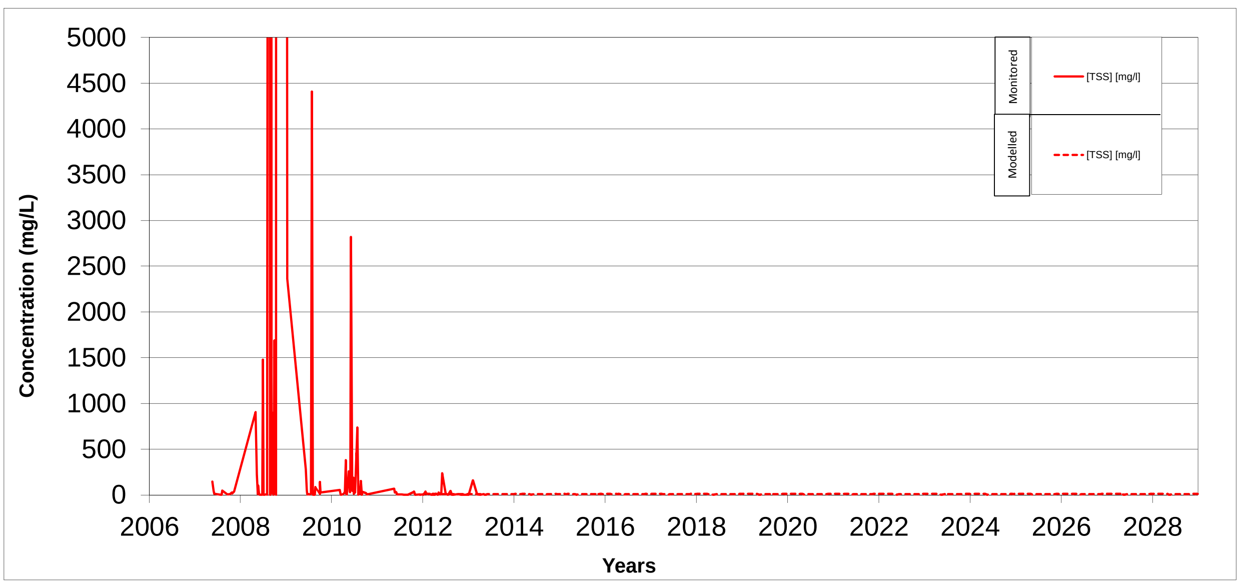
Date: December, 2013
Project: 12-1337-0001

Drawn KAS
Chkd KJD

De Beers Canada Inc.

North Pile Discharge (SNP 02-02) Dissolved Concentrations	FIGURE VII-7b





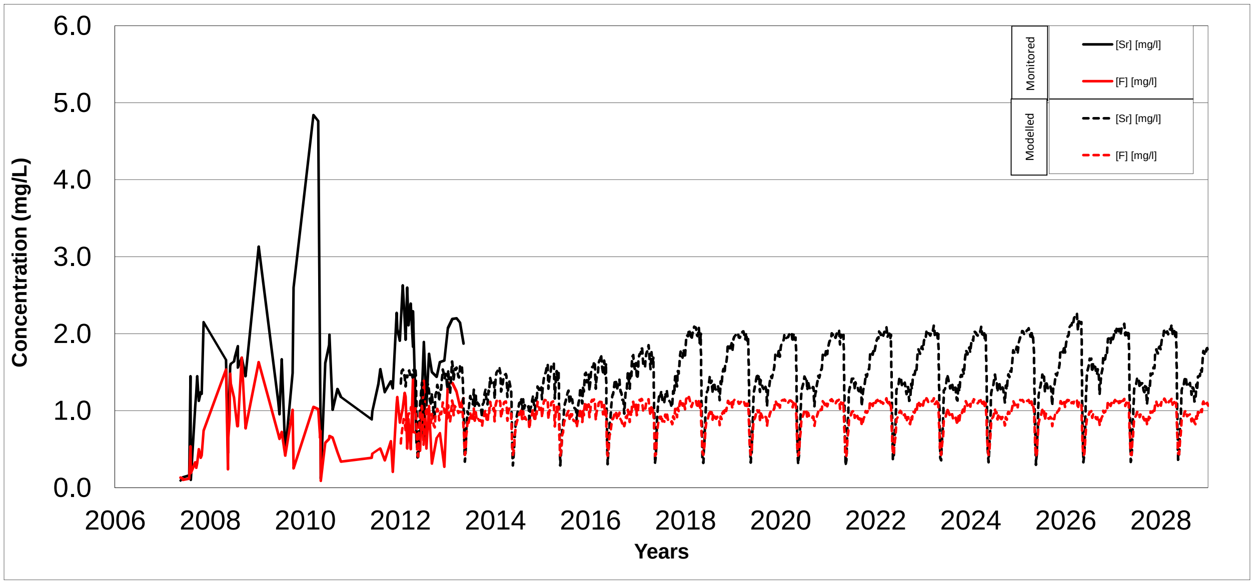
Note: Monitoring values above 5000 mg/L are not shown.

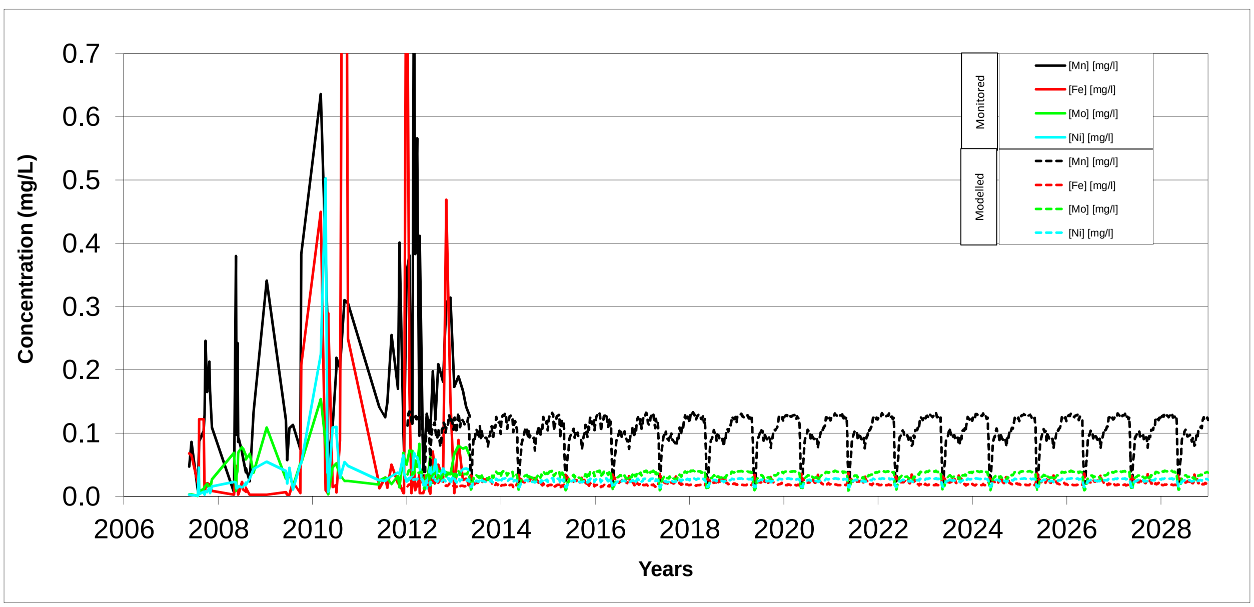
Date: December, 2013
Project: 12-1337-0001

Drawn KAS
Chkd KJD

De Beers Canada Inc.

North Pile Discharge (SNP 02-02) Dissolved Concentrations	FIGURE VII-7c





Note: Monitoring values above 0.7 mg/L are not shown.

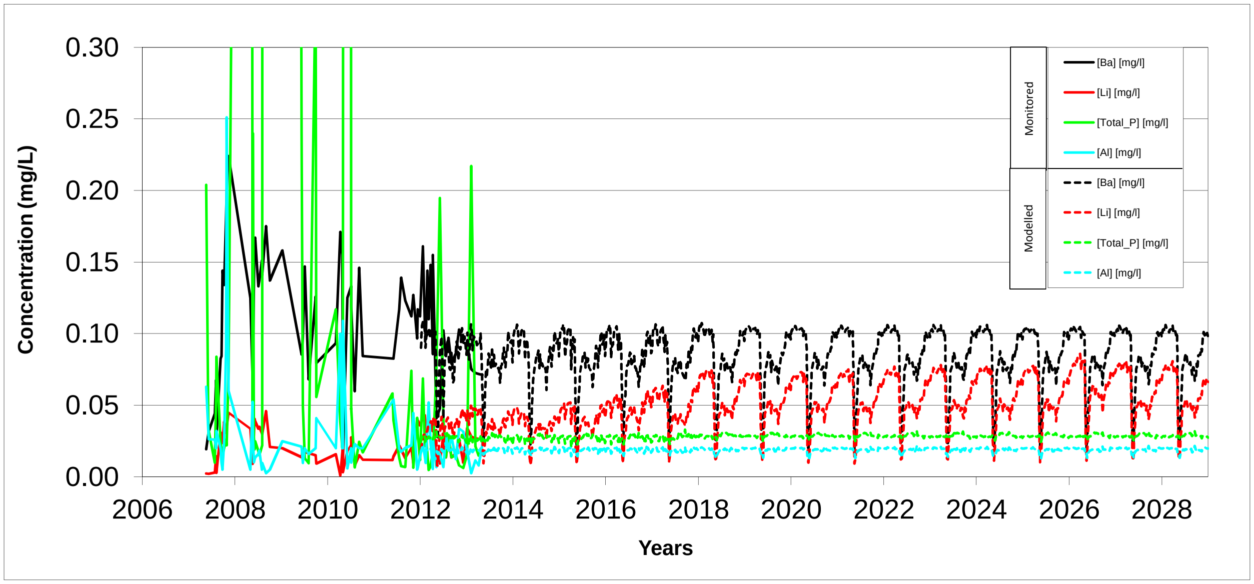
Date: December, 2013
Project: 12-1337-0001

Drawn KAS
Chkd KJD

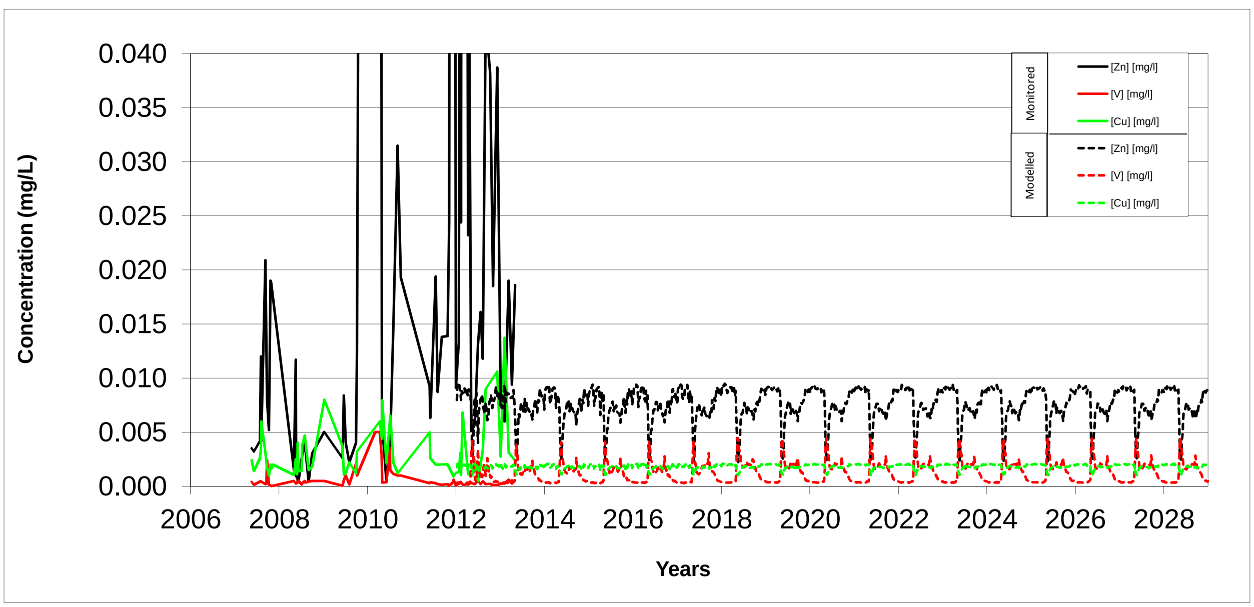
De Beers Canada Inc.

North Pile Discharge (SNP 02-02) Dissolved Concentrations

FIGURE VII-7d



Note: Monitoring values above 0.30 mg/L are not shown.



Note: Monitoring values above 0.40 mg/L are not shown.

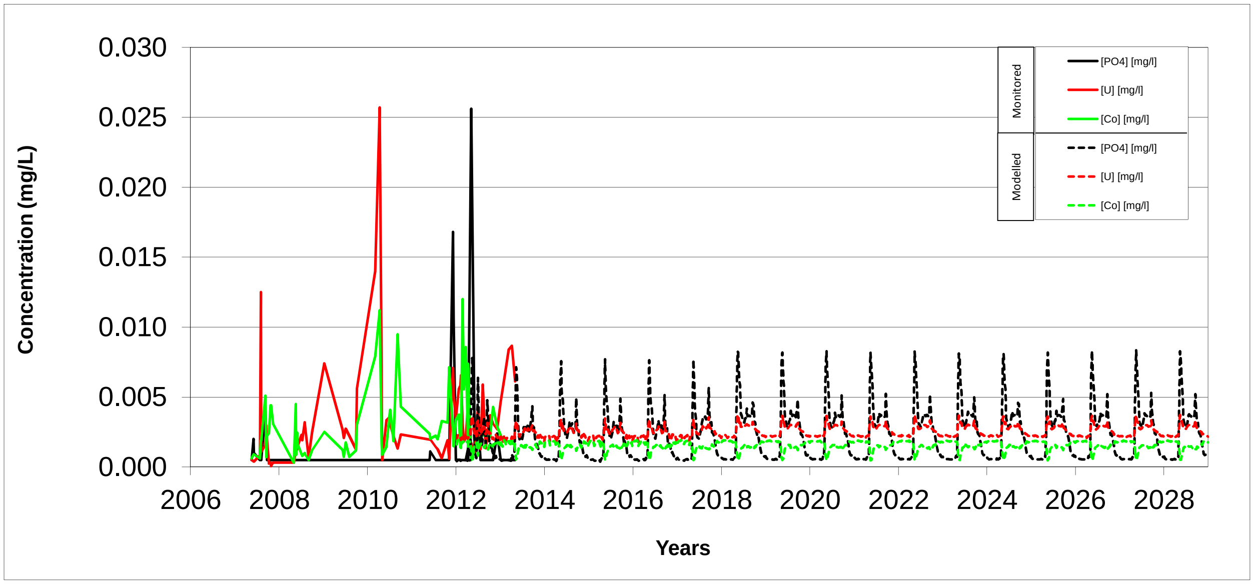
Date: December, 2013
Project: 12-1337-0001

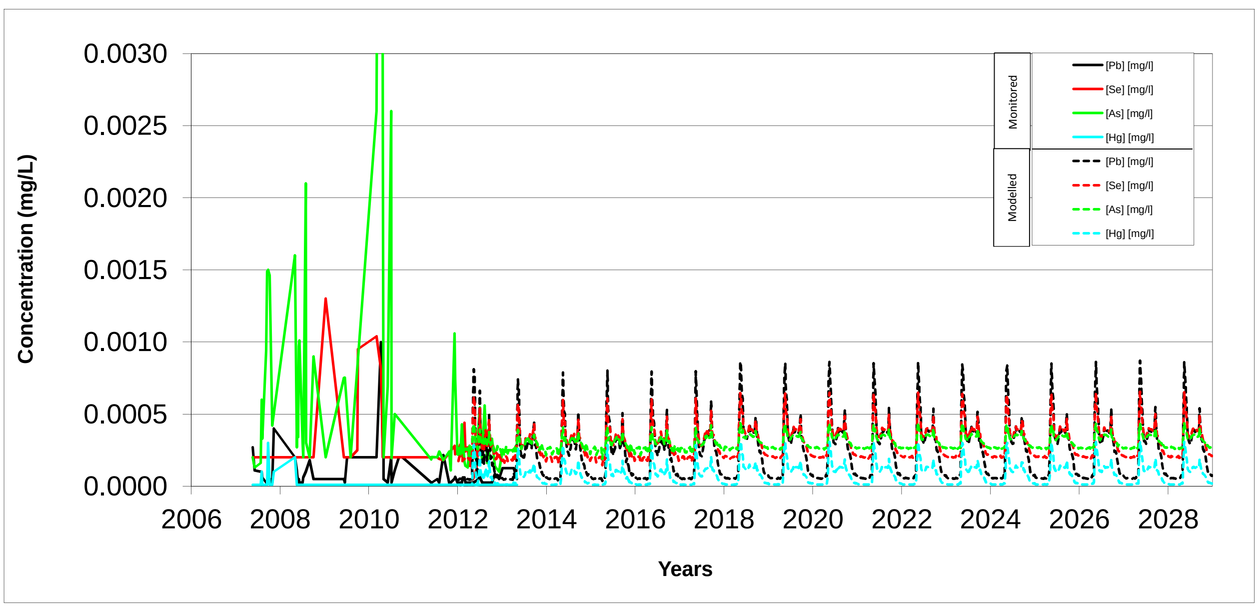
Drawn KAS
Chkd KJD

De Beers Canada Inc.

North Pile Discharge (SNP 02-02) Dissolved Concentrations

FIGURE VII-7e





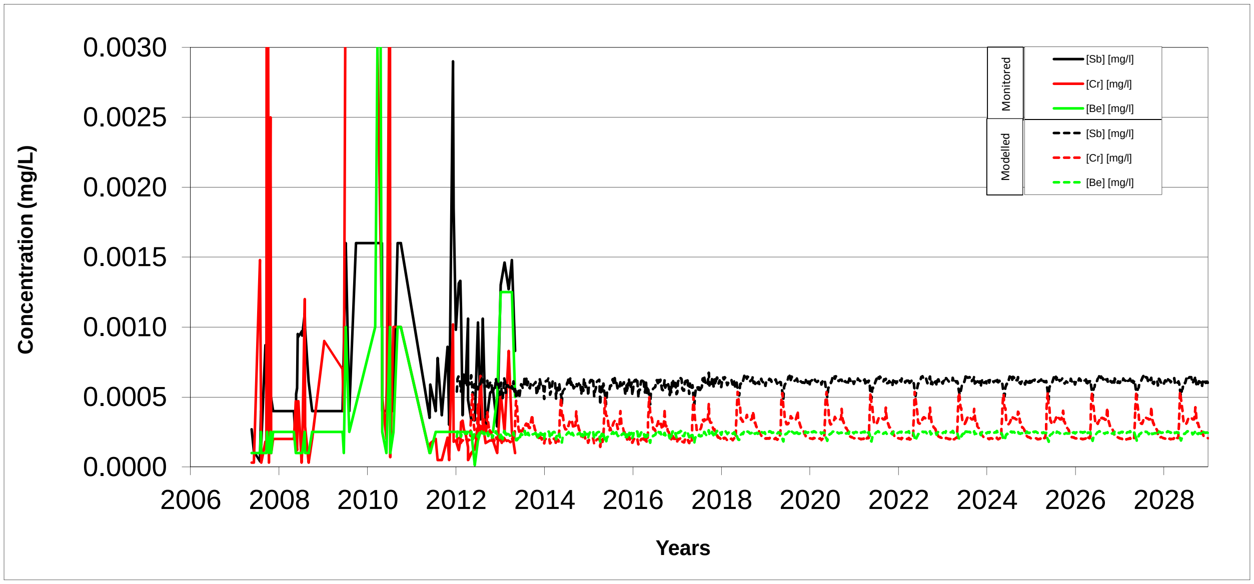
Note: Monitoring values above 0.0030 mg/L are not shown.

Date: December, 2013
Project: 12-1337-0001

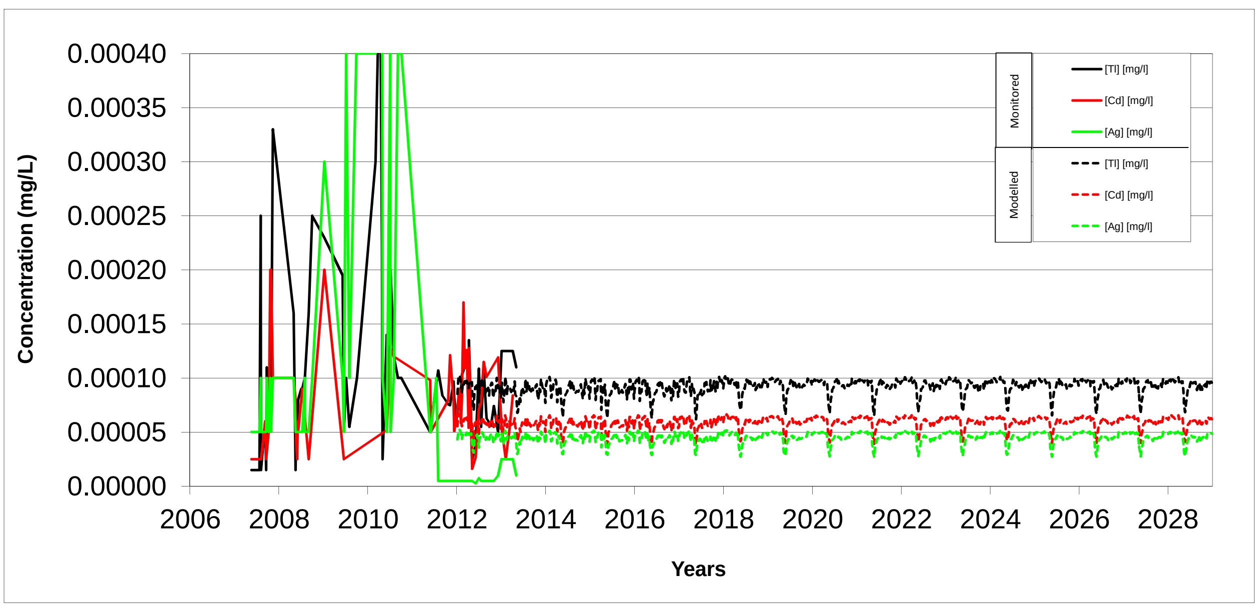
Drawn KAS
Chkd KJD

De Beers Canada Inc.

North Pile Discharge (SNP 02-02) Dissolved Concentrations	FIGURE VII-7f



Note: Monitoring values above 0.0030 mg/L are not shown.



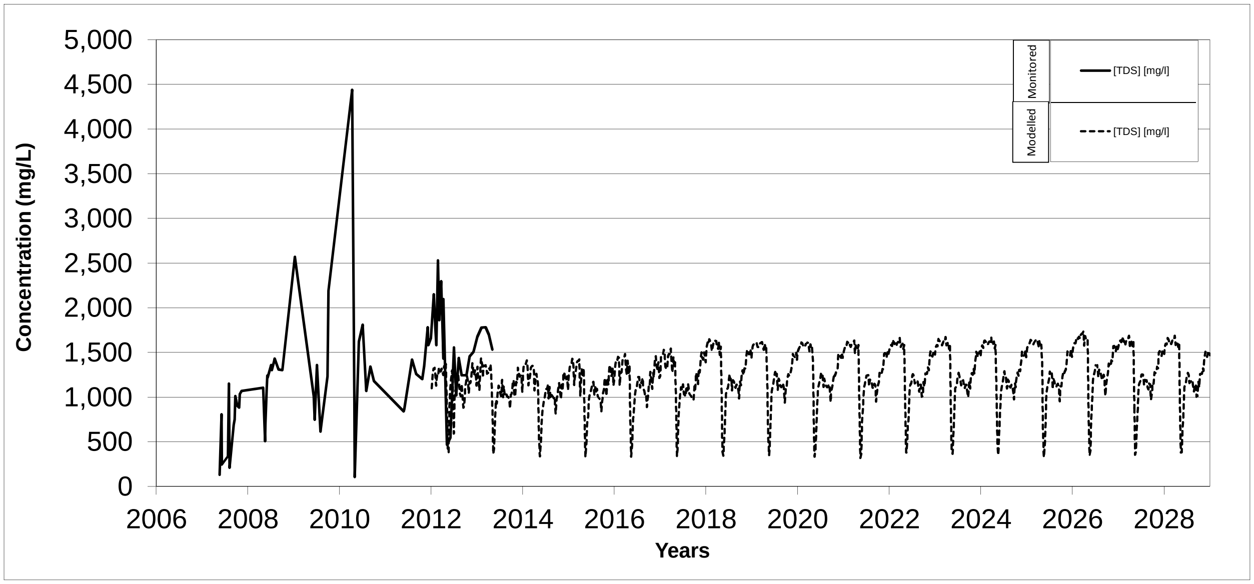
Note: Monitoring values above 0.00040 mg/L are not shown.

Date: December, 2013
Project: 12-1337-0001

Drawn KAS
Chkd KJD

De Beers Canada Inc.

North Pile Discharge (SNP 02-02) Dissolved Concentrations	FIGURE VII-7g

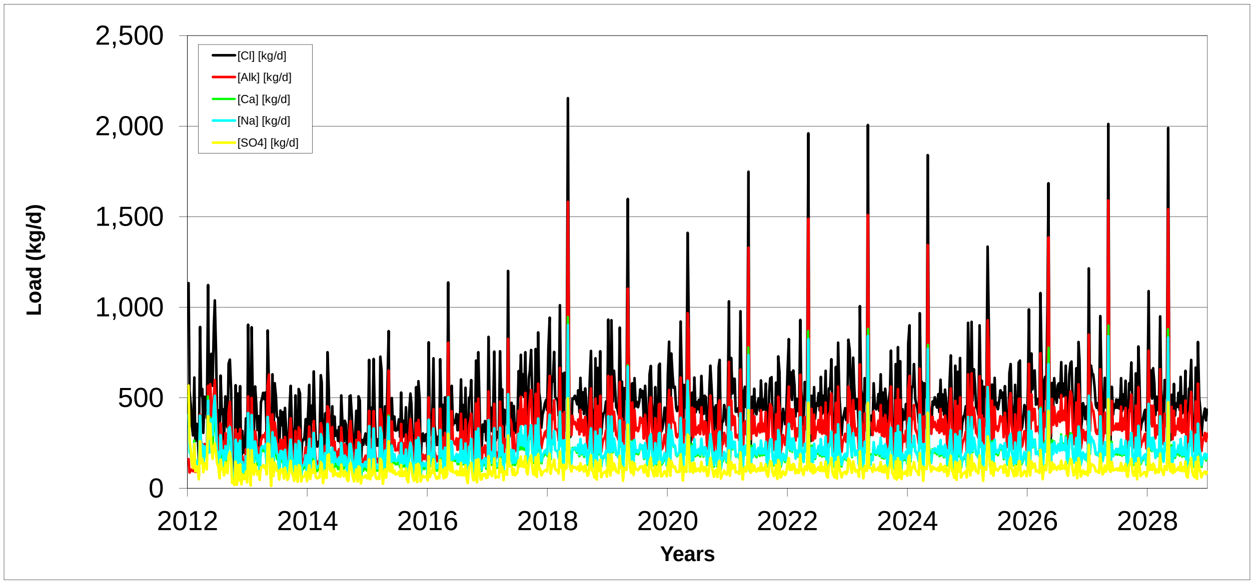


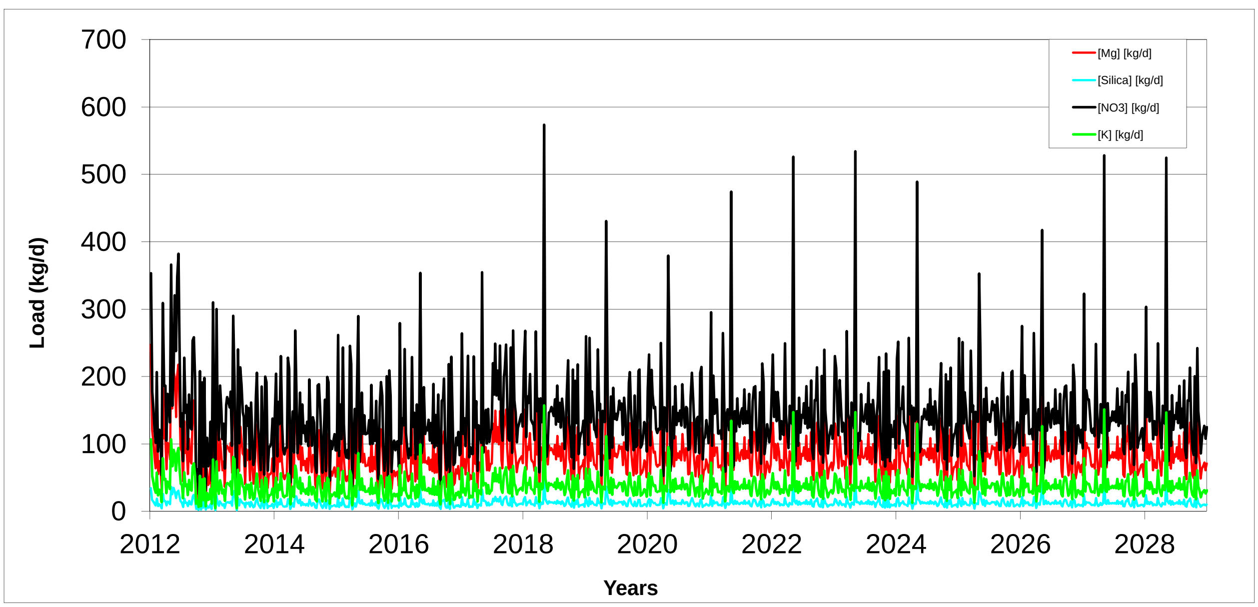
Date: December, 2013
Project: 12-1337-0001

Drawn KAS
Chkd KJD

De Beers Canada Inc.

North Pile Discharge (SNP 02-02) Dissolved Load	FIGURE VII-8a



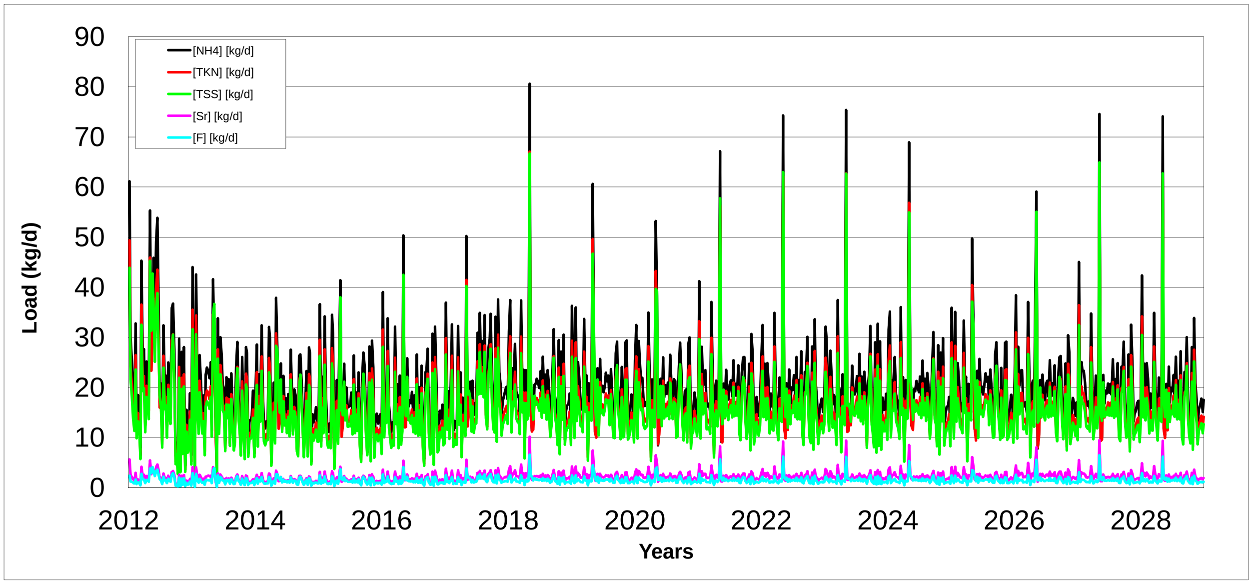


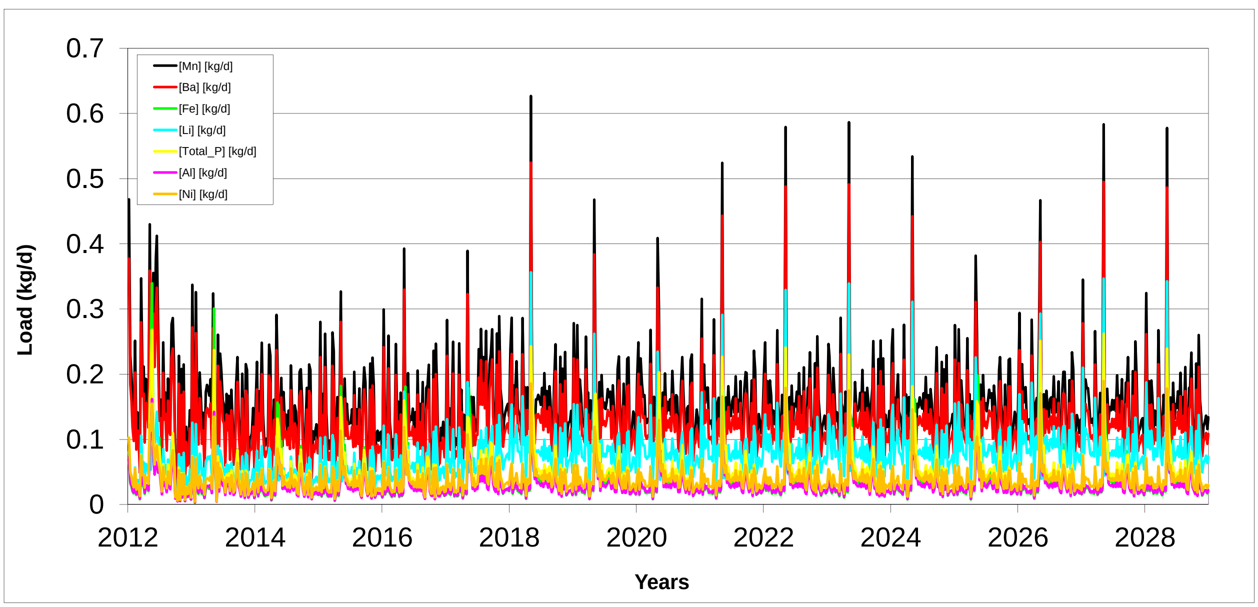
Date: December, 2013
Project: 12-1337-0001

Drawn KAS
Chkd KJD

De Beers Canada Inc.

North Pile Discharge (SNP 02-02) Dissolved Load	FIGURE VII-8b





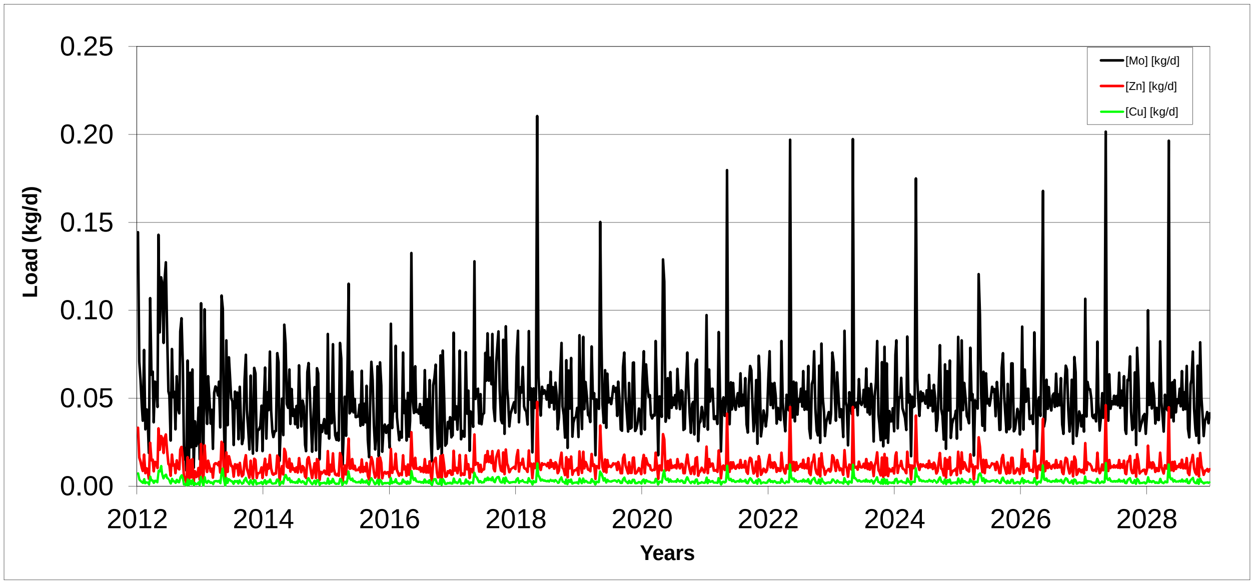
Date: December, 2013
Project: 12-1337-0001

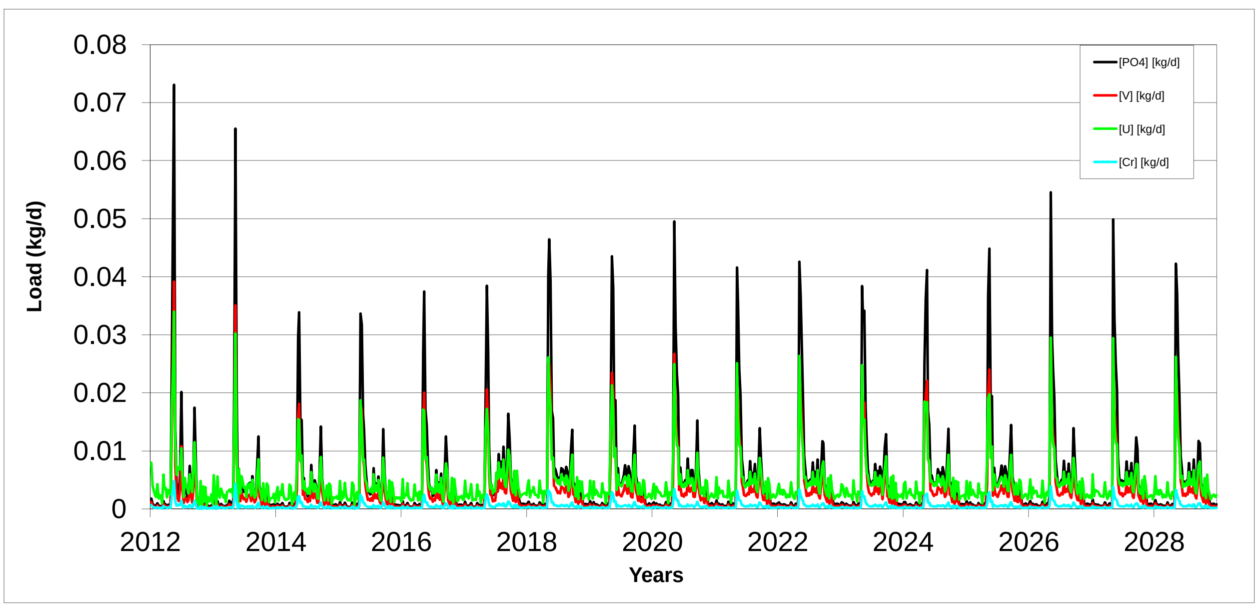
Drawn KAS
Chkd KJD

De Beers Canada Inc.

North Pile Discharge (SNP 02-02) Dissolved Load

FIGURE VII-8c



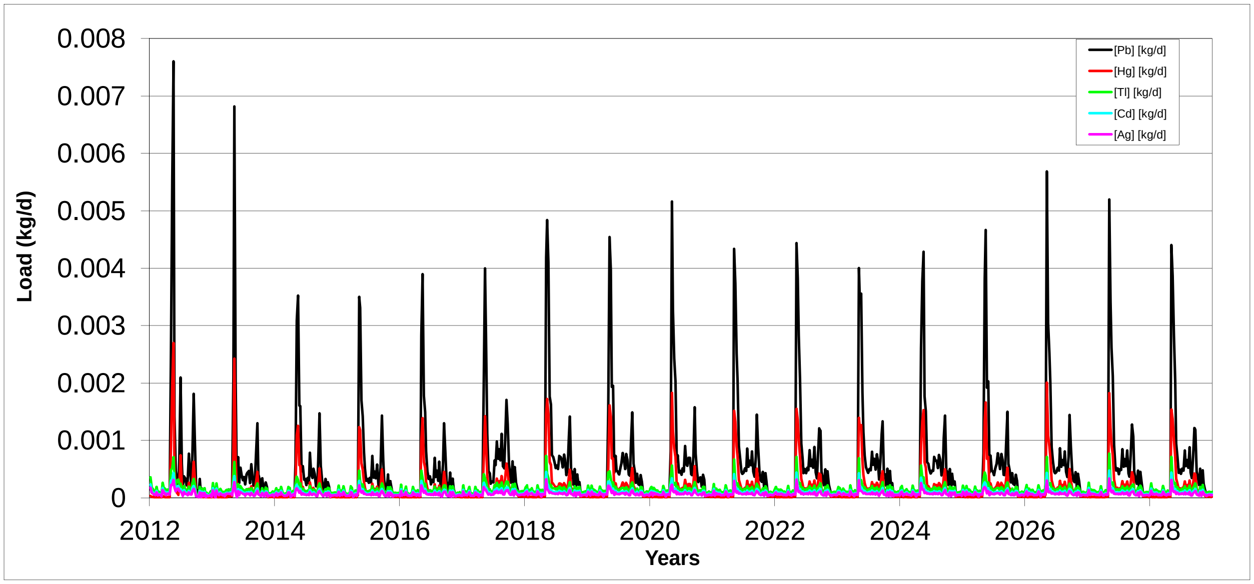


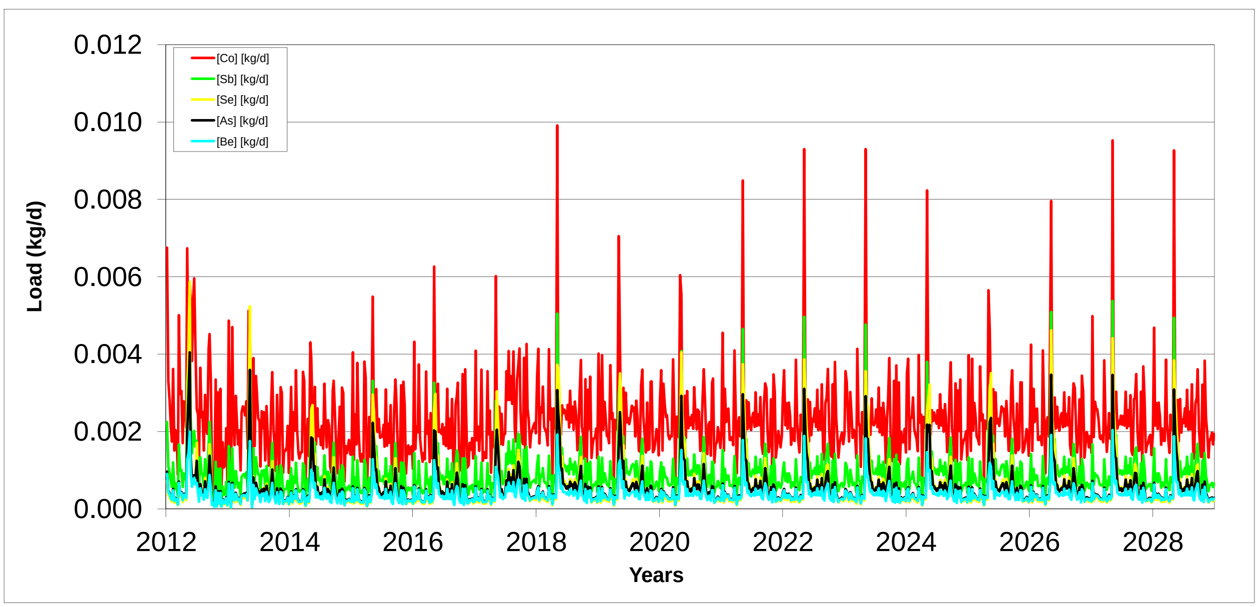
Date: December, 2013
Project: 12-1337-0001

Drawn KAS
Chkd KJD

De Beers Canada Inc.

North Pile Discharge (SNP 02-02) Dissolved Load	FIGURE VII-8d



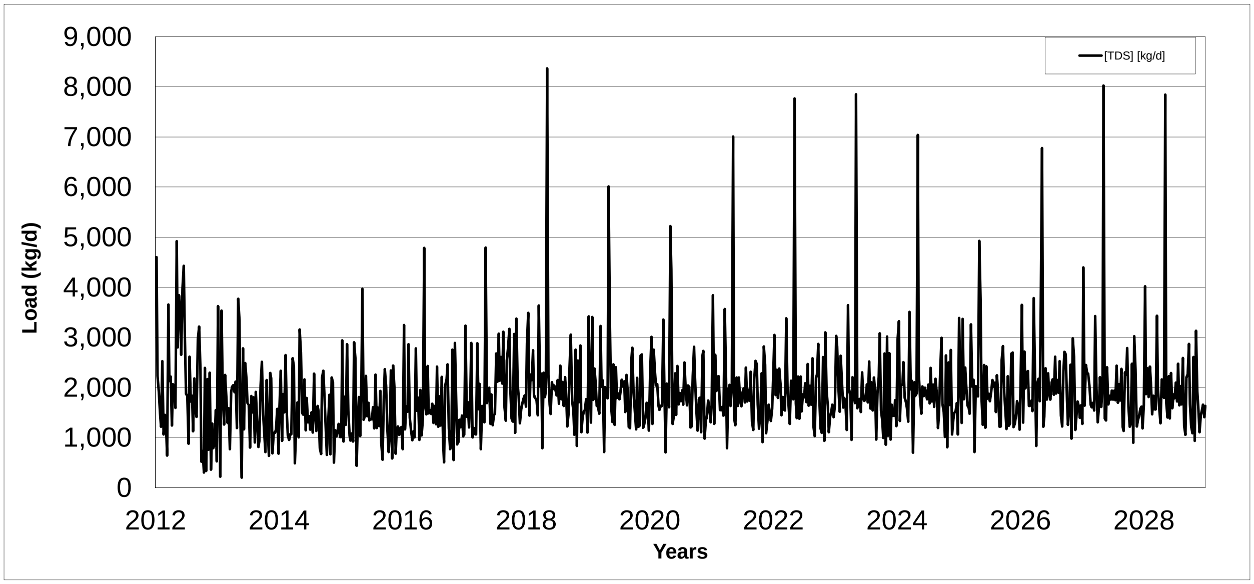


Date: December, 2013
Project: 12-1337-0001

Drawn KAS
Chkd KJD

De Beers Canada Inc.

North Pile Discharge (SNP 02-02) Dissolved Load	FIGURE VII-8e

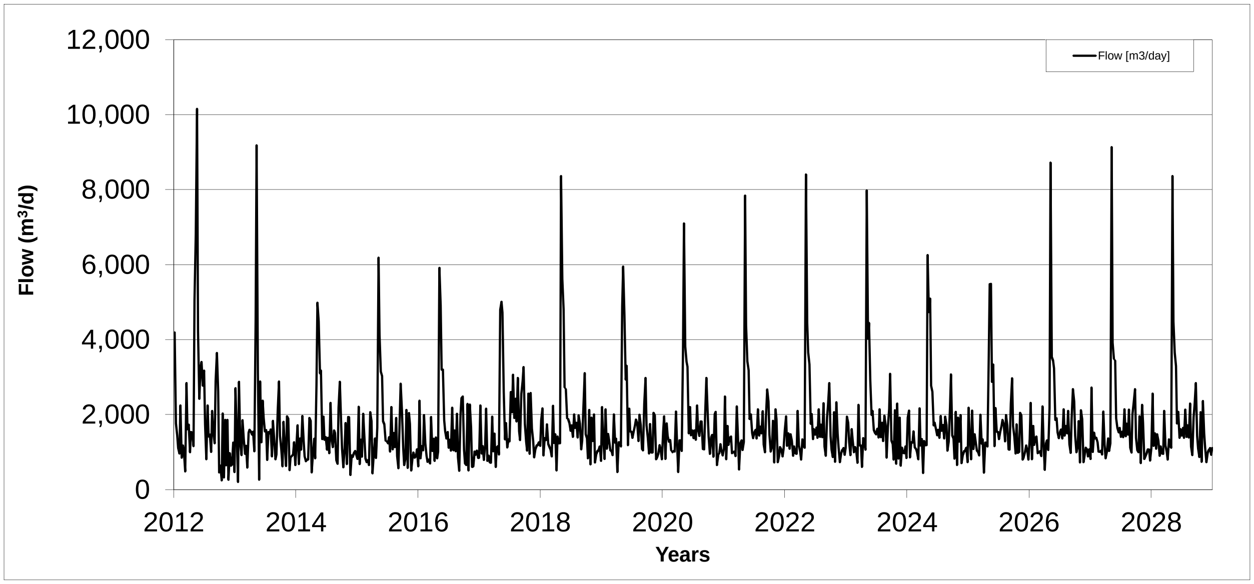


Date: December, 2013
Project: 12-1337-0001

Drawn KAS
Chkd KJD

De Beers Canada Inc.

North Pile Discharge (SNP 02-02) Dissolved Load FLOW	FIGURE VII-8f



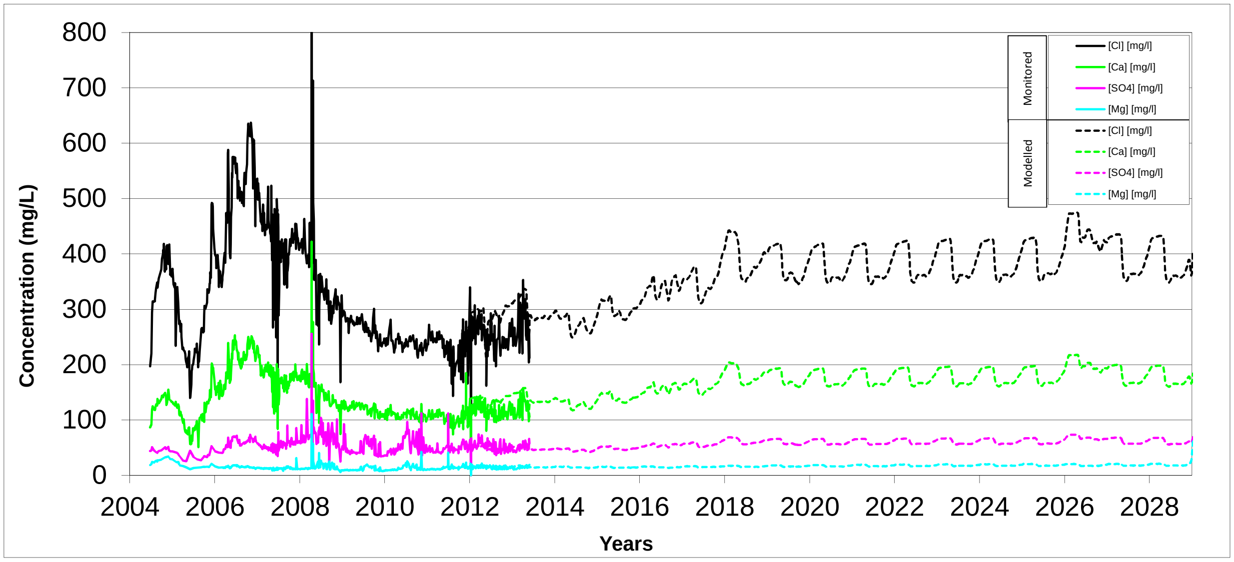
Date: December, 2013
Project: 12-1337-0001

Drawn KAS
Chkd KJD

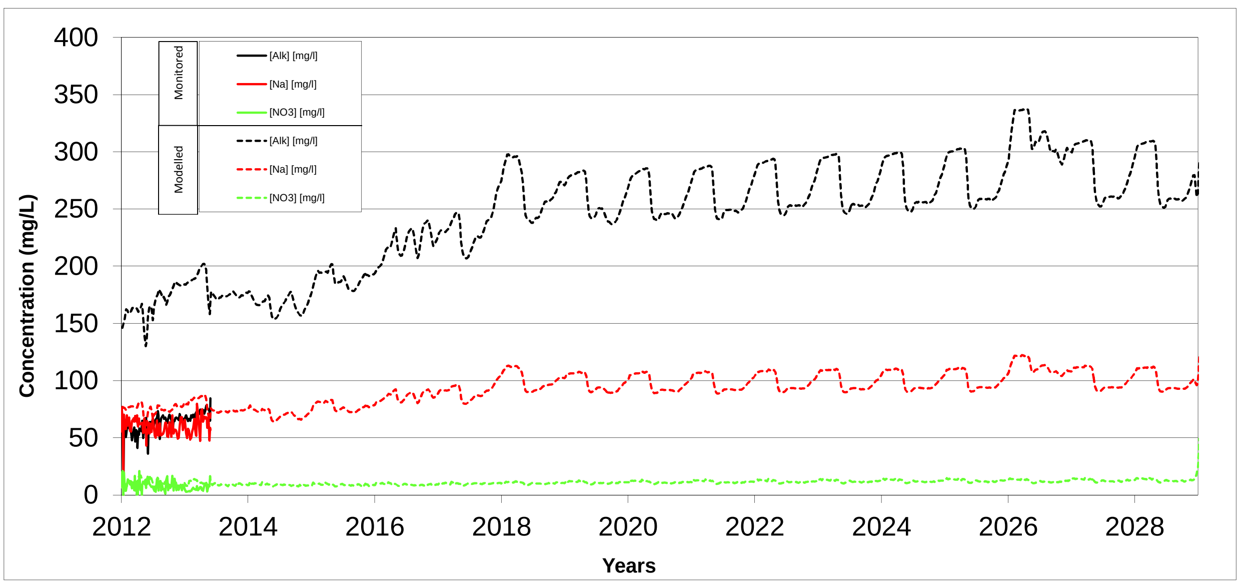
De Beers Canada Inc.

Final Discharge (SNP 02-17B) Dissolved Concentrations

FIGURE VII-9a



Note: Monitored values above 800 mg/L are not shown.

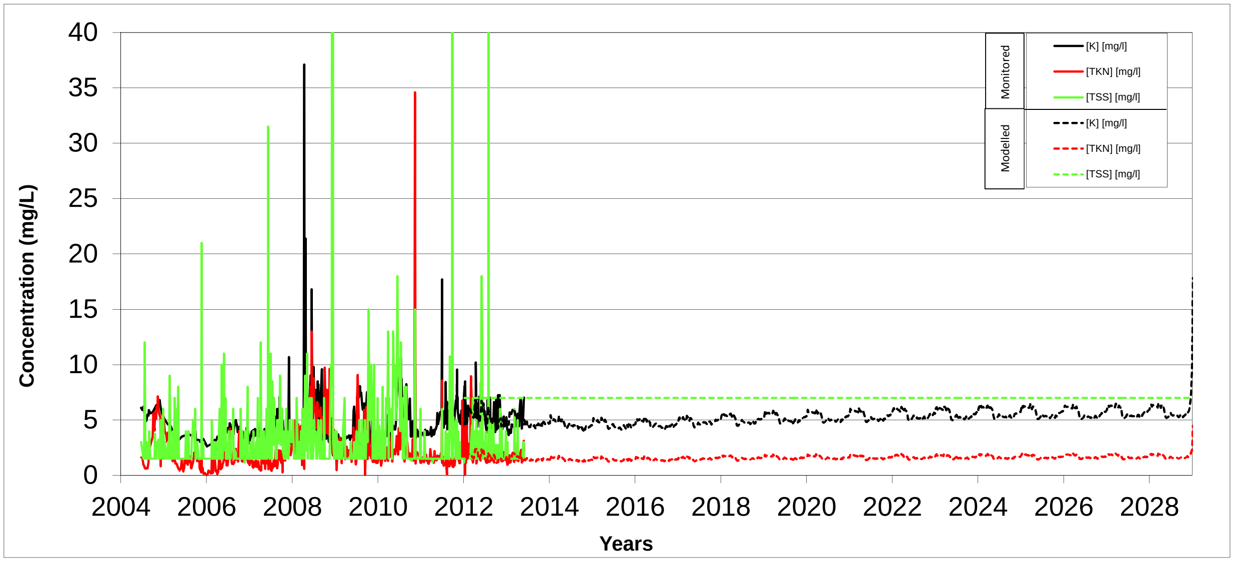


Date: December, 2013
Project: 12-1337-0001

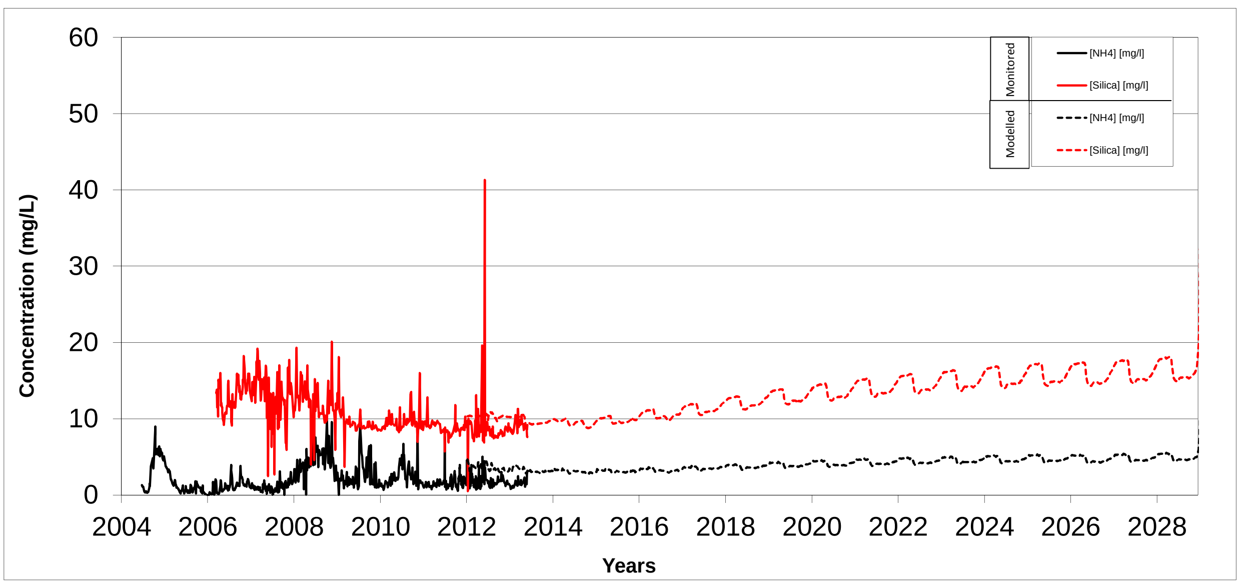
Drawn KAS
Chkd KJD

De Beers Canada Inc.

Final Discharge (SNP 02-17B) Dissolved Concentrations	FIGURE VII-9b



Note: Monitored values above 40 mg/L are not shown.

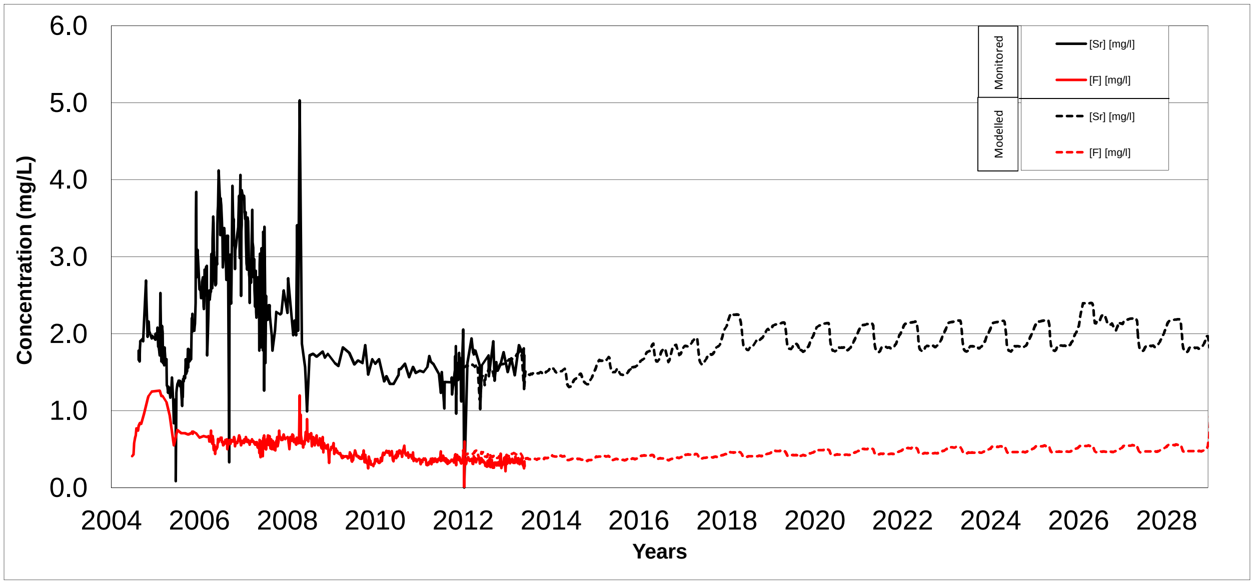


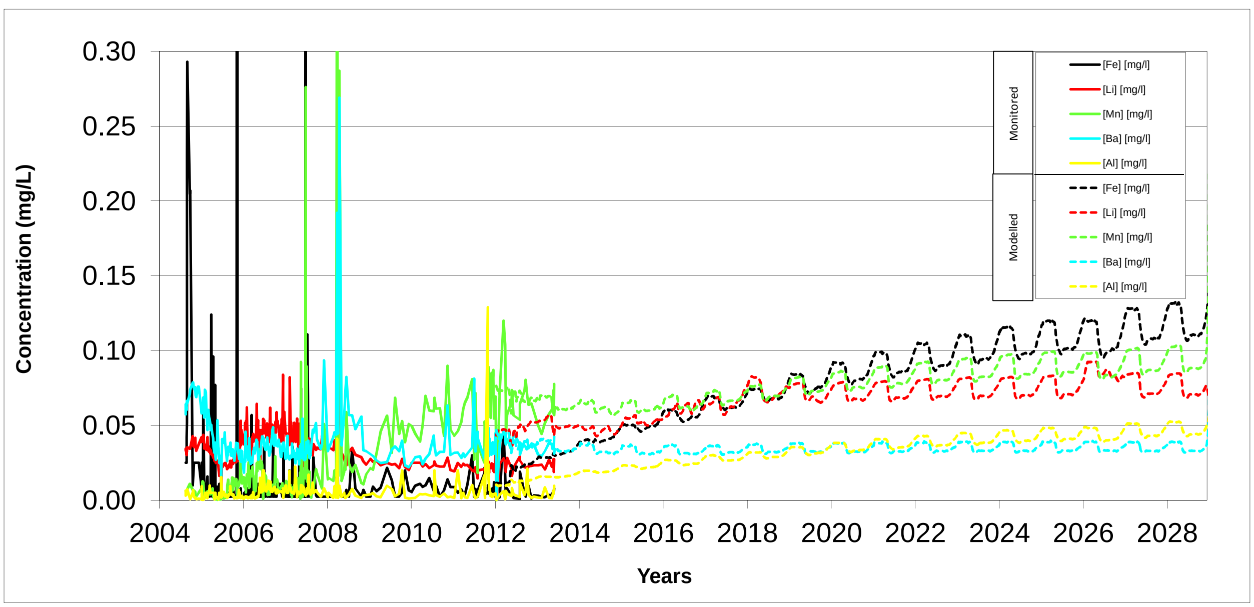
Date: December, 2013
Project: 12-1337-0001

Drawn KAS
Chkd KJD

De Beers Canada Inc.

Final Discharge (SNP 02-17B) Dissolved Concentrations	FIGURE VII-9c





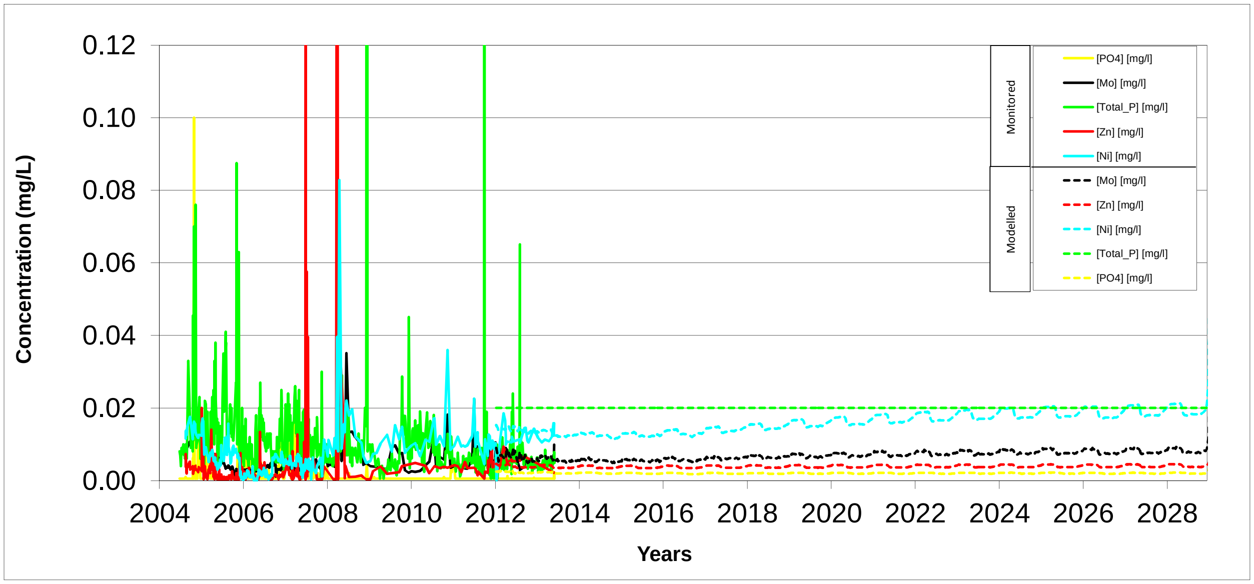
Note: Monitored values above 0.3 mg/L are not shown.

Date: December, 2013
Project: 12-1337-0001

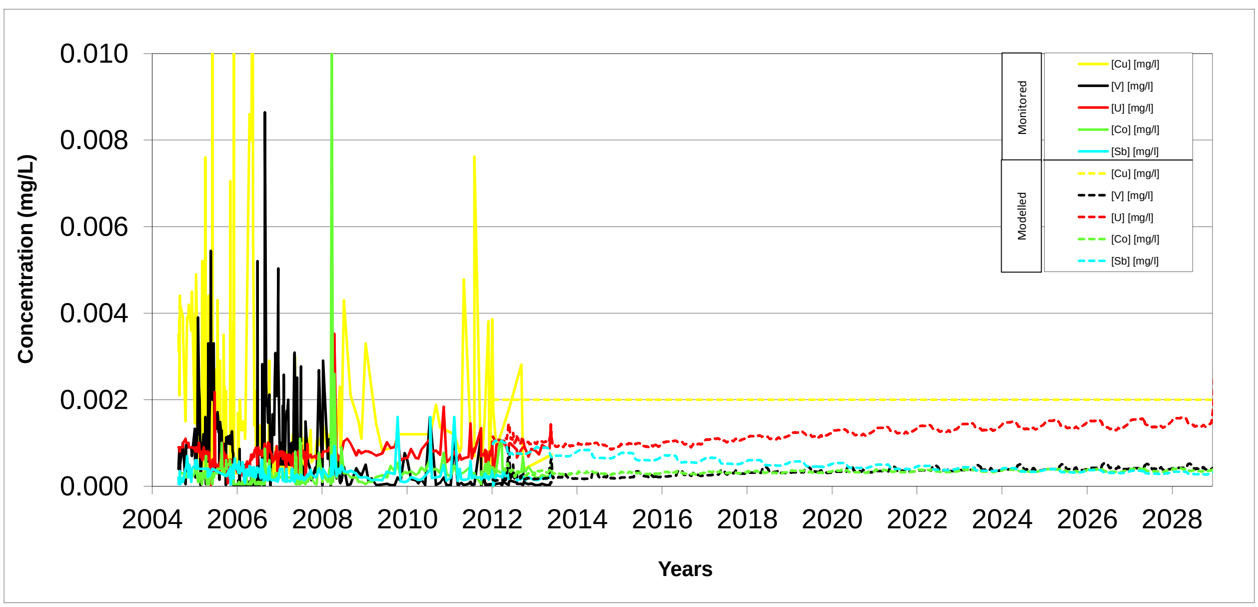
Drawn KAS
Chkd KJD

De Beers Canada Inc.

Final Discharge (SNP 02-17B) Dissolved Concentrations	FIGURE VII-9d



Note: Monitored values above 0.12 mg/L are not shown.



Note: Monitored values above 0.01 mg/L are not shown.

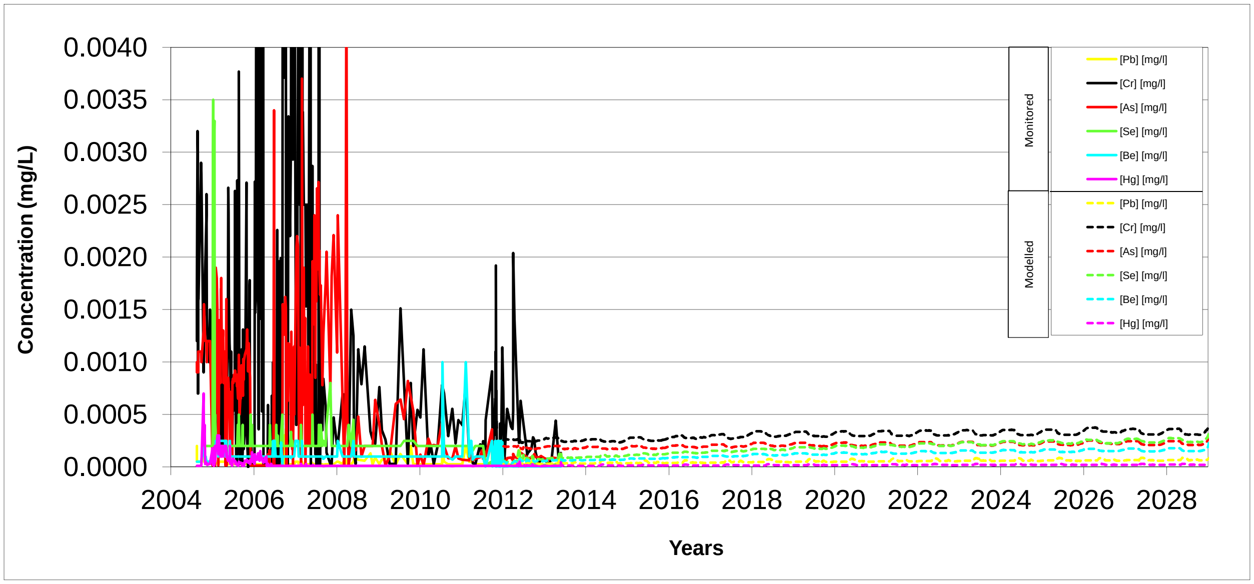
Date: December, 2013
Project: 12-1337-0001

Drawn KAS
Chkd KJD

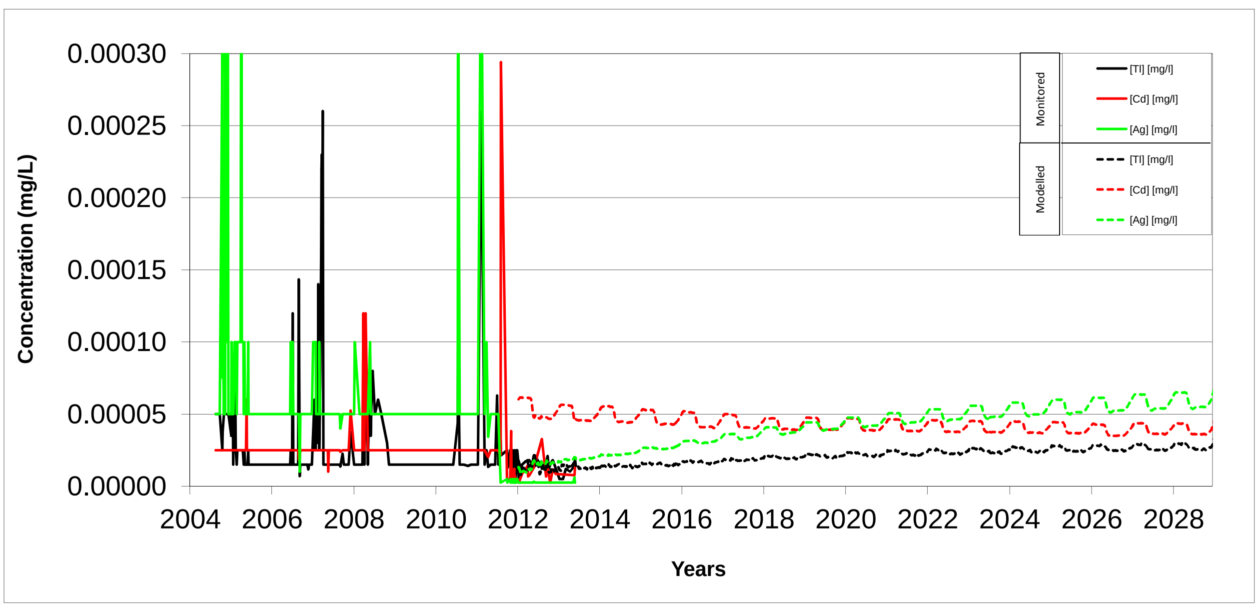
De Beers Canada Inc.

Final Discharge (SNP 02-17B) Dissolved Concentrations

FIGURE VII-9e



Note: Monitored values above 0.0040 mg/L are not shown.



Note: Monitored values above 0.00030 mg/L are not shown.

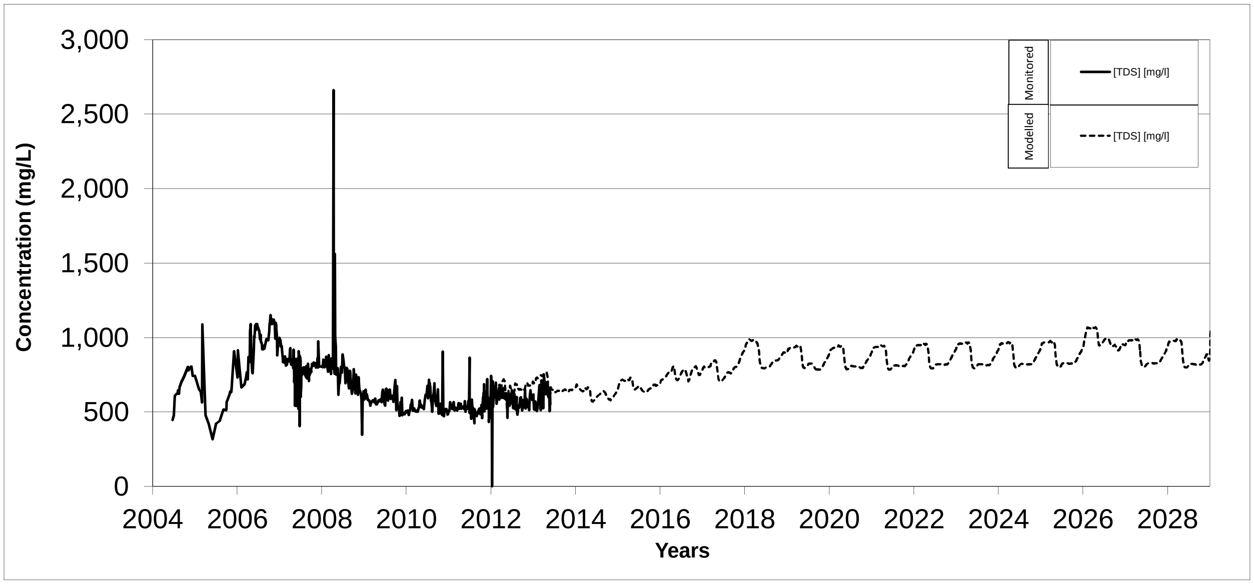
Date: December, 2013
Project: 12-1337-0001

Drawn KAS
Chkd KJD

De Beers Canada Inc.

Final Discharge (SNP 02-17B) Dissolved Concentrations

FIGURE VII-9f



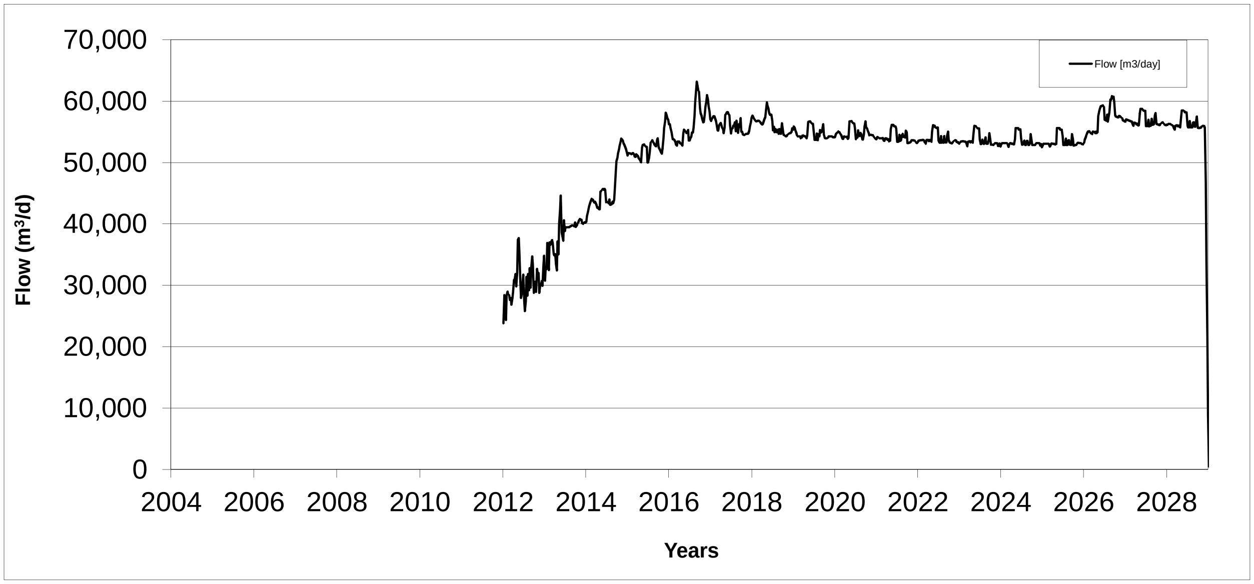
Date: December, 2013
Project: 12-1337-0001

Drawn KAS
Chkd KJD

De Beers Canada Inc.

Final Discharge (SNP 02-17B) Dissolved Concentrations

FIGURE VII-9g



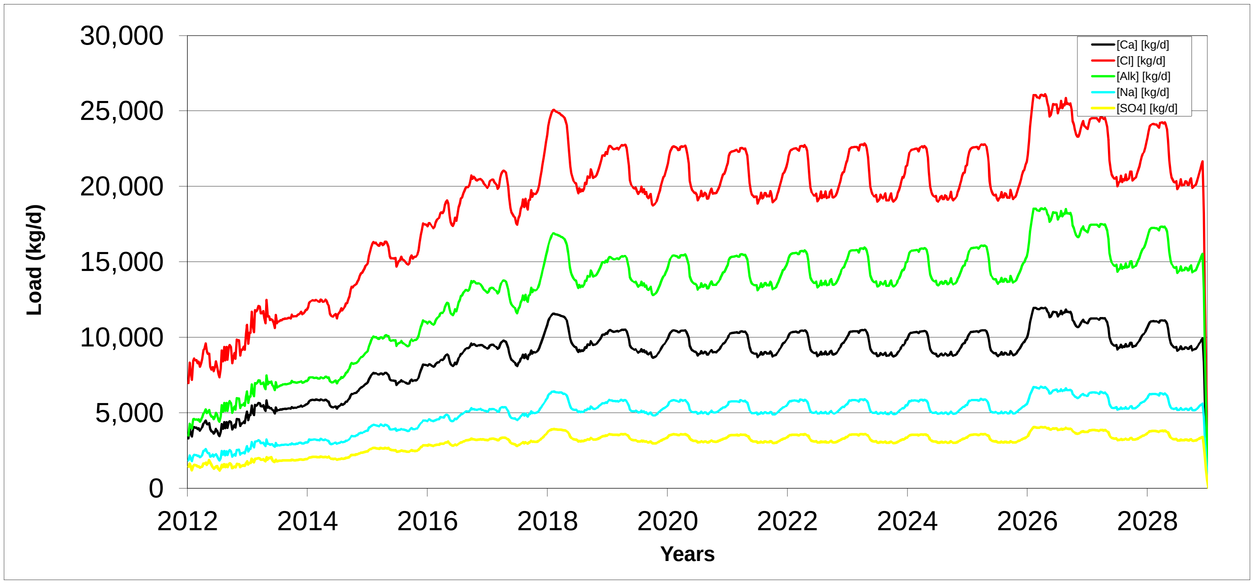
Date: December, 2013
Project: 12-1337-0001

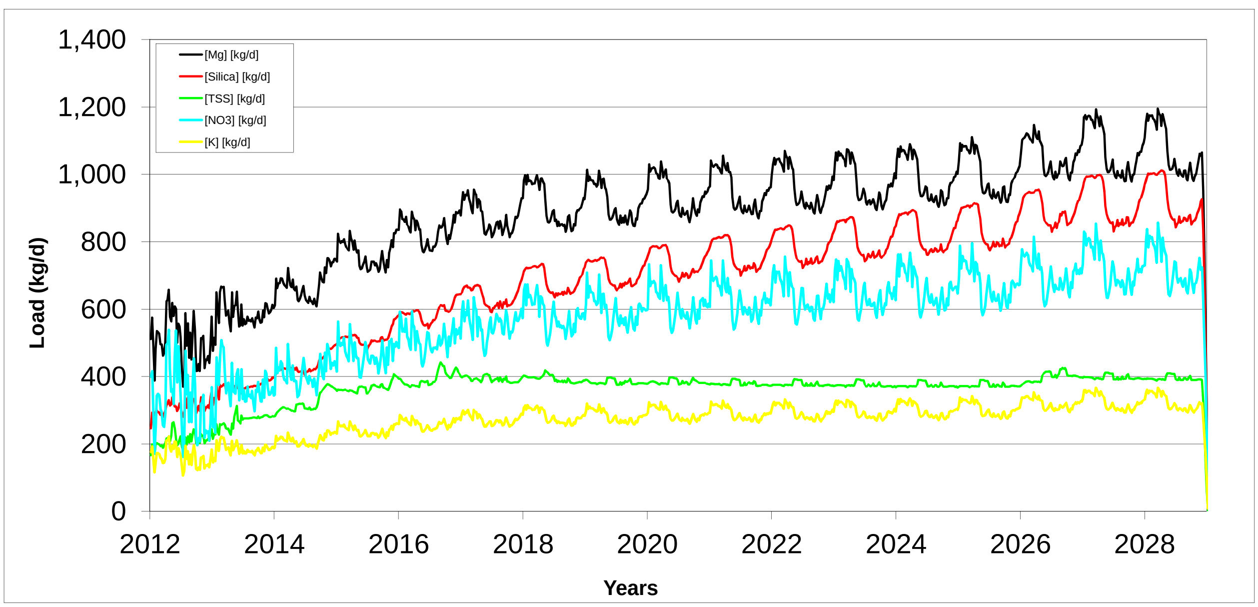
Drawn KAS
Chkd KJD

De Beers Canada Inc.

Final Discharge (SNP 02-17B) Dissolved Load

FIGURE VII-10a



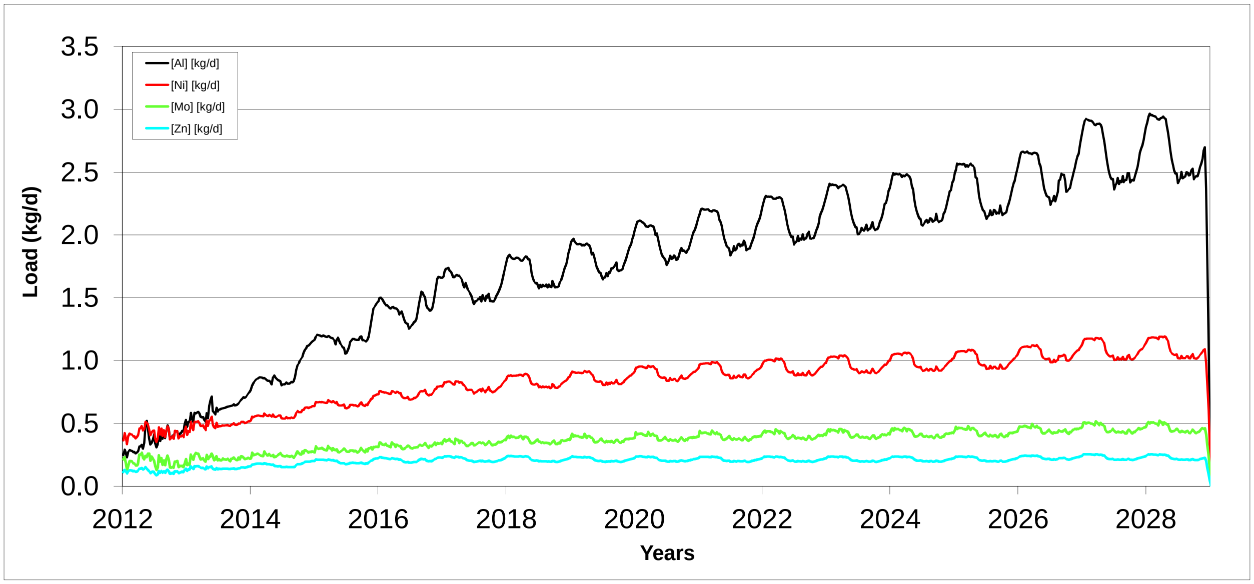


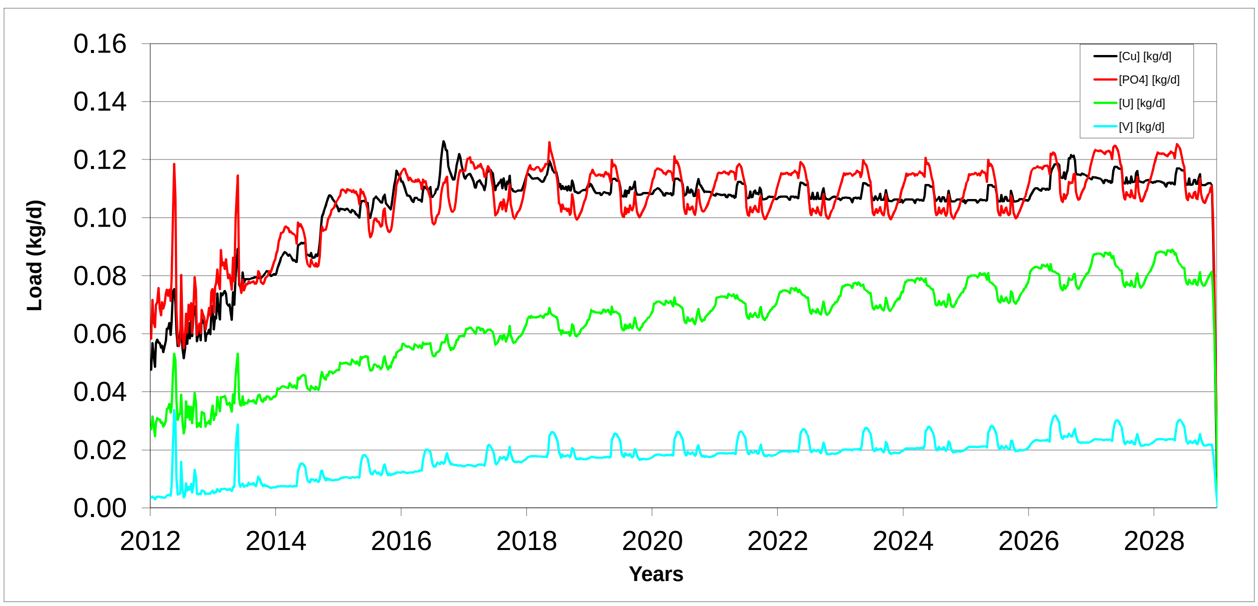
Date: December, 2013
Project: 12-1337-0001

Drawn KAS
Chkd KJD

De Beers Canada Inc.

Final Discharge (SNP 02-17B) Dissolved Load	FIGURE VII-10c





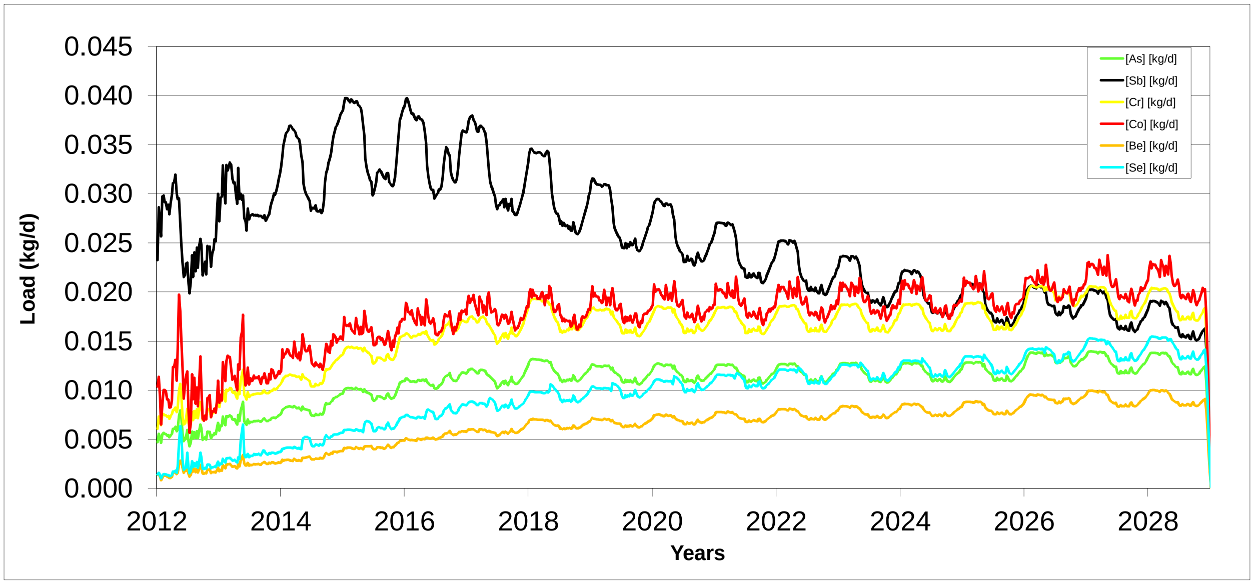
Date: December, 2013
Project: 12-1337-0001

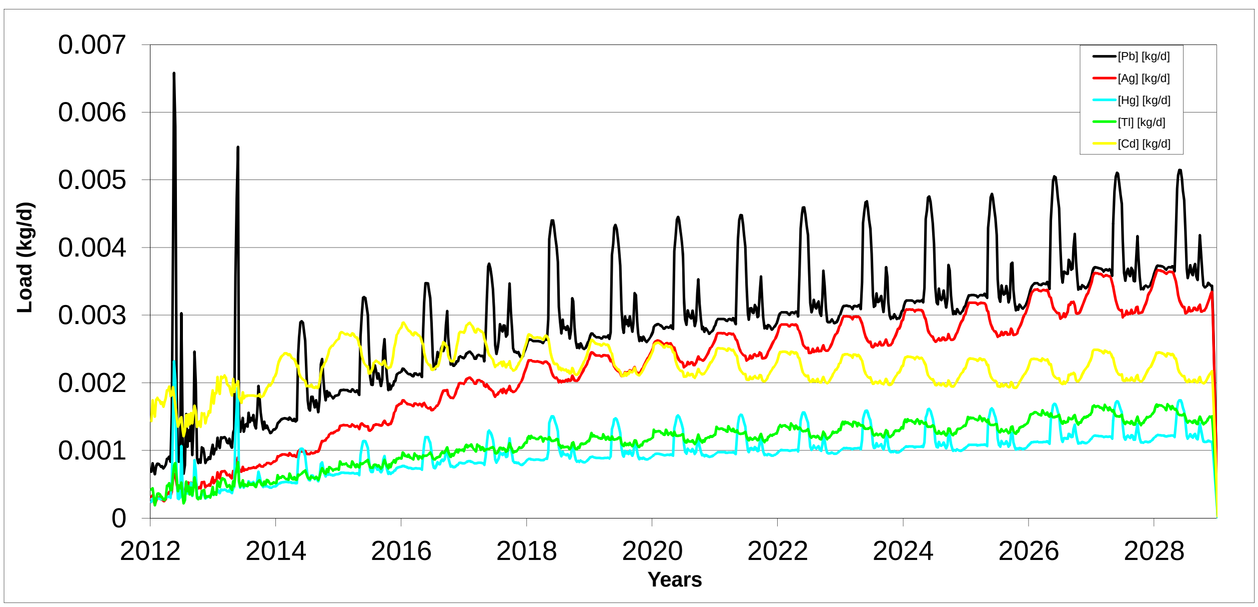
Drawn KAS
Chkd KJD

De Beers Canada Inc.

Final Discharge (SNP 02-17B) Dissolved Load

FIGURE VII-10d





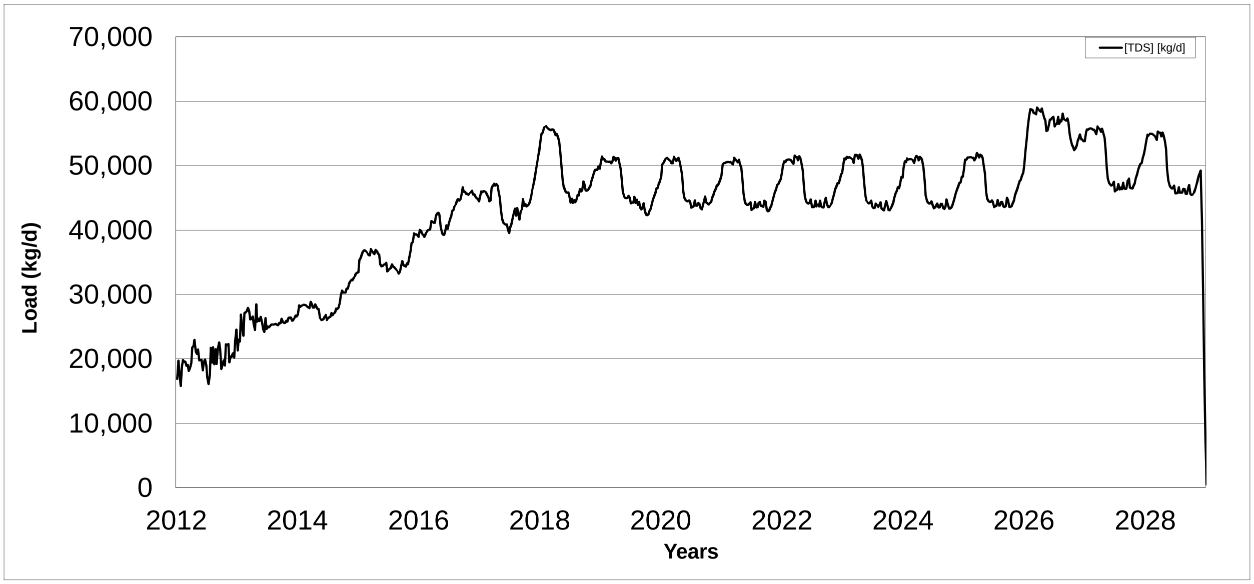
Date: December, 2013
Project: 12-1337-0001

Drawn KAS
Chkd KJD

De Beers Canada Inc.

Final Discharge (SNP 02-17B) Dissolved Load

FIGURE VII-10e



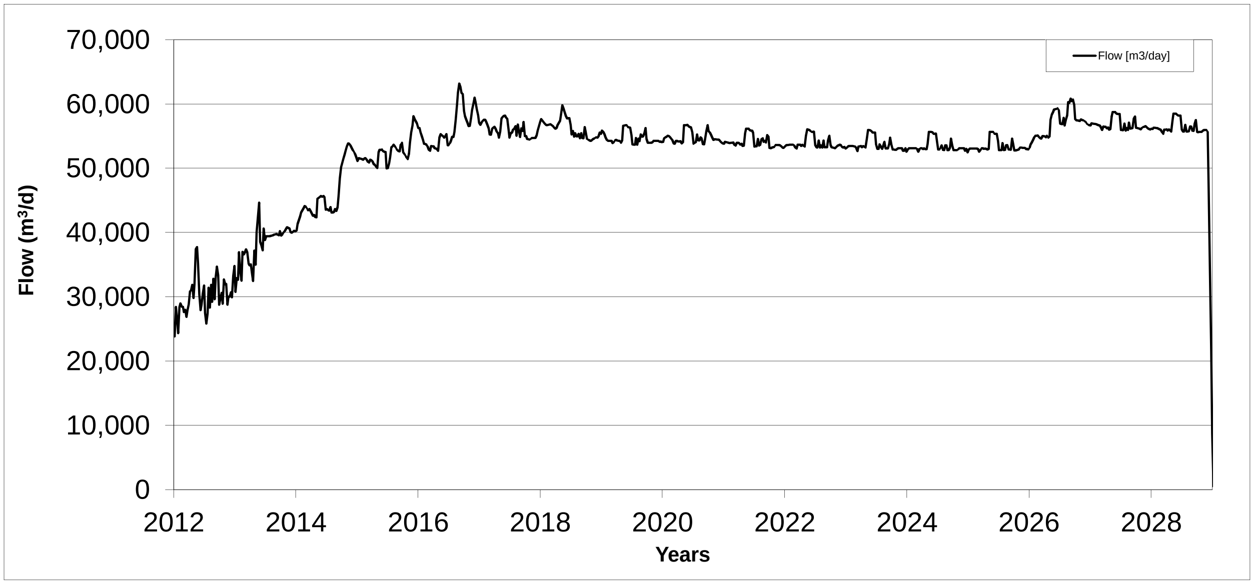
Date: December, 2013
Project: 12-1337-0001

Drawn KAS
Chkd KJD

De Beers Canada Inc.

Final Discharge (SNP 02-17B) Dissolved Load FLOW

FIGURE VII-10f



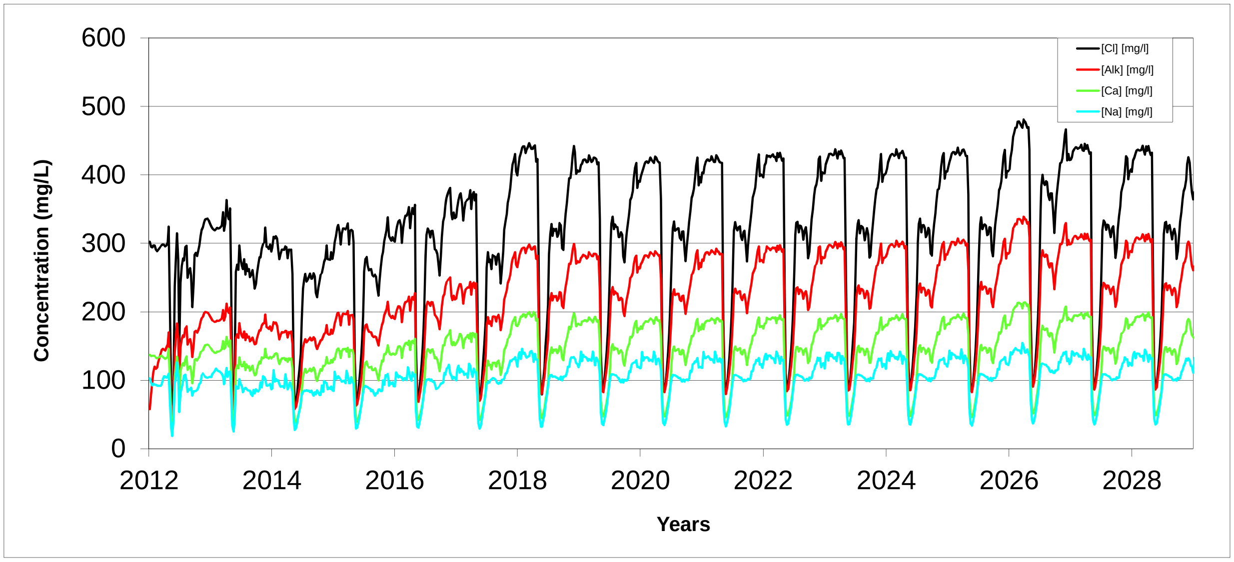
Date: December, 2013
Project: 12-1337-0001

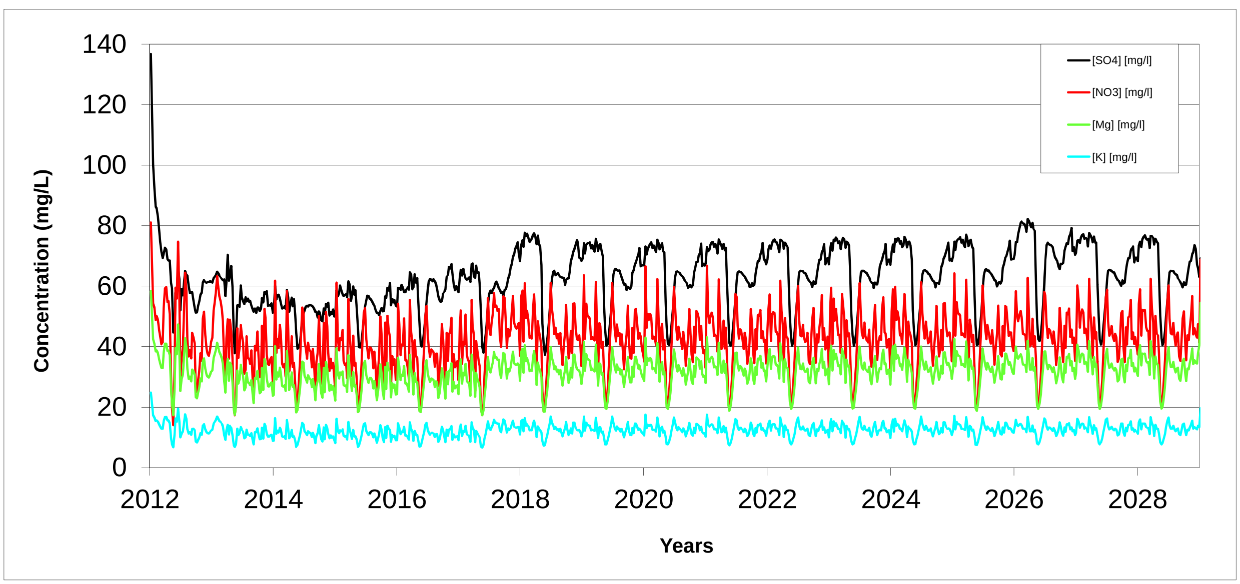
Drawn KAS
Chkd KJD

De Beers Canada Inc.

Water Management Pond Seepage Dissolved Concentrations

FIGURE VII-11a





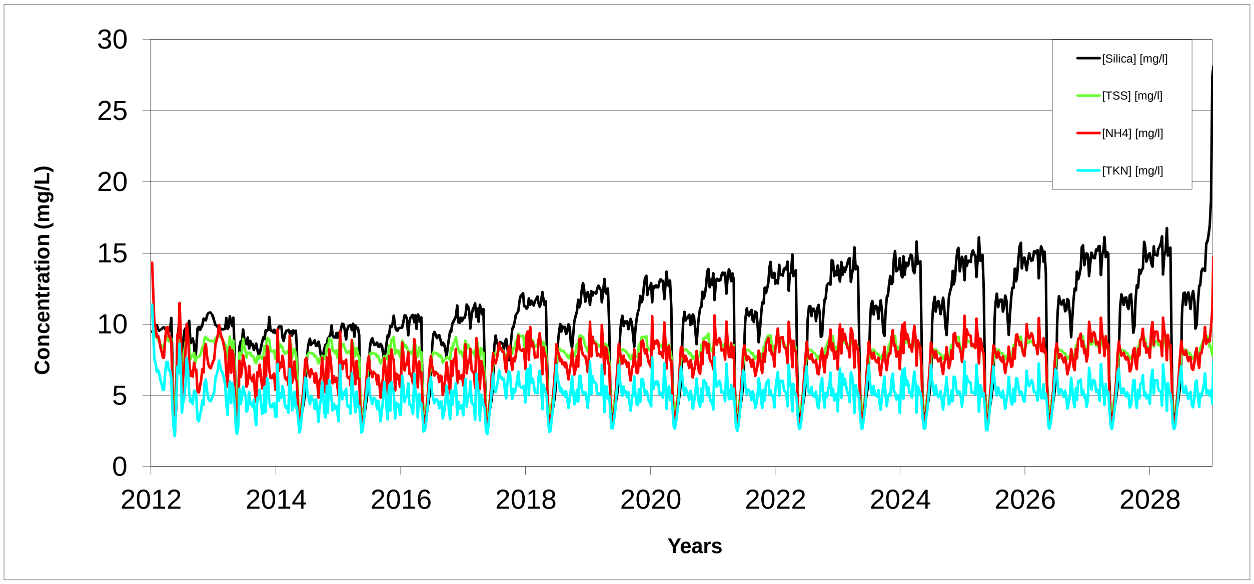
Date: December, 2013
Project: 12-1337-0001

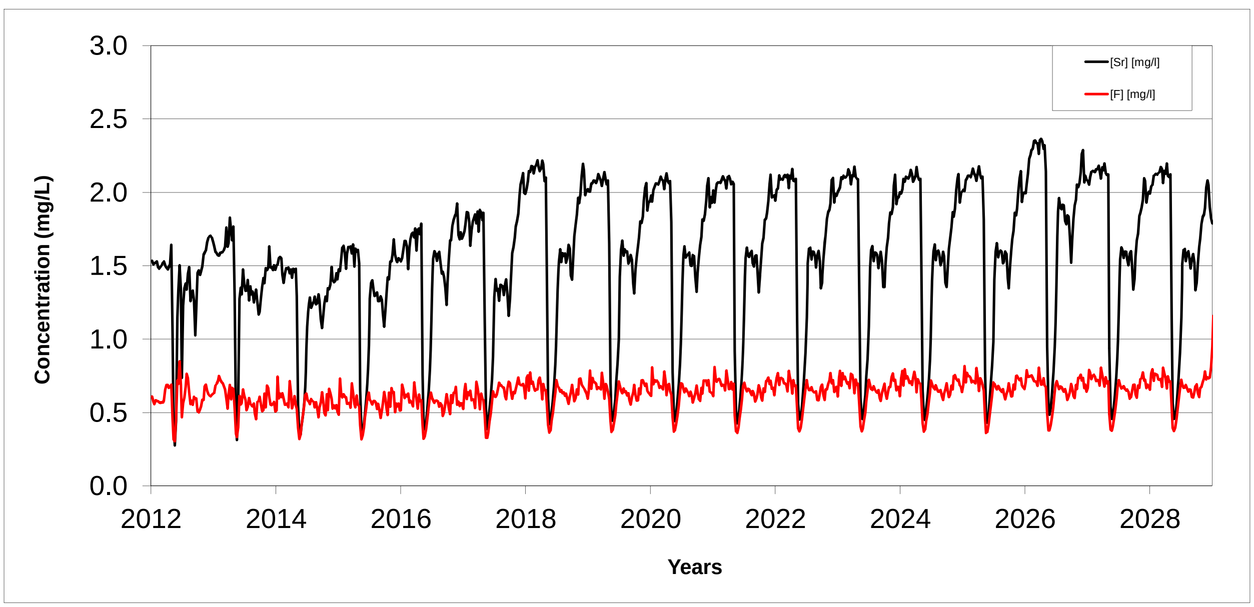
Drawn KAS
Chkd KJD

Ass

De Beers Canada Inc.

Water Management Pond Seepage Dissolved Concentrations	FIGURE VII-11b



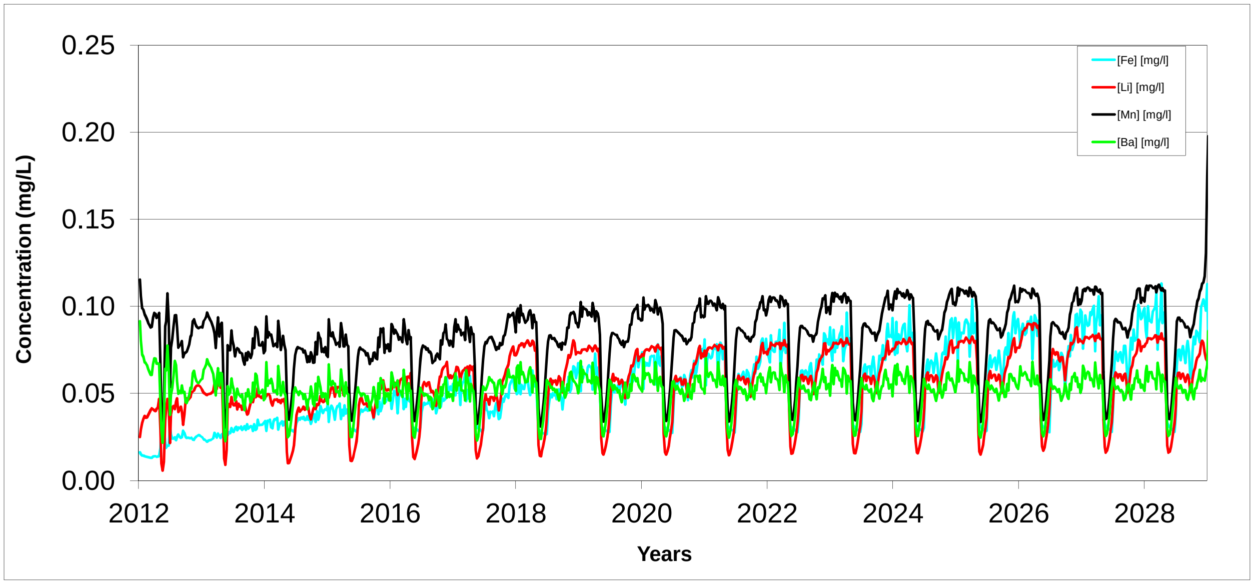


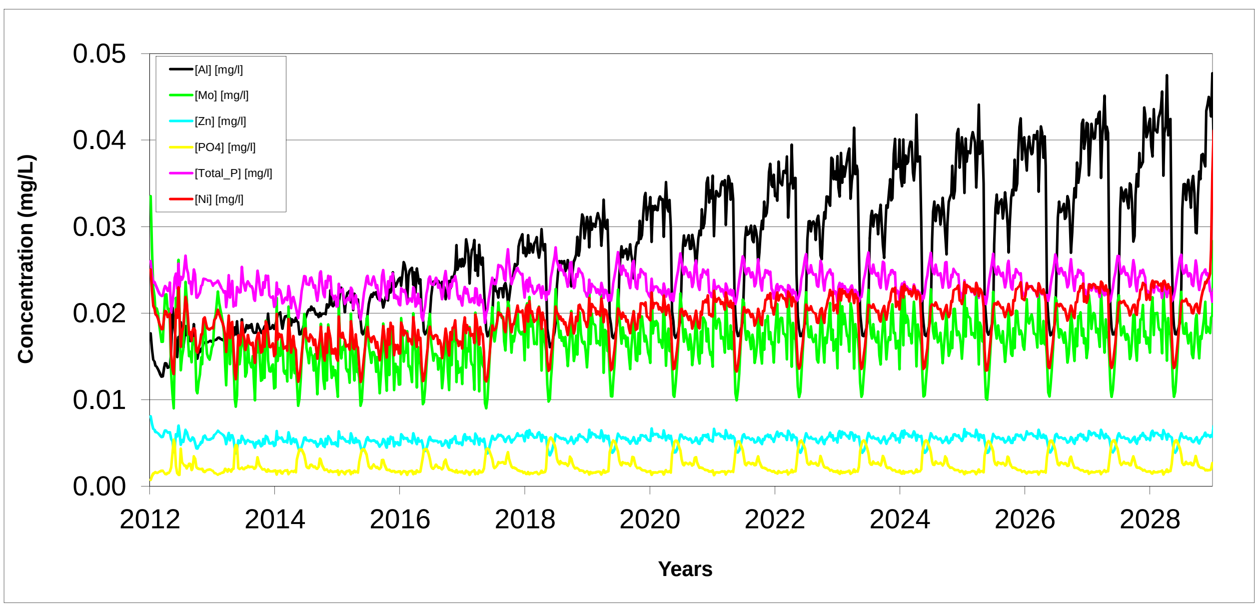
Date: December, 2013
Project: 12-1337-0001

Drawn KAS
Chkd KJD

De Beers Canada Inc.

Water Management Pond Seepage Dissolved Concentrations	FIGURE VII-11c



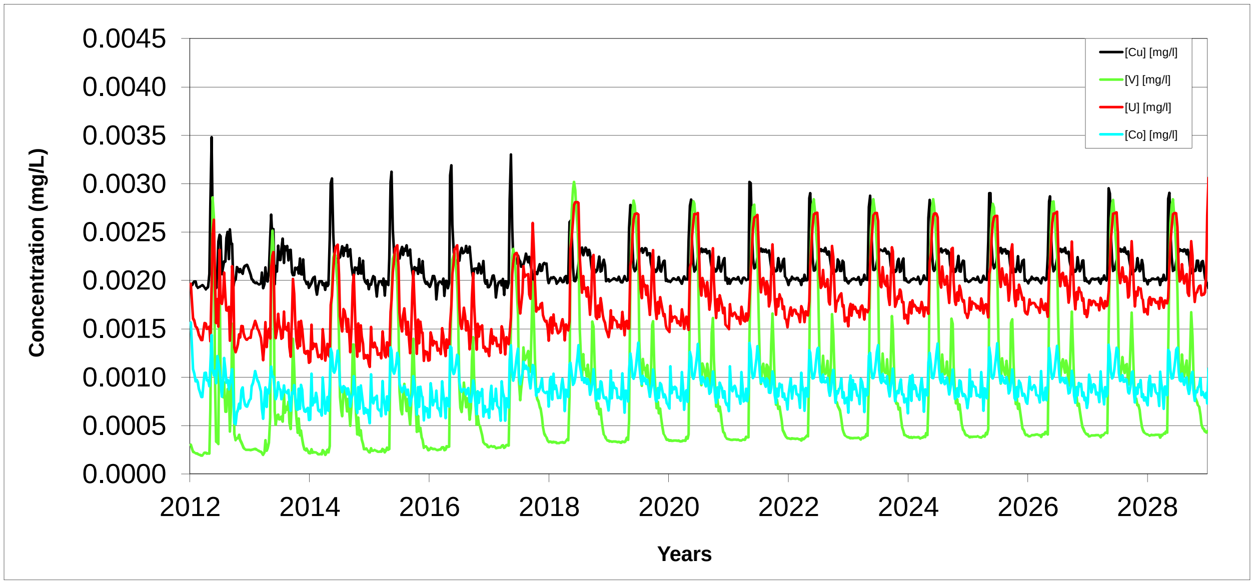


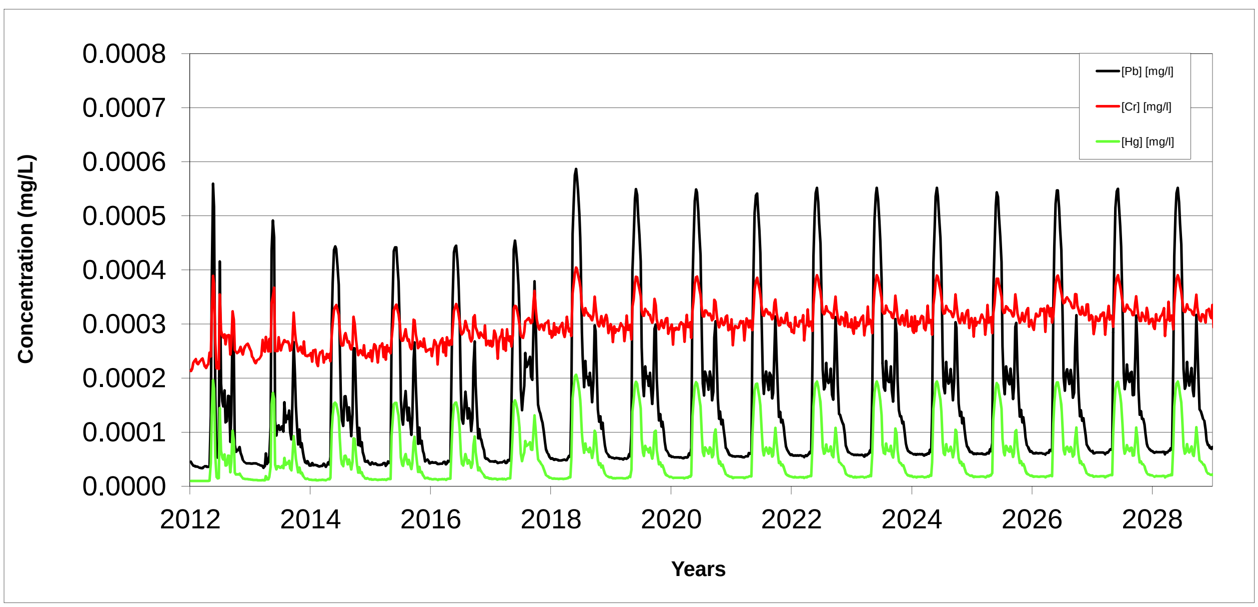
Date: December, 2013
Project: 12-1337-0001

Drawn KAS
Chkd KJD

De Beers Canada Inc.

Water Management Pond Seepage Dissolved Concentrations	FIGURE VII-11d



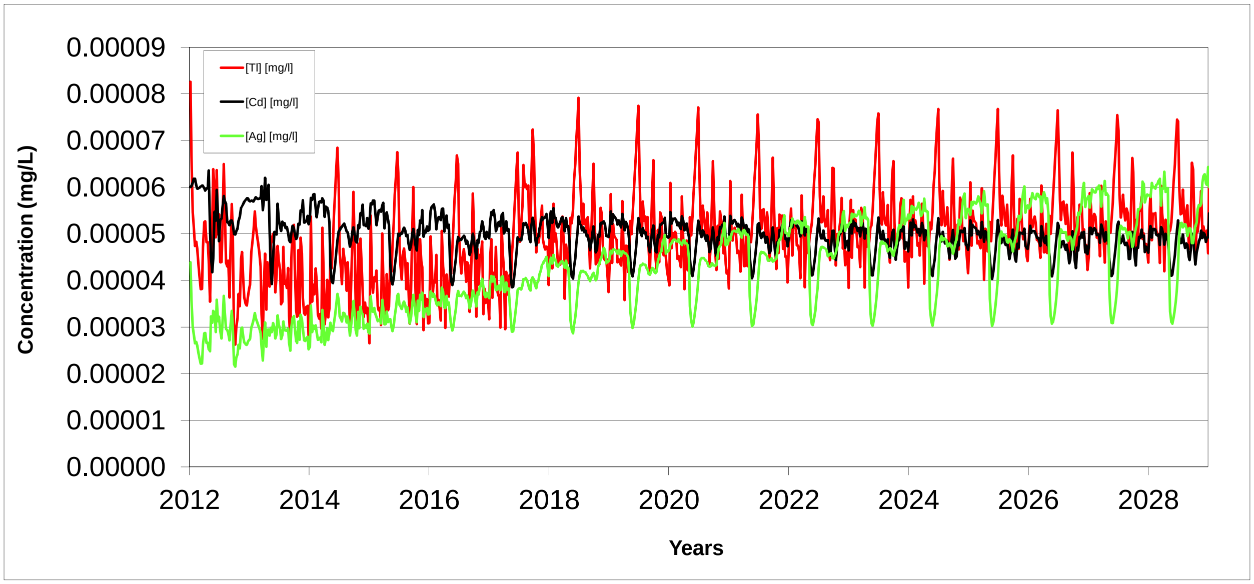


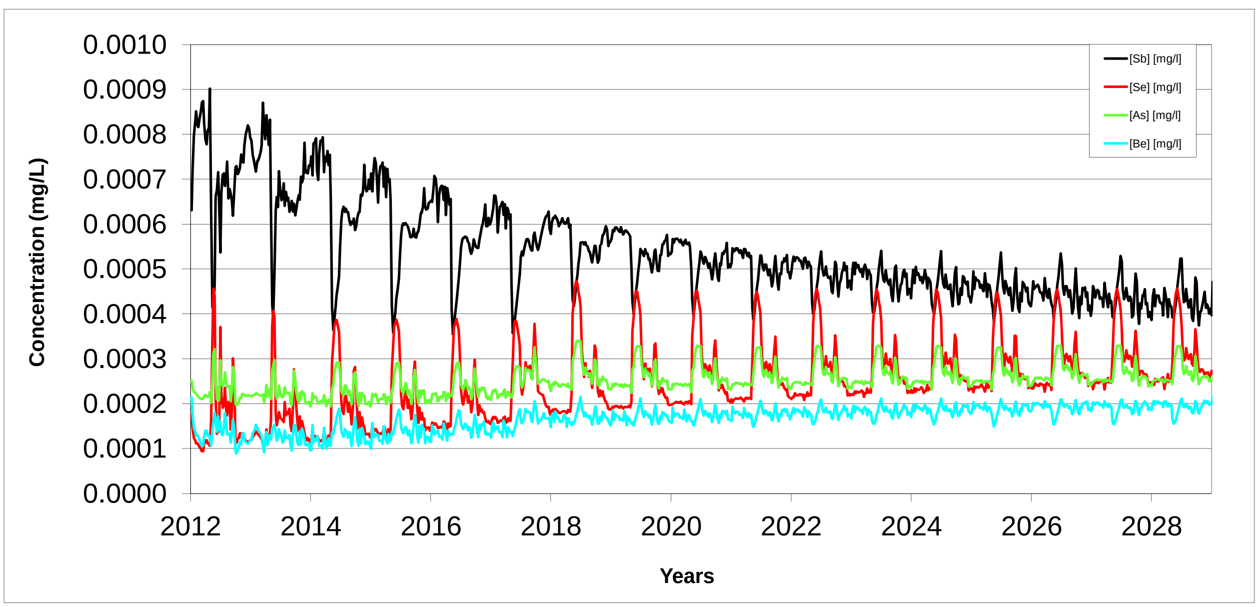
Date: December, 2013
Project: 12-1337-0001

Drawn KAS
Chkd KJD

De Beers Canada Inc.

Water Management Pond Seepage Dissolved Concentrations	FIGURE VII-11e



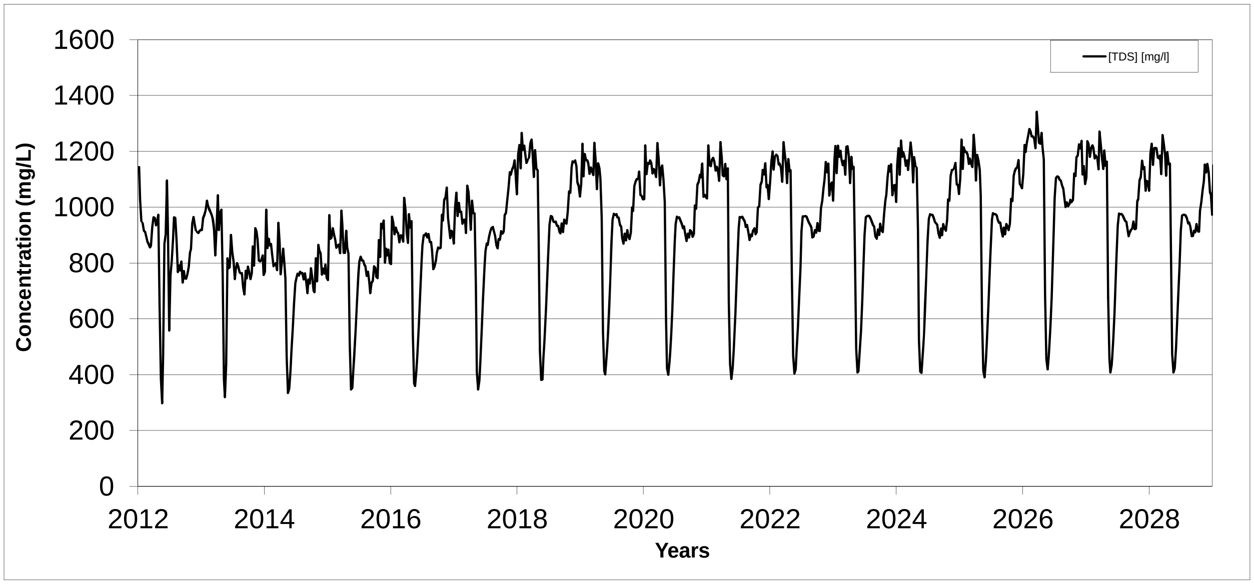


Date: December, 2013
Project: 12-1337-0001

Drawn KAS
Chkd KJD

De Beers Canada Inc.

Water Management Pond Seepage Dissolved Concentrations	FIGURE VII-11f



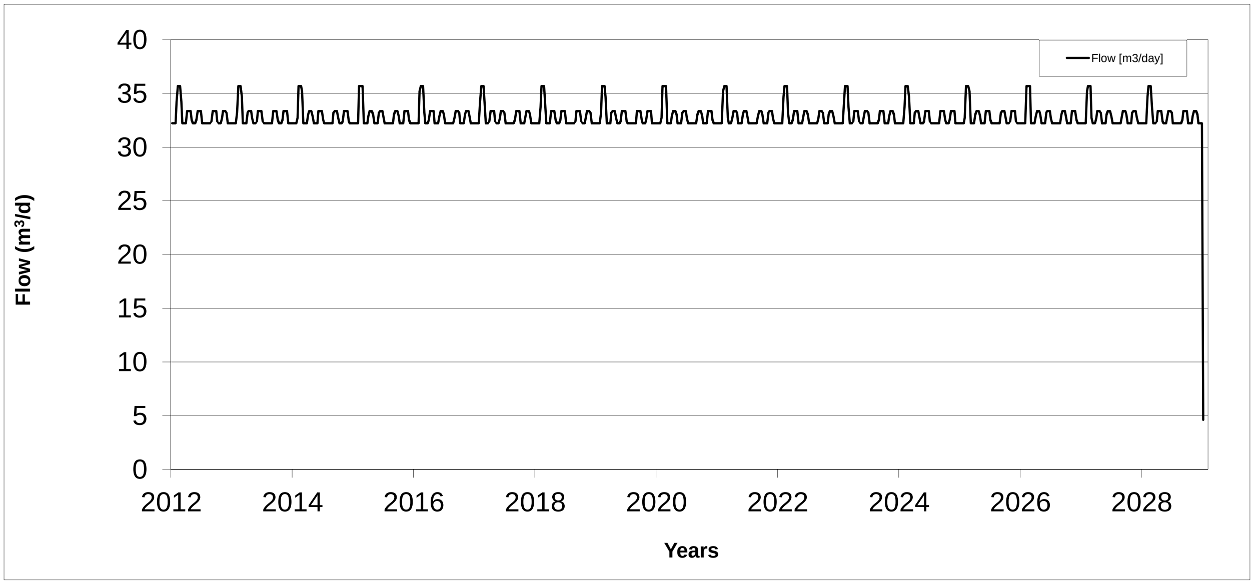
Date: December, 2013
Project: 12-1337-0001

Drawn KAS
Chkd KJD

De Beers Canada Inc.

Water Management Pond Seepage Dissolved Concentrations

FIGURE VII-11g



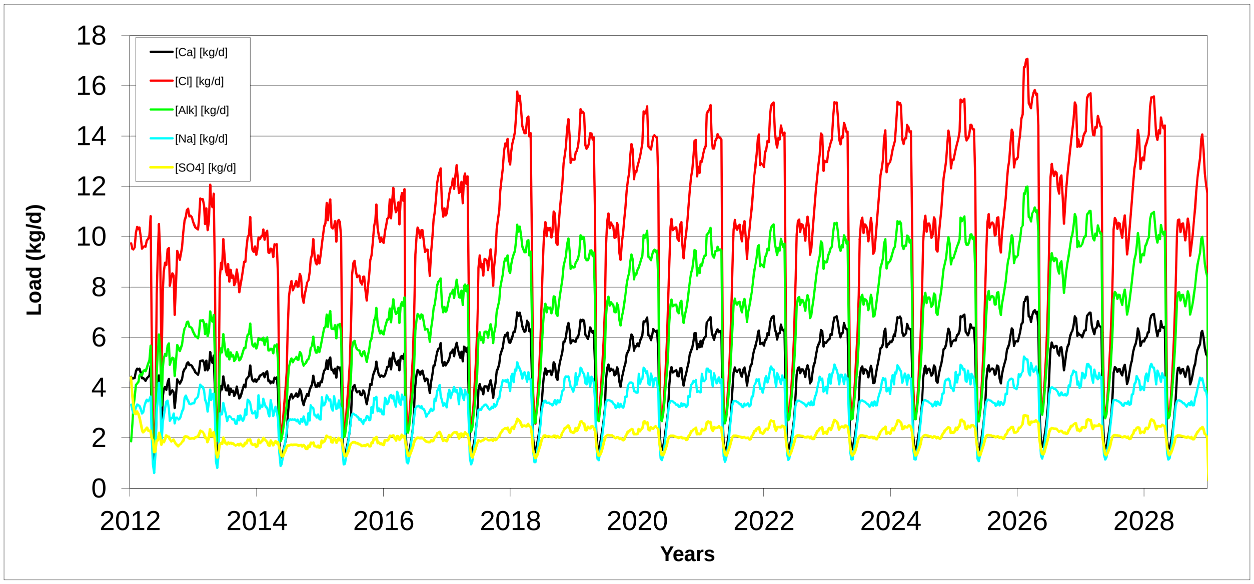
Date: December, 2013
Project: 12-1337-0001

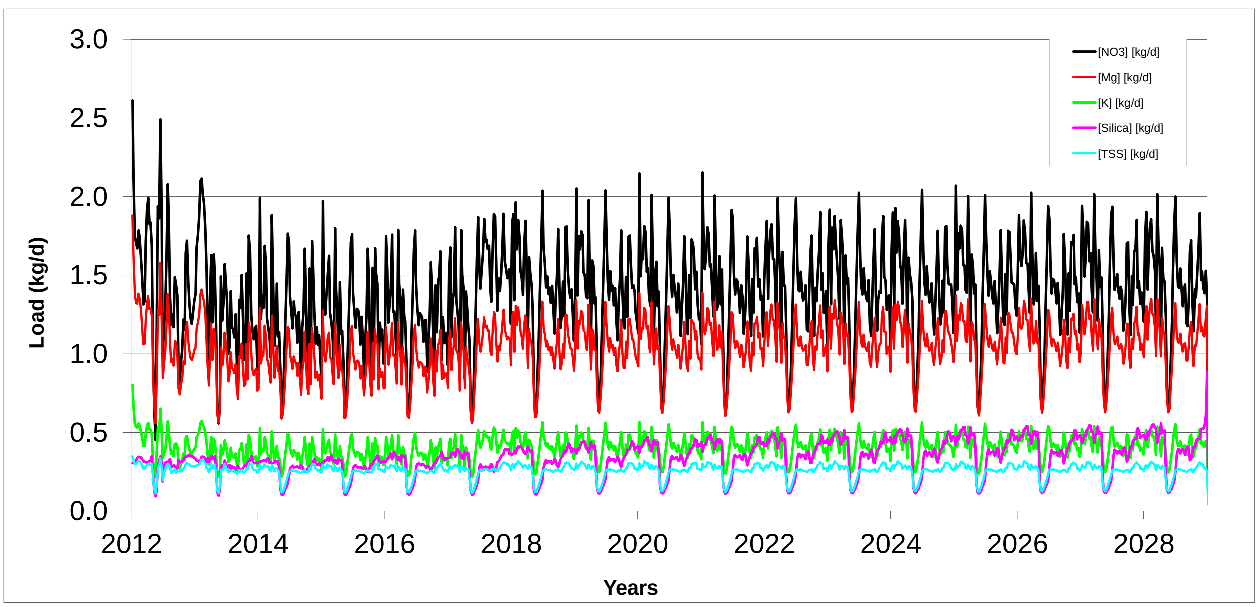
Drawn KAS
Chkd KJD

De Beers Canada Inc.

Water Management Pond Seepage Dissolved Load

FIGURE VII-12a



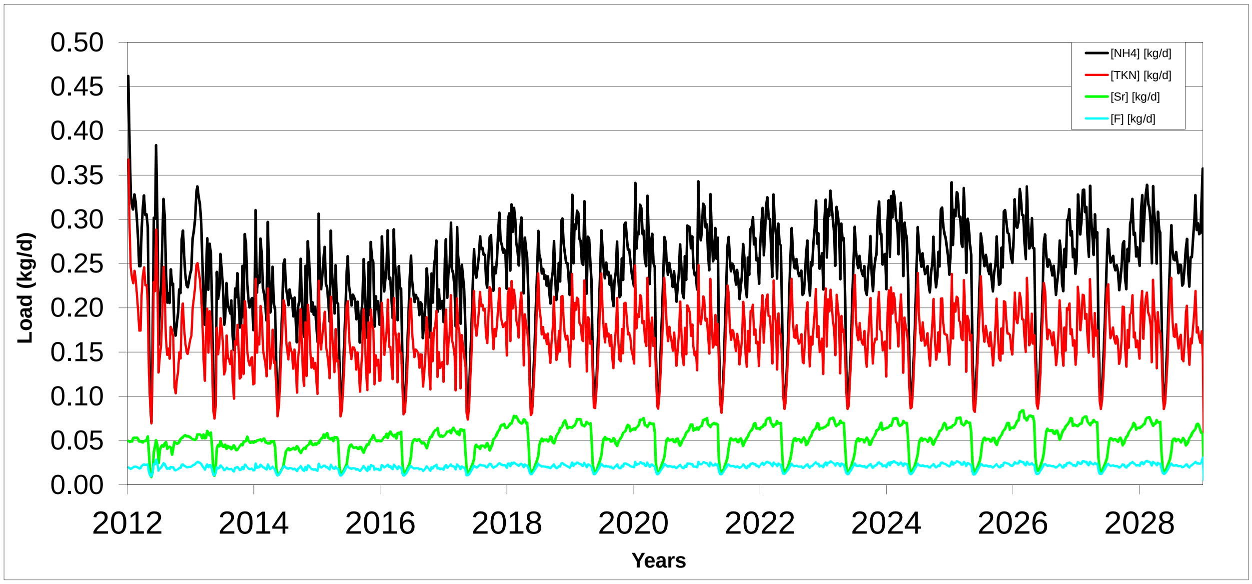


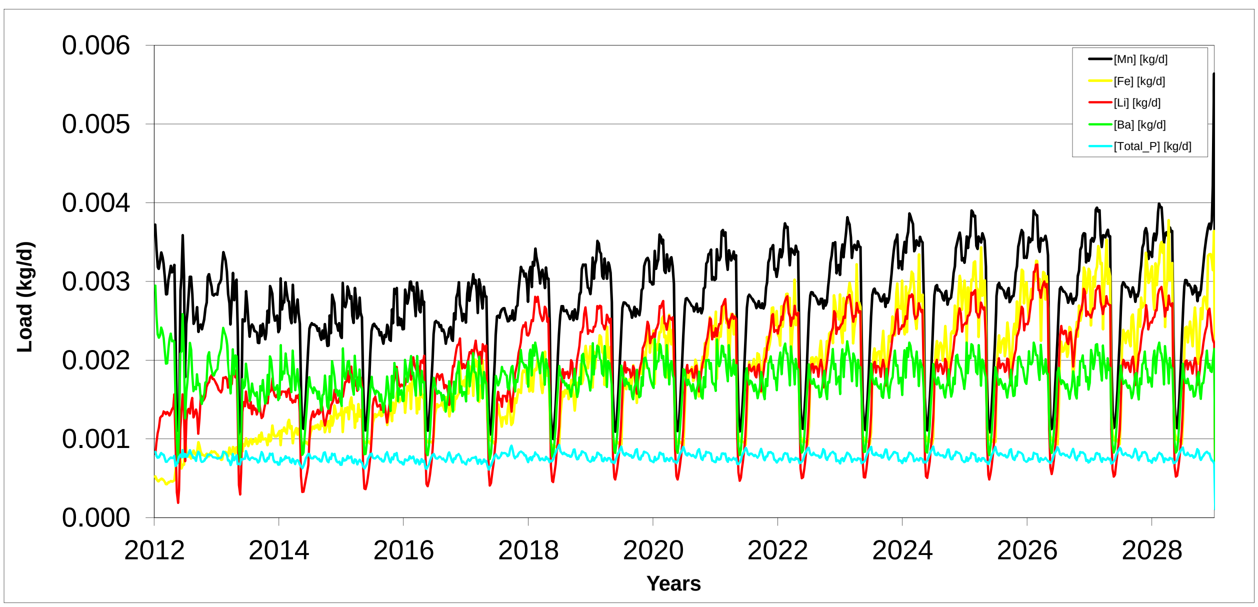
Date: December, 2013
Project: 12-1337-0001

Drawn KAS
Chkd KJD

De Beers Canada Inc.

Water Management Pond Seepage Dissolved Load	FIGURE VII-12b



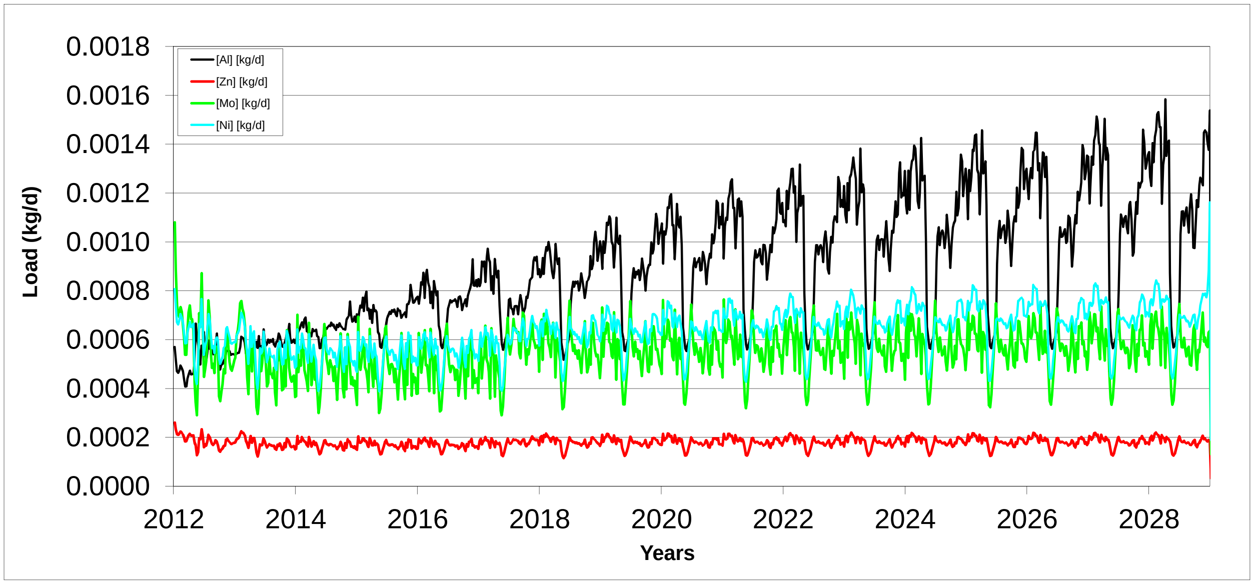


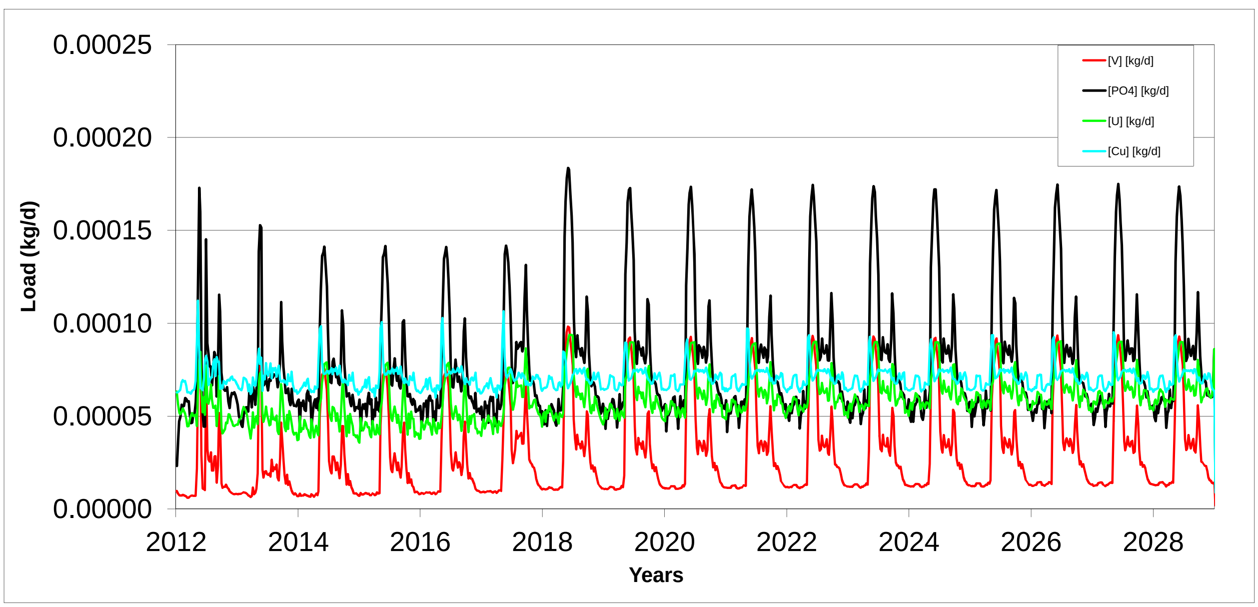
Date: December, 2013
Project: 12-1337-0001

Drawn KAS
Chkd KJD

De Beers Canada Inc.

Water Management Pond Seepage Dissolved Load	FIGURE VII-12c





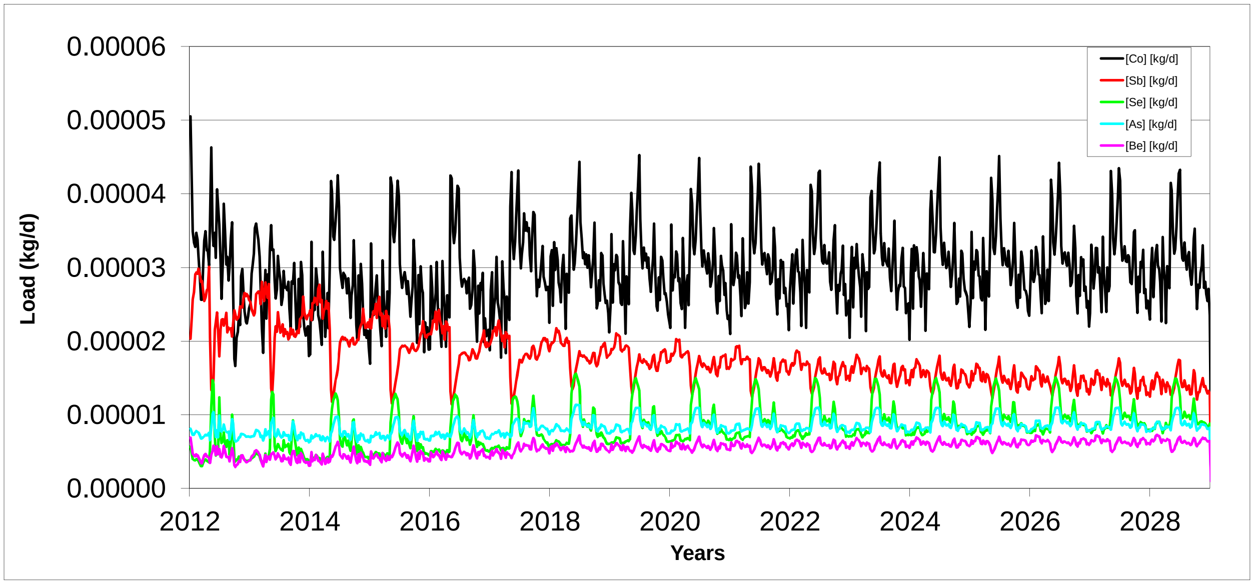
Date: December, 2013
Project: 12-1337-0001

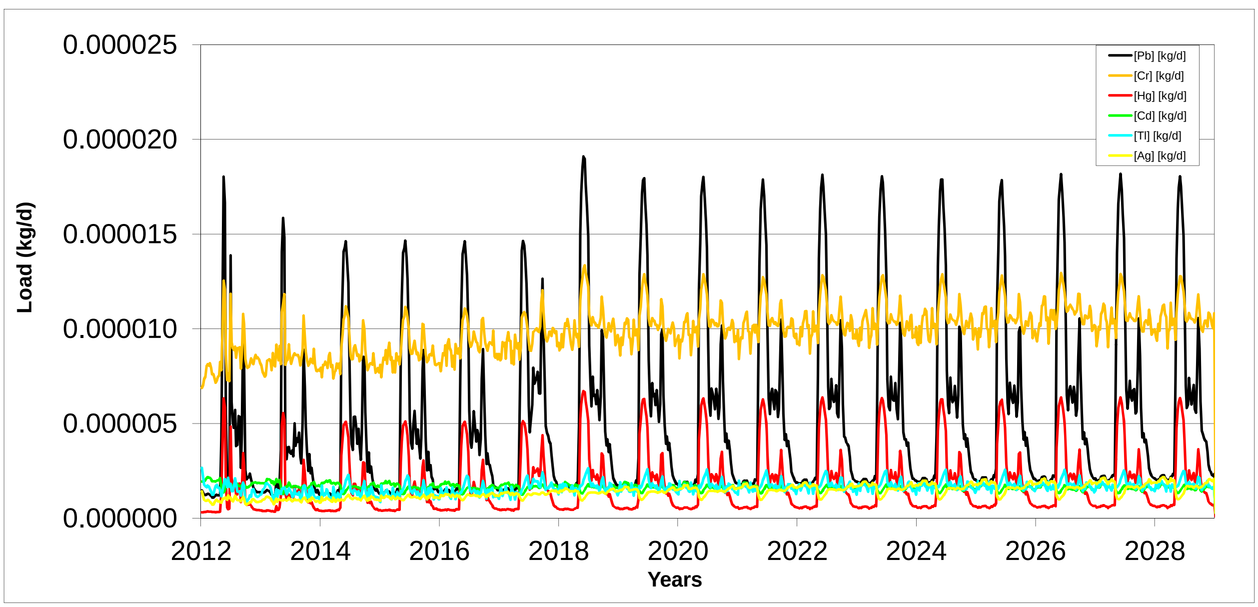
Drawn KAS
Chkd KJD

De Beers Canada Inc.

Water Management Pond Seepage Dissolved Load

FIGURE VII-12d



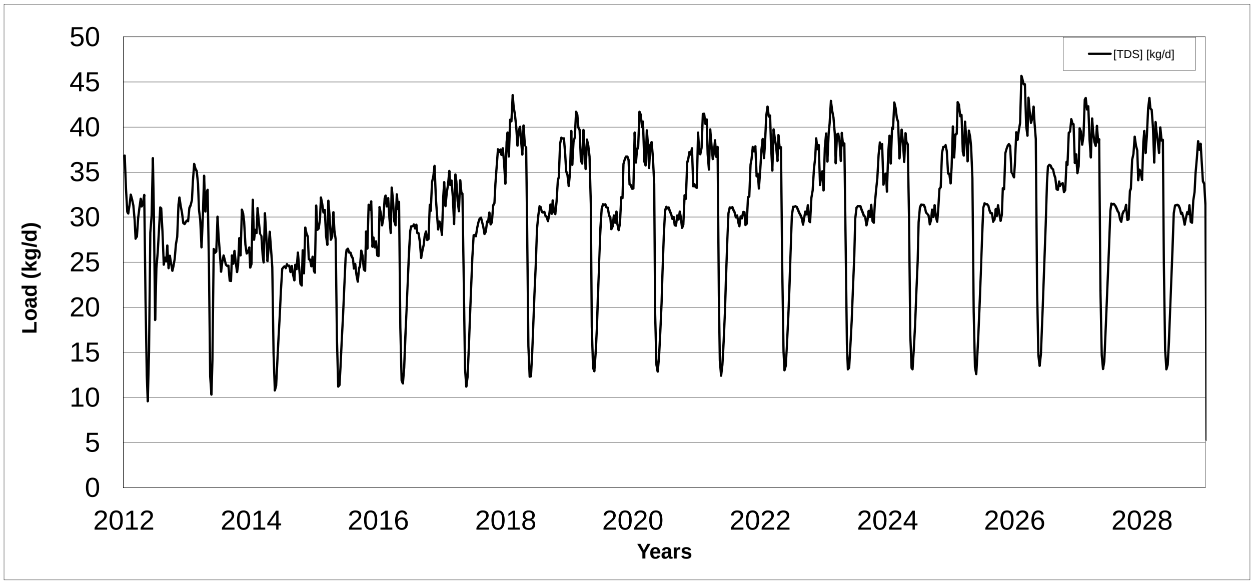


Date: December, 2013
Project: 12-1337-0001

Drawn KAS
Chkd KJD

De Beers Canada Inc.

Water Management Pond Seepage Dissolved Load	FIGURE VII-12e



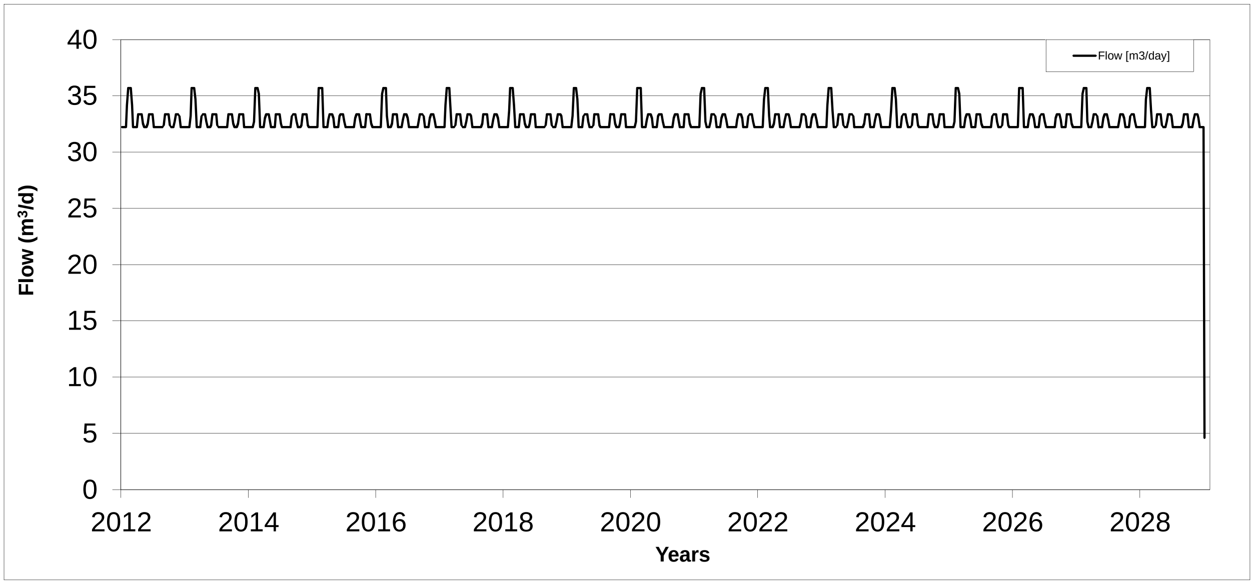
Date: December, 2013
Project: 12-1337-0001

Drawn KAS
Chkd KJD

De Beers Canada Inc.

Water Management Pond Seepage Dissolved Load FLOW

FIGURE VII-12f



Date: December, 2013
Project: 12-1337-0001

Drawn KAS
Chkd KJD

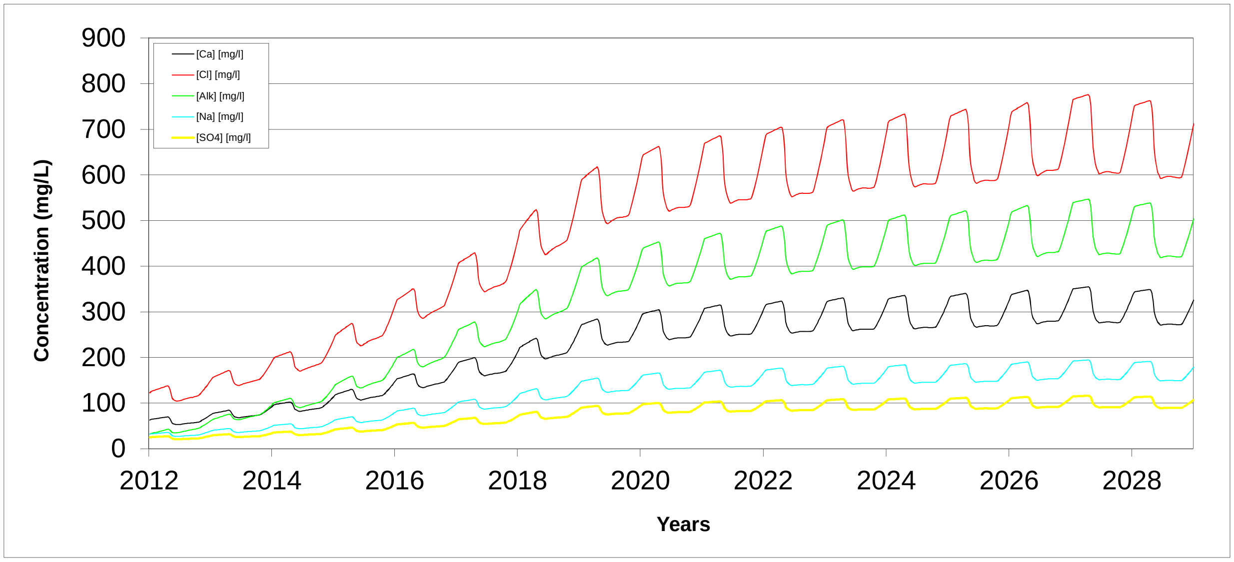
De Beers Canada Inc.

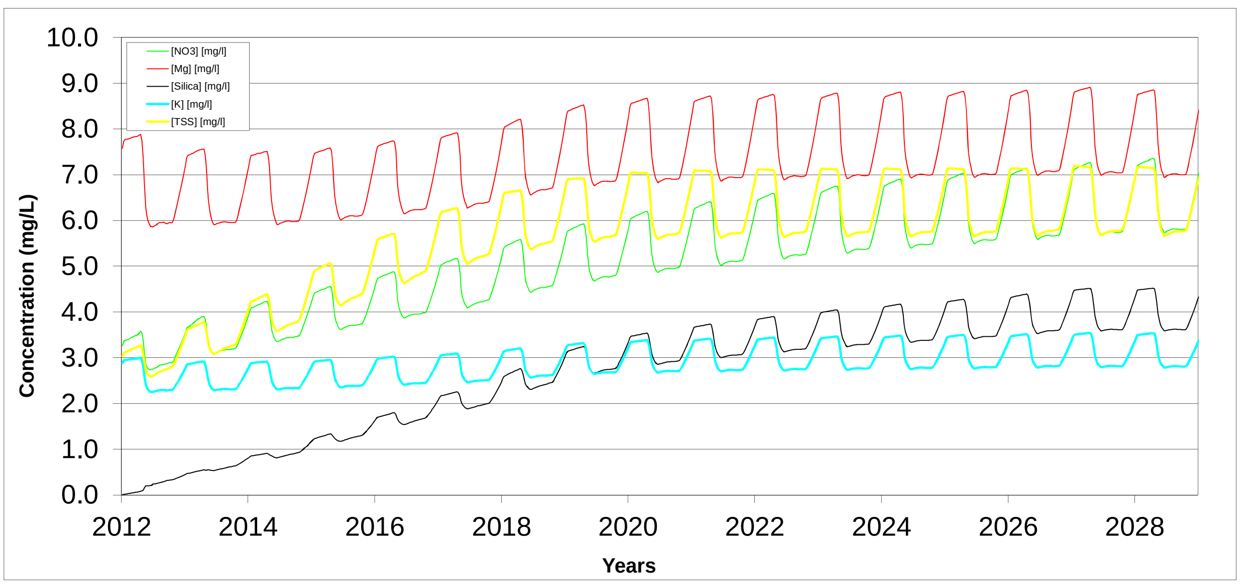
APPENDIX VIII

UPPER BOUND SCENARIO A

December 2013

Snap Lake Outflow Dissolved Concentrations	**FIGURE VIII-1a**





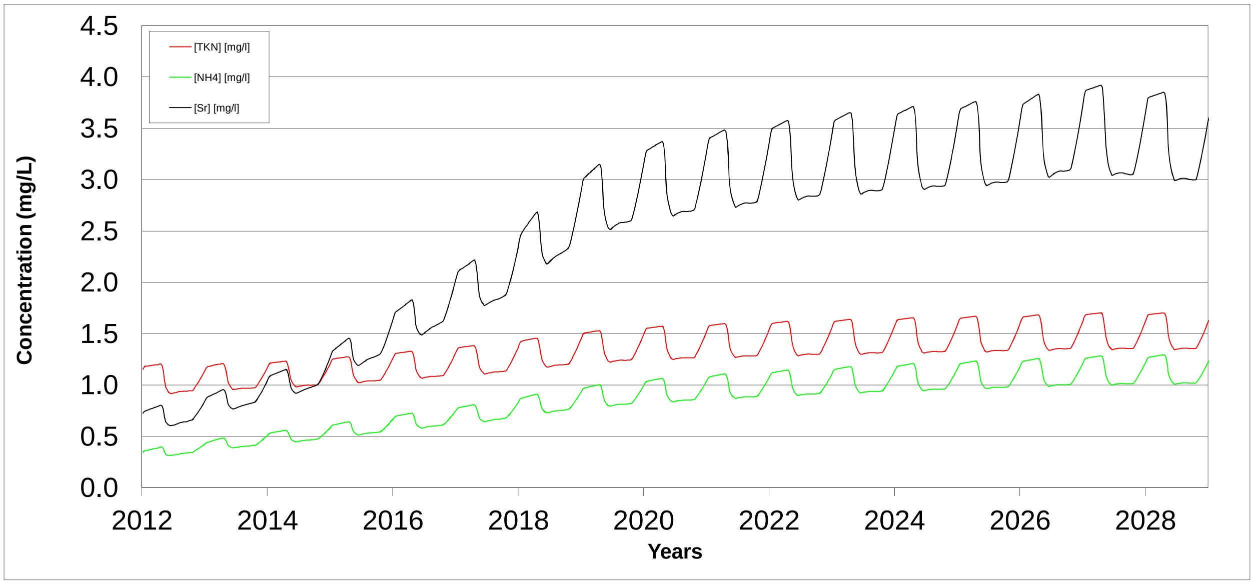
Date: December, 2013
Project: 12-1337-0001

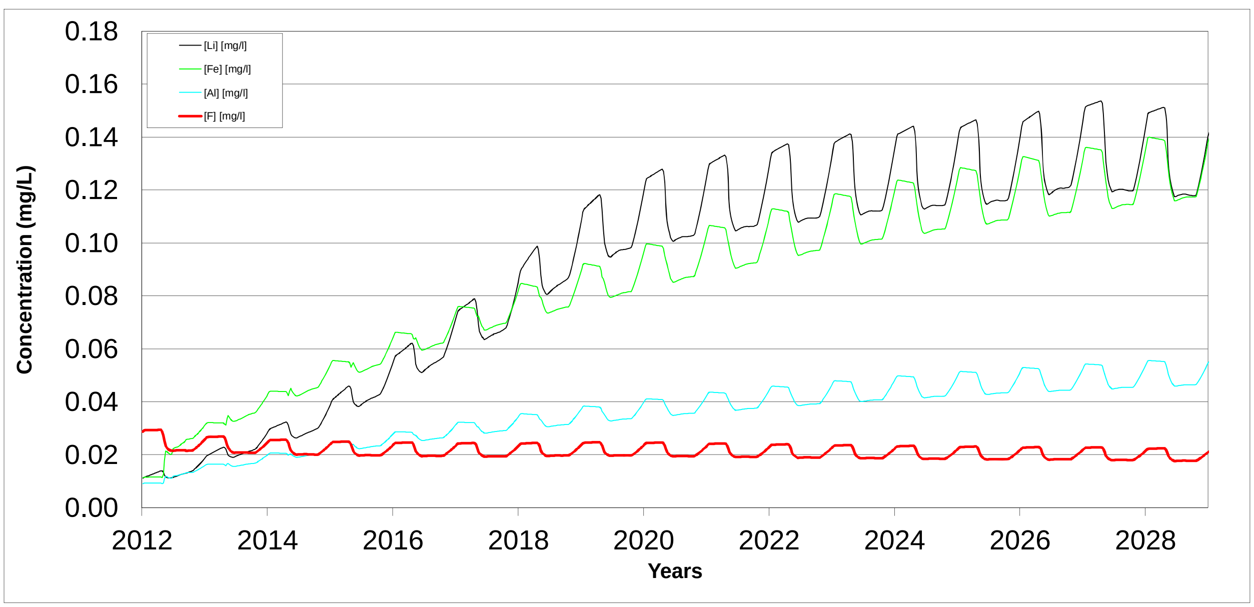
Drawn KAS
Chkd KJD

De Beers Canada Inc.

Snap Lake Outflow Dissolved Concentrations

FIGURE VIII-1b





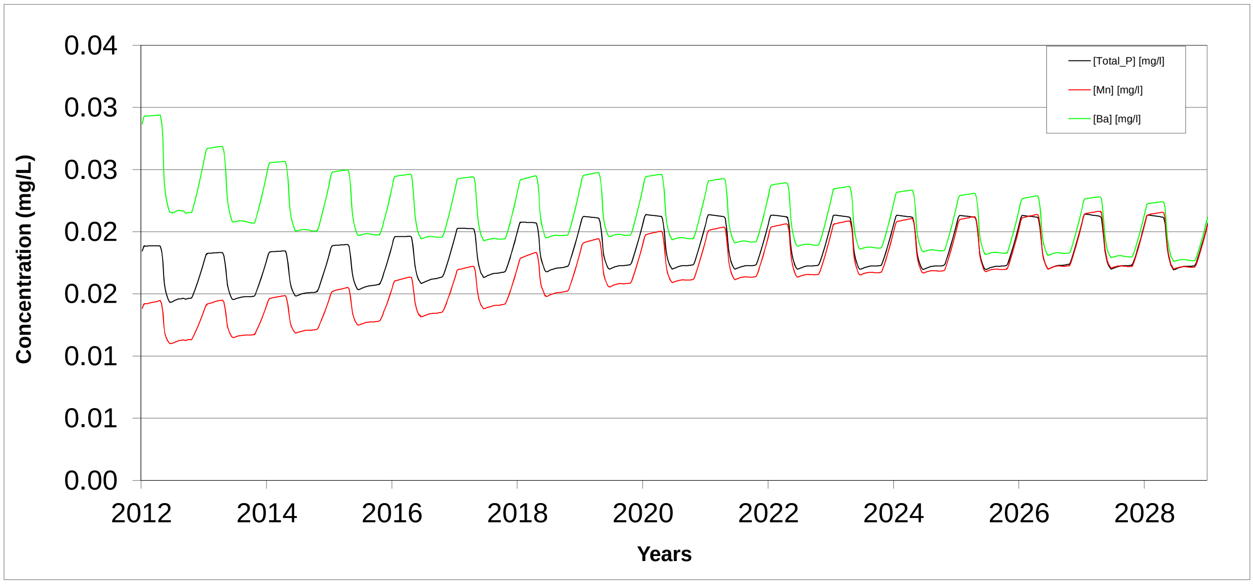
Date: December, 2013
Project: 12-1337-0001

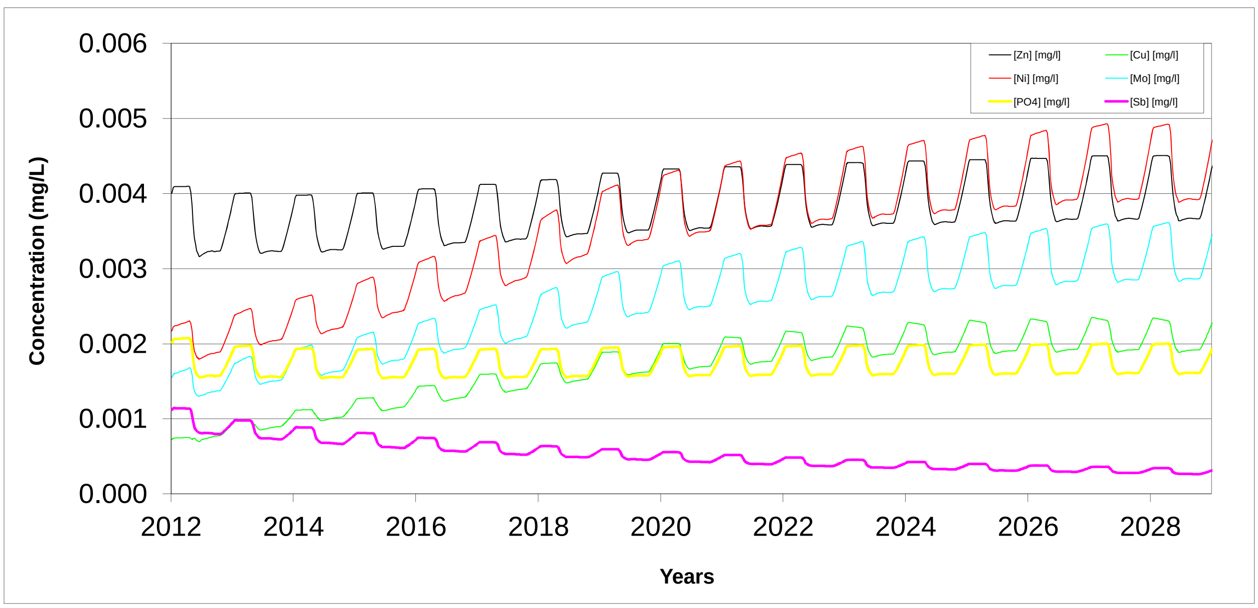
Drawn KAS
Chkd KJD

De Beers Canada Inc.

Snap Lake Outflow Dissolved Concentrations

FIGURE VIII-1c



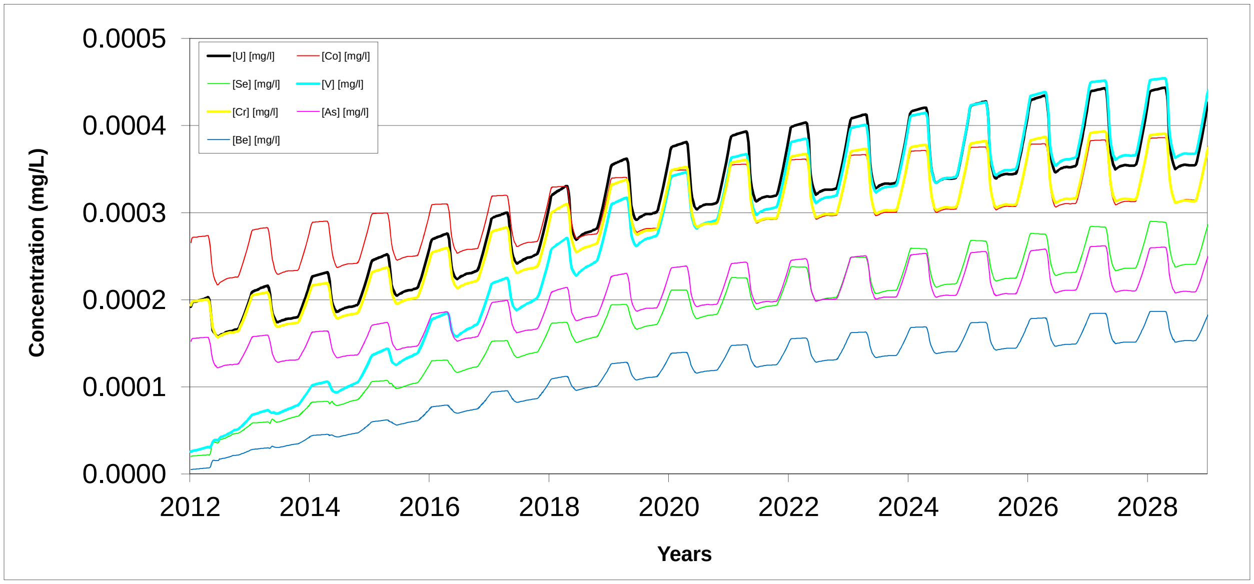


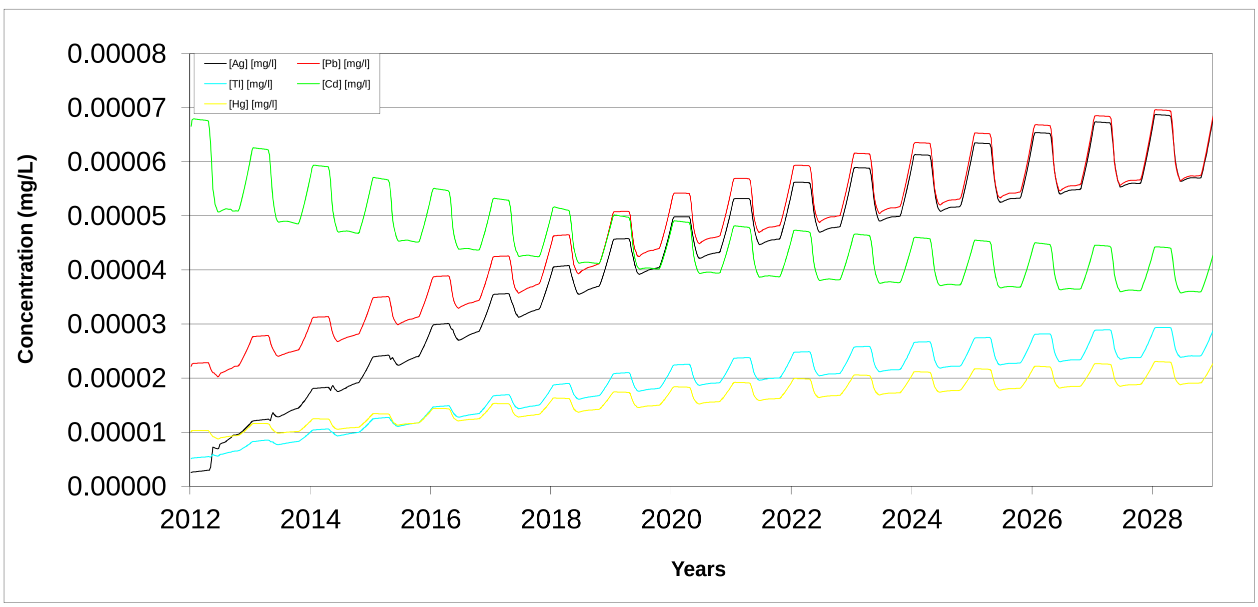
Date: December, 2013
Project: 12-1337-0001

Drawn KAS
Chkd KJD

De Beers Canada Inc.

Snap Lake Outflow Dissolved Concentrations	FIGURE VIII-1d



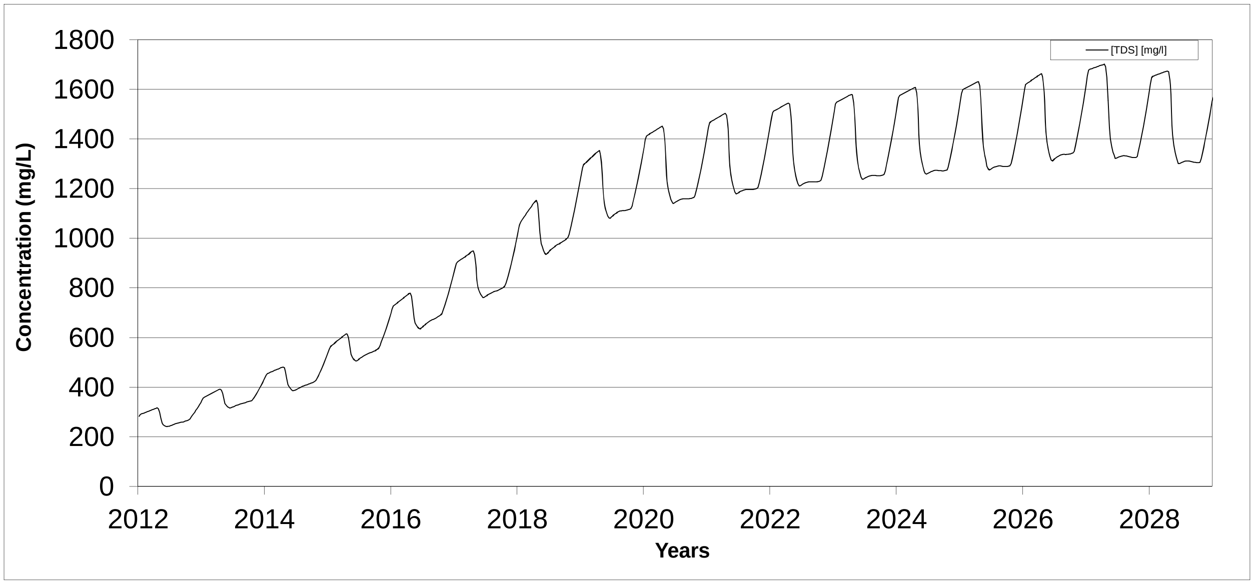


Date: December, 2013
Project: 12-1337-0001

Drawn KAS
Chkd KJD

De Beers Canada Inc.

Snap Lake Outflow Dissolved Concentrations	FIGURE VIII-1e

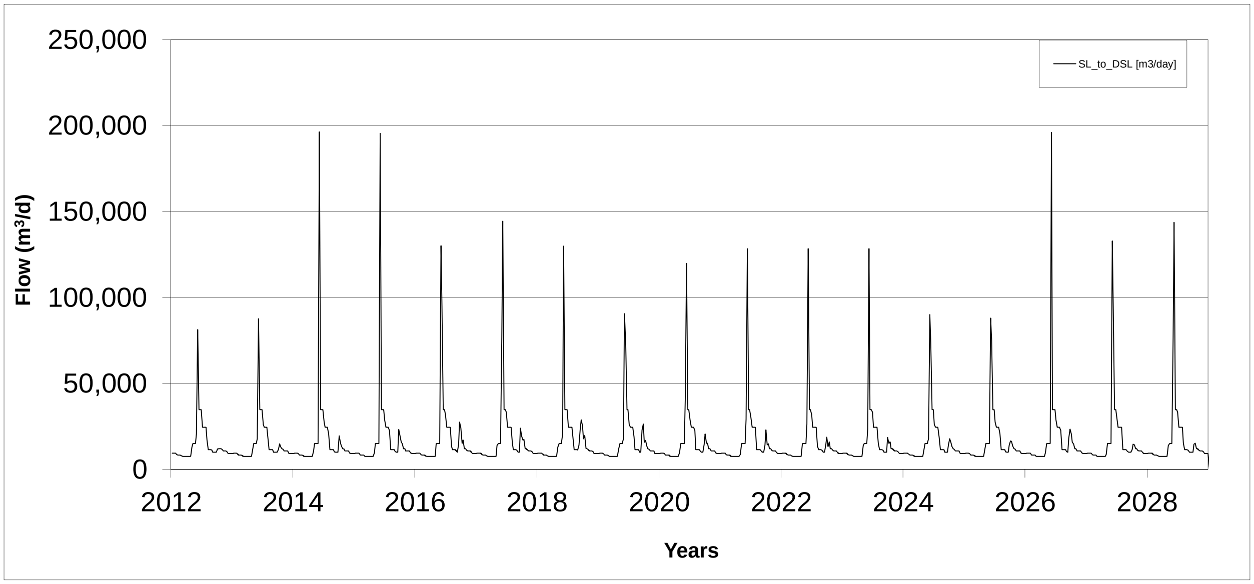


Date: December, 2013
Project: 12-1337-0001

Drawn KAS
Chkd KJD

De Beers Canada Inc.

Snap Lake Outflow Dissolved Concentrations	FIGURE VIII-1f

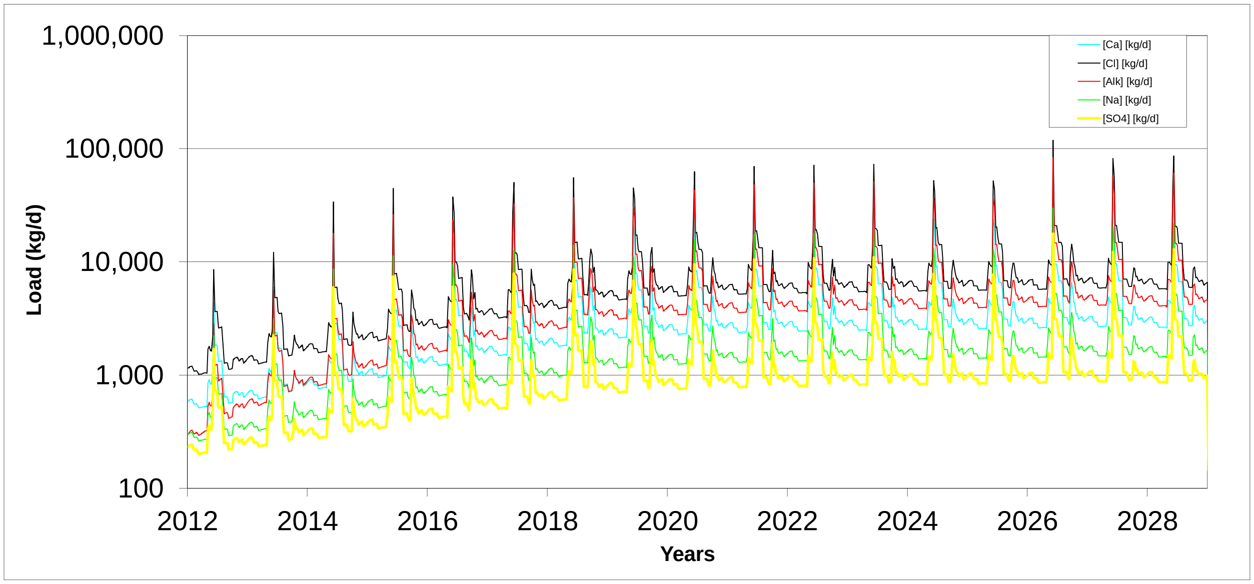


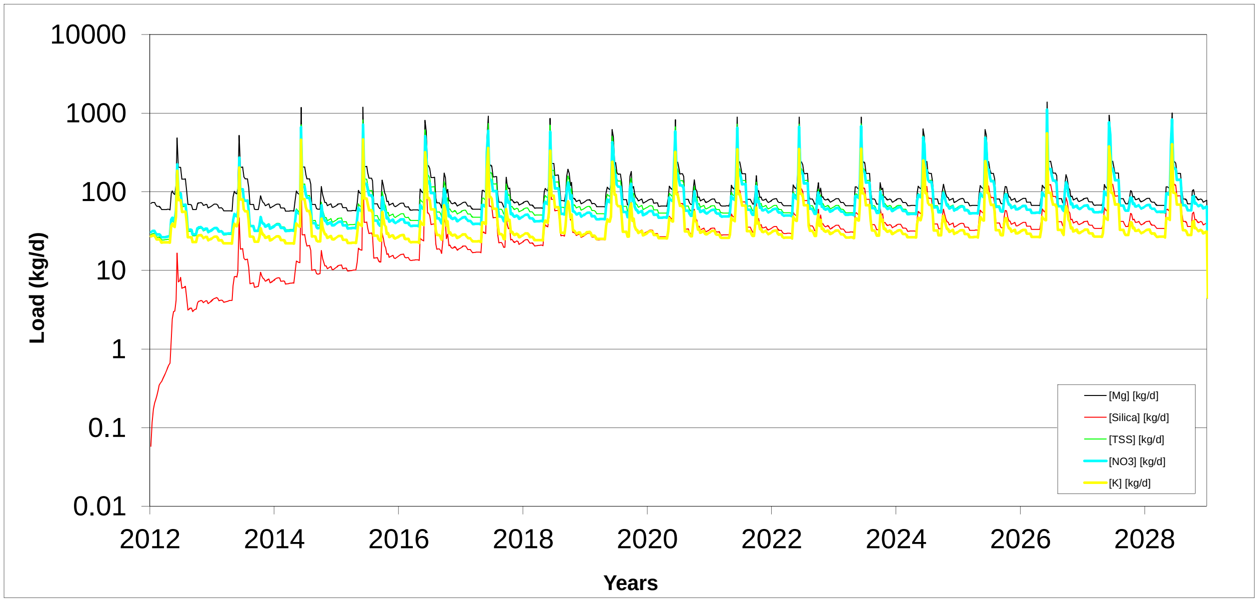
Date: December, 2013
Project: 12-1337-0001

Drawn KAS
Chkd KJD

De Beers Canada Inc.

Snap Lake Outflow Dissolved Load	FIGURE VIII-2a





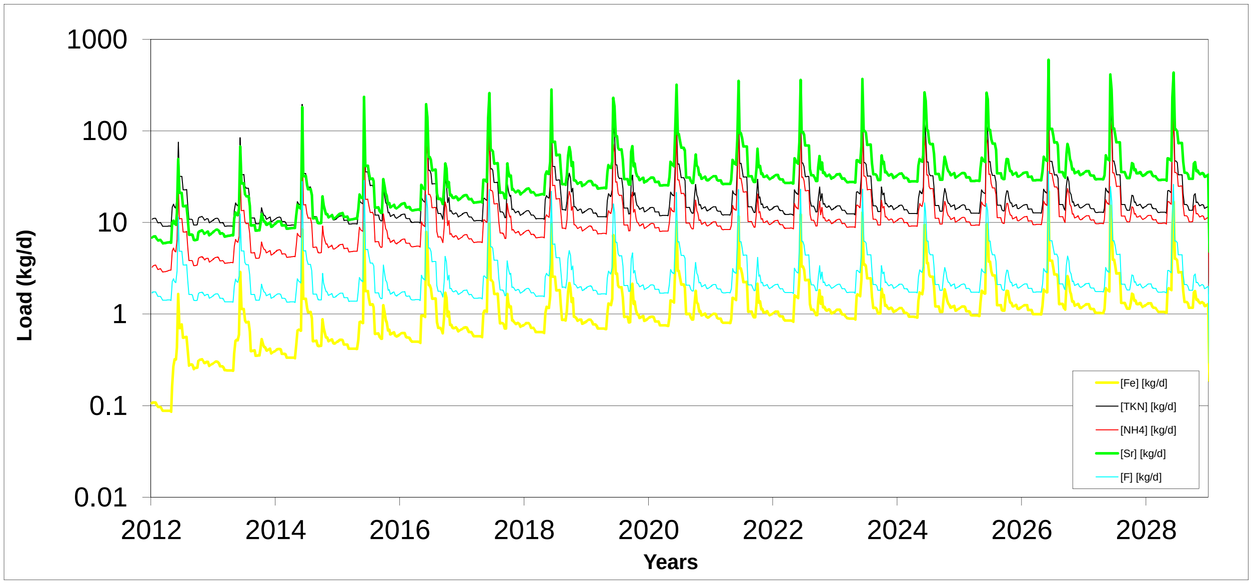
Date: December, 2013
Project: 12-1337-0001

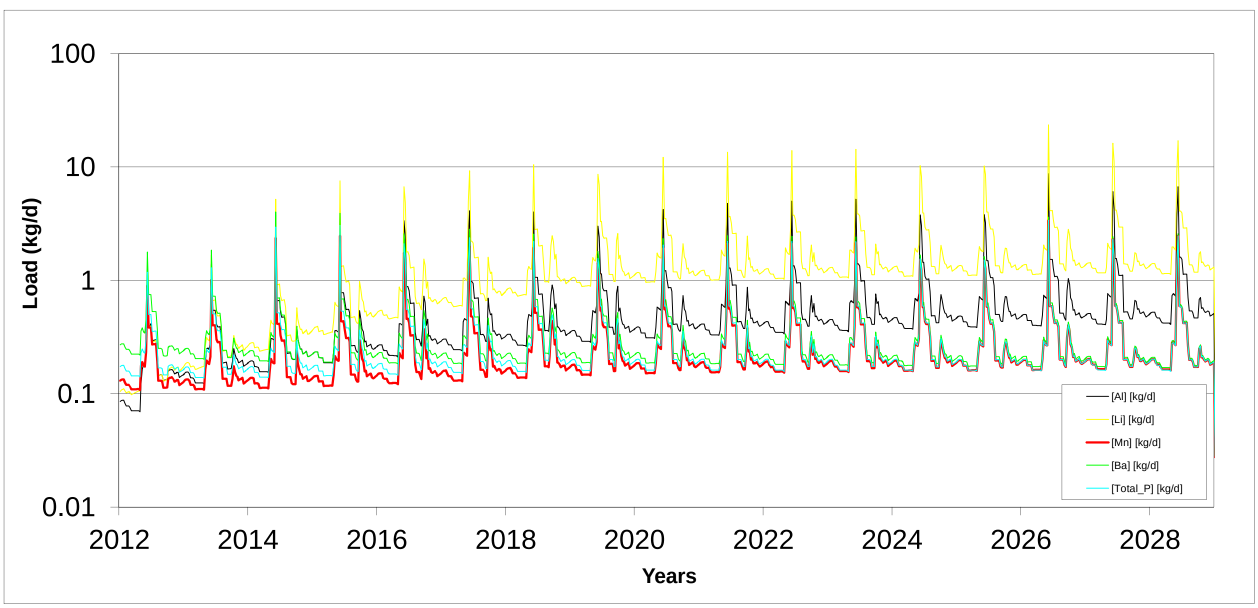
Drawn KAS
Chkd KJD

De Beers Canada Inc.

Snap Lake Outflow Dissolved Load

FIGURE VIII-2b





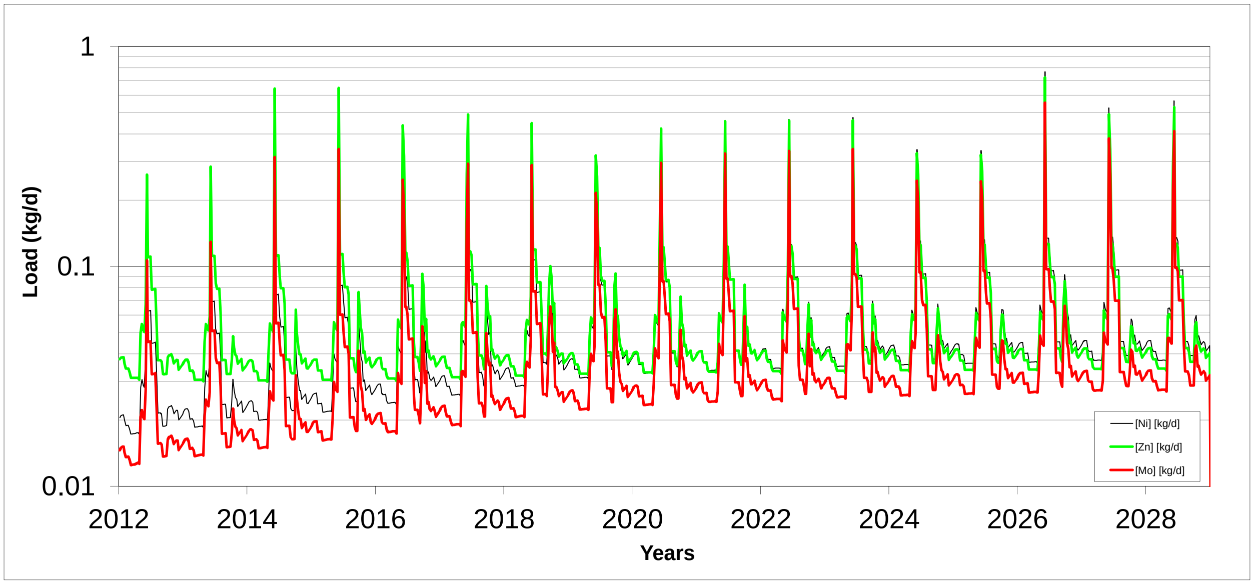
Date: December, 2013
Project: 12-1337-0001

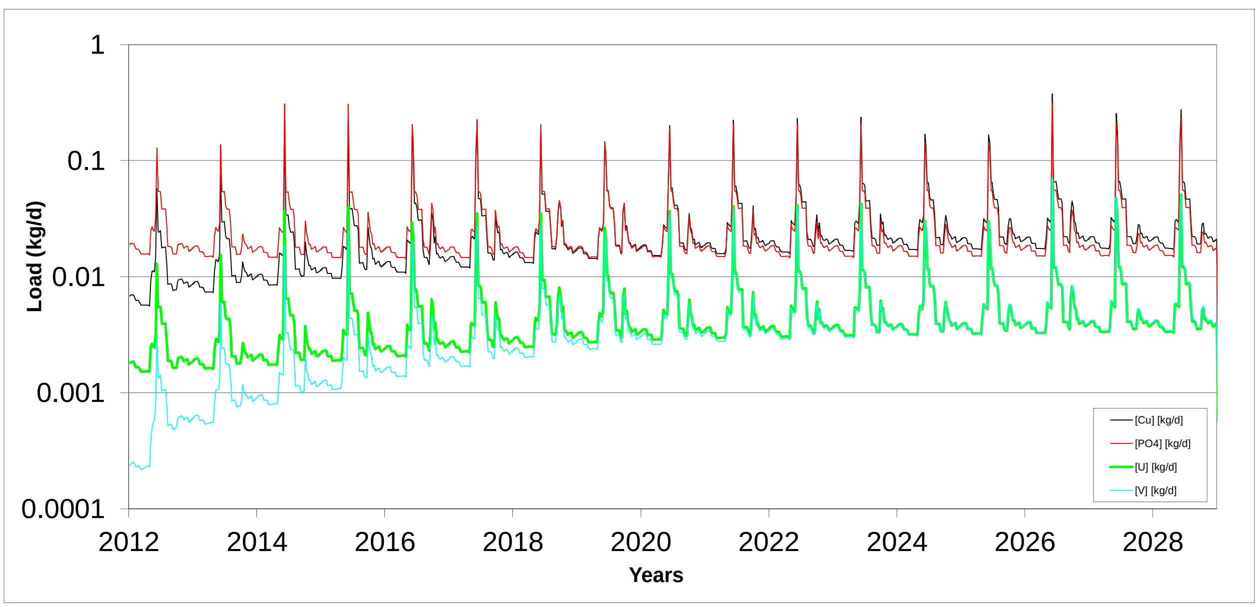
Drawn KAS
Chkd KJD

De Beers Canada Inc.

Snap Lake Outflow Dissolved Load

FIGURE VIII-2c





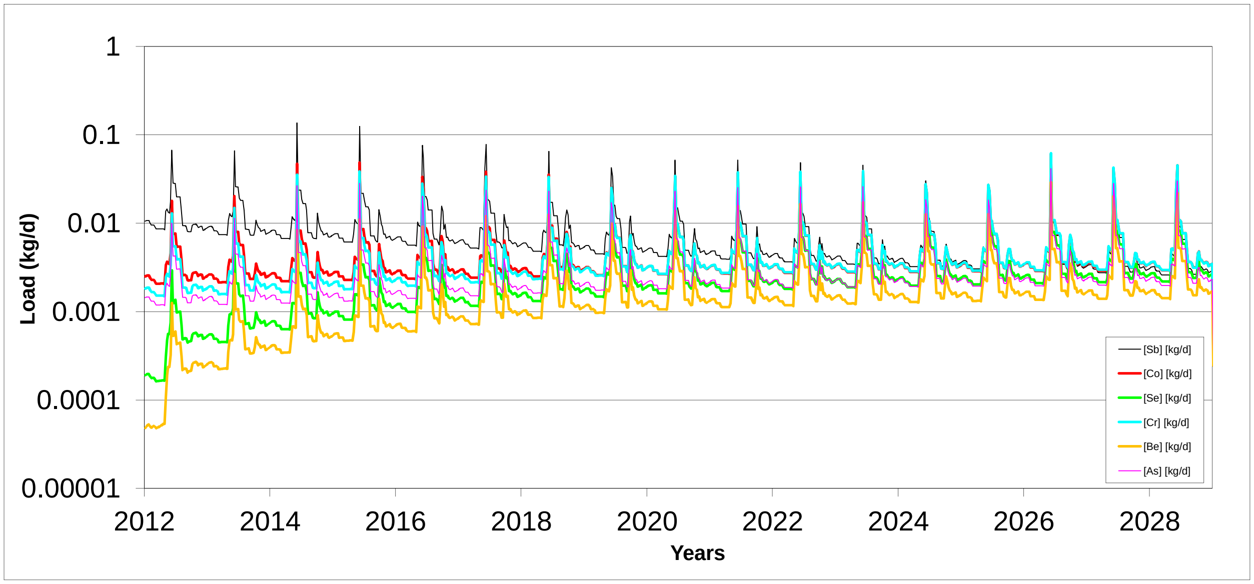
Date: December, 2013
Project: 12-1337-0001

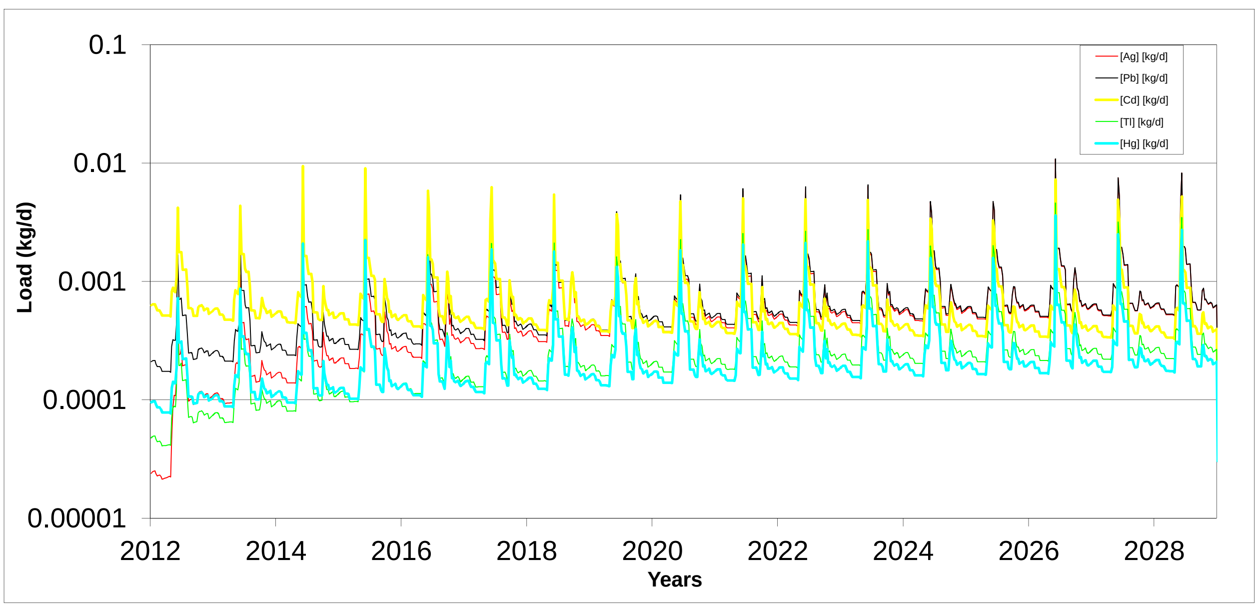
Drawn KAS
Chkd KJD

De Beers Canada Inc.

Snap Lake Outflow Dissolved Load

FIGURE VIII-2d





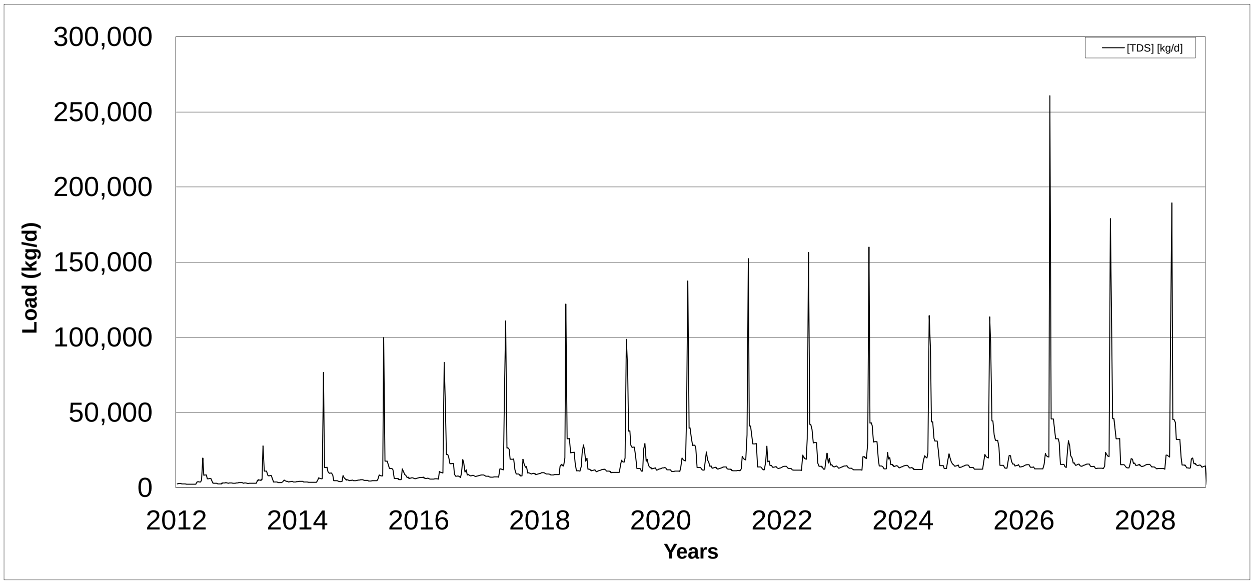
Date: December, 2013
Project: 12-1337-0001

Drawn KAS
Chkd KJD

De Beers Canada Inc.

Snap Lake Outflow Dissolved Load

FIGURE VIII-2e

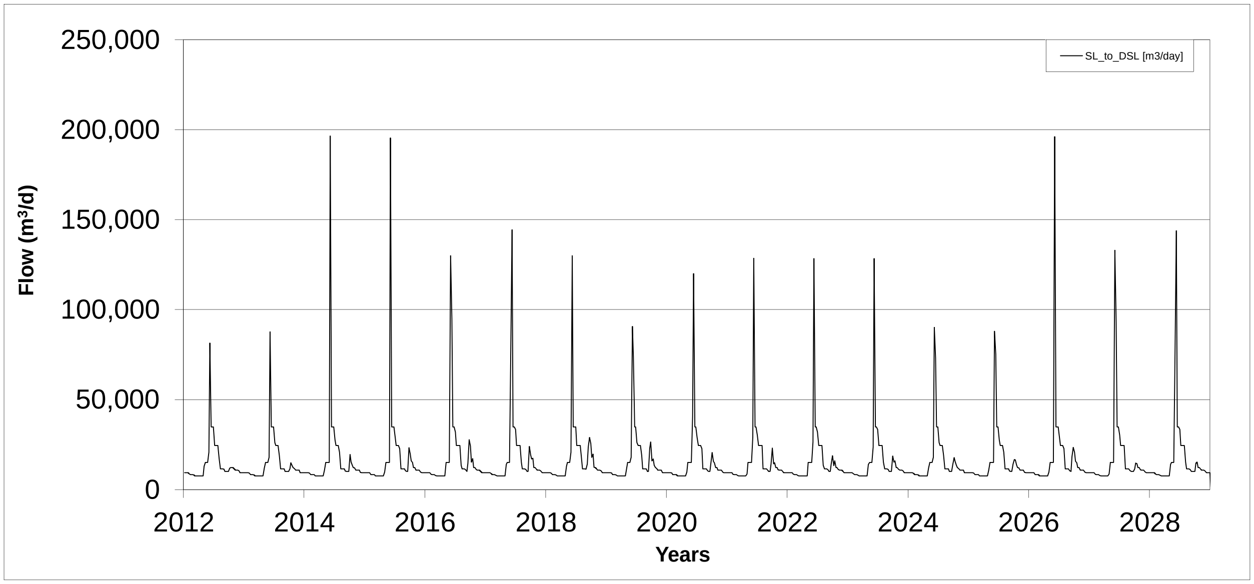


Date: December, 2013
Project: 12-1337-0001

Drawn KAS
Chkd KJD

De Beers Canada Inc.

Snap Lake Outflow Dissolved Load FLOW	FIGURE VIII-2f



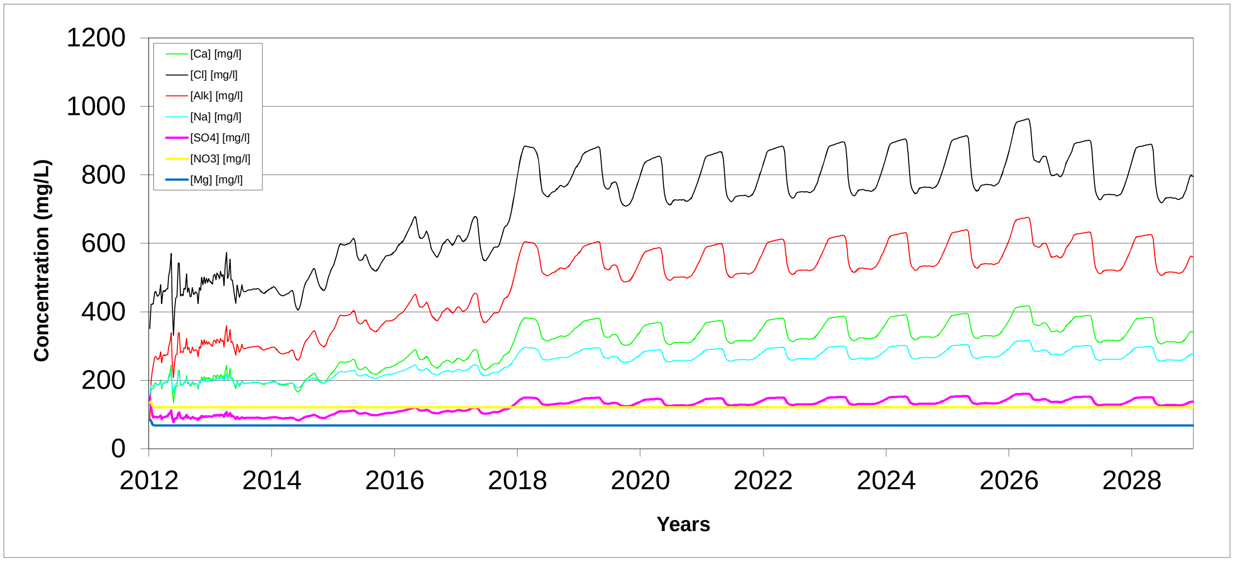
Date: December, 2013
Project: 12-1337-0001

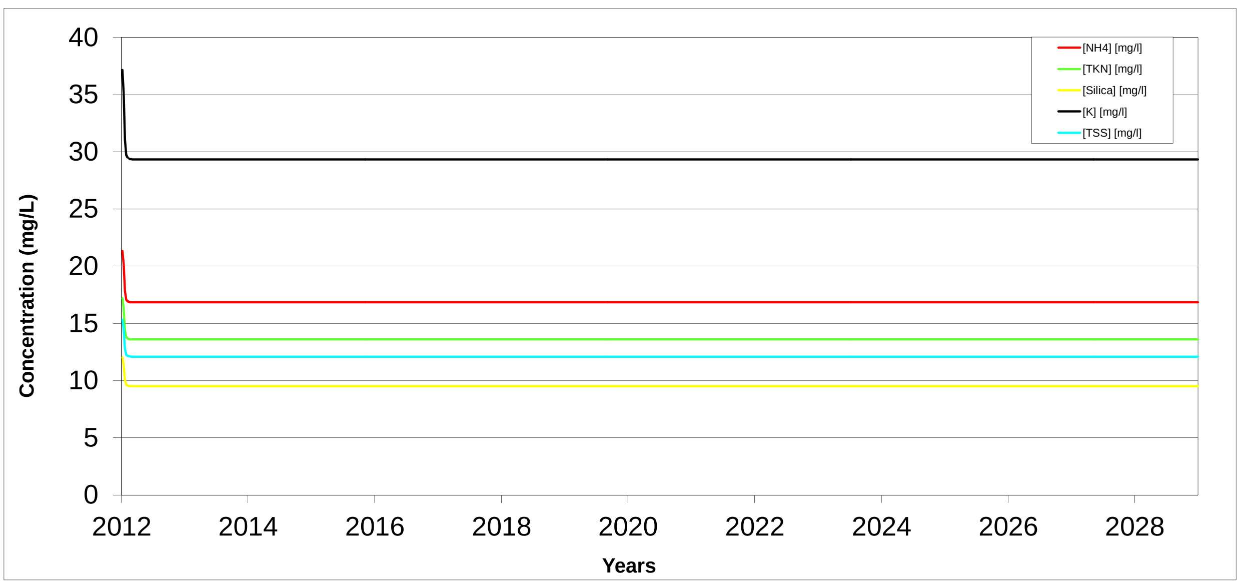
Drawn KAS
Chkd KJD

De Beers Canada Inc.

Process Water Dissolved Concentrations

FIGURE VIII-3a



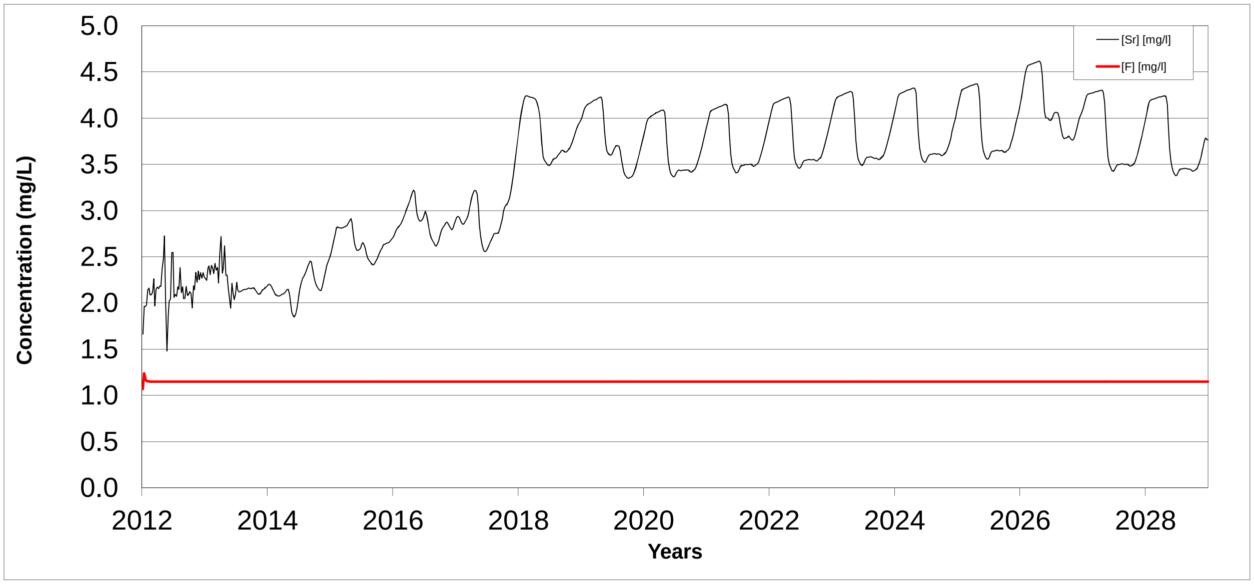


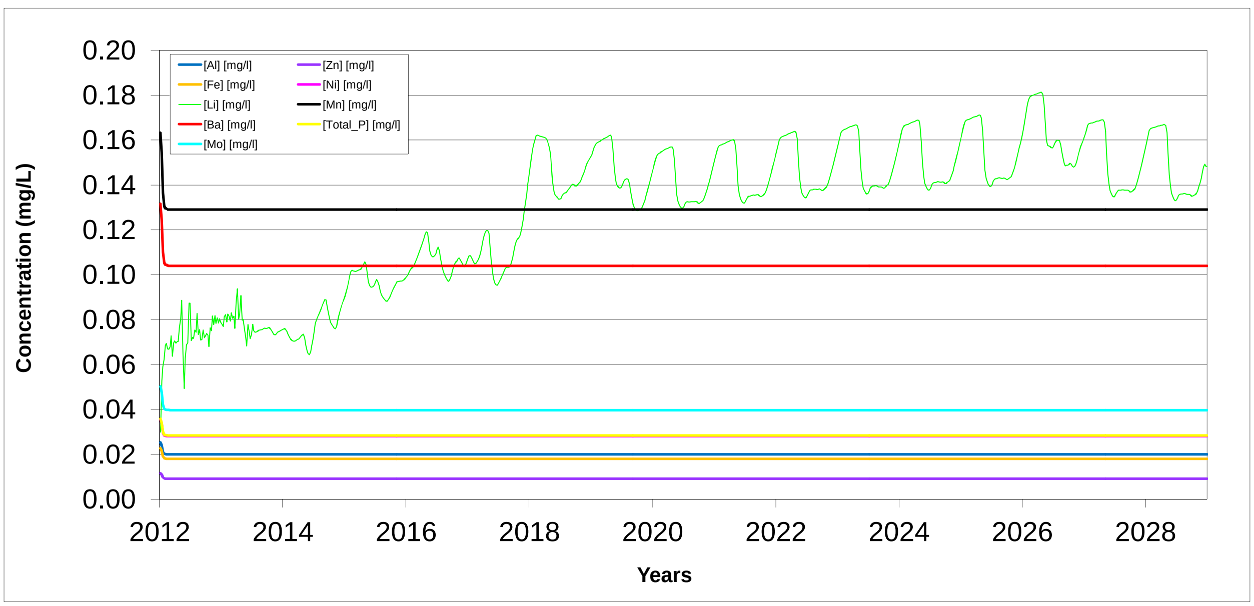
Date: December, 2013
Project: 12-1337-0001

Drawn KAS
Chkd KJD

De Beers Canada Inc.

Process Water Dissolved Concentrations	FIGURE VIII-3b





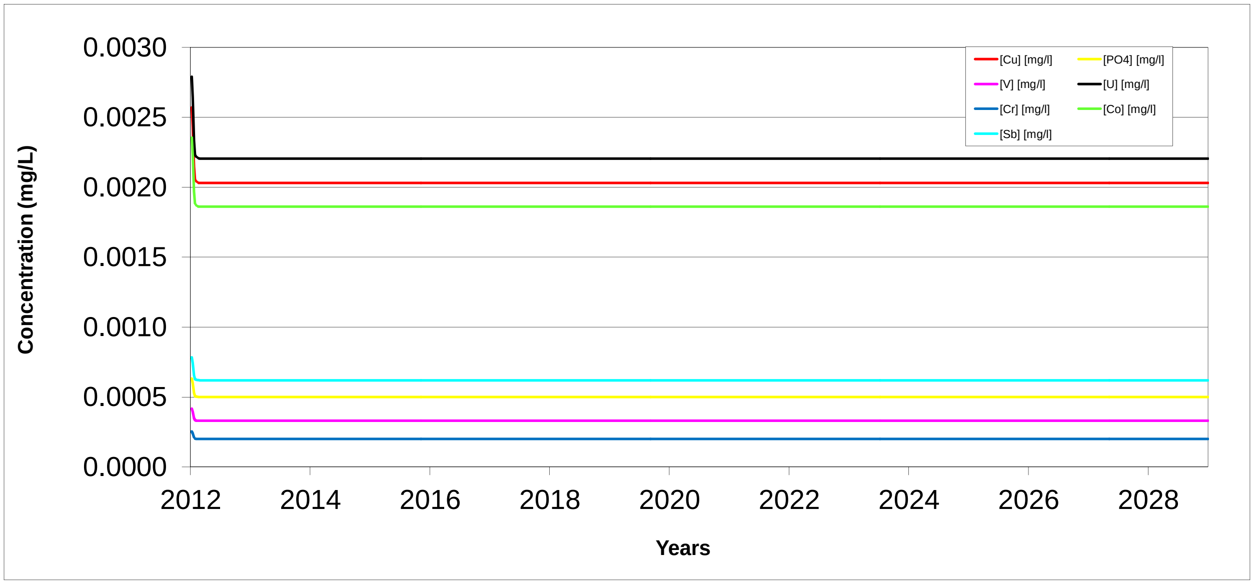
Date: December, 2013
Project: 12-1337-0001

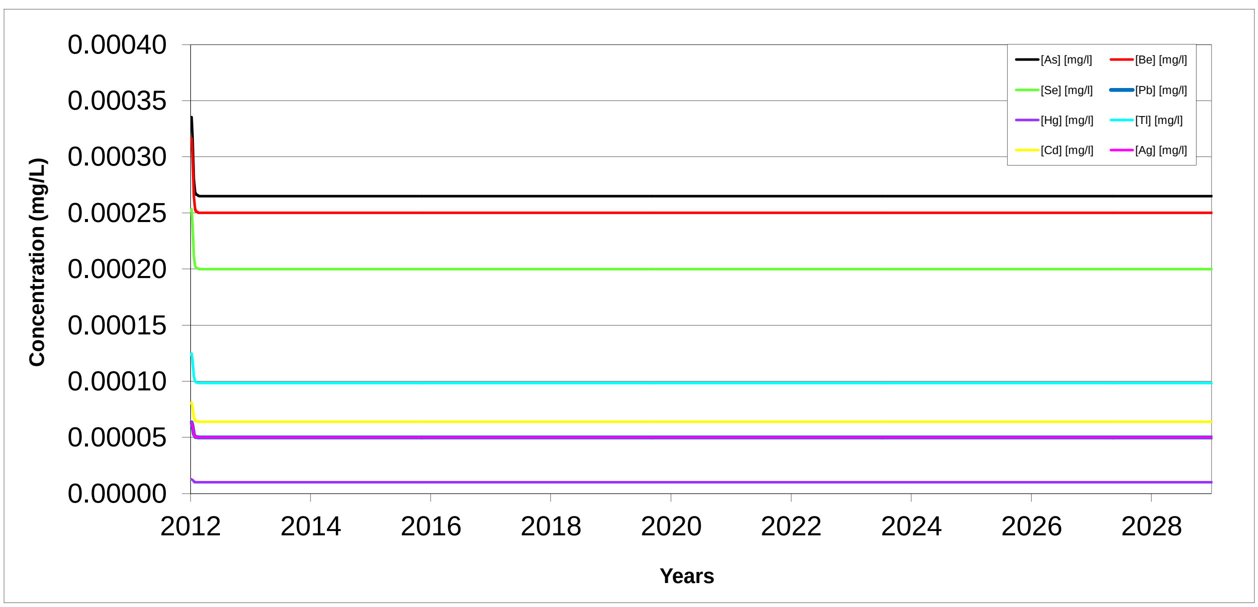
Drawn KAS
Chkd KJD

De Beers Canada Inc.

Process Water Dissolved Concentrations

FIGURE VIII-3c





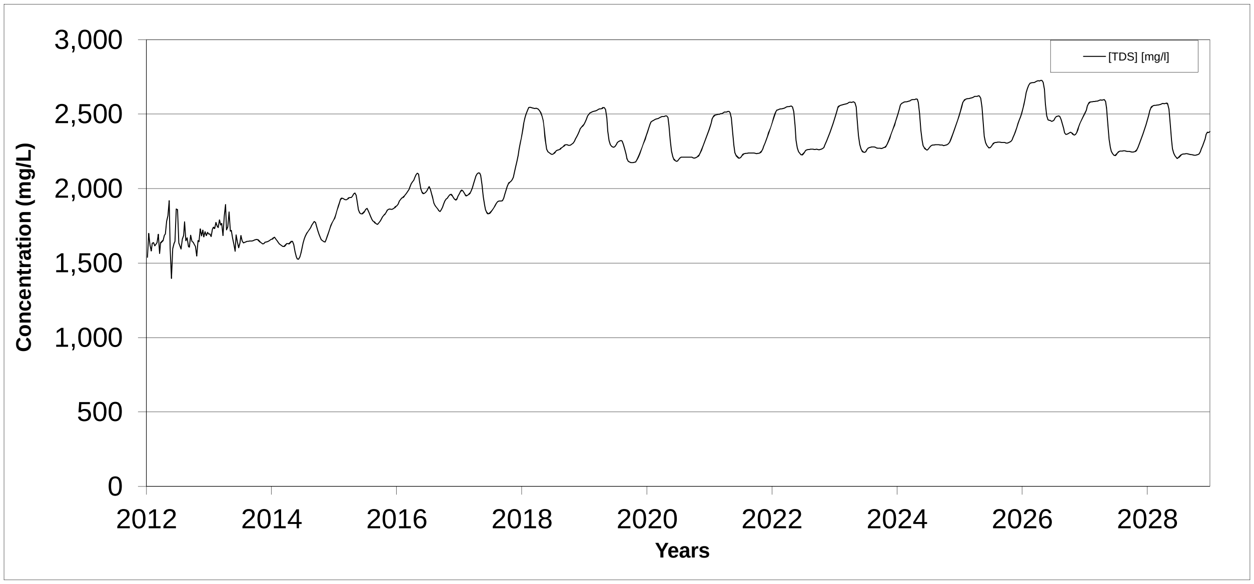
Date: December, 2013
Project: 12-1337-0001

Drawn KAS
Chkd KJD

De Beers Canada Inc.

AppVIII_Fig3.xls-App VIII-3c

Process Water Dissolved Concentrations	FIGURE VIII-3d

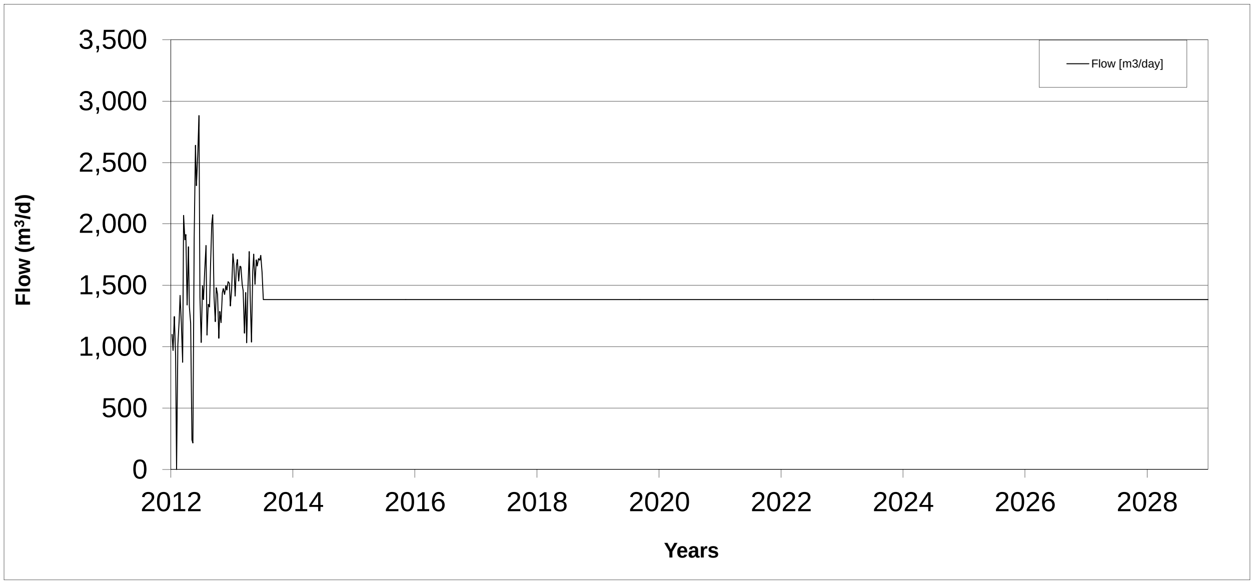


Date: December, 2013
Project: 12-1337-0001

Drawn KAS
Chkd KJD

De Beers Canada Inc.

Process Water Dissolved Concentrations	FIGURE VIII-3e

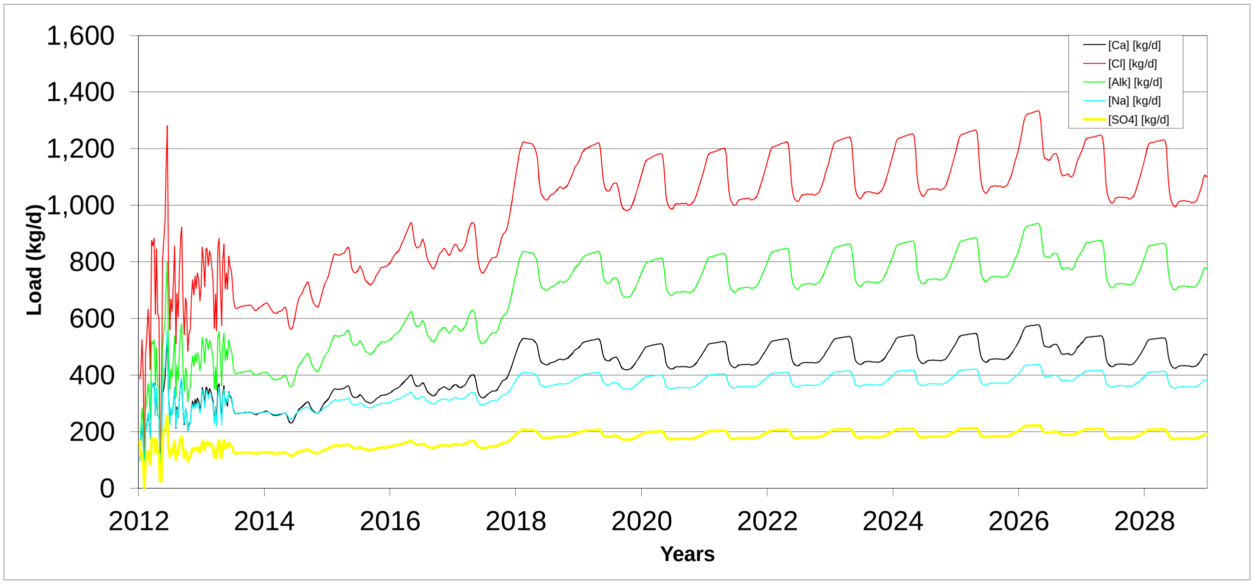


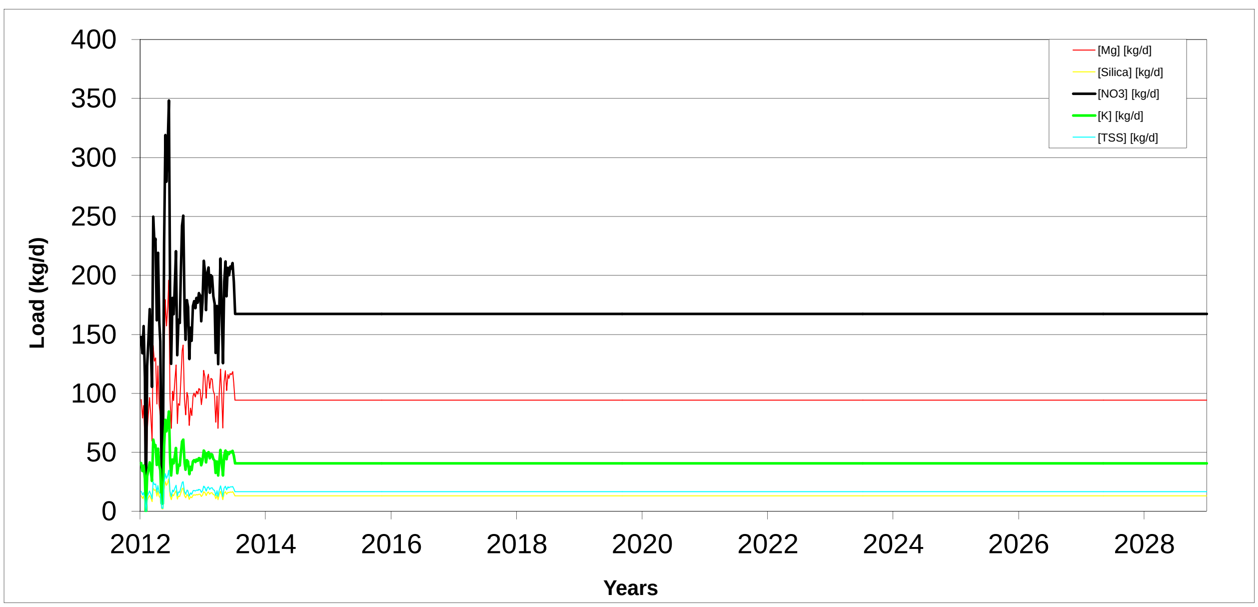
Date: December, 2013
Project: 12-1337-0001

Drawn KAS
Chkd KJD

De Beers Canada Inc.

Process Water Dissolved Load	FIGURE VIII-4a



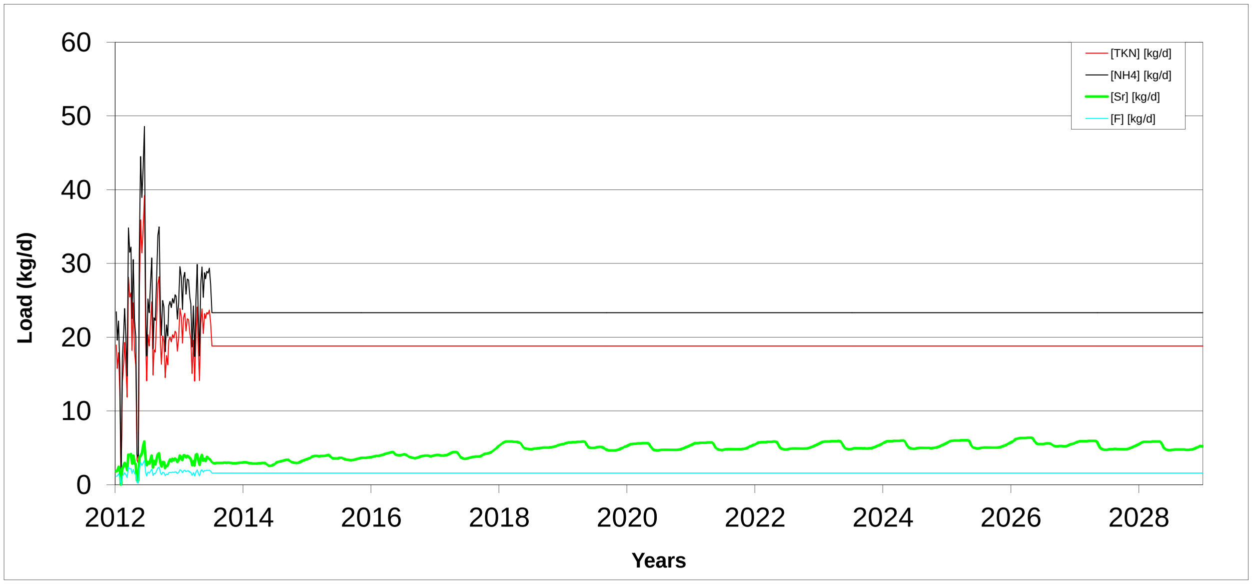


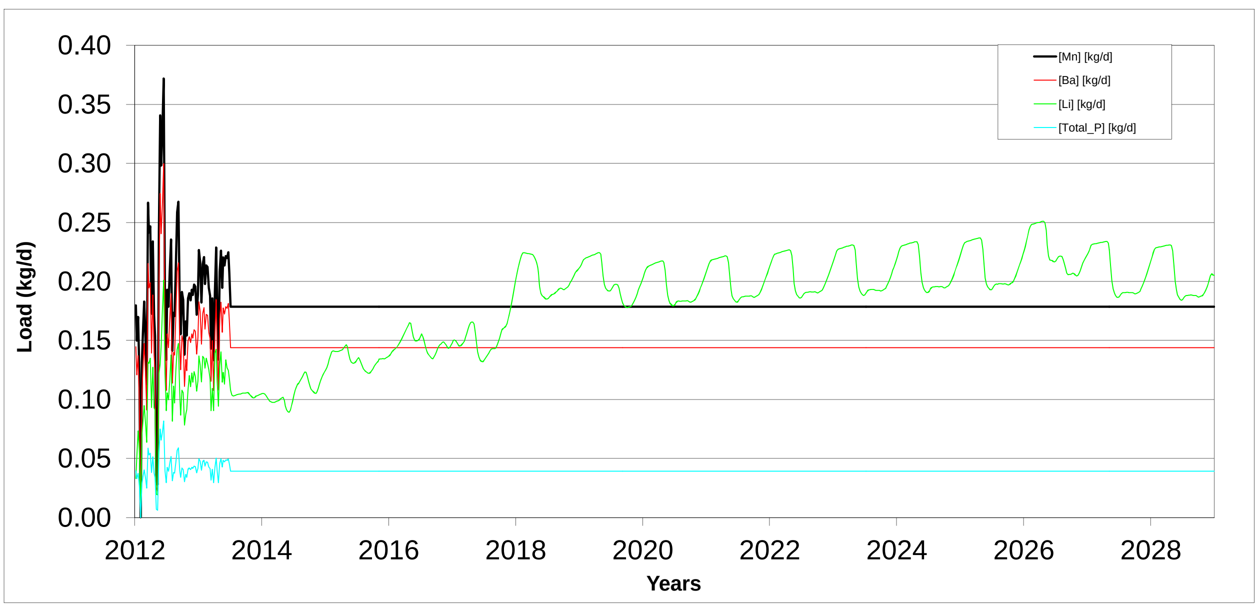
Date: December, 2013
Project: 12-1337-0001

Drawn KAS
Chkd KJD

De Beers Canada Inc.

Process Water Dissolved Load	FIGURE VIII-4b



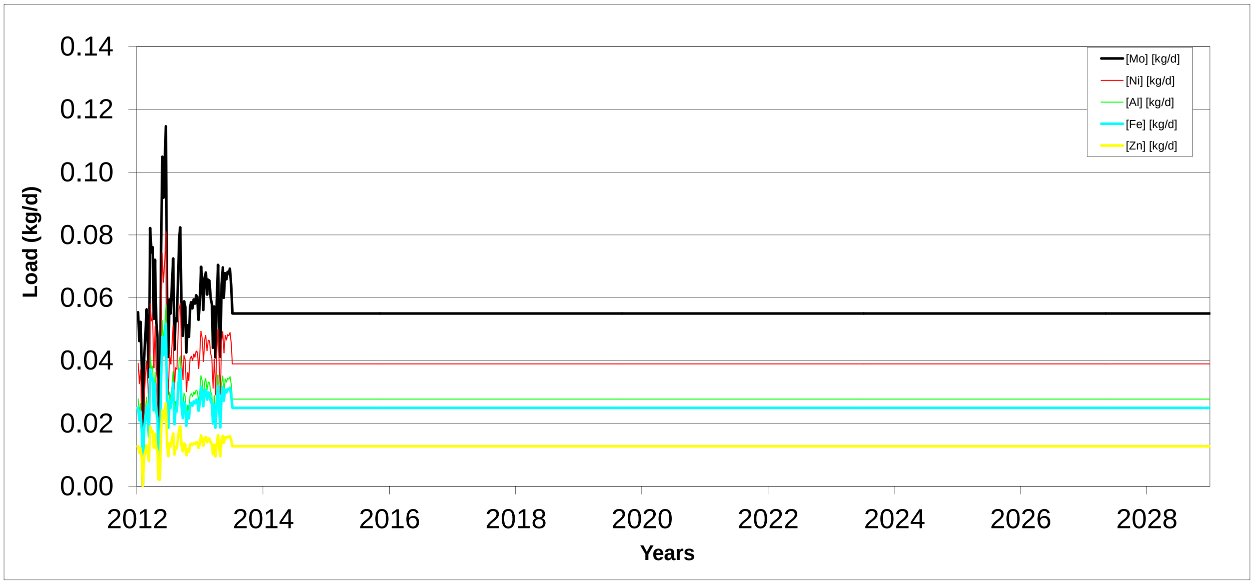


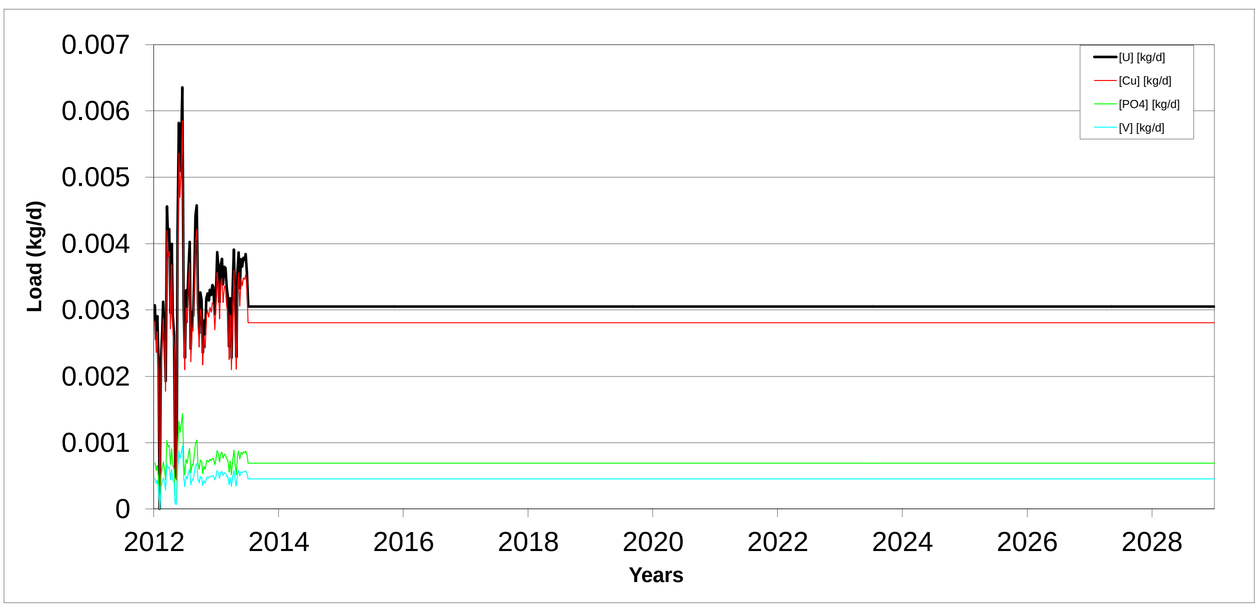
Date: December, 2013
Project: 12-1337-0001

Drawn KAS
Chkd KJD

De Beers Canada Inc.

Process Water Dissolved Load	FIGURE VIII-4c





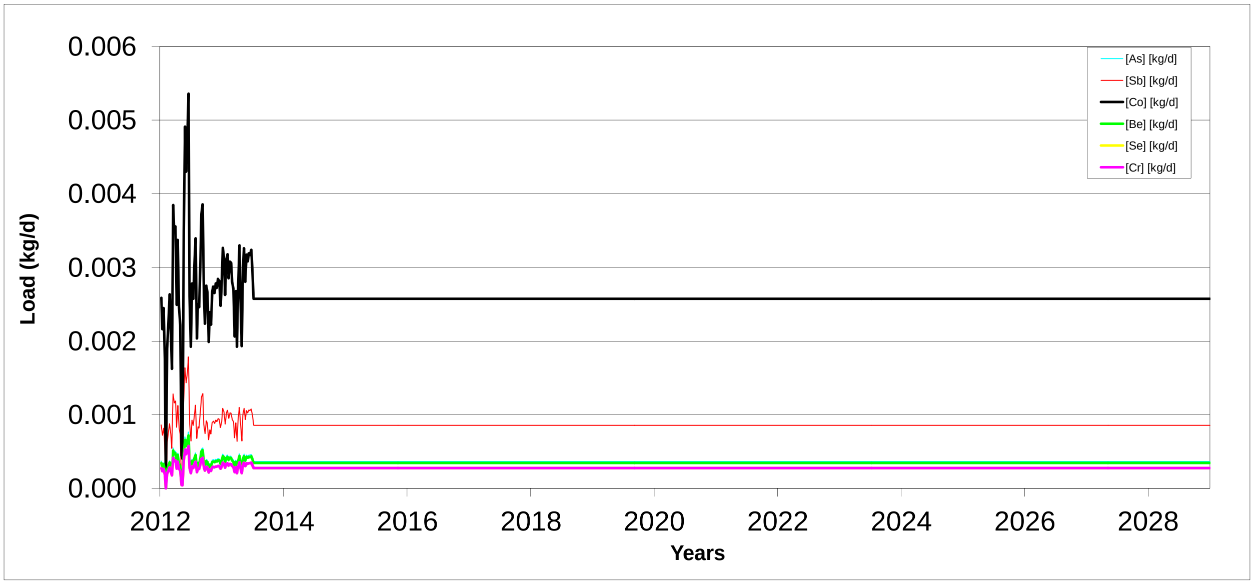
Date: December, 2013
Project: 12-1337-0001

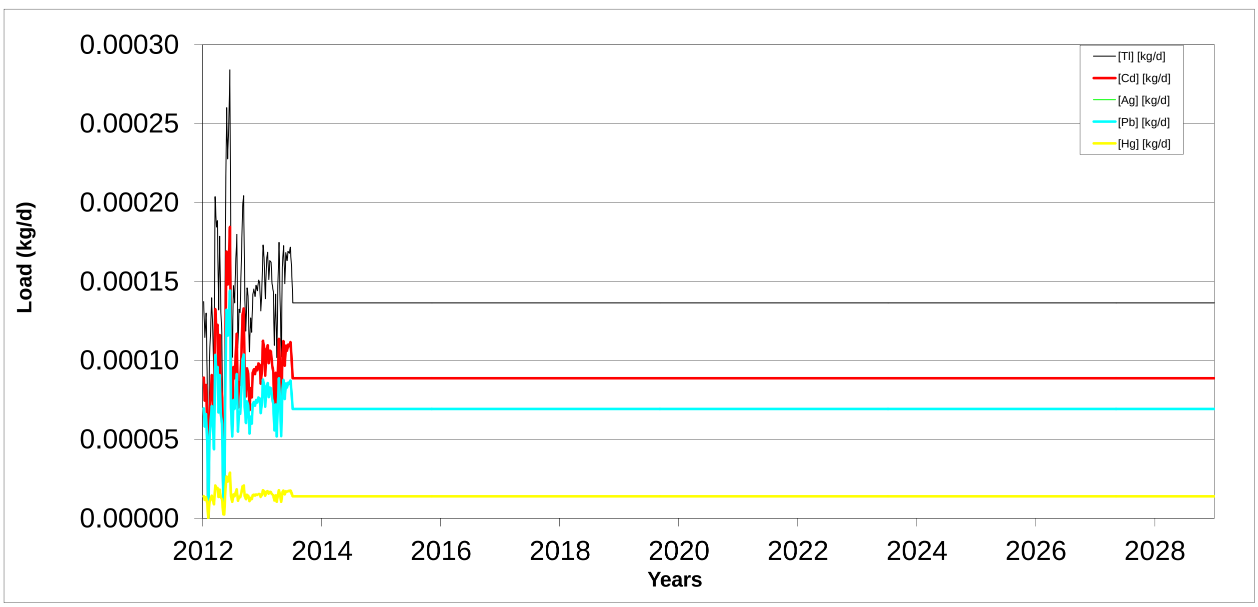
Drawn KAS
Chkd KJD

De Beers Canada Inc.

Process Water Dissolved Load

FIGURE VIII-4d





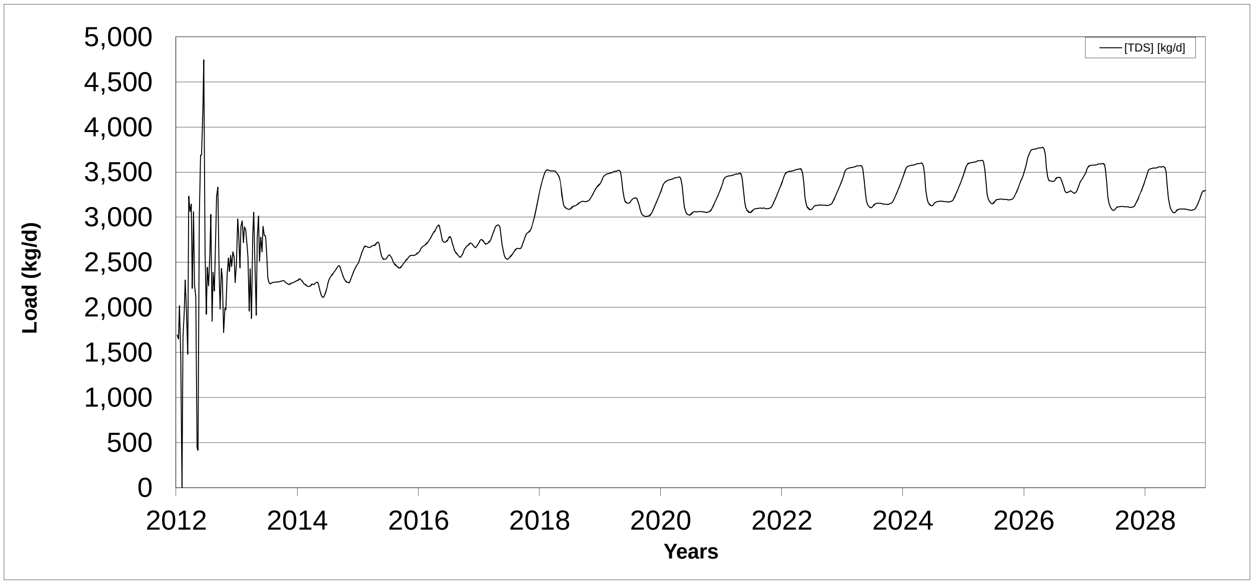
Date: December, 2013
Project: 12-1337-0001

Drawn KAS
Chkd KJD

De Beers Canada Inc.

Process Water Dissolved Load

FIGURE VIII-4e

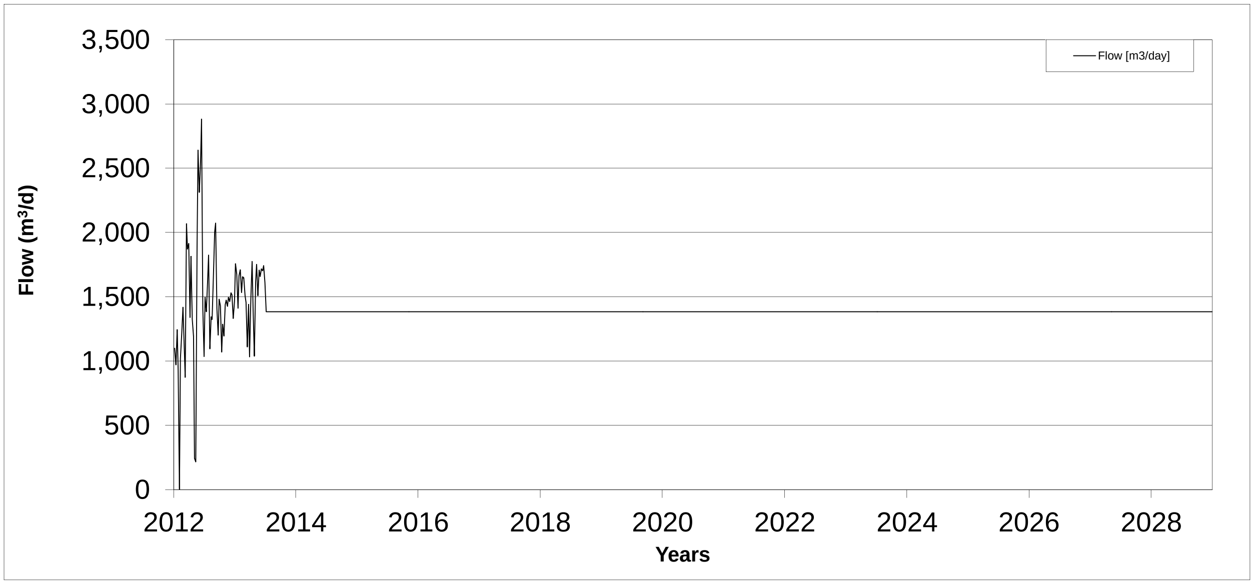


Date: December, 2013
Project: 12-1337-0001

Drawn KAS
Chkd KJD

De Beers Canada Inc.

Process Water Dissolved Load FLOW	FIGURE VIII-4f

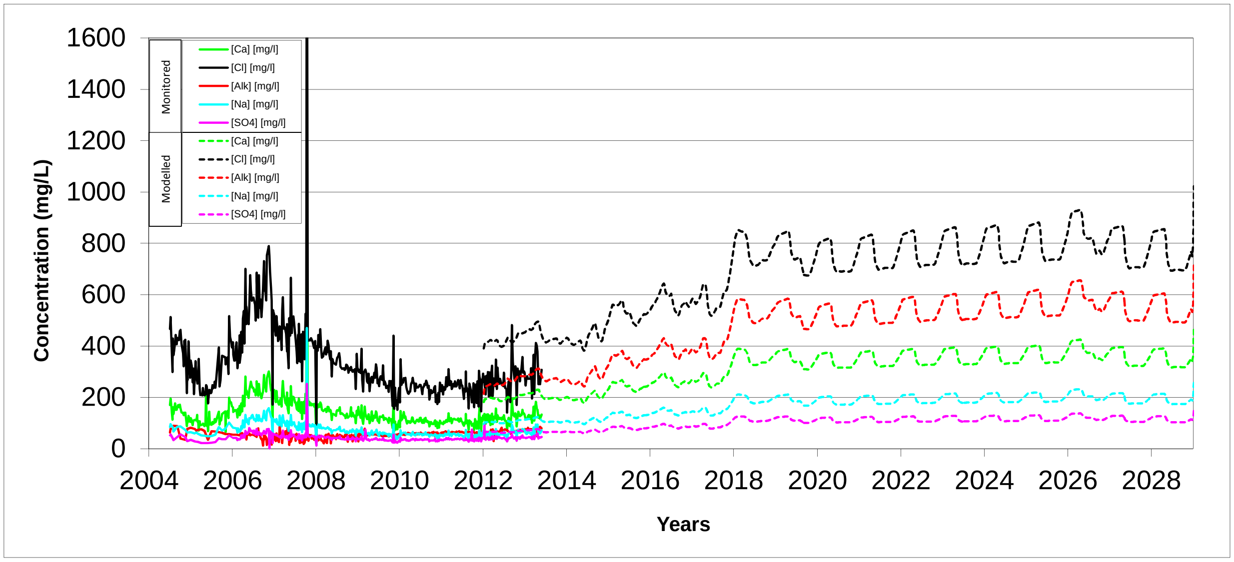


Date: December, 2013
Project: 12-1337-0001

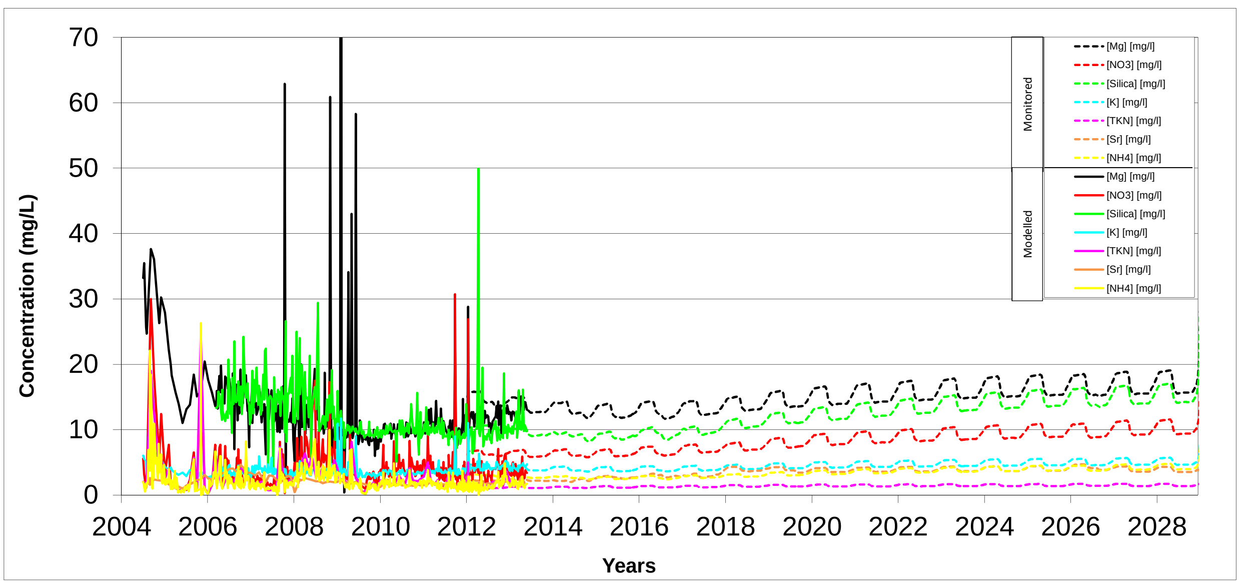
Drawn KAS
Chkd KJD

De Beers Canada Inc.

Mine Water (SNP 02-01) Dissolved Concentrations	FIGURE VIII-5a



Note: Monitoring values above 1600 mg/L are not shown.



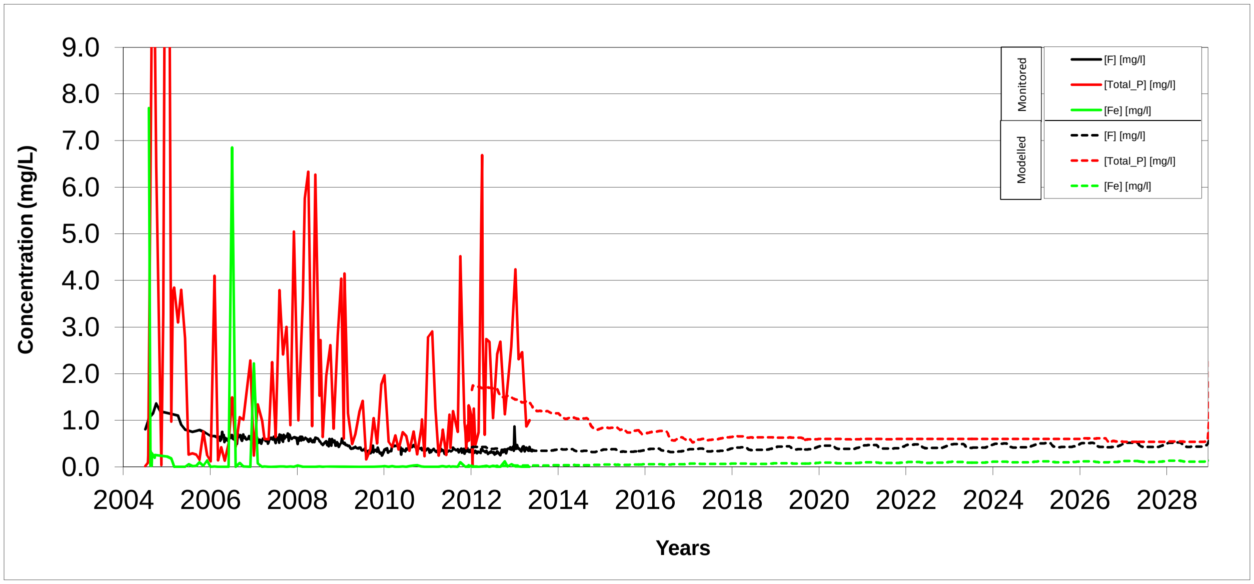
Note: Monitoring values above 70 mg/L are not shown.

Date: December, 2013
Project: 12-1337-0001

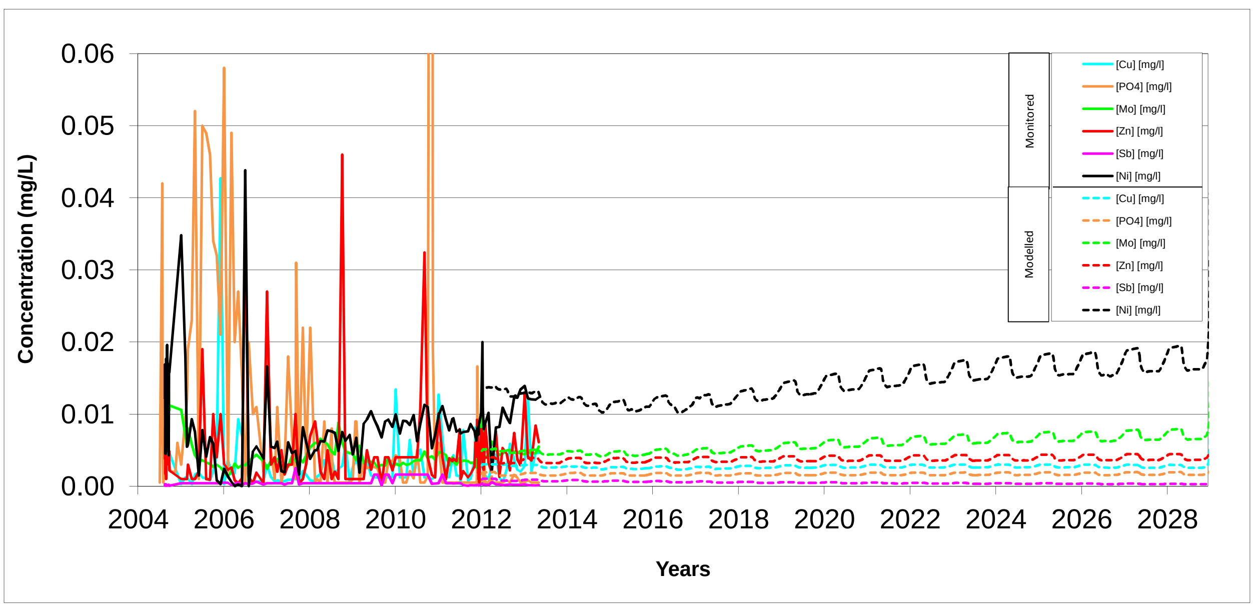
Drawn KAS
Chkd KJD

De Beers Canada Inc.

Mine Water (SNP 02-01) Dissolved Concentrations	FIGURE VIII-5b



Note: Monitored values above 9.0 mg/L are not shown.



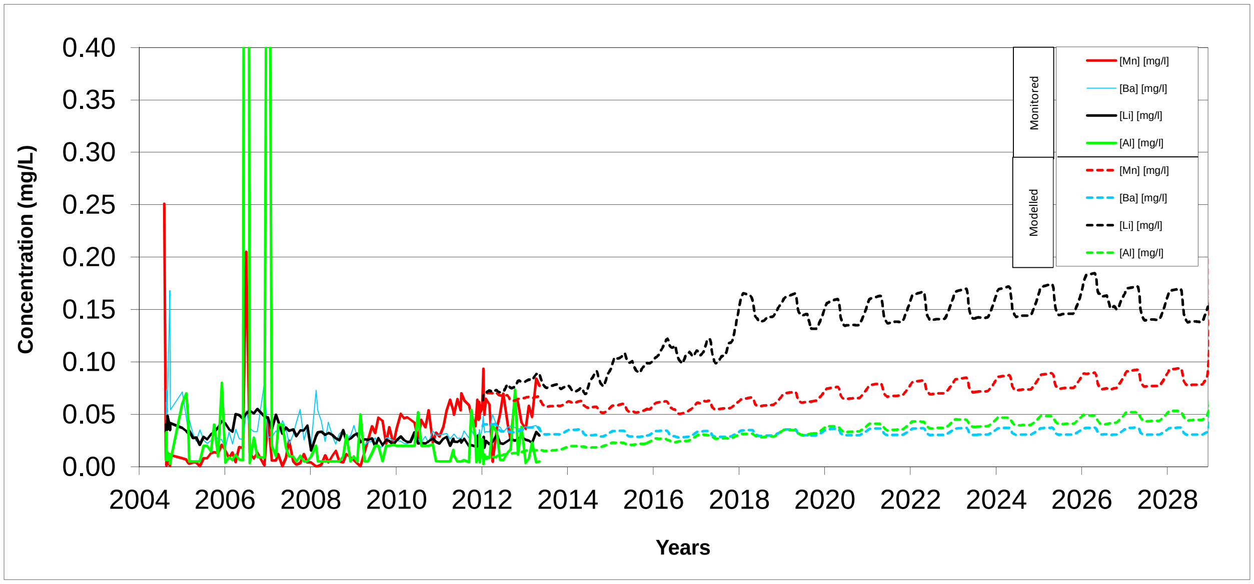
Note: Monitoring values above 0.06 mg/L are not shown.

Date: December, 2013
Project: 12-1337-0001

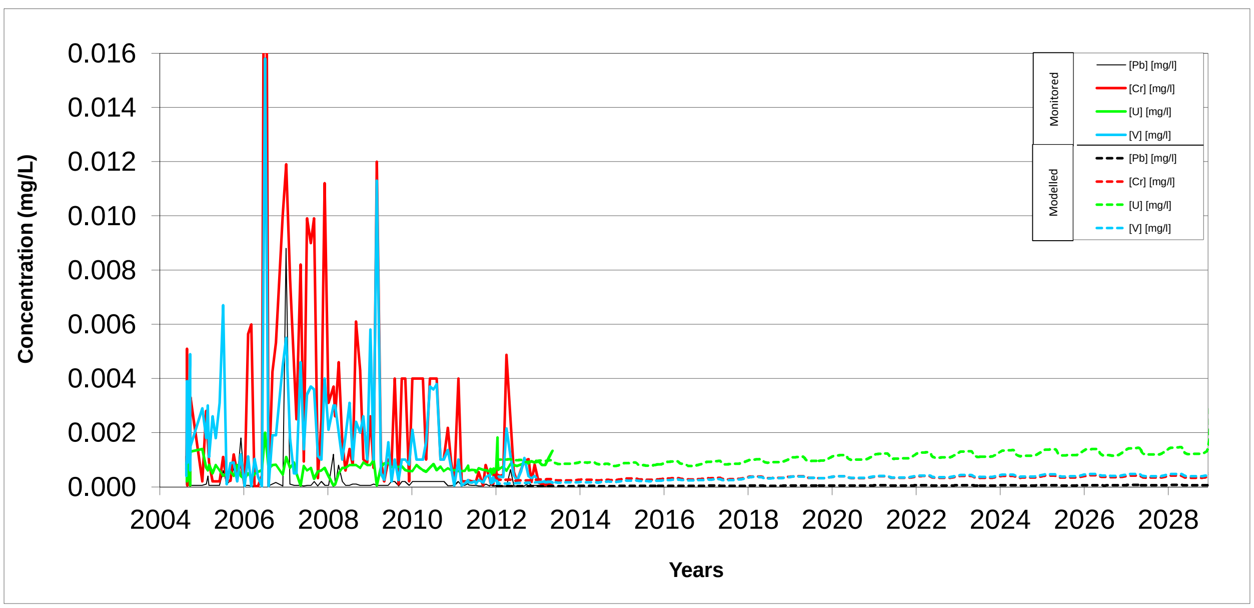
Drawn KAS
Chkd KJD

De Beers Canada Inc.

Mine Water (SNP 02-01) Dissolved Concentrations	FIGURE VIII-5c



Note: Monitored values above 0.40 mg/L are not shown.



Note: Monitored values above 0.016 mg/L are not shown.

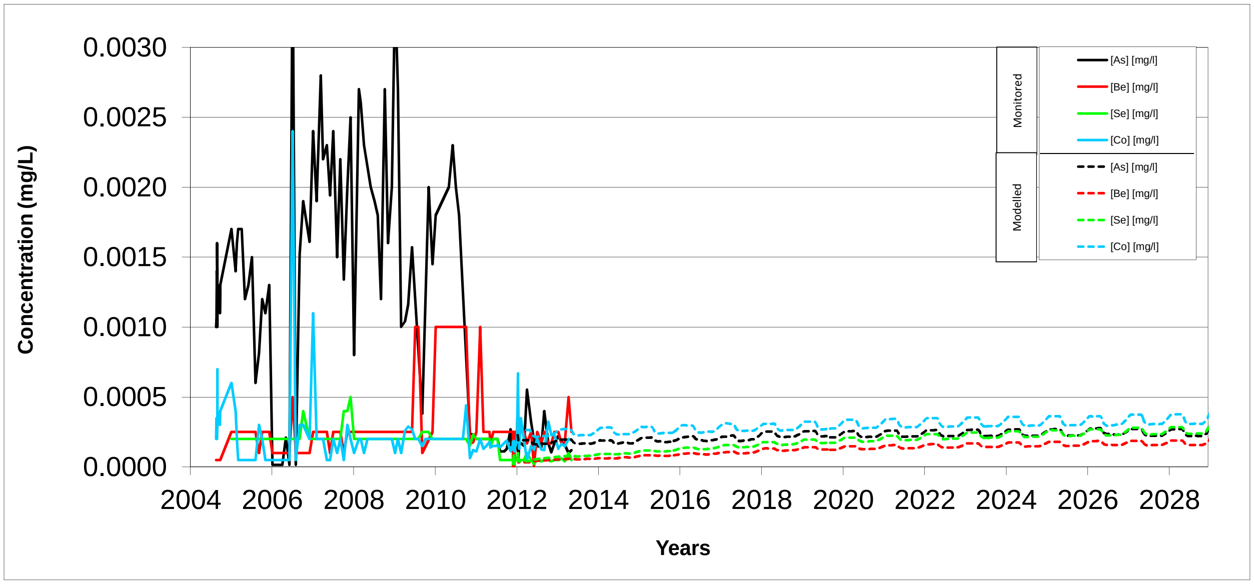
Date: December, 2013
Project: 12-1337-0001

Drawn KAS
Chkd KJD

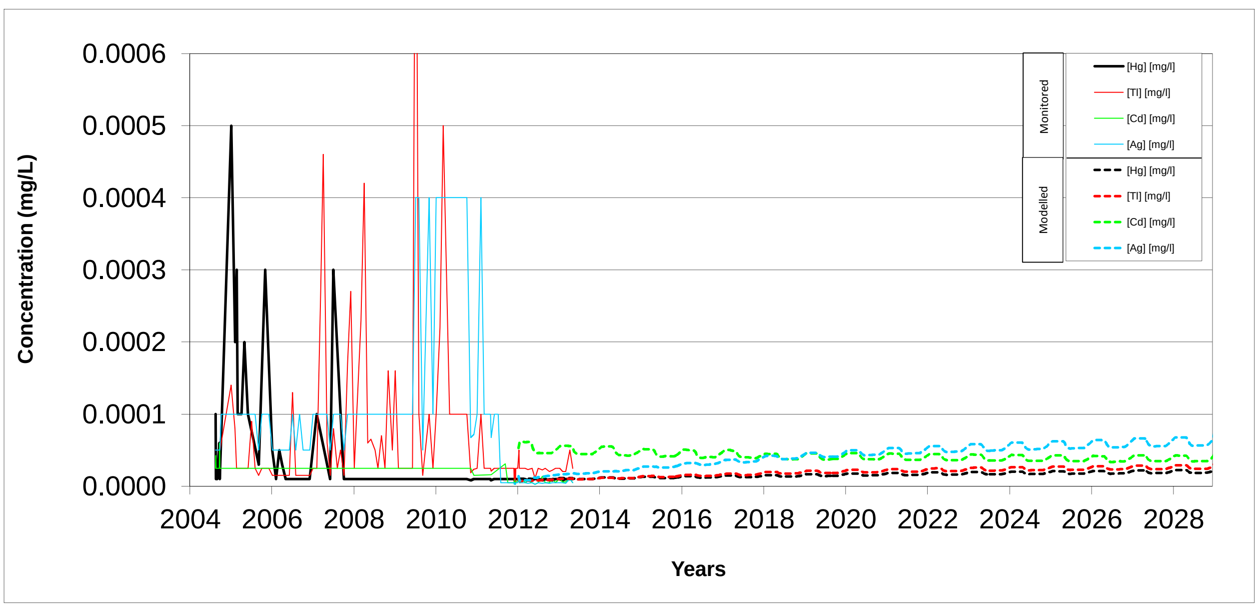
De Beers Canada Inc.

Mine Water (SNP 02-01) Dissolved Concentrations

FIGURE VIII-5d



Note: Monitored values above 0.0030 mg/L are not shown.



Note: Monitored values above 0.0006 mg/L are not shown.

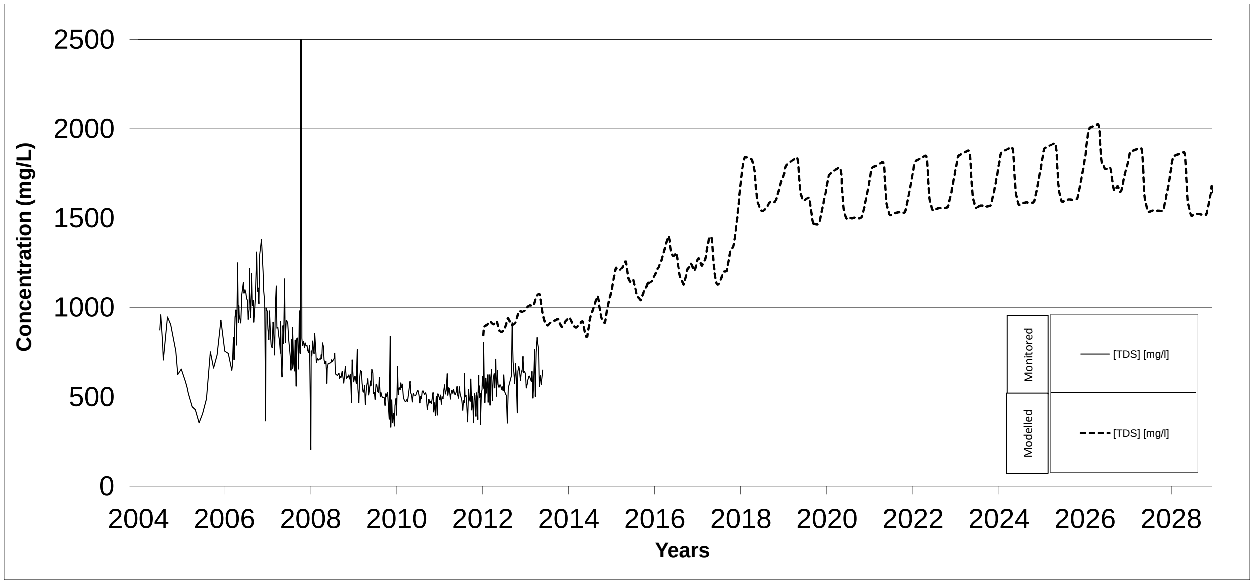
Date: December, 2013
Project: 12-1337-0001

Drawn KAS
Chkd KJD

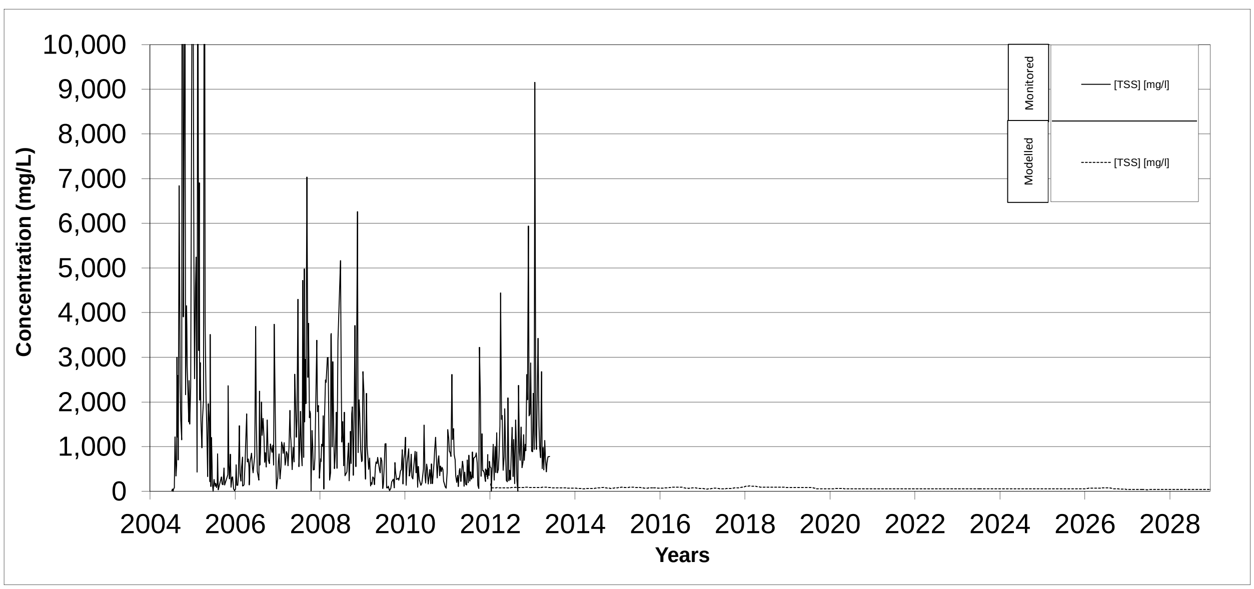
De Beers Canada Inc.

Mine Water (SNP 02-01) Dissolved Concentrations

FIGURE VIII-5e



Note: Monitored values above 2500 mg/L are not shown.



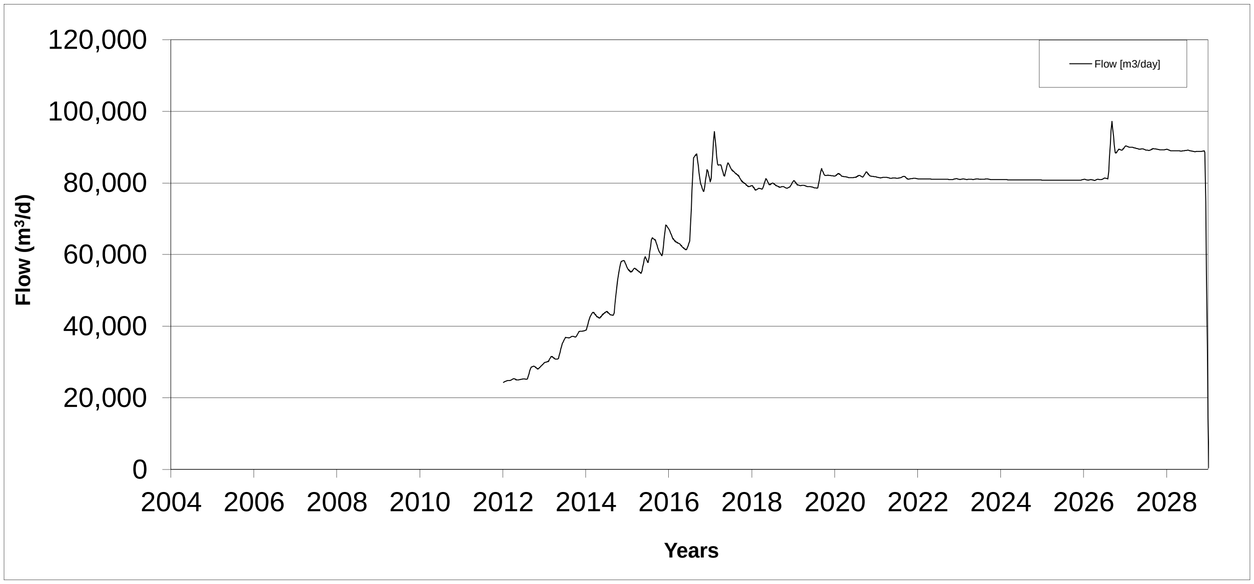
Note: Monitored values above 10,000 mg/L are not shown.

Date: December, 2013
Project: 12-1337-0001

Drawn KAS
Chkd KJD

De Beers Canada Inc.

Mine Water (SNP 02-01) Dissolved Concentrations	FIGURE VIII-5f

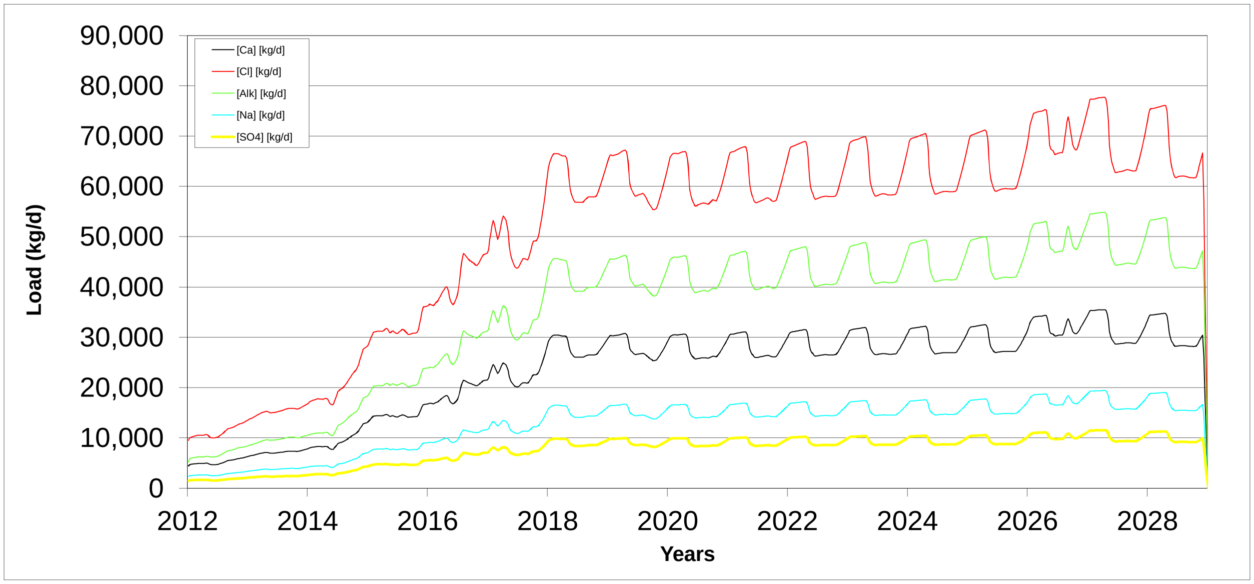


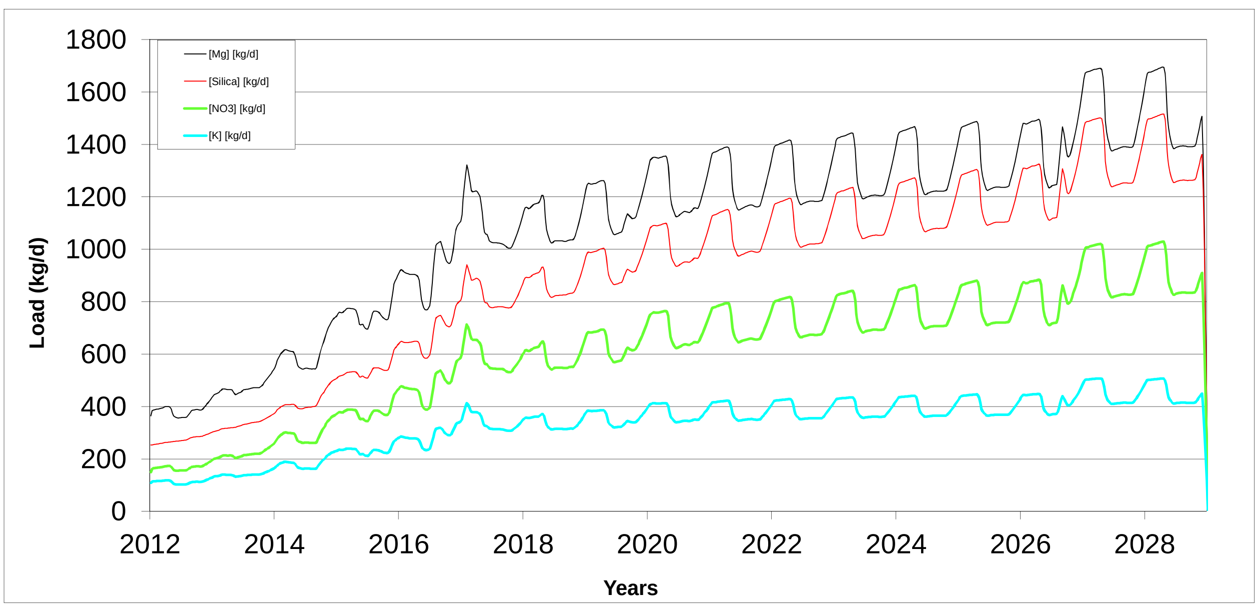
Date: December, 2013
Project: 12-1337-0001

Drawn KAS
Chkd KJD

De Beers Canada Inc.

Mine Water (SNP 02-01) Dissolved Load	FIGURE VIII-6a



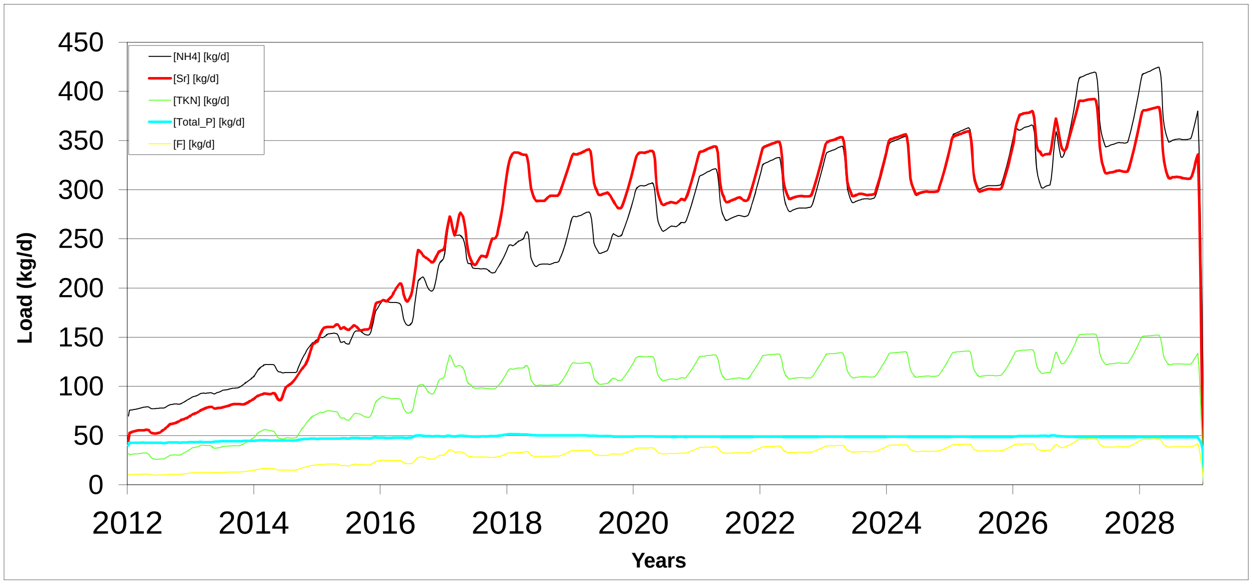


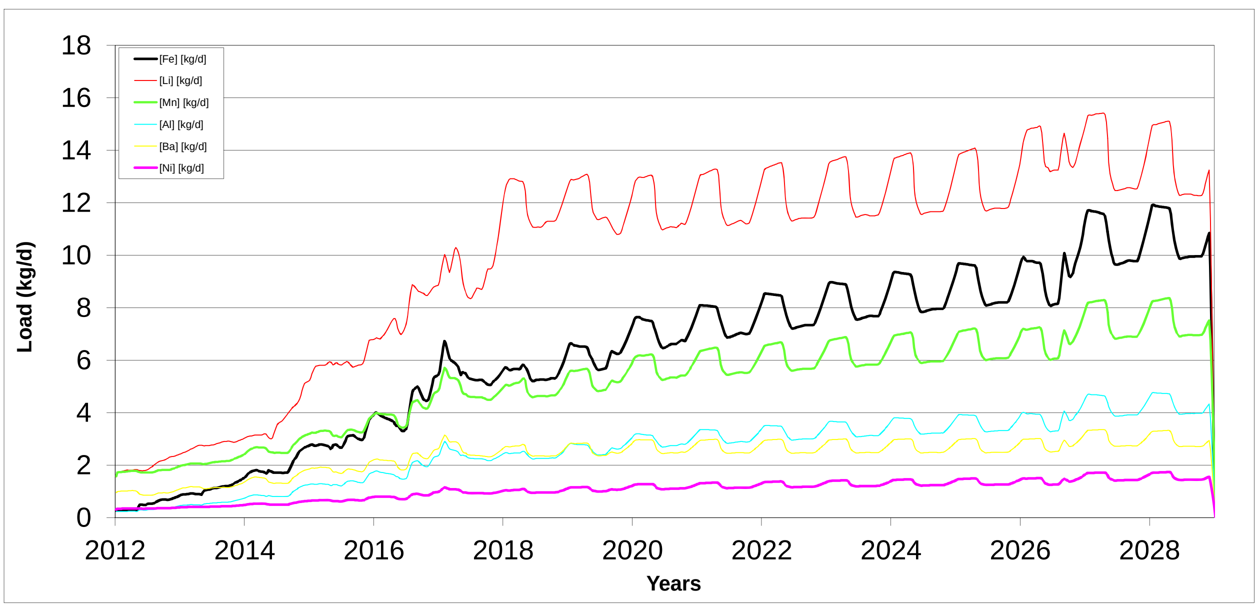
Date: December, 2013
Project: 12-1337-0001

Drawn KAS
Chkd KJD

De Beers Canada Inc.

Mine Water (SNP 02-01) Dissolved Load	FIGURE VIII-6b



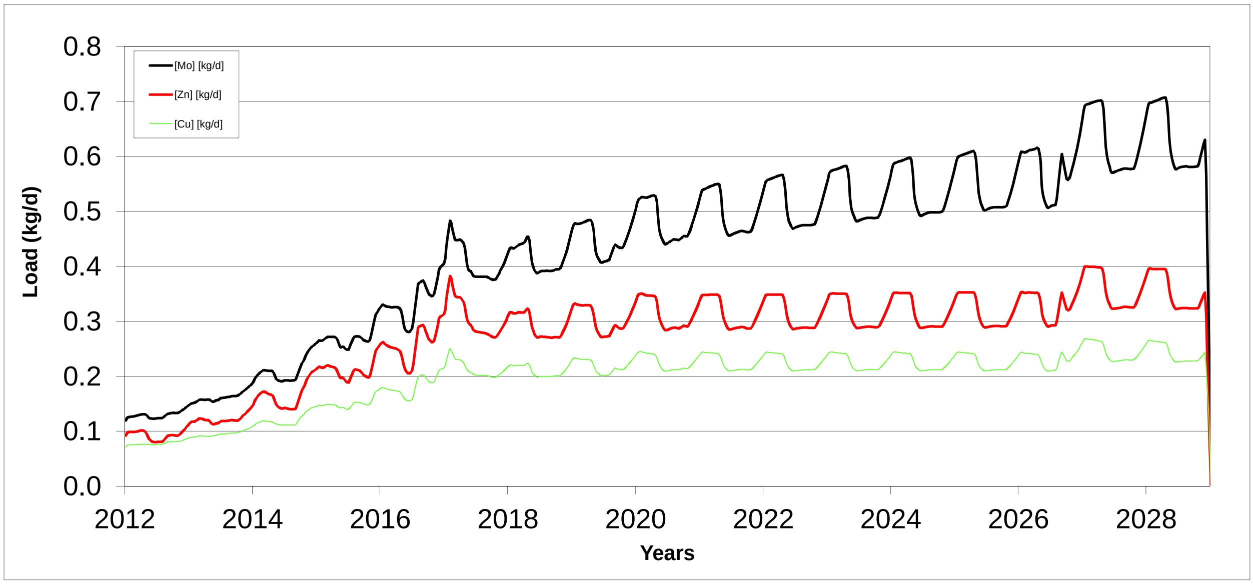


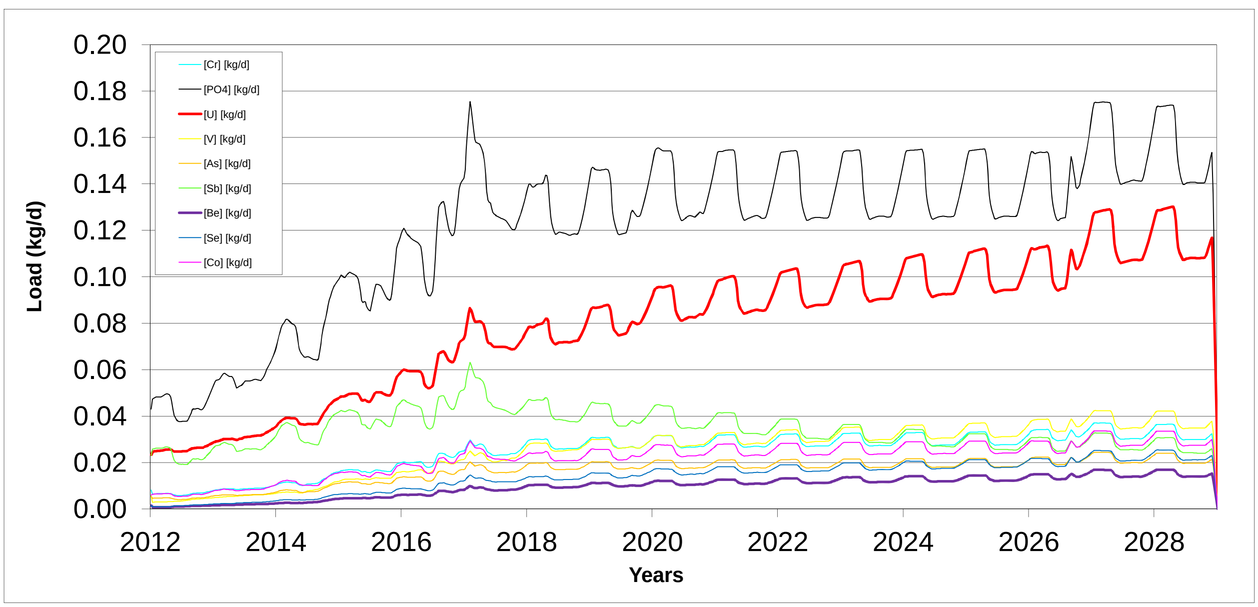
Date: December, 2013
Project: 12-1337-0001

Drawn KAS
Chkd KJD

De Beers Canada Inc.

Mine Water (SNP 02-01) Dissolved Load	FIGURE VIII-6c



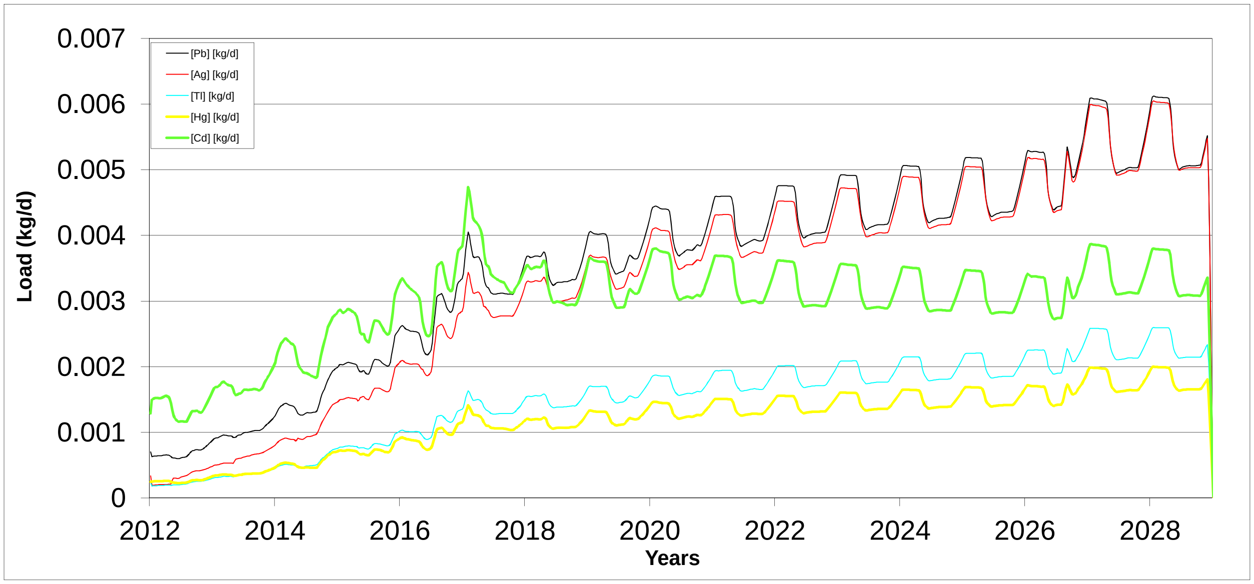


Date: December, 2013
Project: 12-1337-0001

Drawn KAS
Chkd KJD

De Beers Canada Inc.

Mine Water (SNP 02-01) Dissolved Load	FIGURE VIII-6d



Date: December, 2013
Project: 12-1337-0001

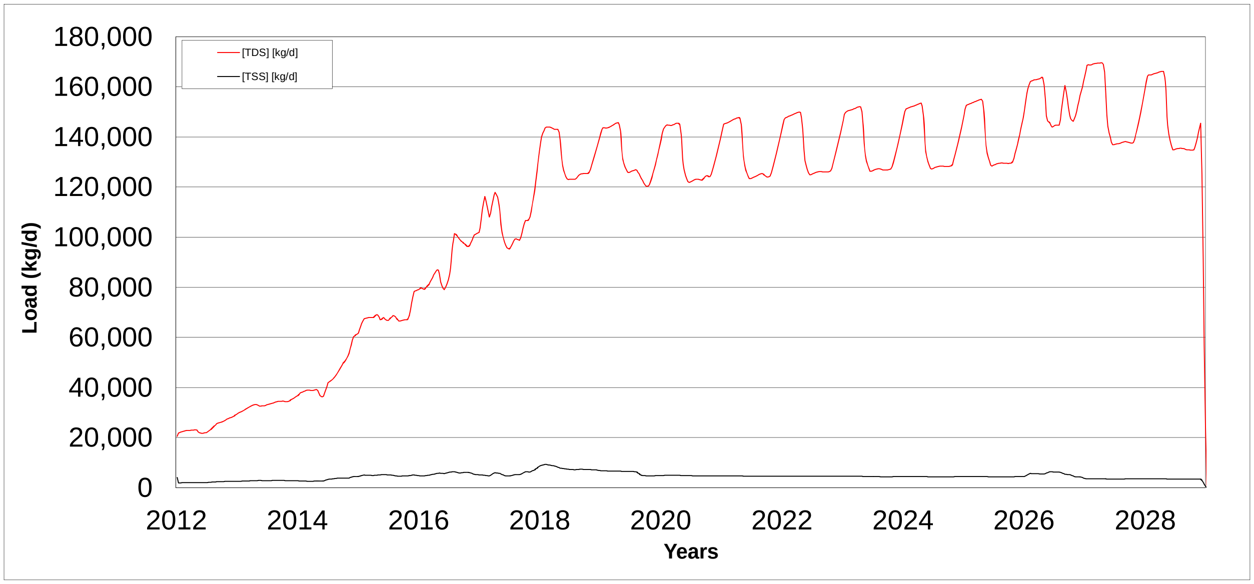
Drawn KAS
Chkd KJD

De Beers Canada Inc.

AppVIII_Fig6.xls-App VIII-6d

Mine Water (SNP 02-01) Dissolved Load

FIGURE VIII-6e



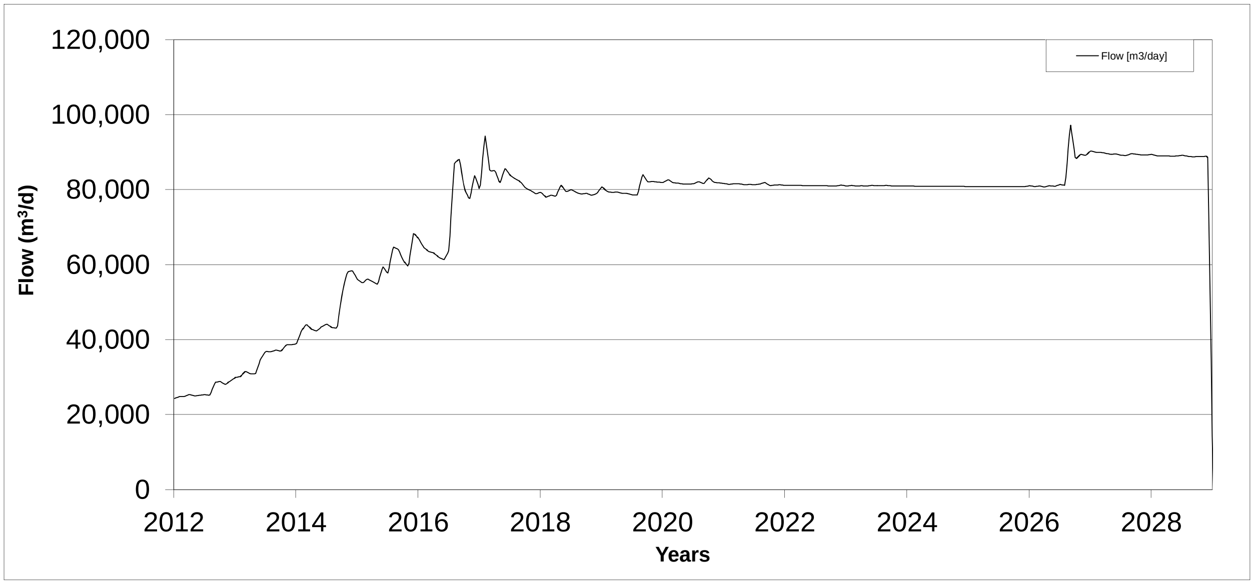
Date: December, 2013
Project: 12-1337-0001

Drawn KAS
Chkd KJD

De Beers Canada Inc.

Mine Water (SNP 02-01) Dissolved Load FLOW

FIGURE VIII-6f



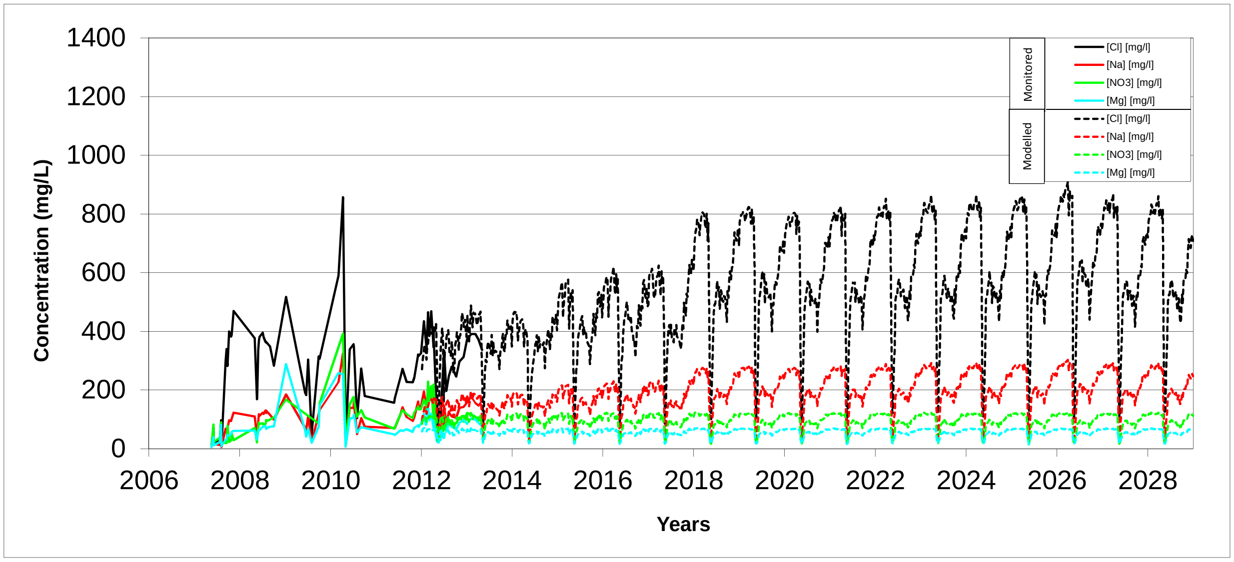
Date: December, 2013
Project: 12-1337-0001

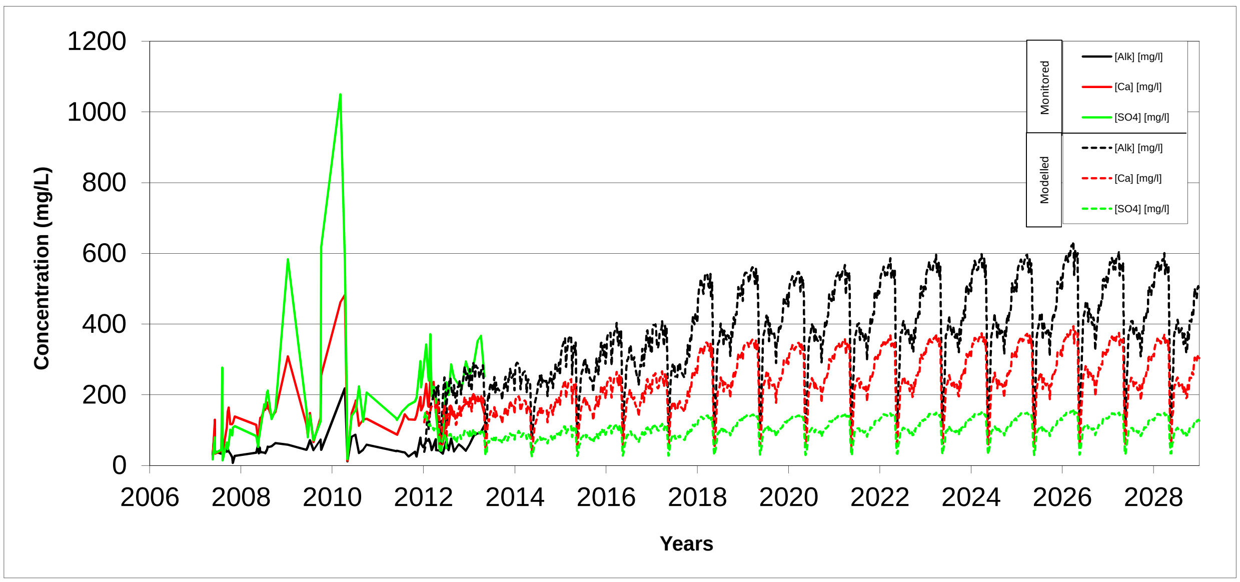
Drawn KAS
Chkd KJD

De Beers Canada Inc.

North Pile Discharge (SNP 02-02) Dissolved Concentrations

FIGURE VIII-7a





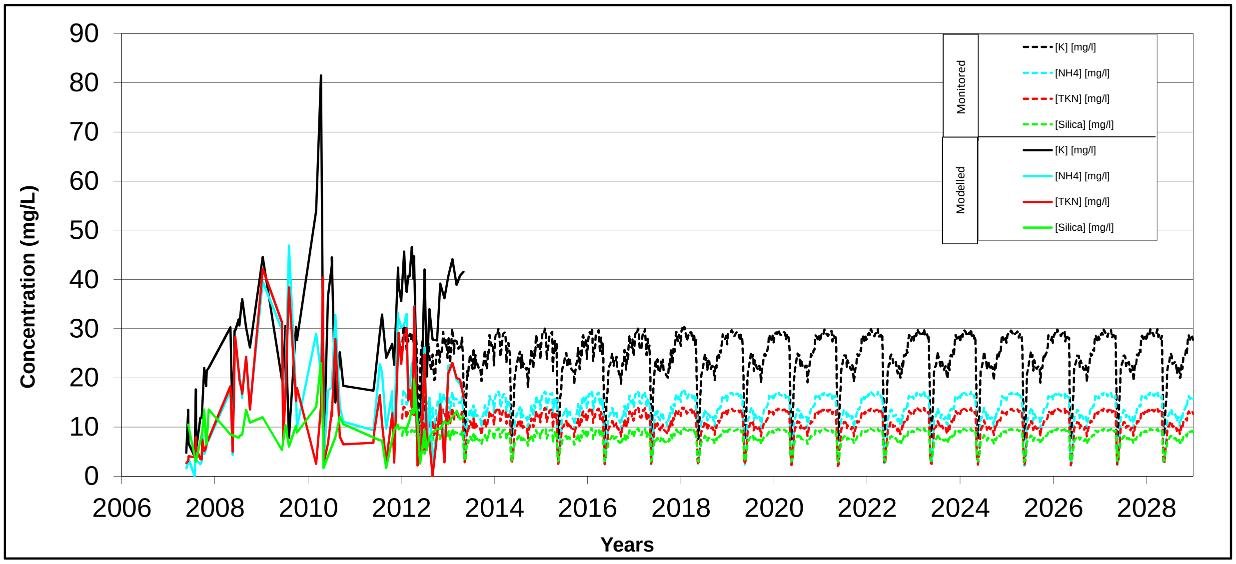
Date: December, 2013
Project: 12-1337-0001

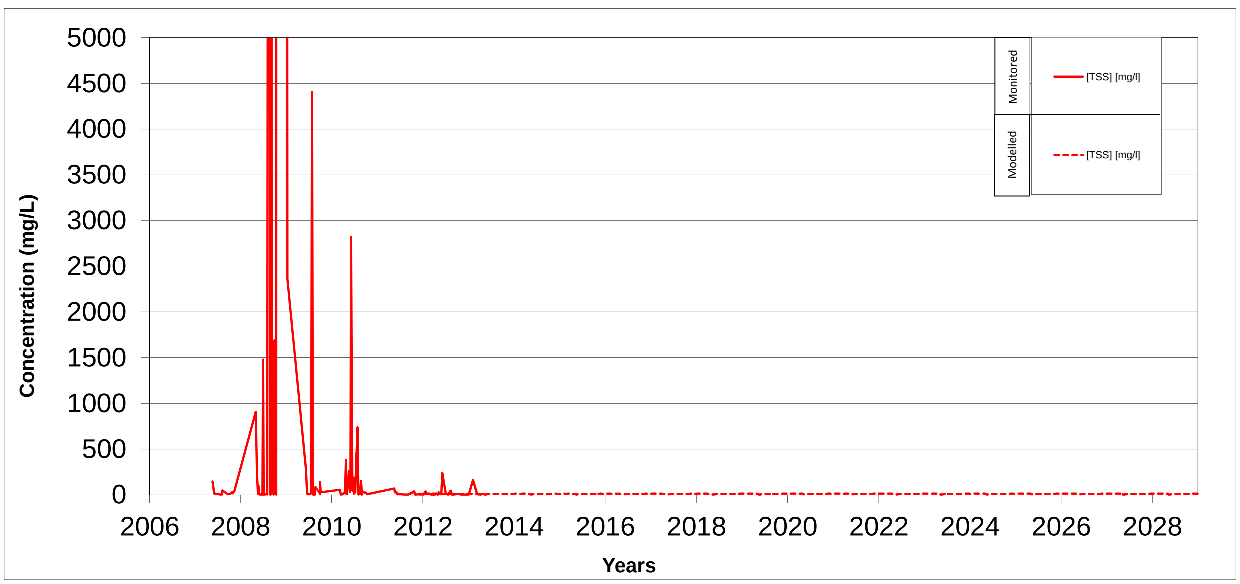
Drawn KAS
Chkd KJD

De Beers Canada Inc.

North Pile Discharge (SNP 02-02) Dissolved Concentrations

FIGURE VIII-7b





Note: Monitoring values above 5000 mg/L are not shown.

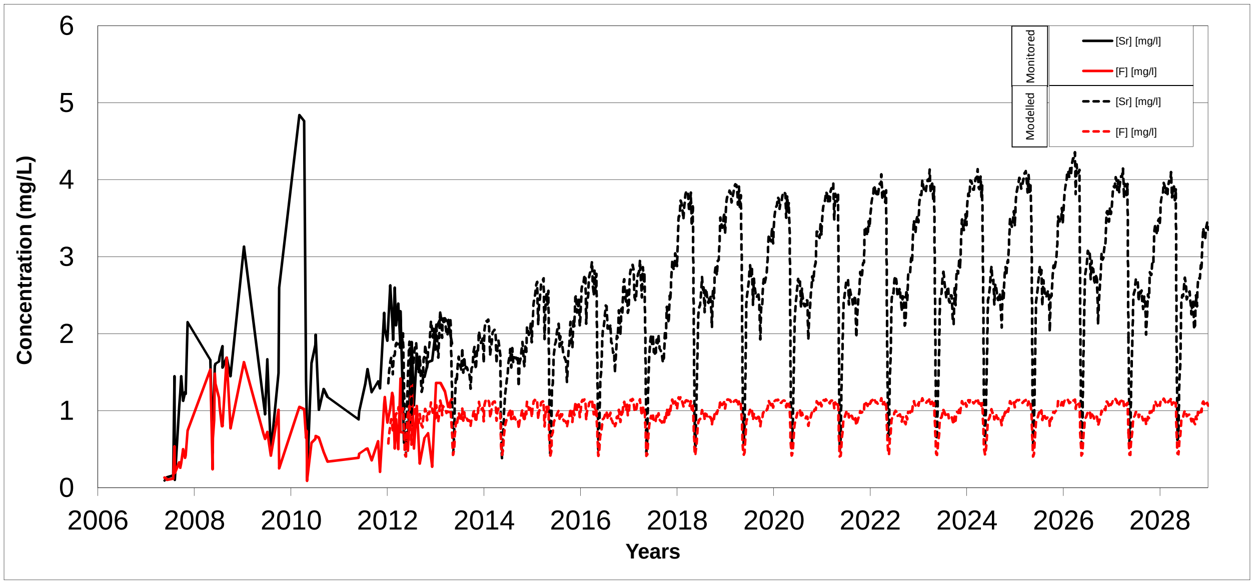
Date: December, 2013
Project: 12-1337-0001

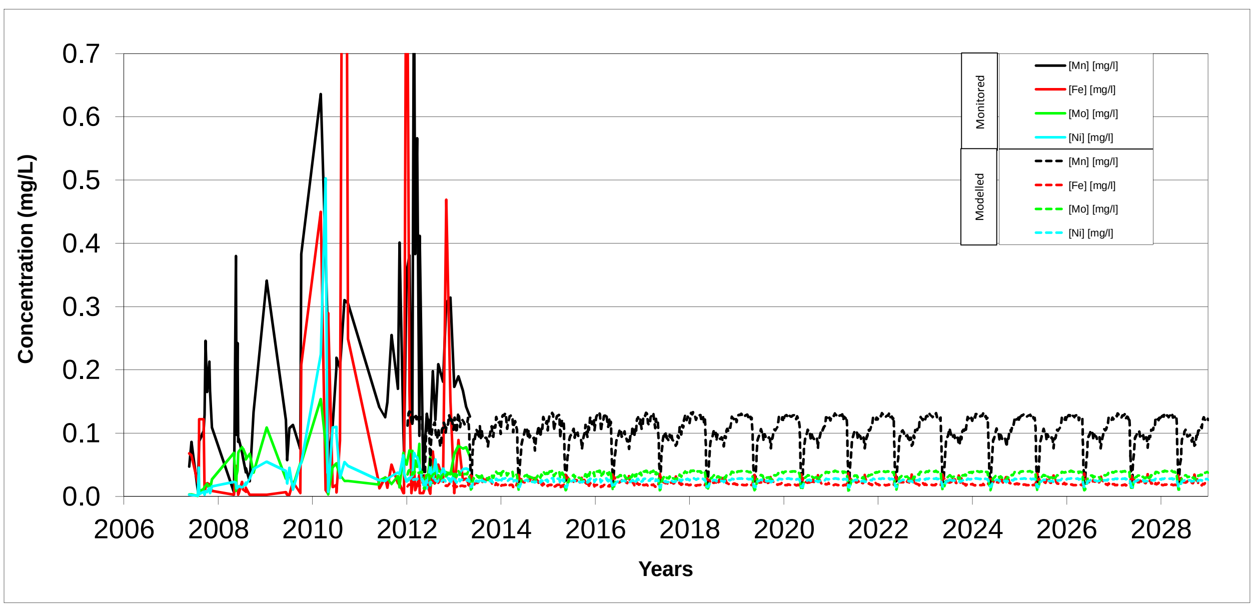
Drawn KAS
Chkd KJD

De Beers Canada Inc.

North Pile Discharge (SNP 02-02) Dissolved Concentrations

FIGURE VIII-7c





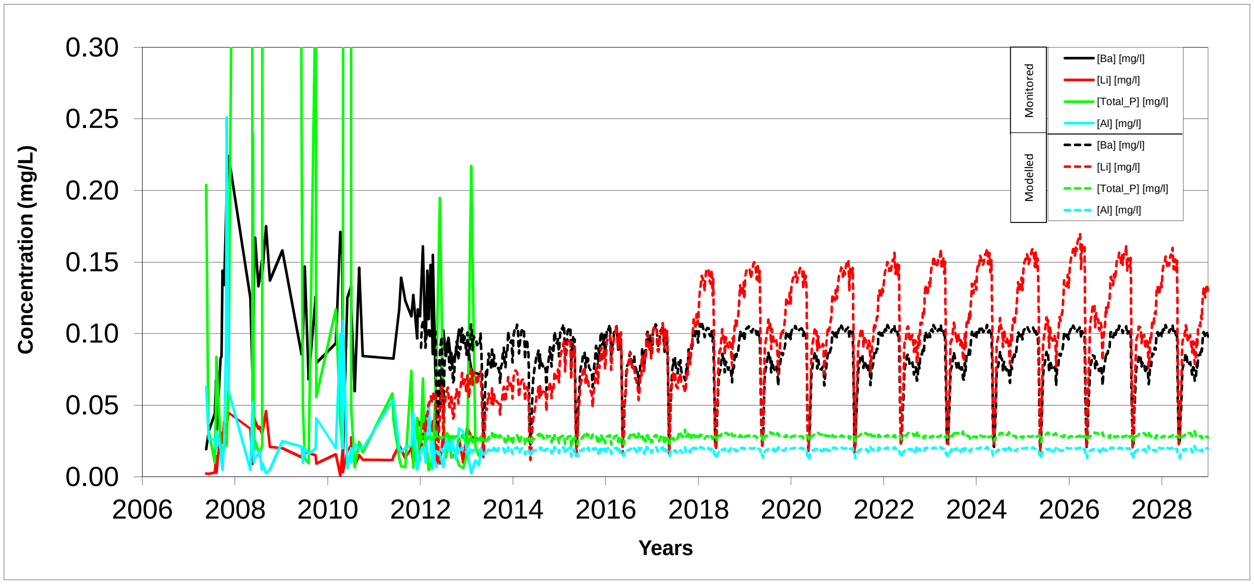
Note: Monitoring values above 0.7 mg/L are not shown.

Date: December, 2013
Project: 12-1337-0001

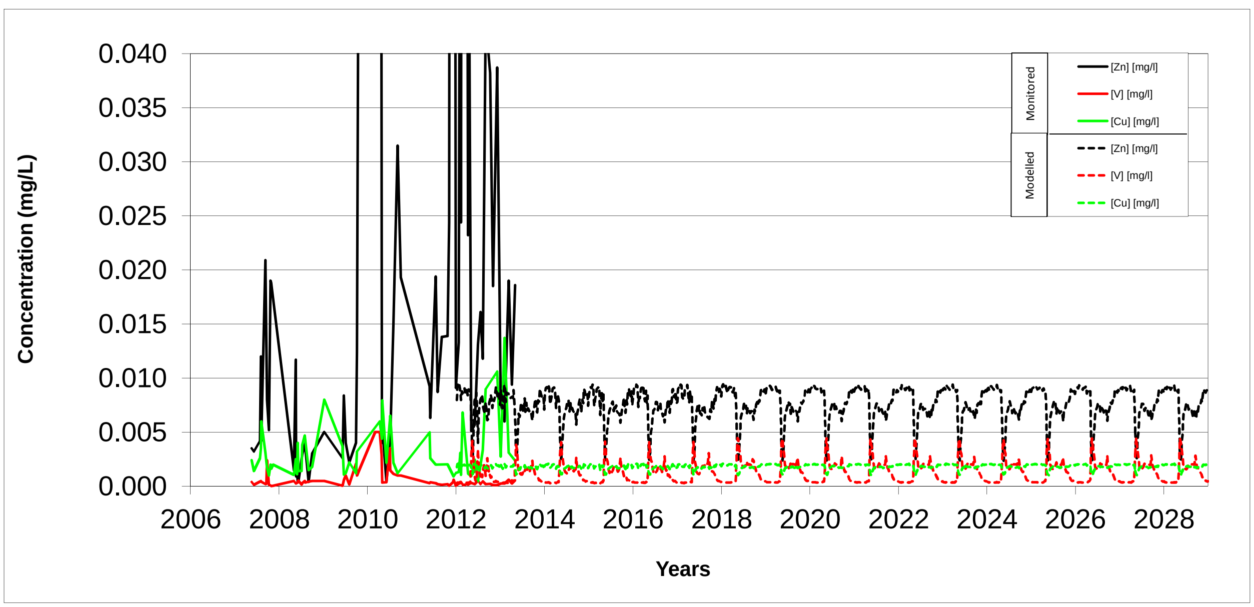
Drawn KAS
Chkd KJD

De Beers Canada Inc.

North Pile Discharge (SNP 02-02) Dissolved Concentrations	FIGURE VIII-7d



Note: Monitoring values above 0.30 mg/L are not shown.



Note: Monitoring values above 0.40 mg/L are not shown.

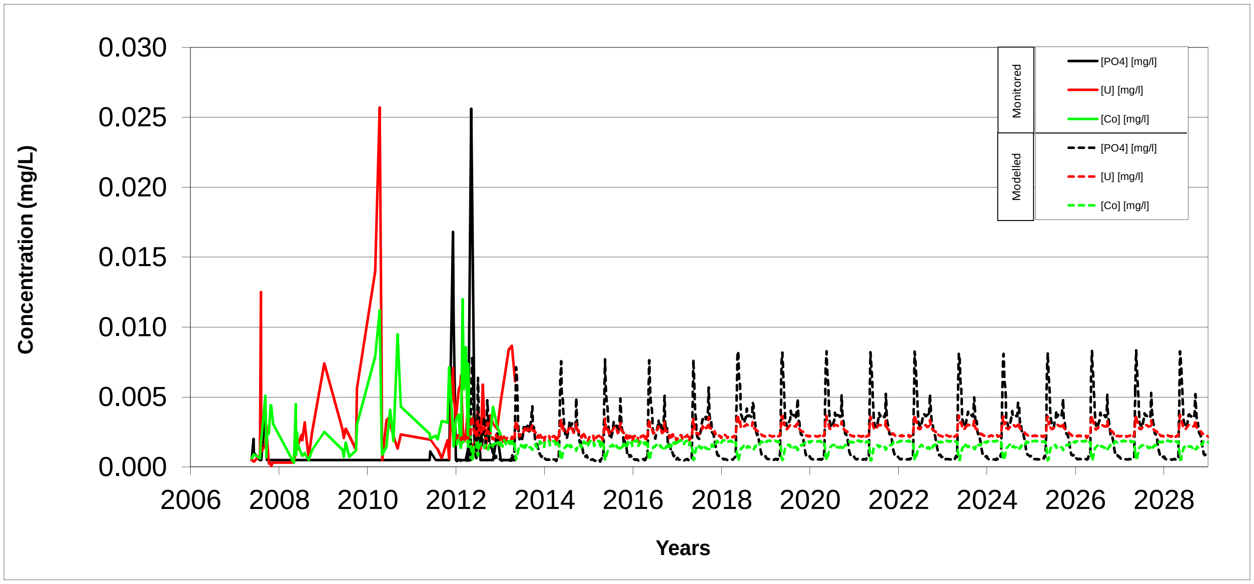
Date: December, 2013
Project: 12-1337-0001

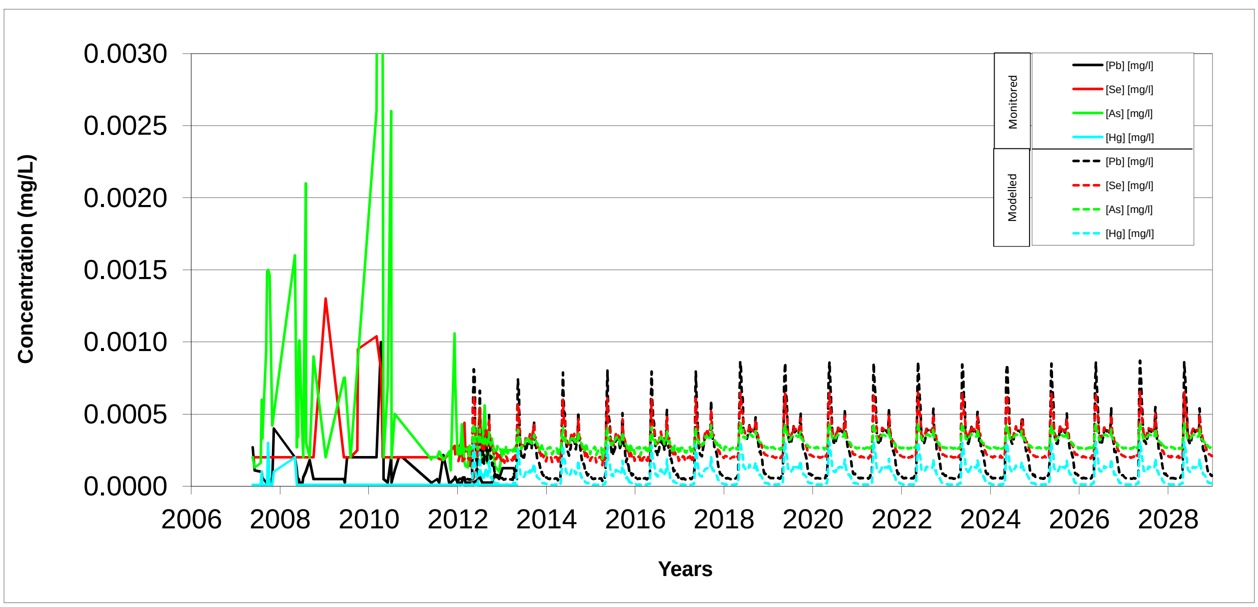
Drawn KAS
Chkd KJD

De Beers Canada Inc.

North Pile Discharge (SNP 02-02) Dissolved Concentrations

FIGURE VIII-7e





Note: Monitoring values above 0.0030 mg/L are not shown.

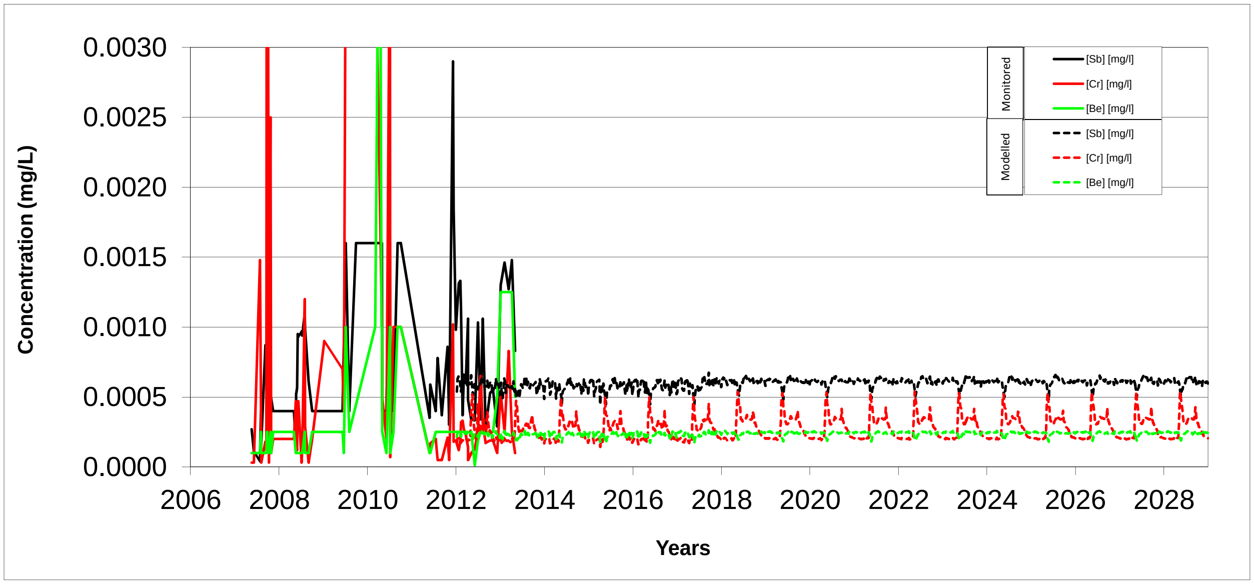
Date: December, 2013
Project: 12-1337-0001

Drawn KAS
Chkd KJD

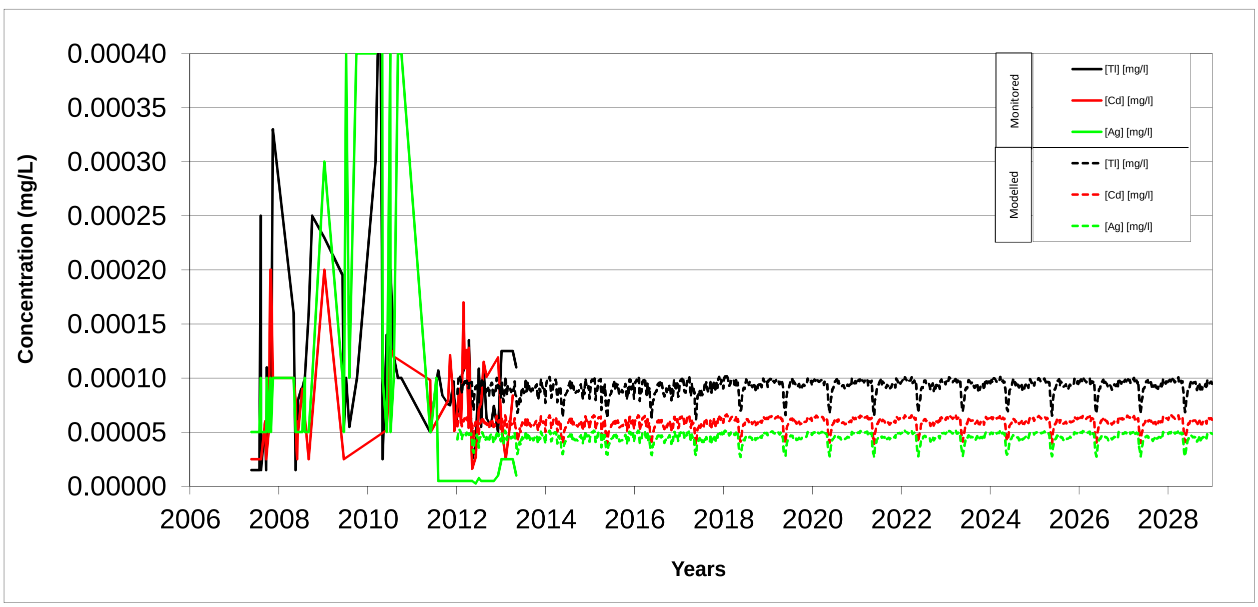
De Beers Canada Inc.

North Pile Discharge (SNP 02-02) Dissolved Concentrations

FIGURE VIII-7f



Note: Monitoring values above 0.0030 mg/L are not shown.



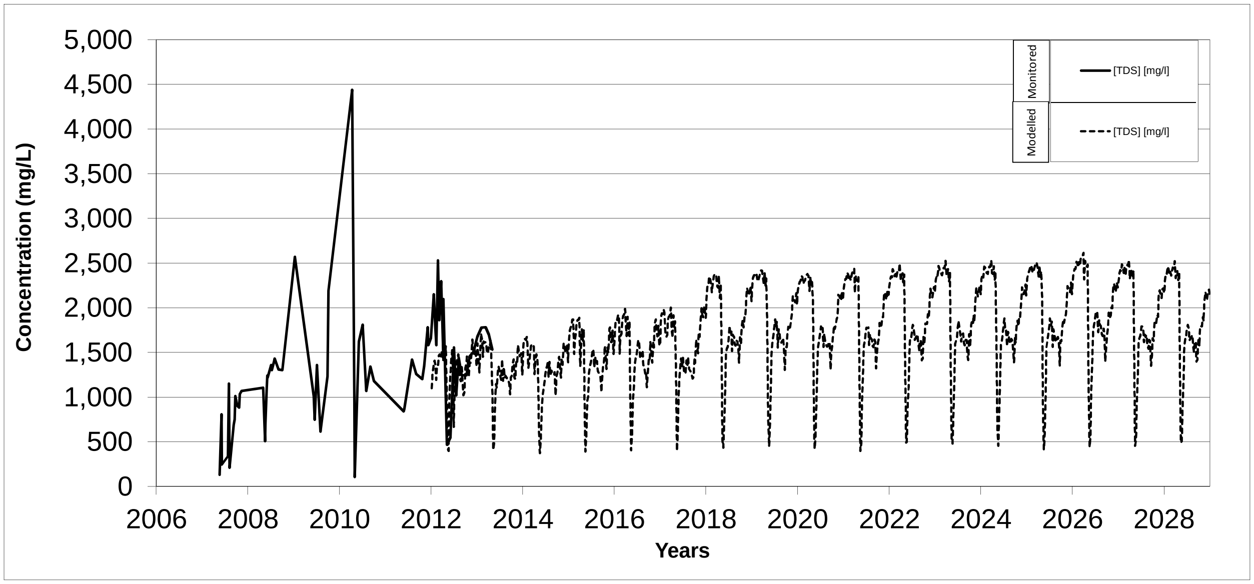
Note: Monitoring values above 0.00040 mg/L are not shown.

Date: December, 2013
Project: 12-1337-0001

Drawn KAS
Chkd KJD

De Beers Canada Inc.

North Pile Discharge (SNP 02-02) Dissolved Concentrations	FIGURE VIII-7g



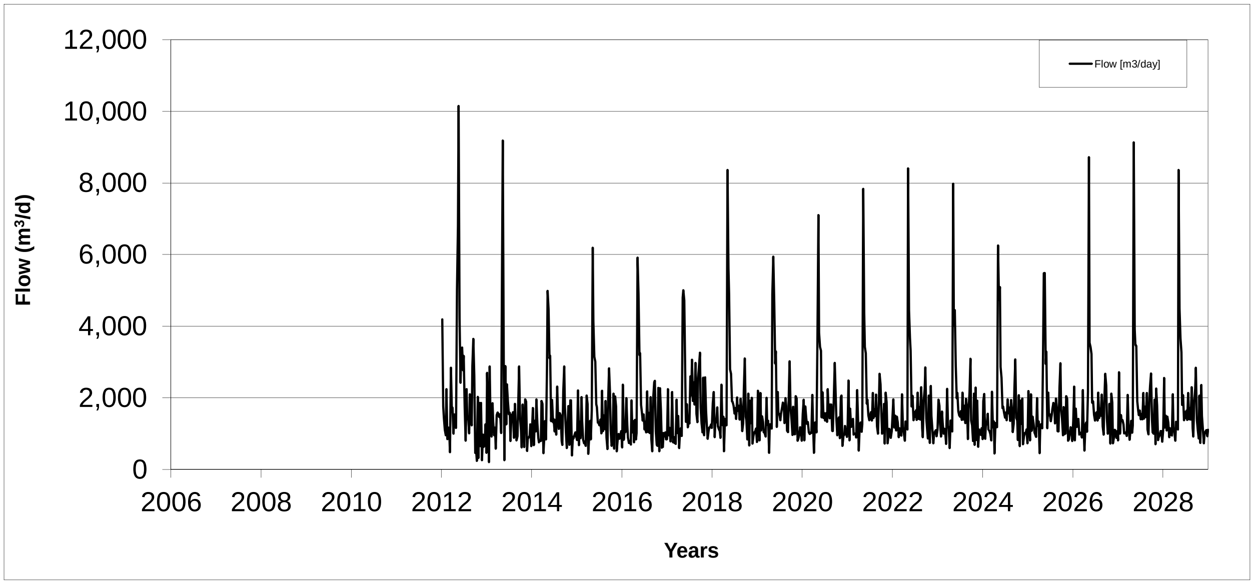
Date: December, 2013
Project: 12-1337-0001

Drawn KAS
Chkd KJD

De Beers Canada Inc.

North Pile Discharge (SNP 02-02) Dissolved Concentrations

FIGURE VIII-7h

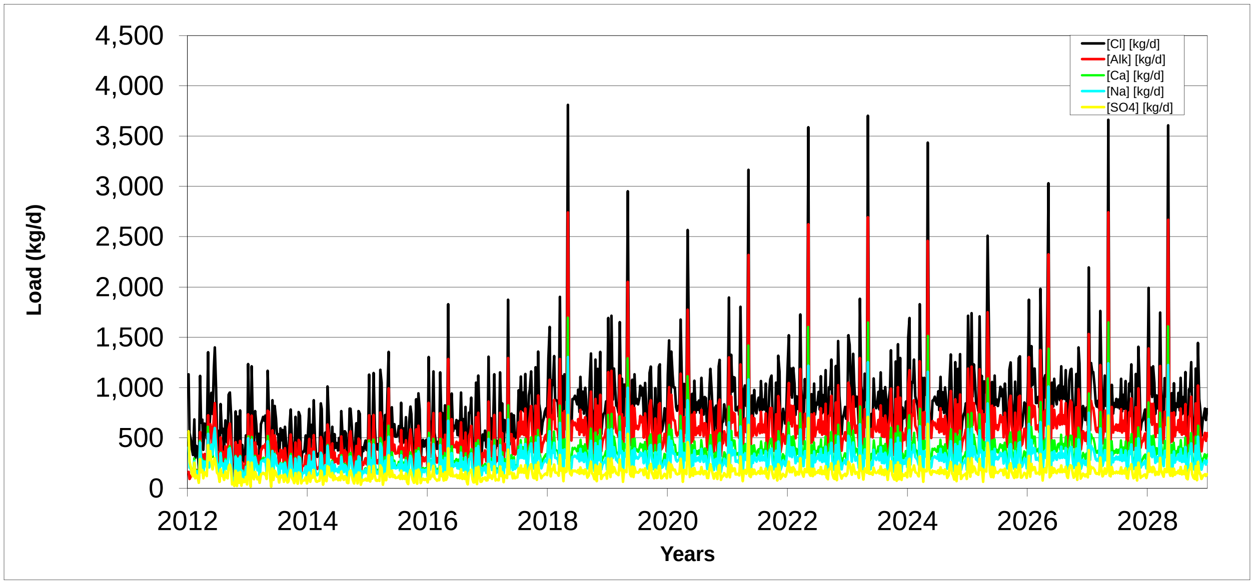


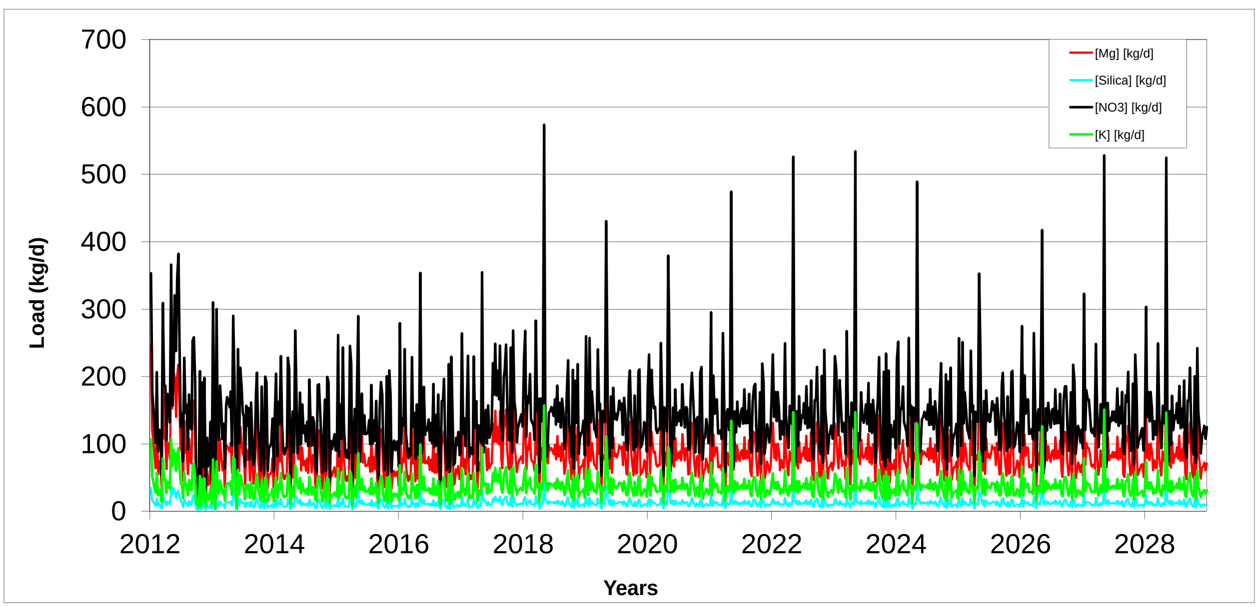
Date: December, 2013
Project: 12-1337-0001

Drawn KAS
Chkd KJD

De Beers Canada Inc.

North Pile Discharge (SNP 02-02) Dissolved Load	FIGURE VIII-8a





Date: December, 2013
Project: 12-1337-0001

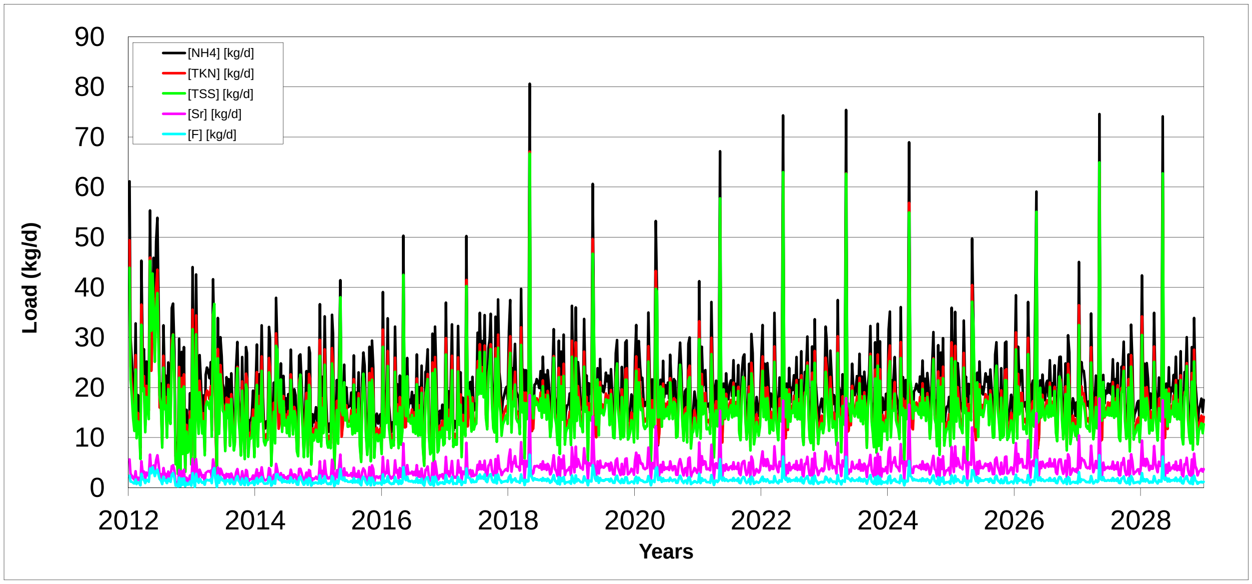
Drawn KAS
Chkd KJD

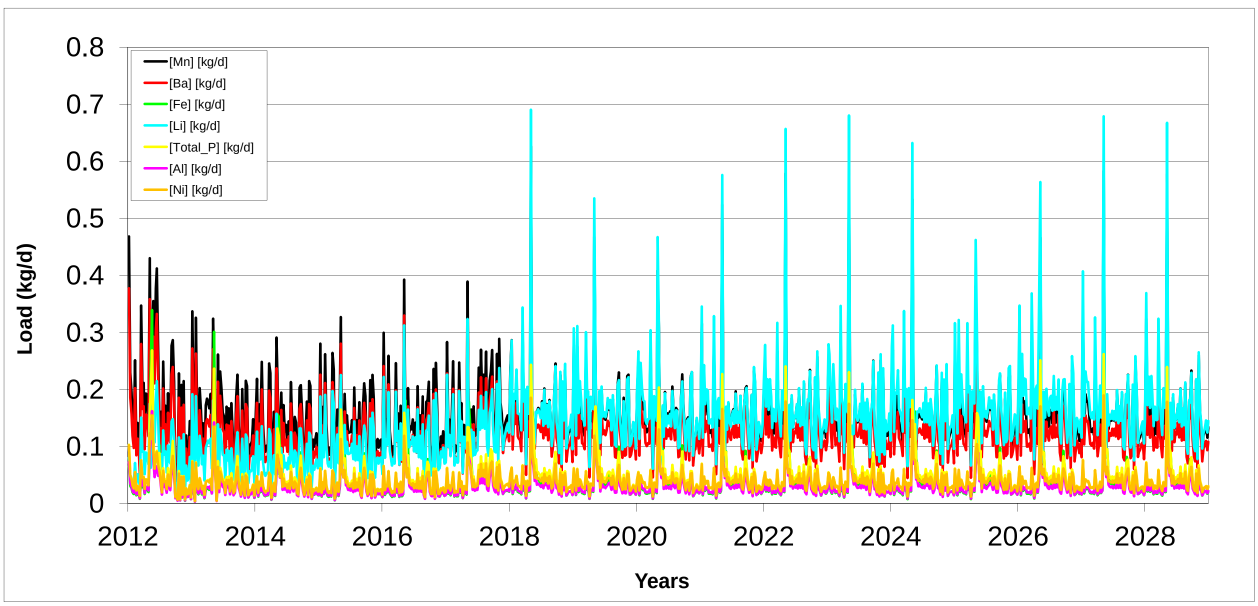
De Beers Canada Inc.

AppVIII_Fig8.xls-App VIII-8a

North Pile Discharge (SNP 02-02) Dissolved Load

FIGURE VIII-8b





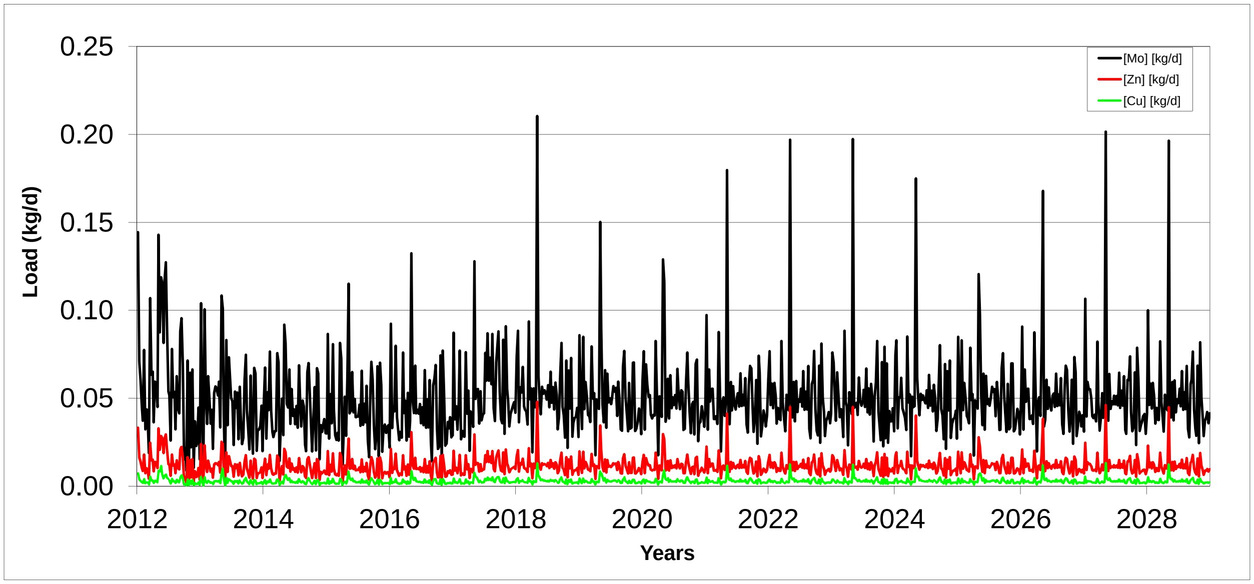
Date: December, 2013
Project: 12-1337-0001

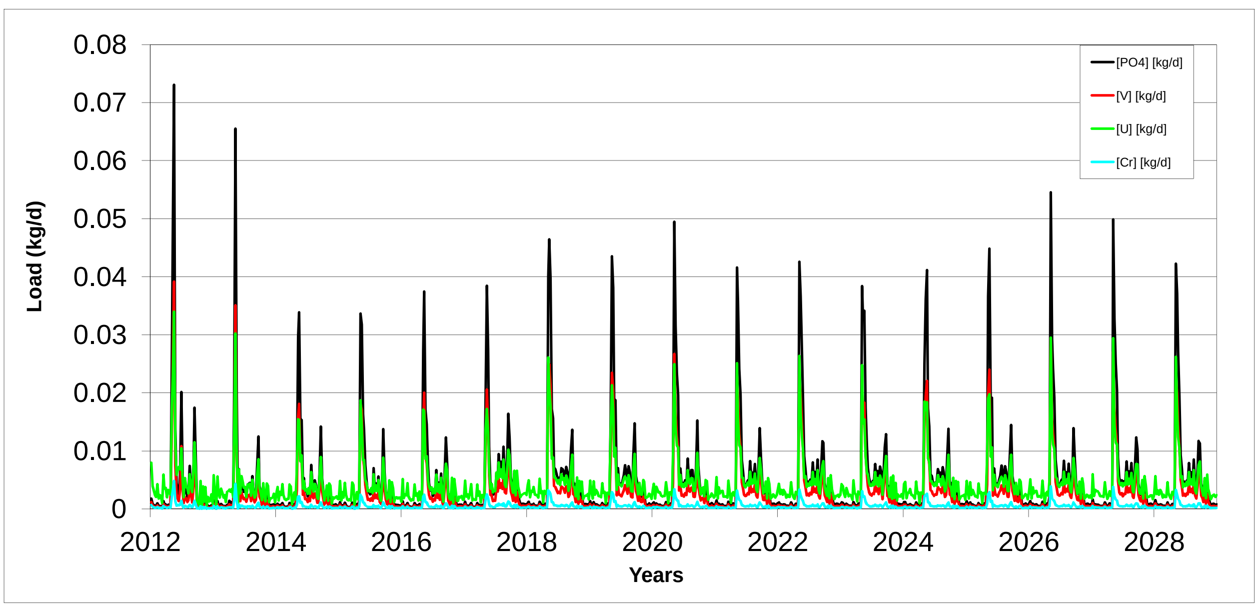
Drawn KAS
Chkd KJD

De Beers Canada Inc.

AppVIII_Fig8.xls-App VIII-8b

North Pile Discharge (SNP 02-02) Dissolved Load | **FIGURE VIII-8c**





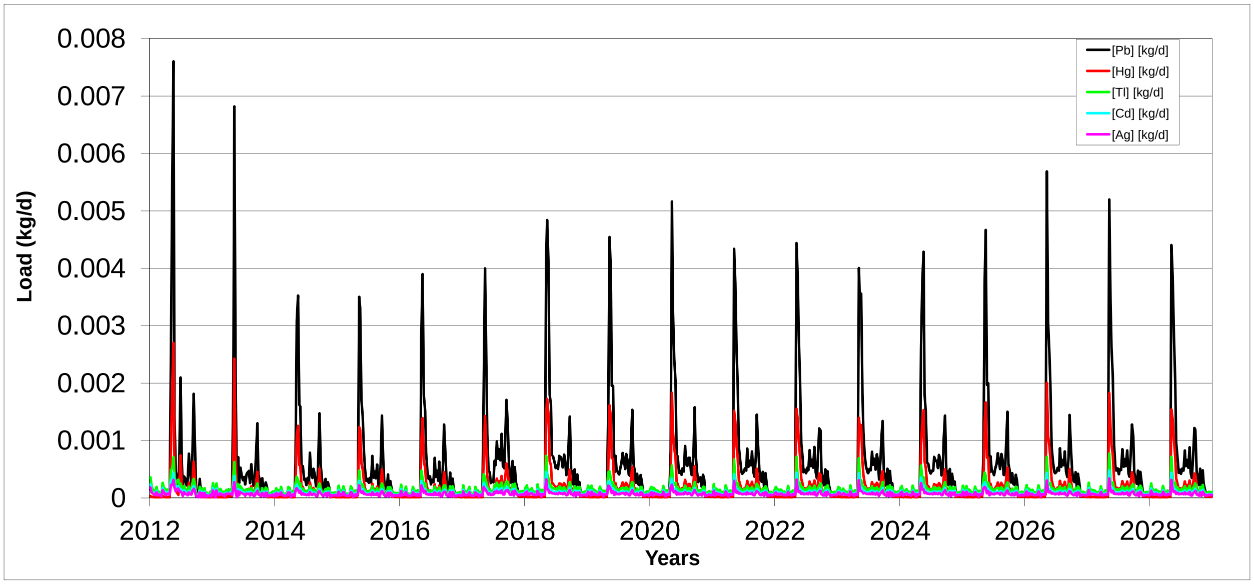
Date: December, 2013
Project: 12-1337-0001

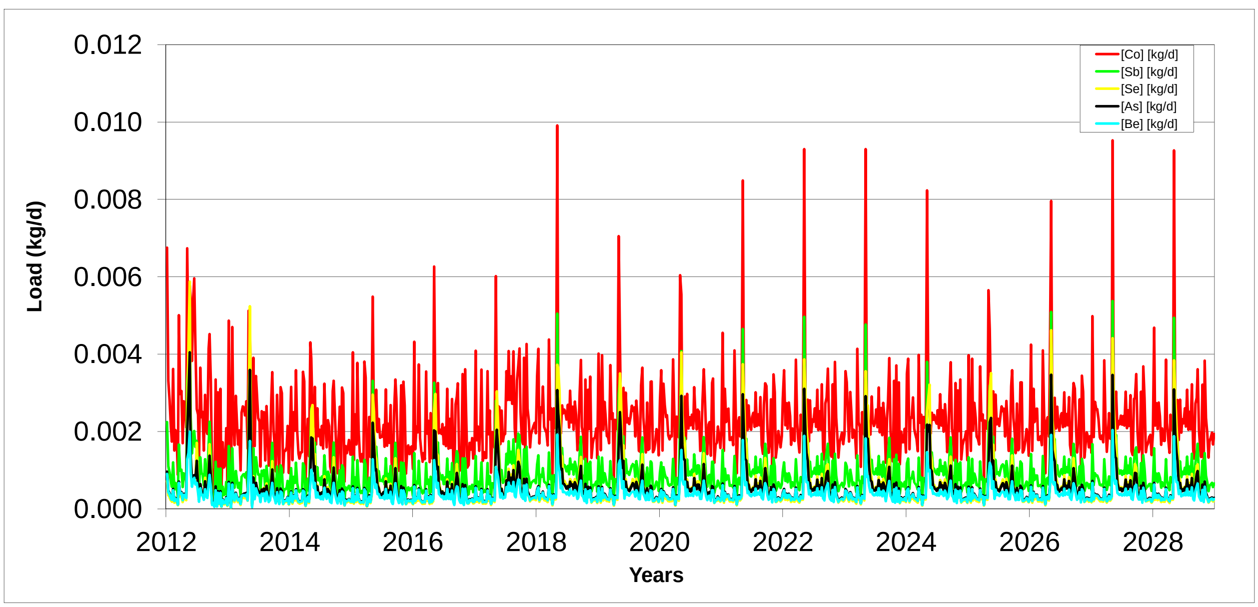
Drawn KAS
Chkd KJD

De Beers Canada Inc.

North Pile Discharge (SNP 02-02) Dissolved Load

FIGURE VIII-8d





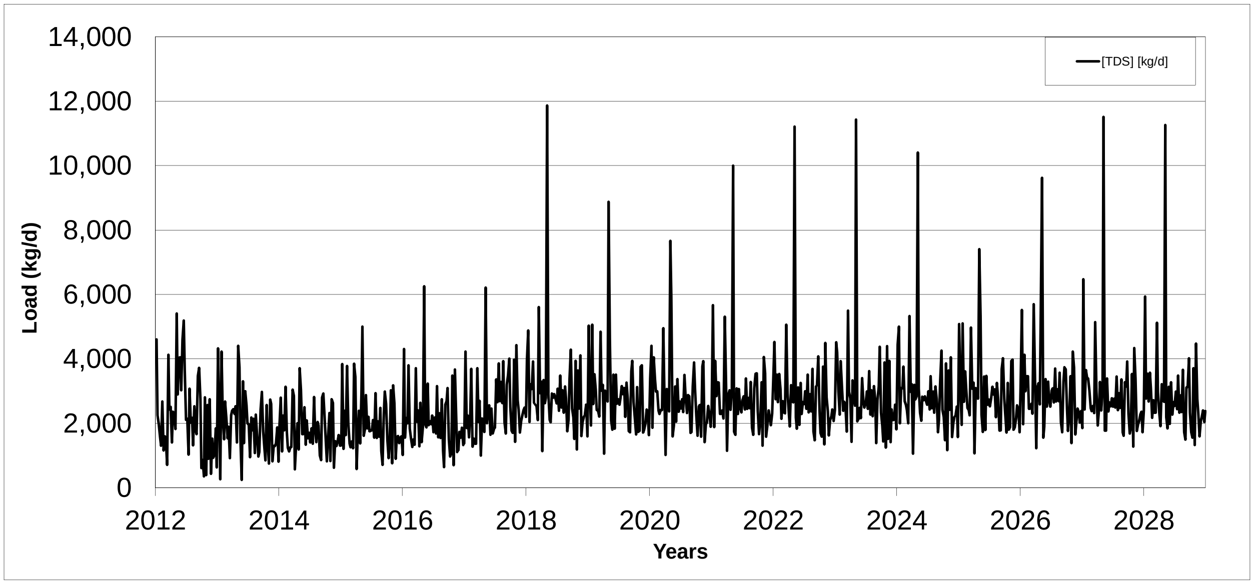
Date: December, 2013
Project: 12-1337-0001

Drawn KAS
Chkd KJD

De Beers Canada Inc.

AppVIII_Fig8.xls-App VIII-8d

North Pile Discharge (SNP 02-02) Dissolved Load	FIGURE VIII-8e

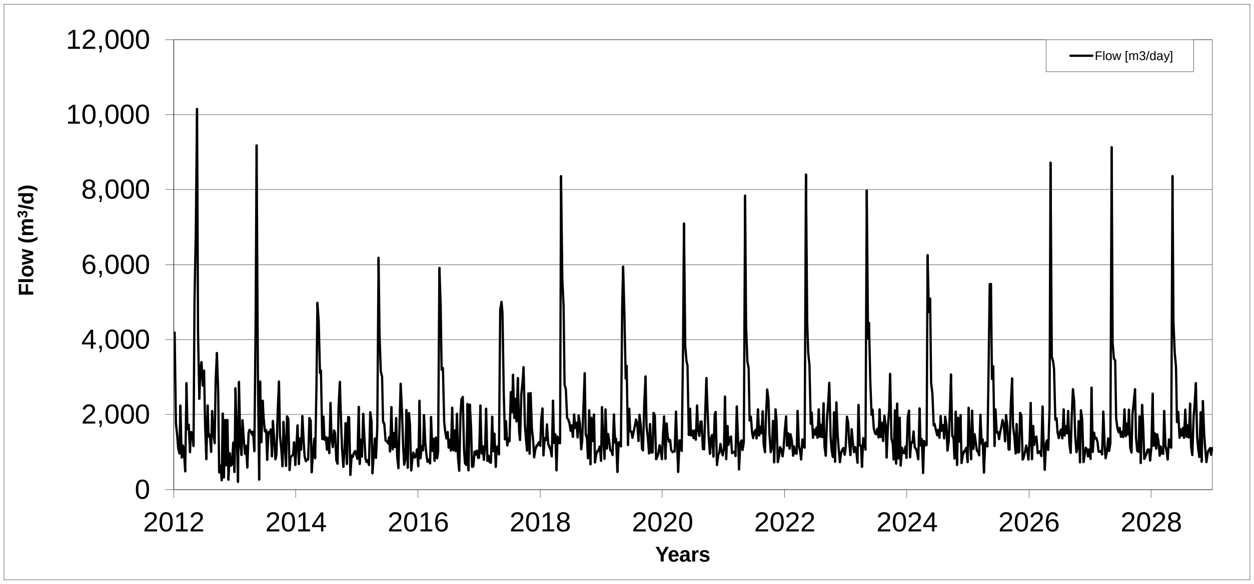


Date: December, 2013
Project: 12-1337-0001

Drawn KAS
Chkd KJD

De Beers Canada Inc.

North Pile Discharge (SNP 02-02) Dissolved Load FLOW	FIGURE VIII-8f

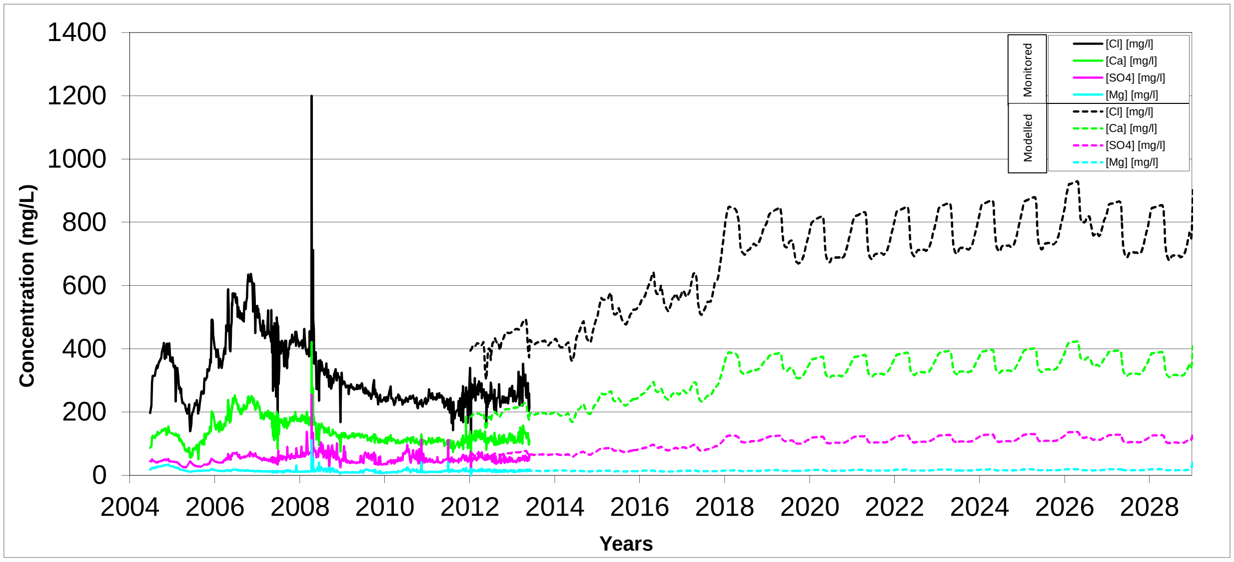


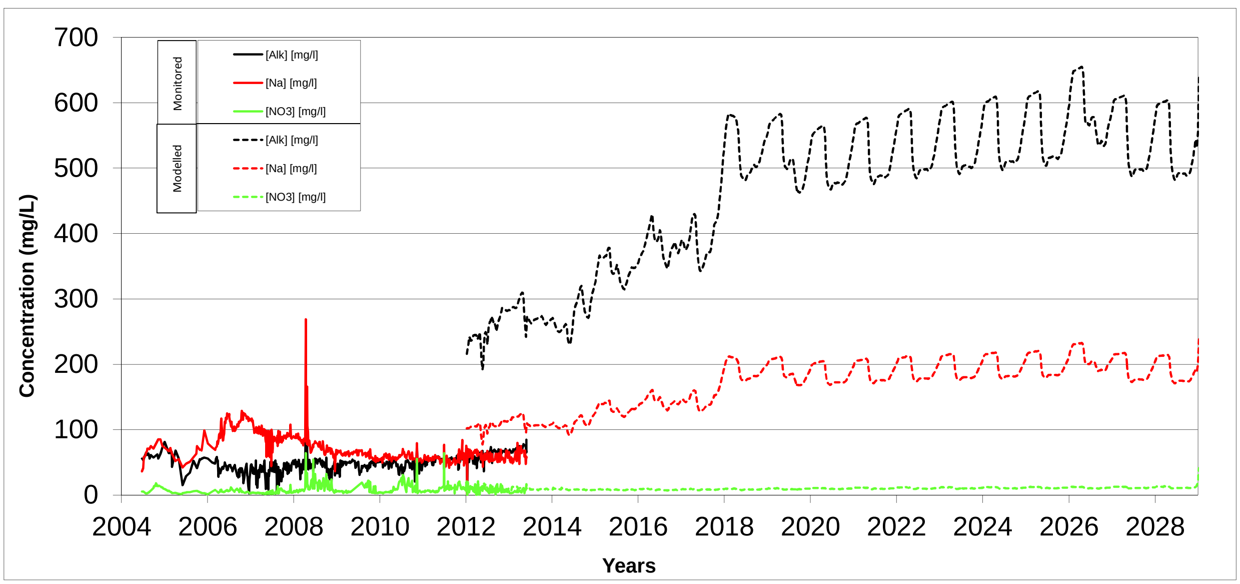
Date: December, 2013
Project: 12-1337-0001

Drawn KAS
Chkd KJD

De Beers Canada Inc.

Final Discharge (SNP 02-17B) Dissolved Concentrations	FIGURE VIII-9a





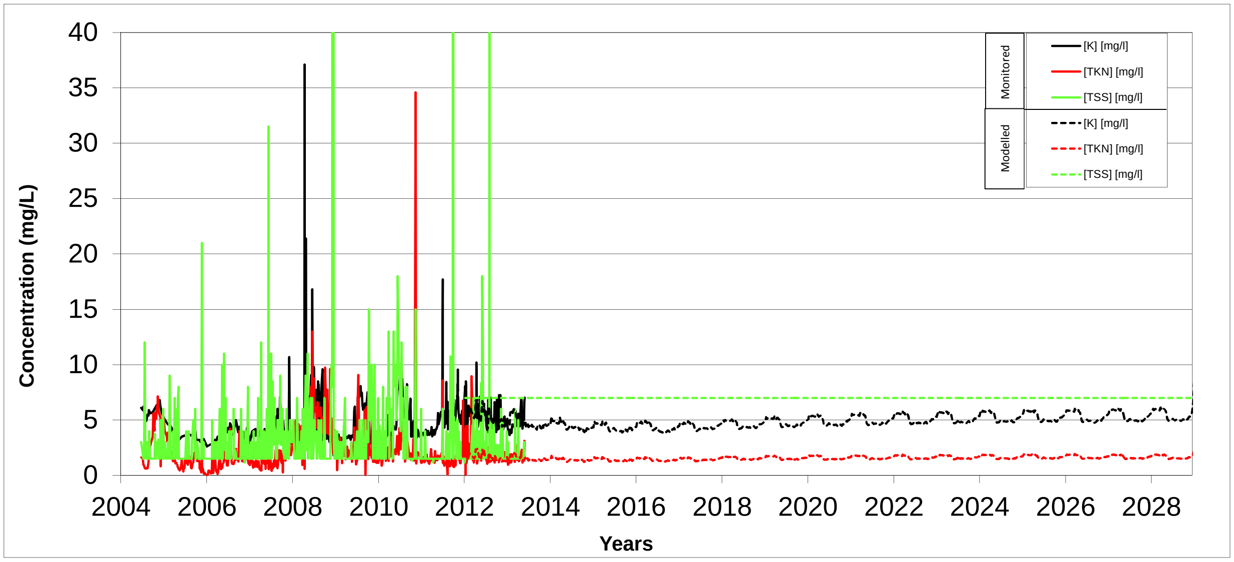
Date: December, 2013
Project: 12-1337-0001

Drawn KAS
Chkd KJD

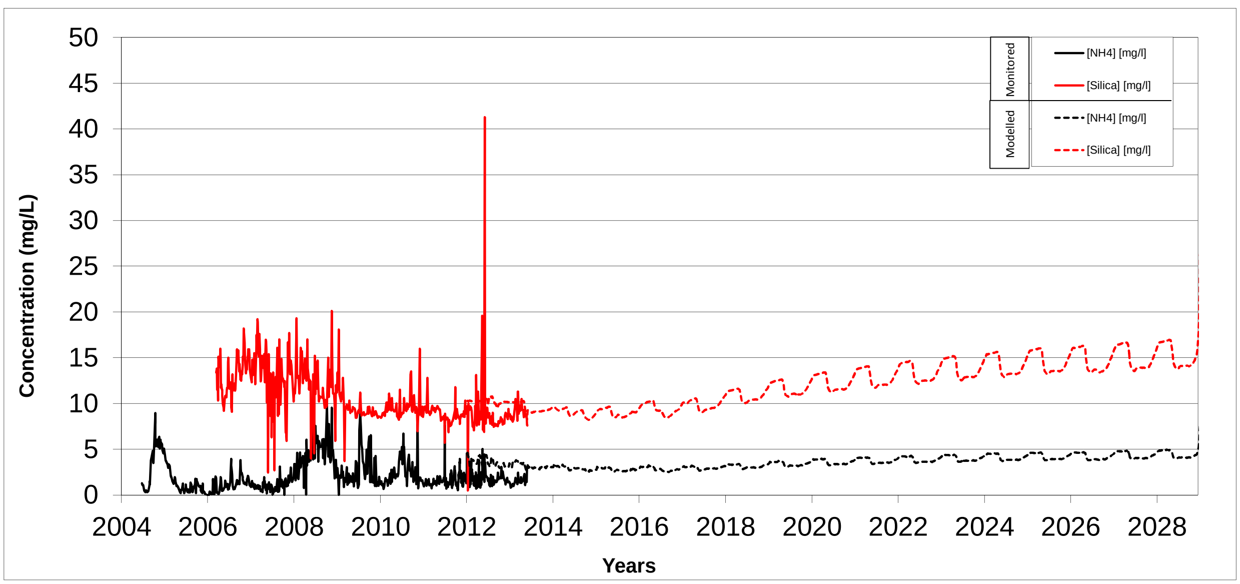
De Beers Canada Inc.

Final Discharge (SNP 02-17B) Dissolved Concentrations

FIGURE VIII-9b



Note: Monitored values above 40 mg/L are not shown.



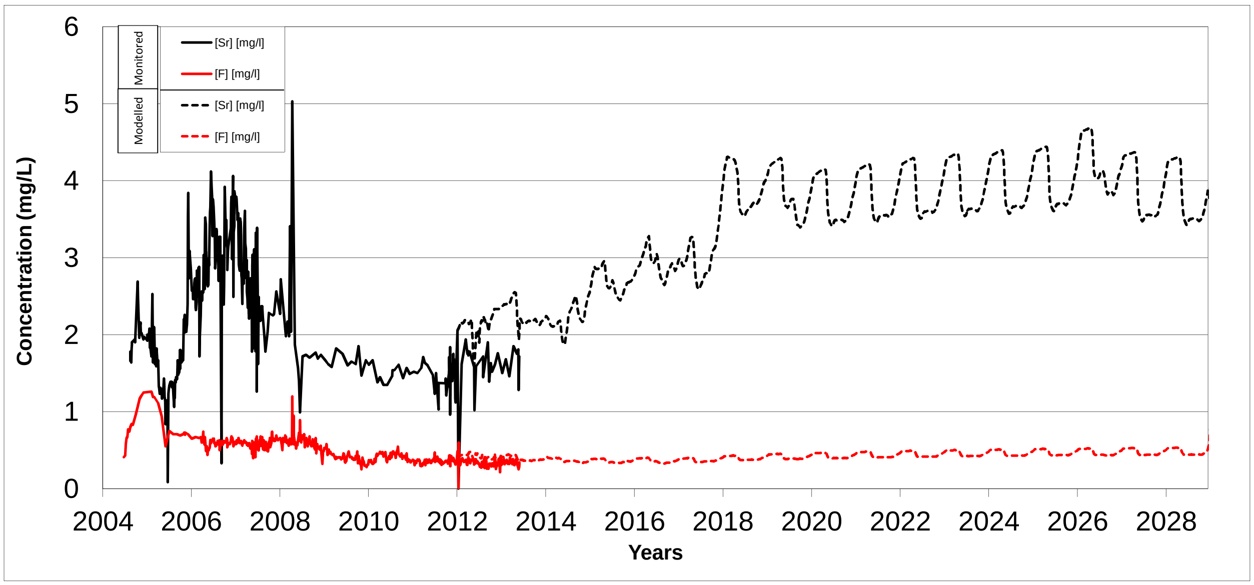
Date: December, 2013
Project: 12-1337-0001

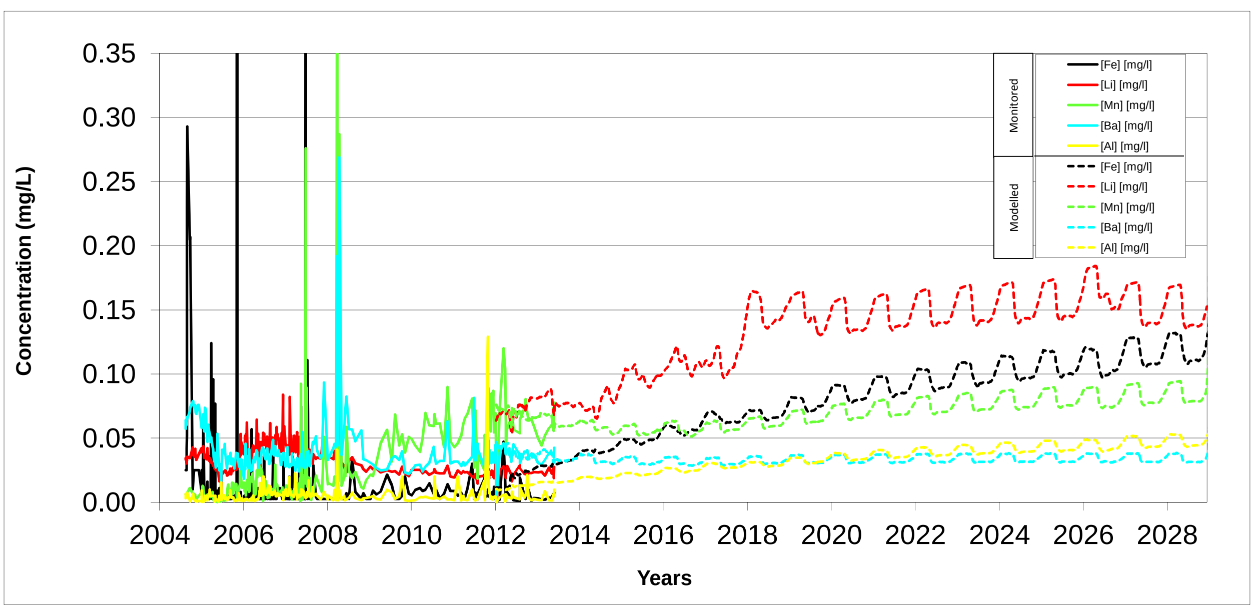
Drawn KAS
Chkd KJD

De Beers Canada Inc.

Final Discharge (SNP 02-17B) Dissolved Concentrations

FIGURE VIII-9c





Note: Monitored values above 0.35 mg/L are not shown.

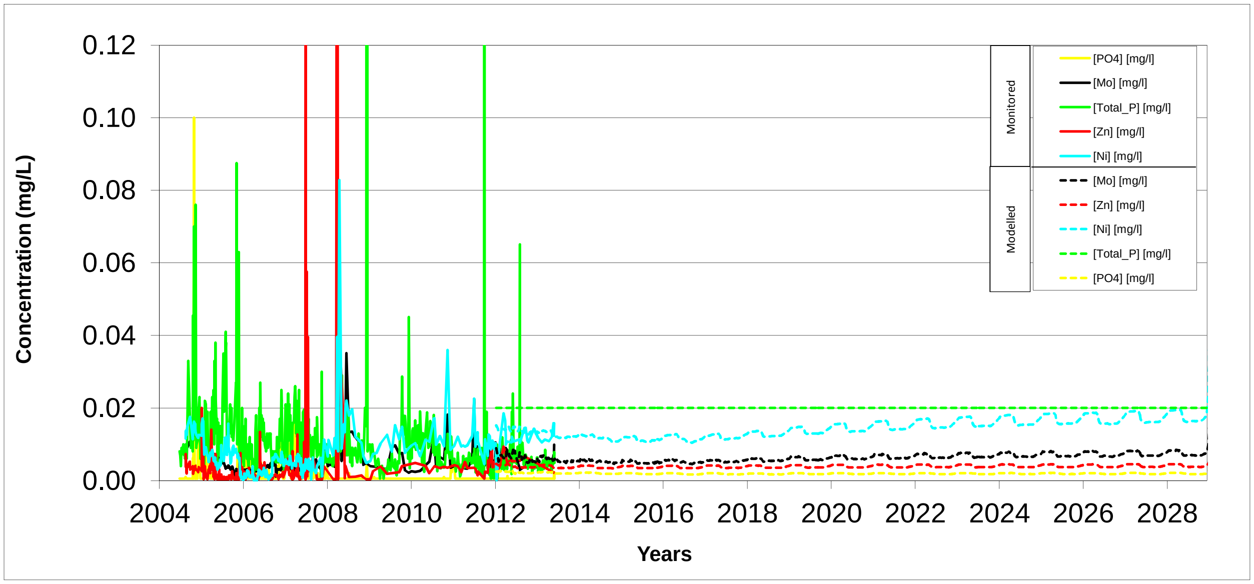
Date: December, 2013
Project: 12-1337-0001

Drawn KAS
Chkd KJD

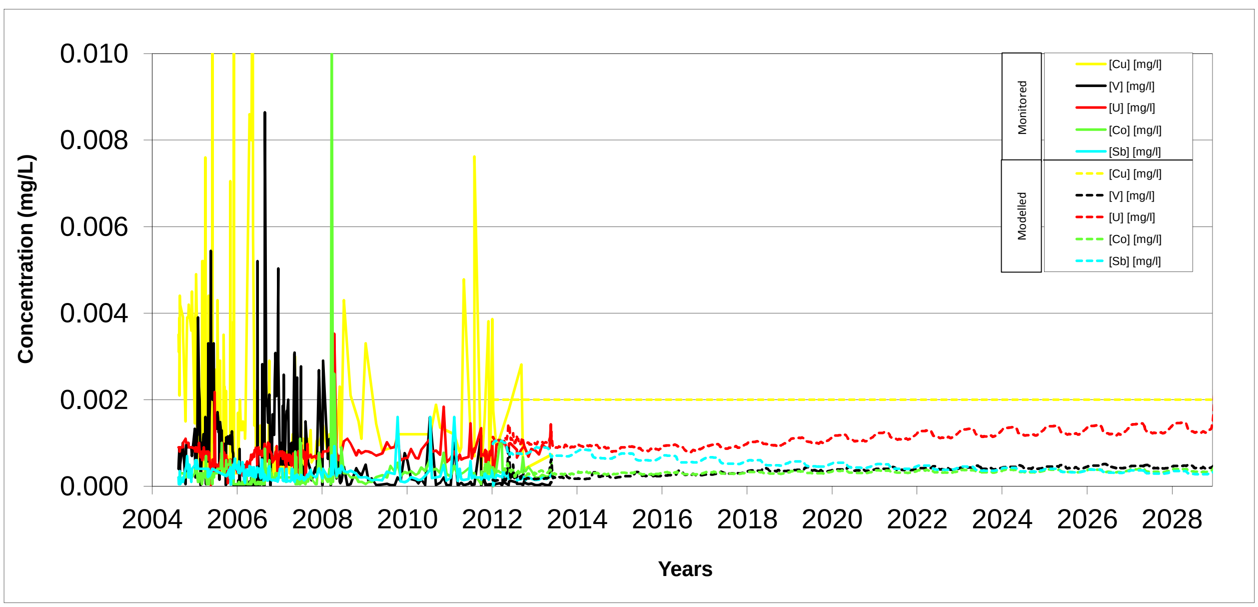
De Beers Canada Inc.

Final Discharge (SNP 02-17B) Dissolved Concentrations

FIGURE VIII-9d



Note: Monitored values above 0.12 mg/L are not shown.



Note: Monitored values above 0.01 mg/L are not shown.

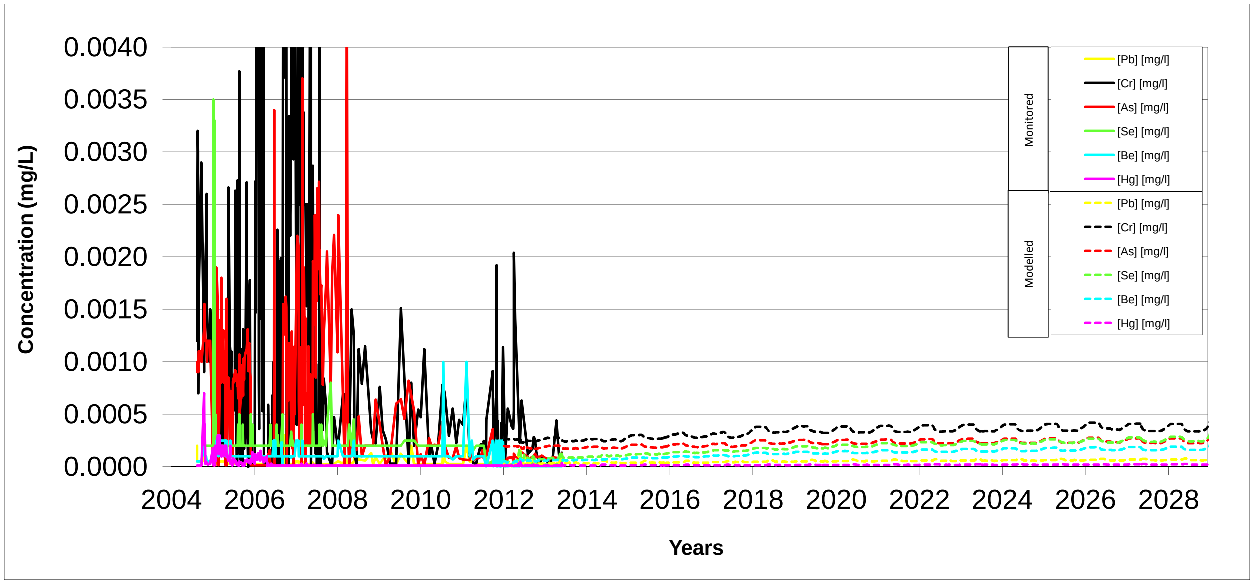
Date: December, 2013
Project: 12-1337-0001

Drawn KAS
Chkd KJD

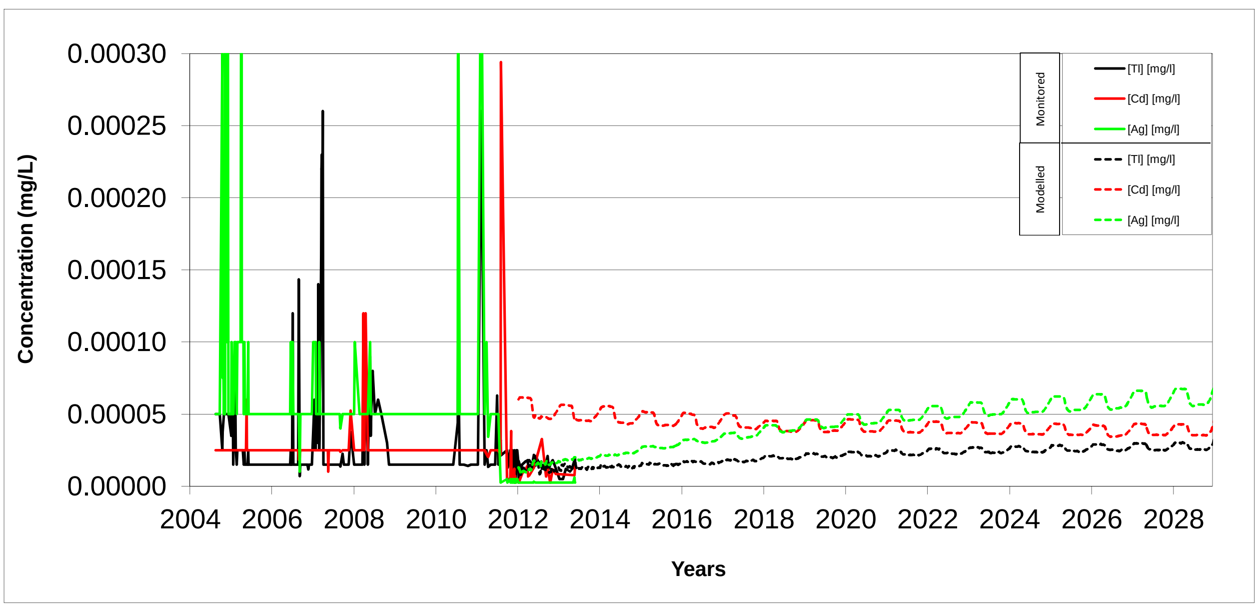
De Beers Canada Inc.

Final Discharge (SNP 02-17B) Dissolved Concentrations

FIGURE VIII-9e



Note: Monitored values above 0.0040 mg/L are not shown.



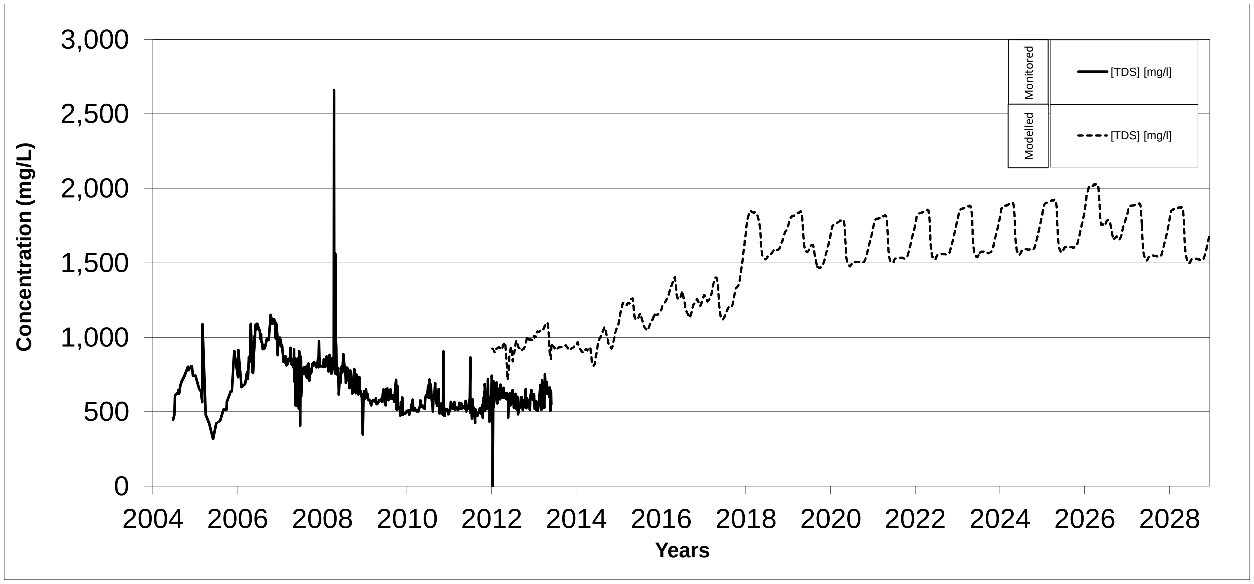
Note: Monitored values above 0.00030 mg/L are not shown.

Date: December, 2013
Project: 12-1337-0001

Drawn KAS
Chkd KJD

De Beers Canada Inc.

Final Discharge (SNP 02-17B) Dissolved Concentrations	FIGURE VIII-9f

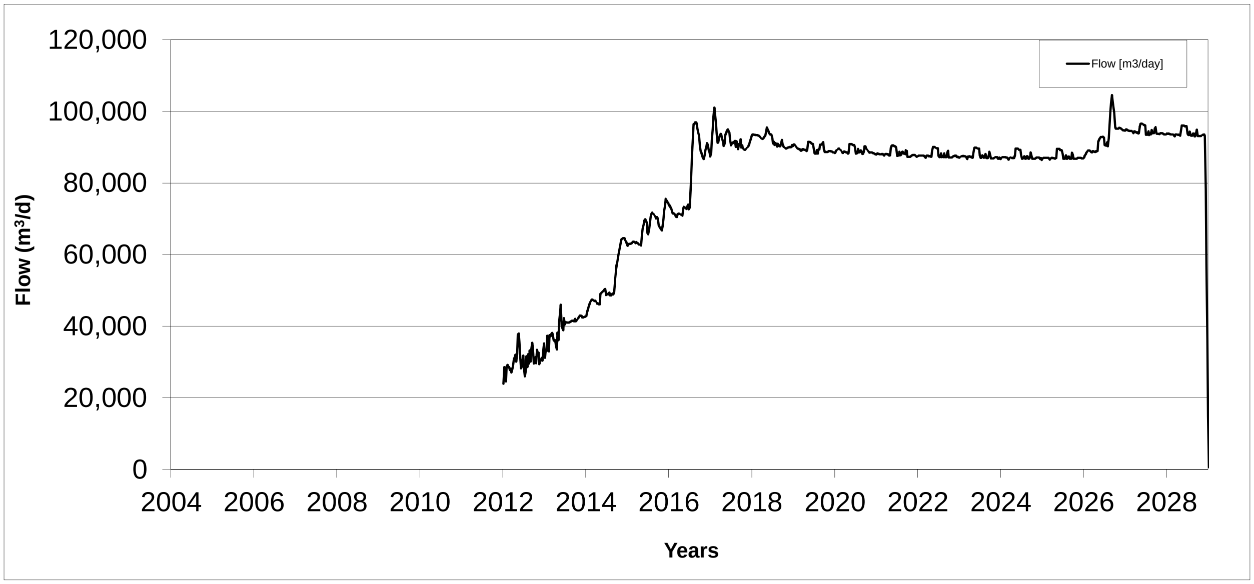


Date: December, 2013
Project: 12-1337-0001

Drawn KAS
Chkd KJD

De Beers Canada Inc.

Final Discharge (SNP 02-17B) Dissolved Concentrations	FIGURE VIII-9g

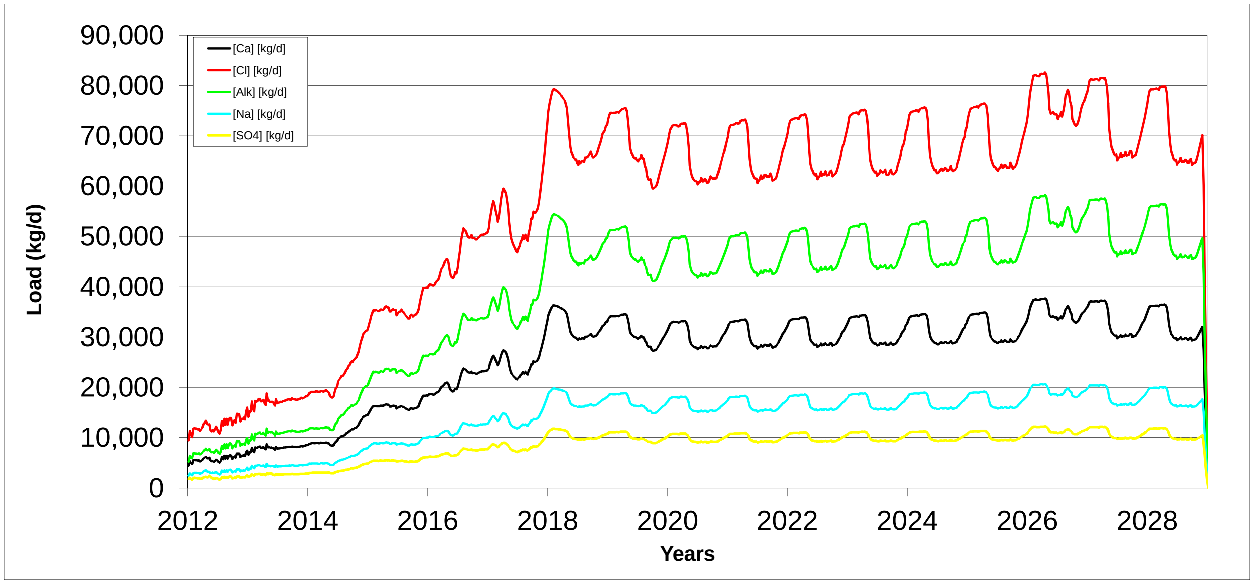


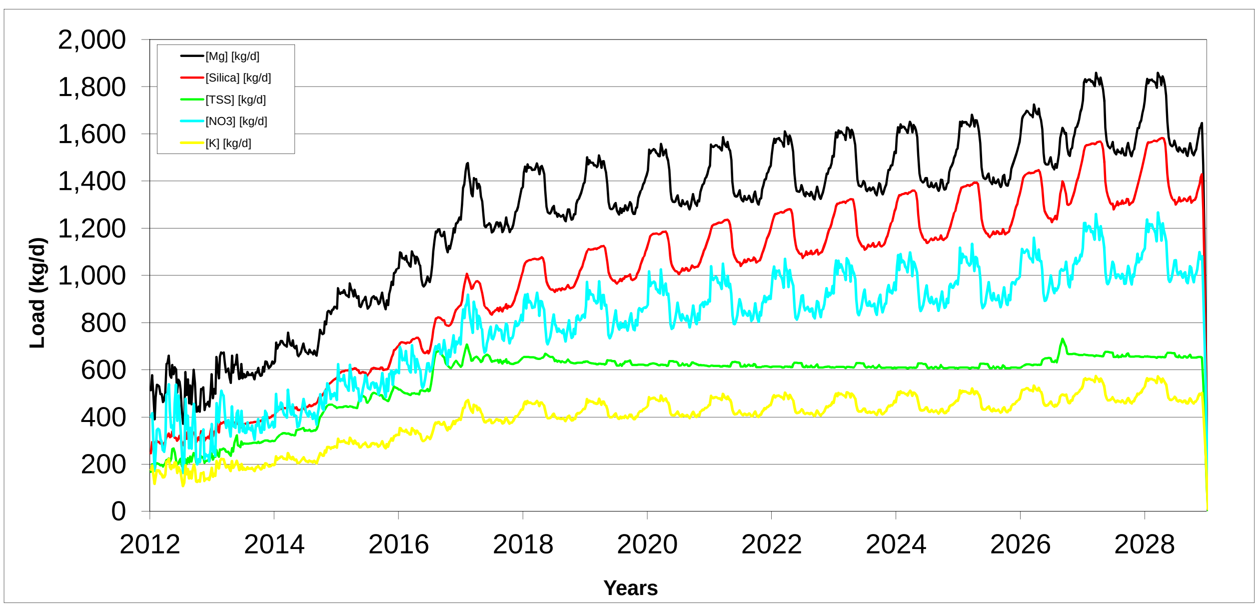
Date: December, 2013
Project: 12-1337-0001

Drawn KAS
Chkd KJD

De Beers Canada Inc.

Final Discharge (SNP 02-17B) Dissolved Load	FIGURE VIII-10a



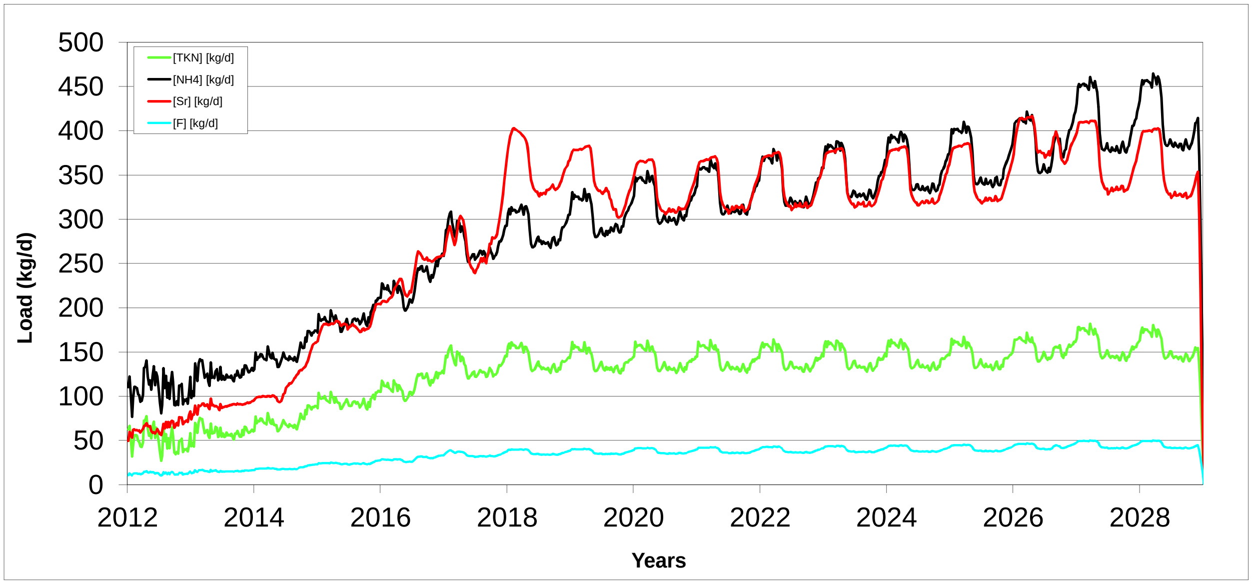


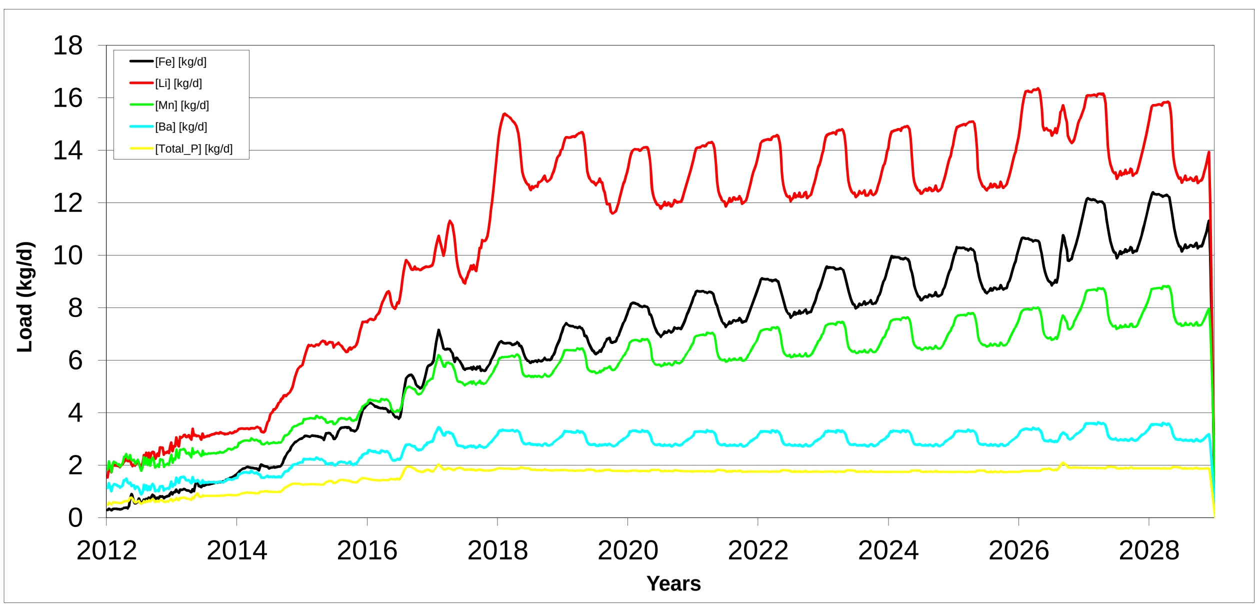
Date: December, 2013
Project: 12-1337-0001

Drawn KAS
Chkd KJD

De Beers Canada Inc.

Final Discharge (SNP 02-17B) Dissolved Load	FIGURE VIII-10b



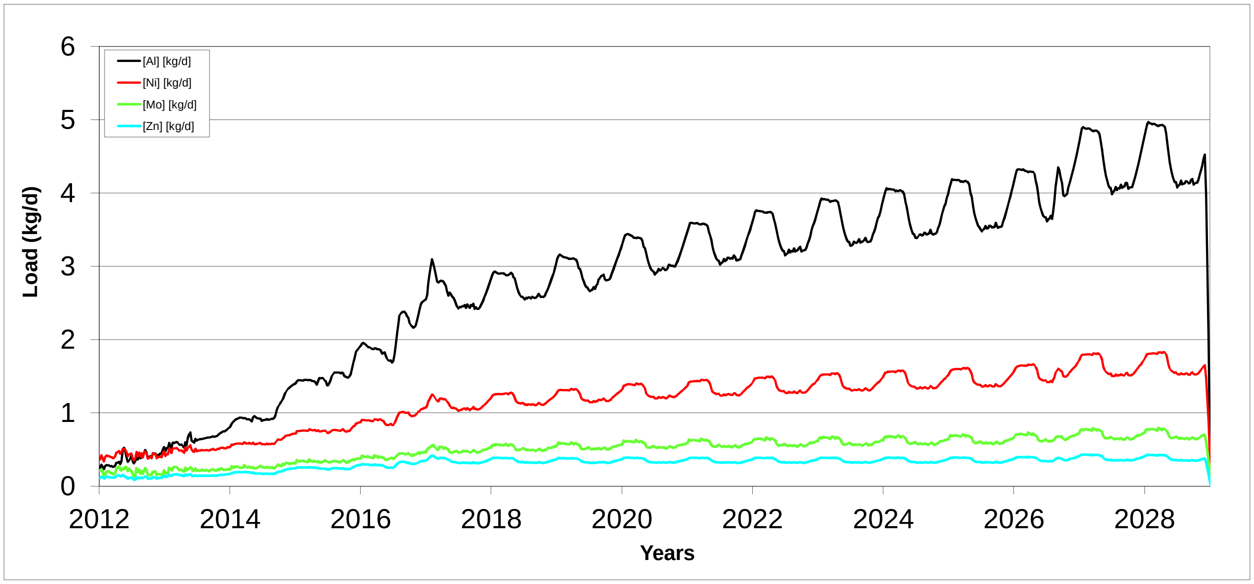


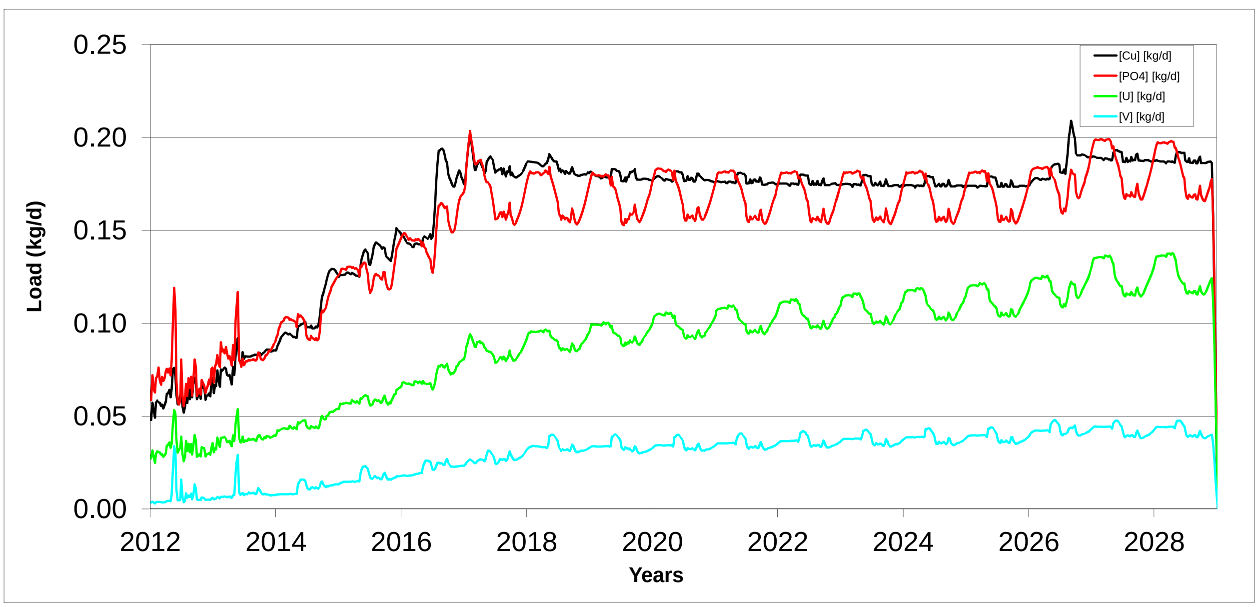
Date: December, 2013
Project: 12-1337-0001

Drawn KAS
Chkd KJD

De Beers Canada Inc.

Final Discharge (SNP 02-17B) Dissolved Load	FIGURE VIII-10c





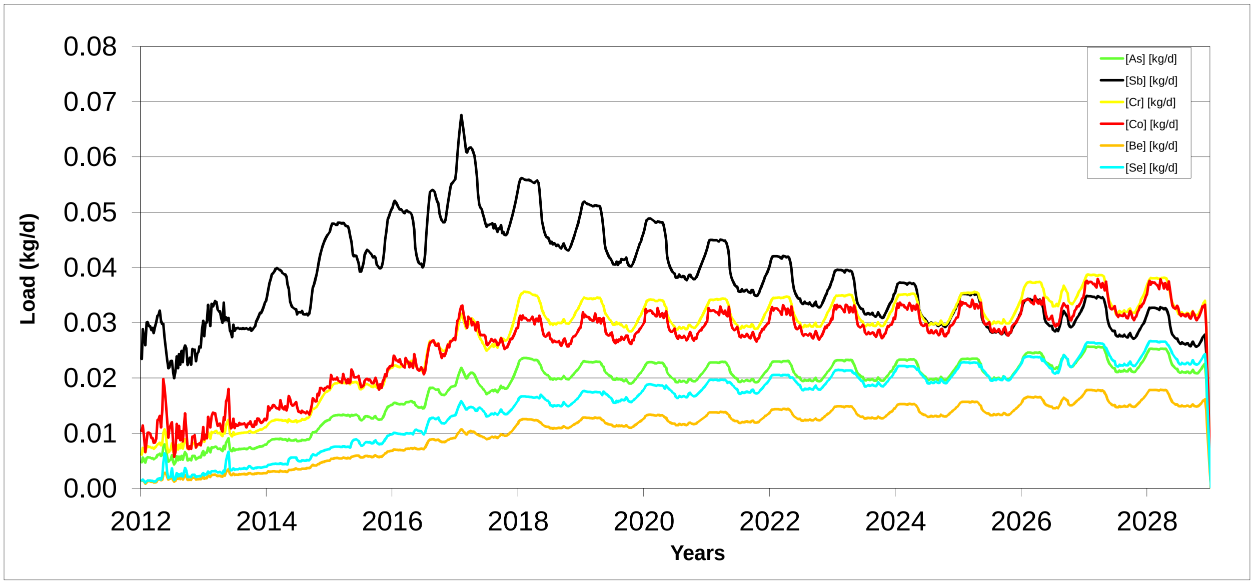
Date: December, 2013
Project: 12-1337-0001

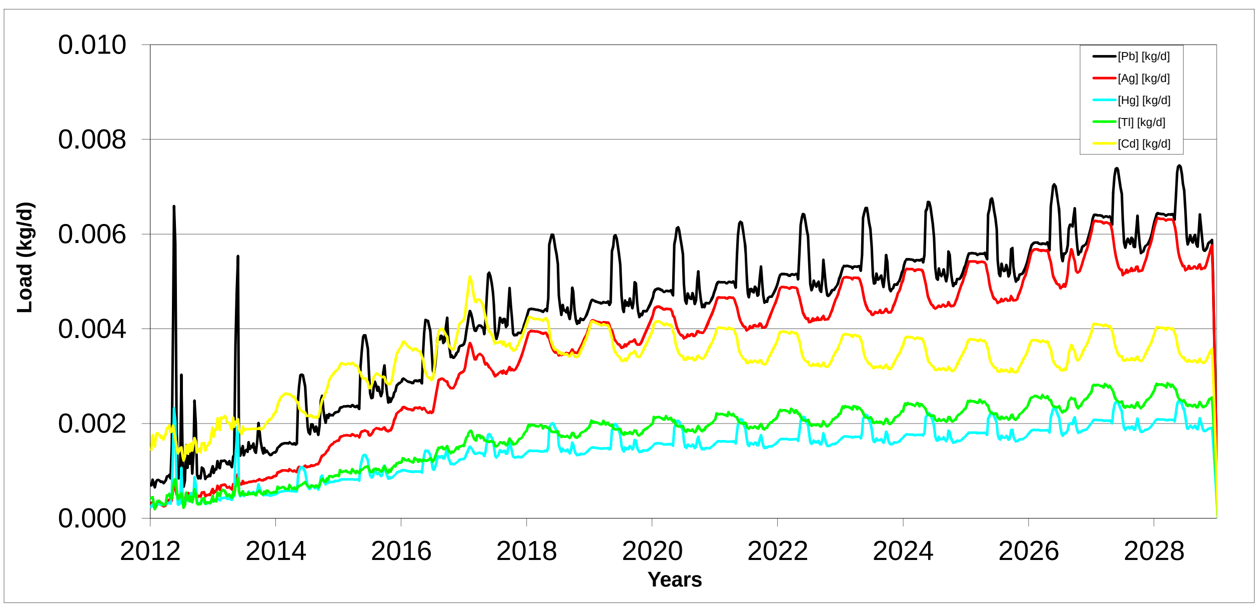
Drawn KAS
Chkd KJD

De Beers Canada Inc.

Final Discharge (SNP 02-17B) Dissolved Load

FIGURE VIII-10d





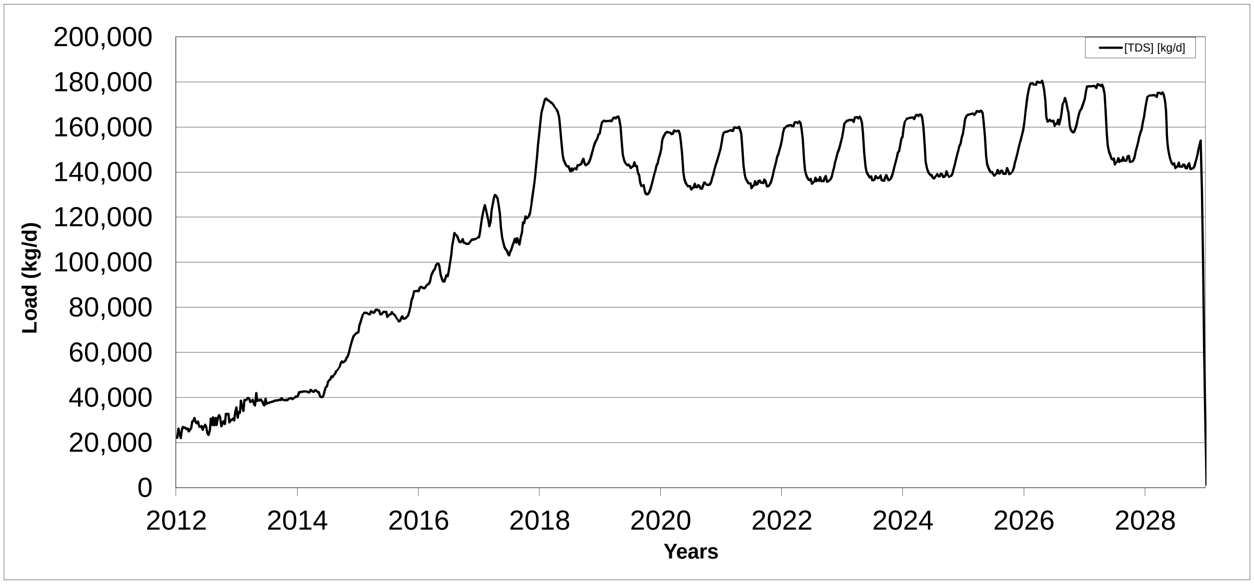
Date: December, 2013
Project: 12-1337-0001

Drawn KAS
Chkd KJD

De Beers Canada Inc.

Final Discharge (SNP 02-17B) Dissolved Load

FIGURE VIII-10e

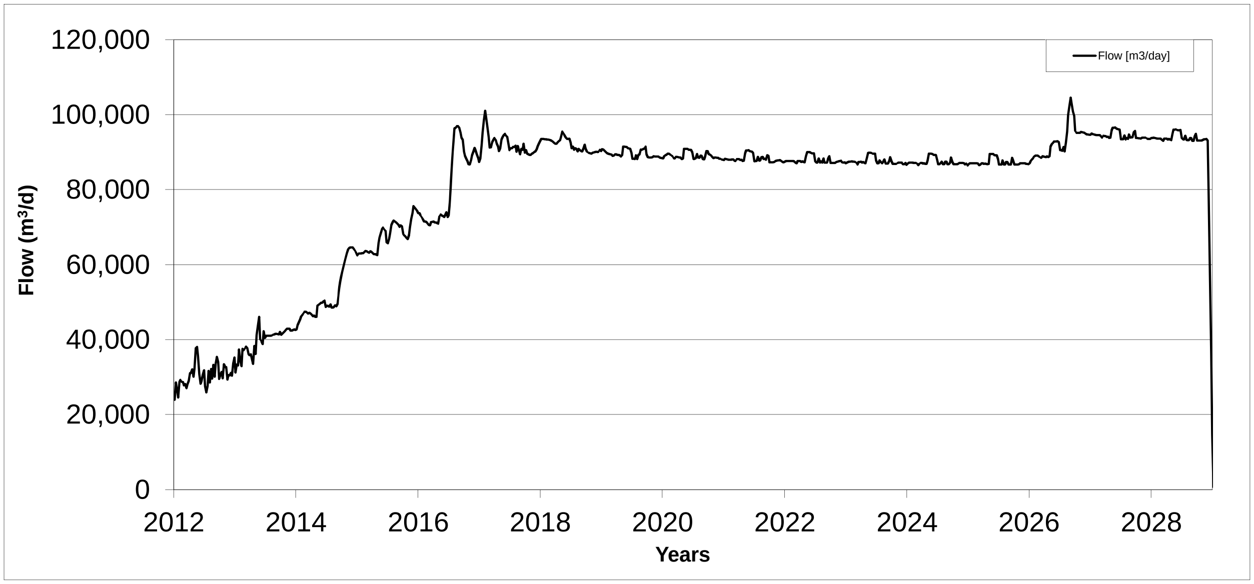


Date: December, 2013
Project: 12-1337-0001

Drawn KAS
Chkd KJD

De Beers Canada Inc.

Final Discharge (SNP 02-17B) Dissolved Load FLOW	FIGURE VIII-10f



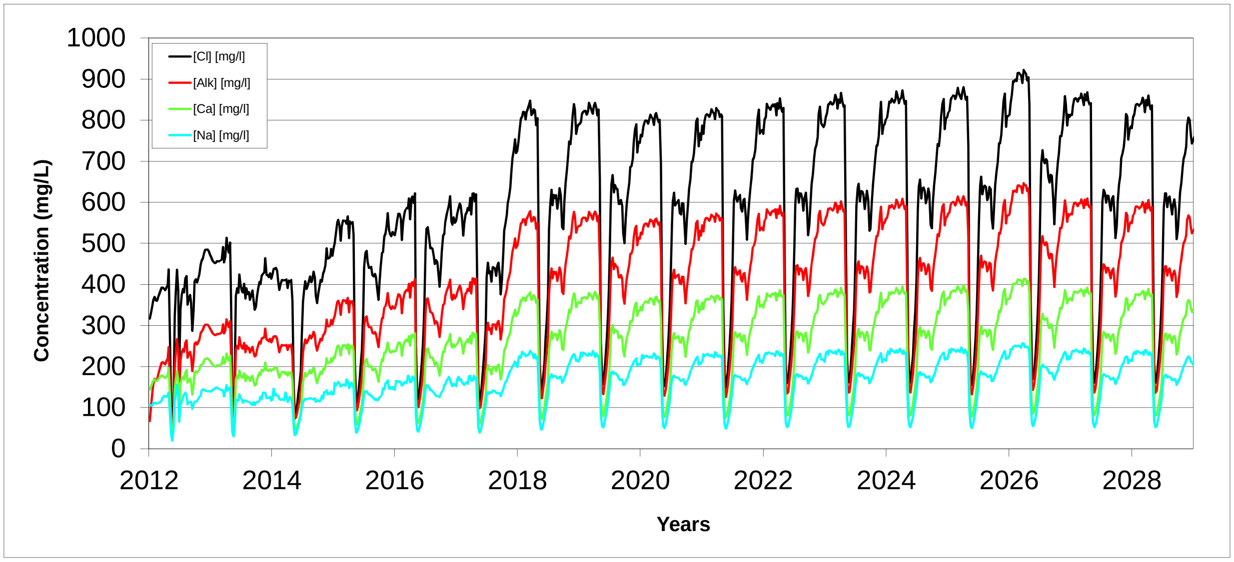
Date: December, 2013
Project: 12-1337-0001

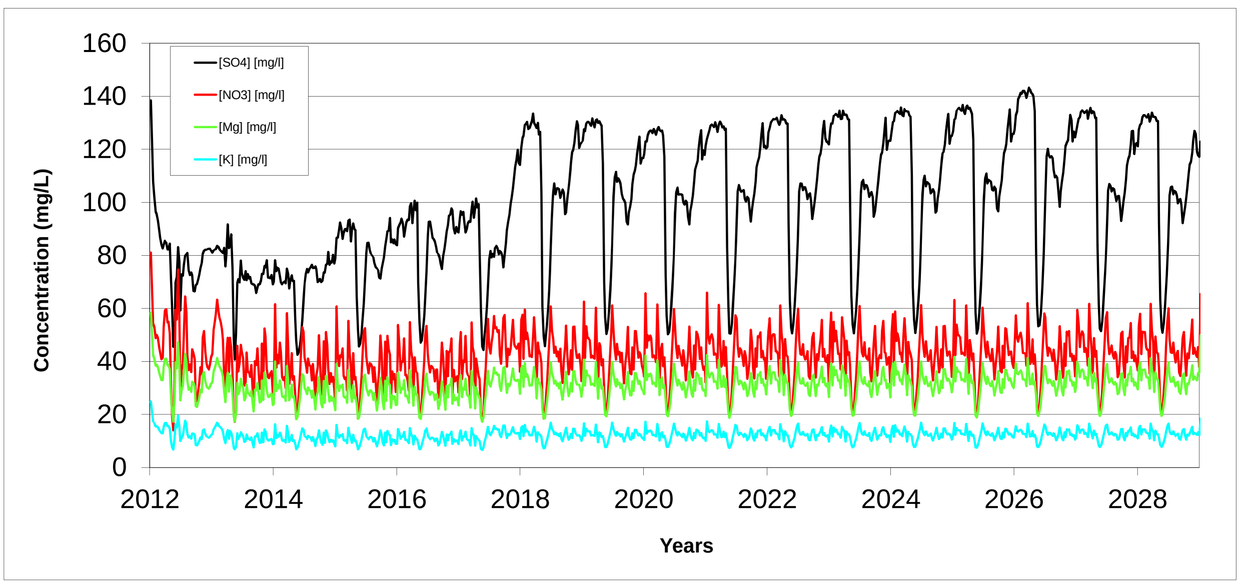
Drawn KAS
Chkd KJD

De Beers Canada Inc.

Water Management Pond Seepage Dissolved Concentrations

FIGURE VIII-11a



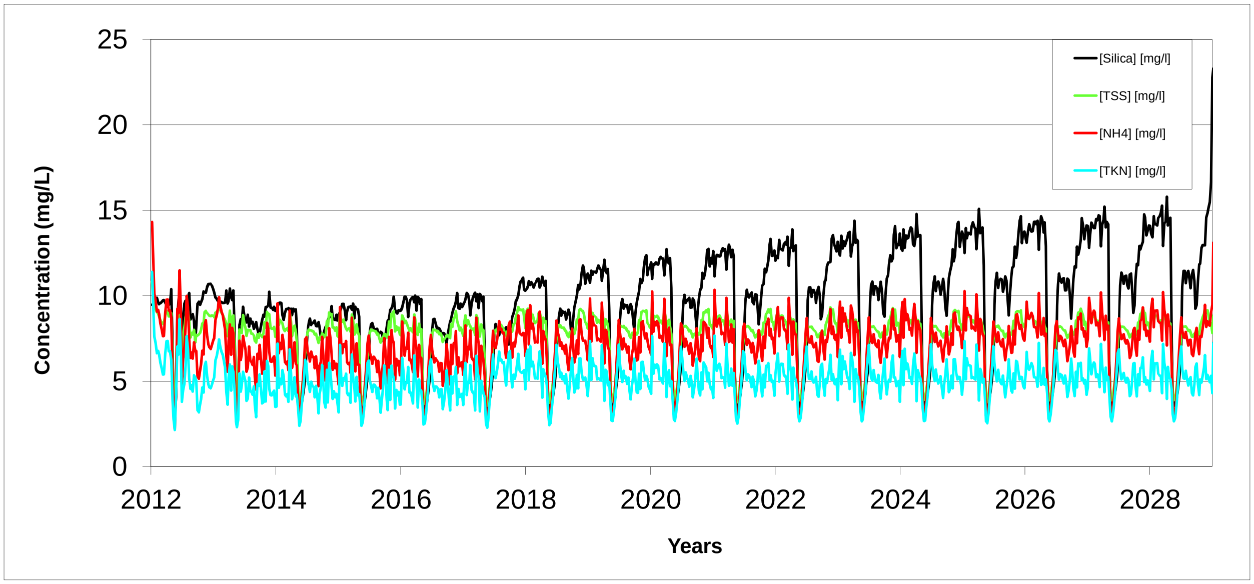


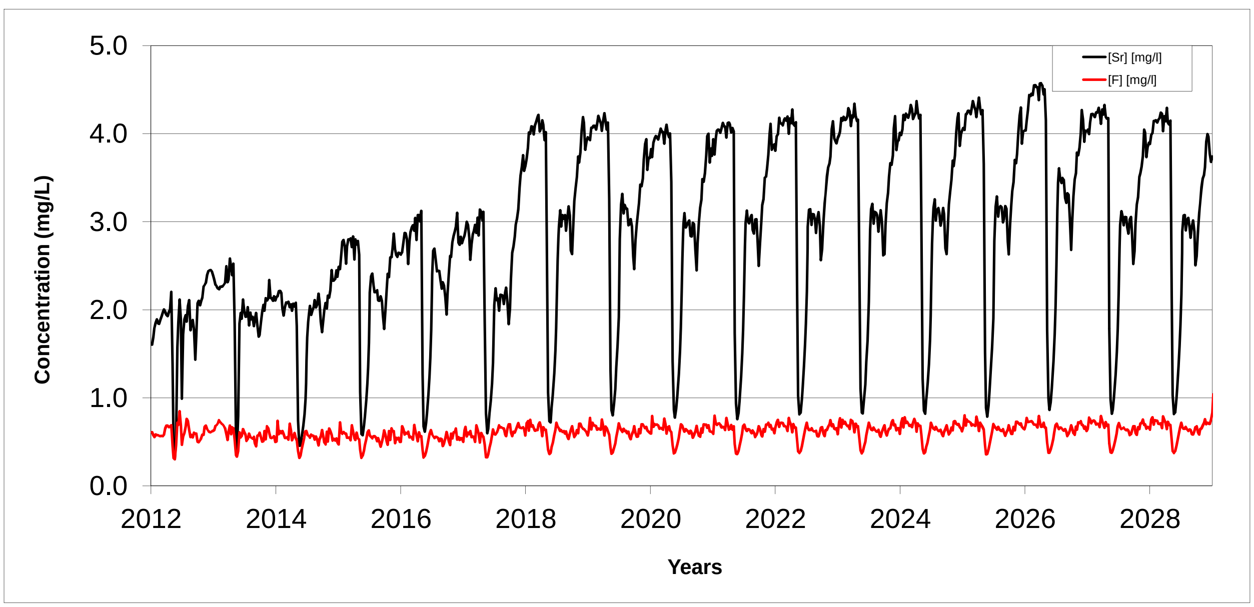
Date: December, 2013
Project: 12-1337-0001

Drawn KAS
Chkd KJD

De Beers Canada Inc.

Water Management Pond Seepage Dissolved Concentrations	FIGURE VIII-11b



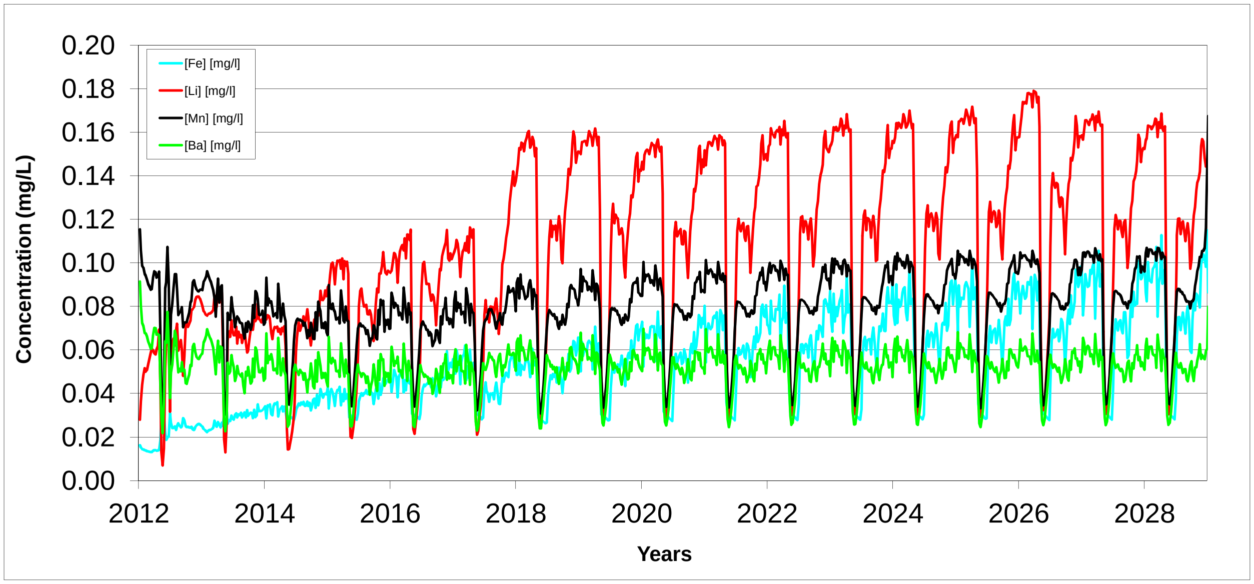


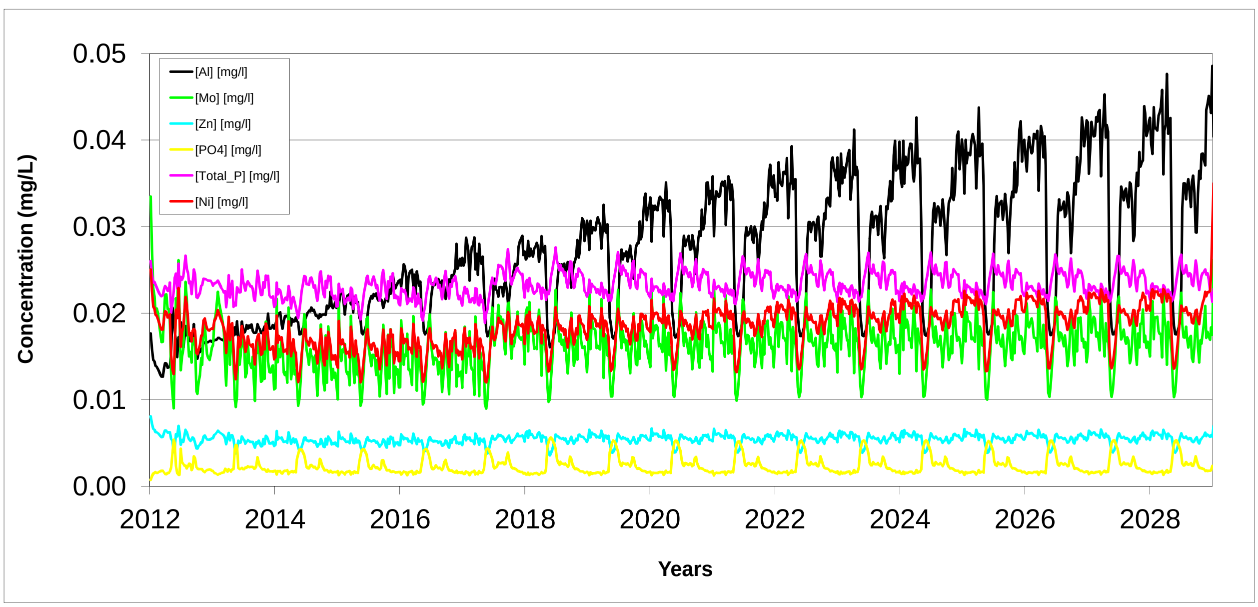
Date: December, 2013
Project: 12-1337-0001

Drawn KAS
Chkd KJD

De Beers Canada Inc.

Water Management Pond Seepage Dissolved Concentrations	FIGURE VIII-11c



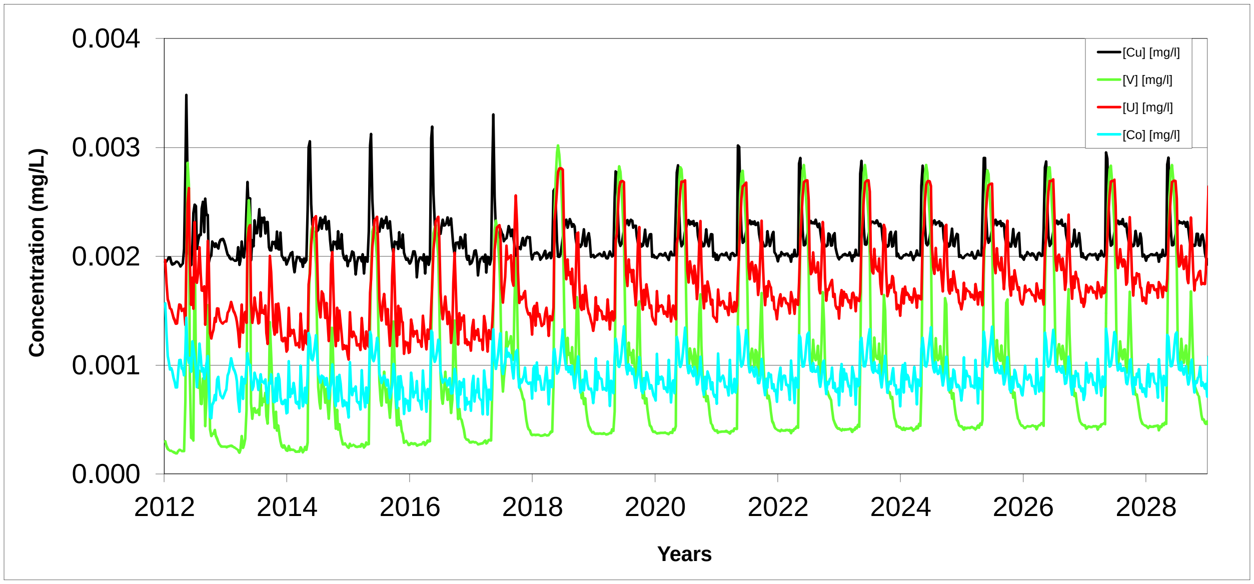


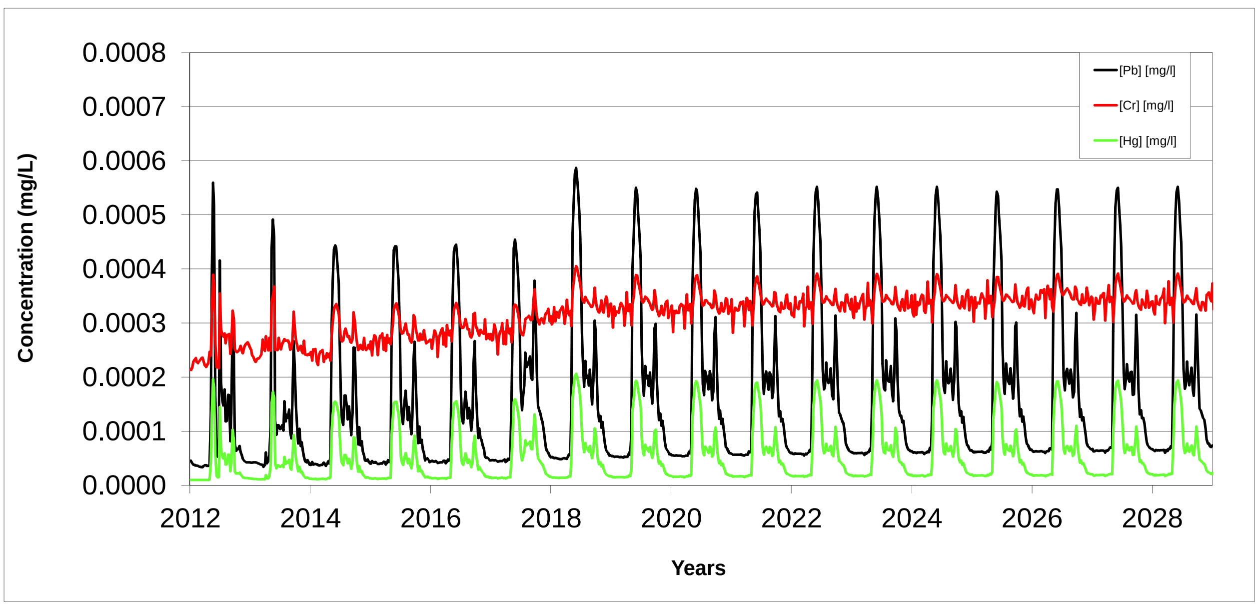
Date: December, 2013
Project: 12-1337-0001

Drawn KAS
Chkd KJD

De Beers Canada Inc.

Water Management Pond Seepage Dissolved Concentrations	FIGURE VIII-11d





Date: December, 2013
Project: 12-1337-0001

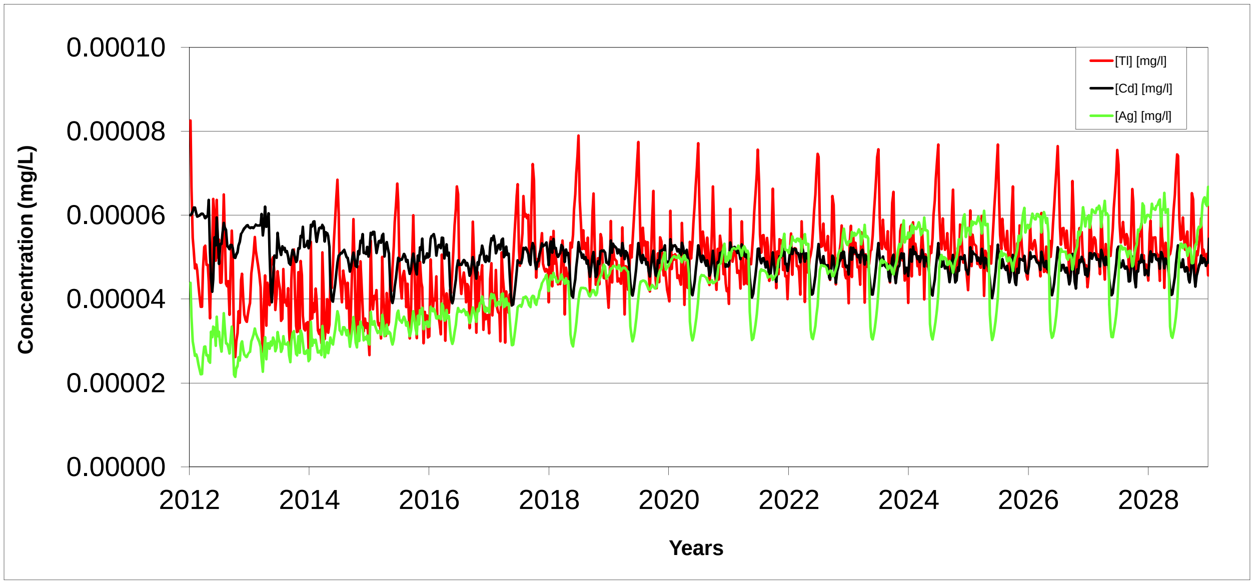
Drawn KAS
Chkd KJD

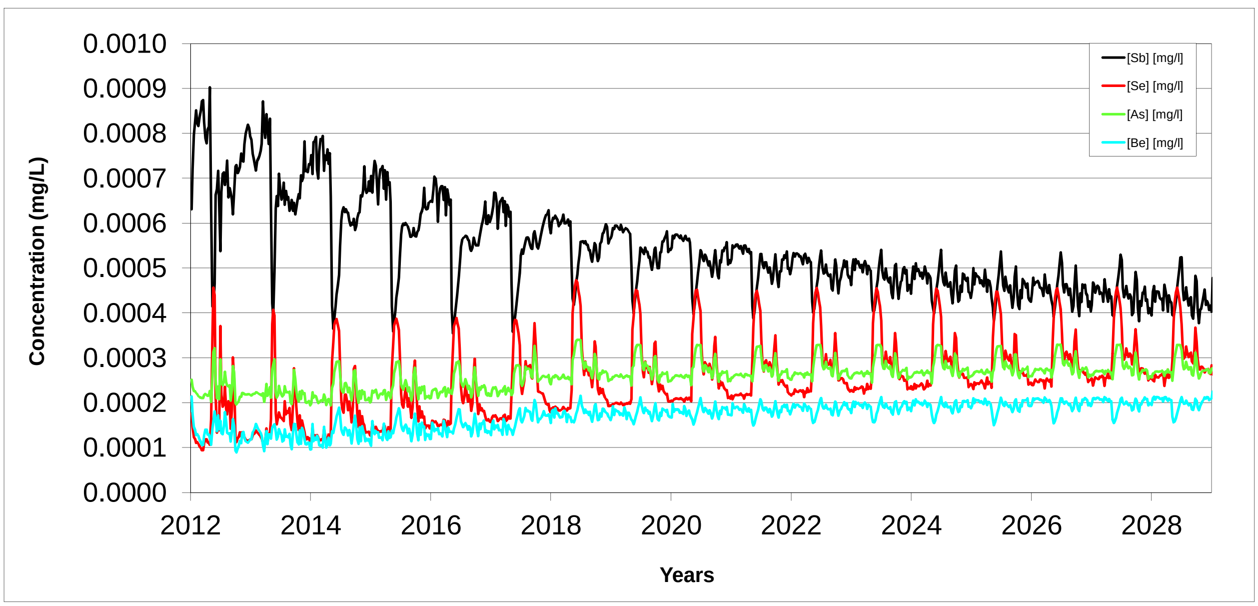
De Beers Canada Inc.

AppVIII_Fig11.xls-App VIII-11d

Water Management Pond Seepage Dissolved Concentrations

FIGURE VIII-11e





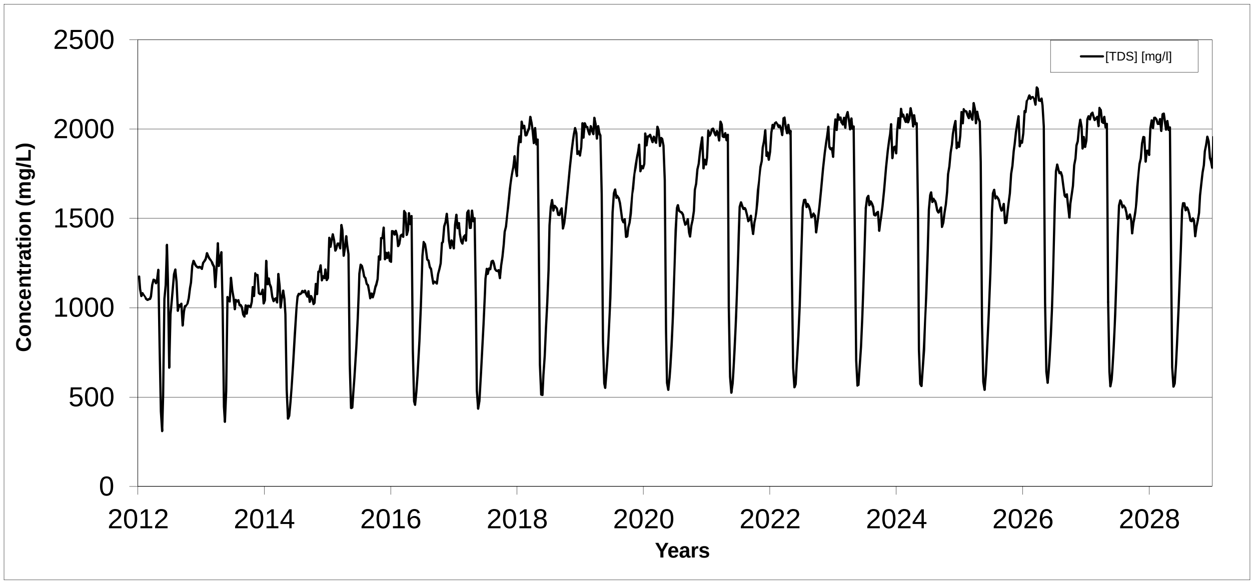
Date: December, 2013
Project: 12-1337-0001

Drawn KAS
Chkd KJD

De Beers Canada Inc.

Water Management Pond Seepage Dissolved Concentrations

FIGURE VIII-11f

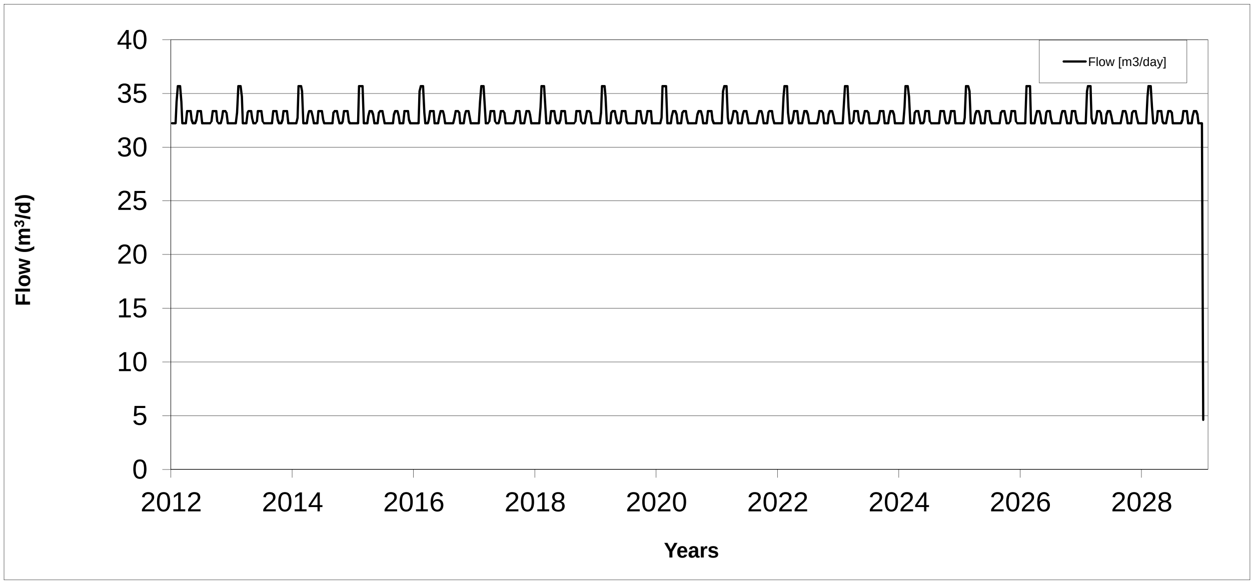


Date: December, 2013
Project: 12-1337-0001

Drawn KAS
Chkd KJD

De Beers Canada Inc.

Water Management Pond Seepage Dissolved Concentrations	FIGURE VIII-11g

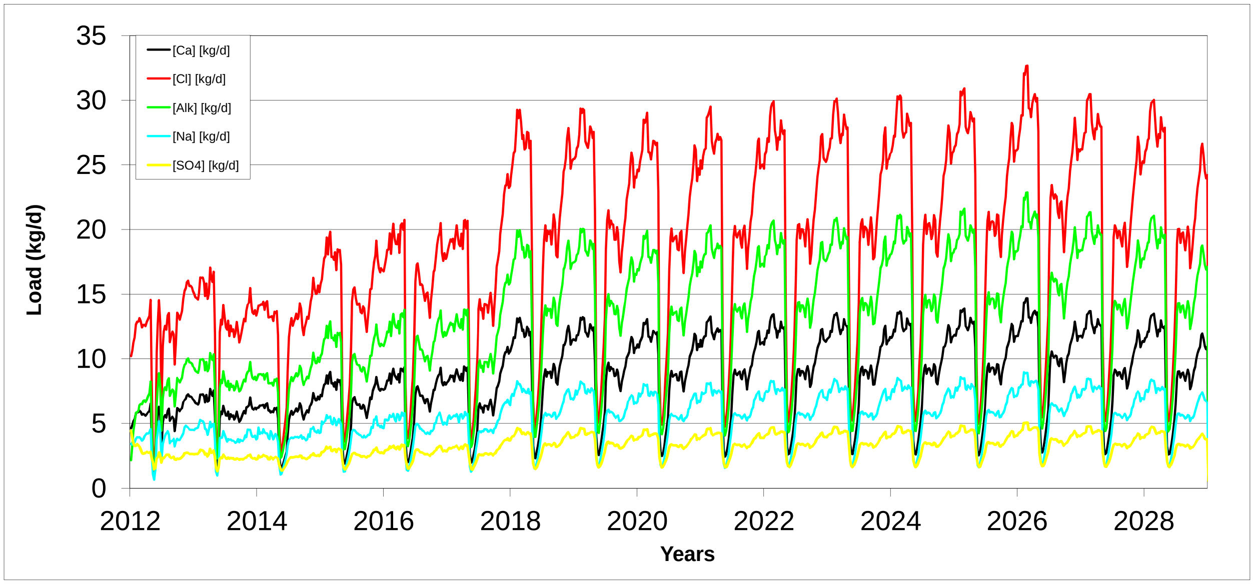


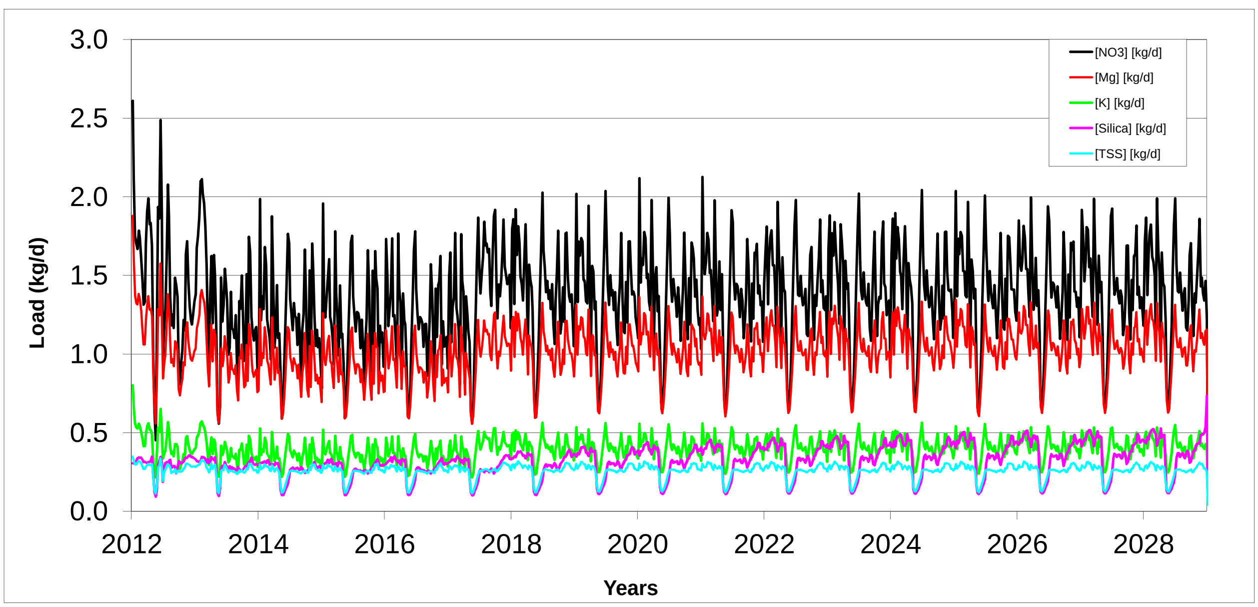
Date: December, 2013
Project: 12-1337-0001

Drawn KAS
Chkd KJD

De Beers Canada Inc.

Water Management Pond Seepage Dissolved Load	FIGURE VIII-12a





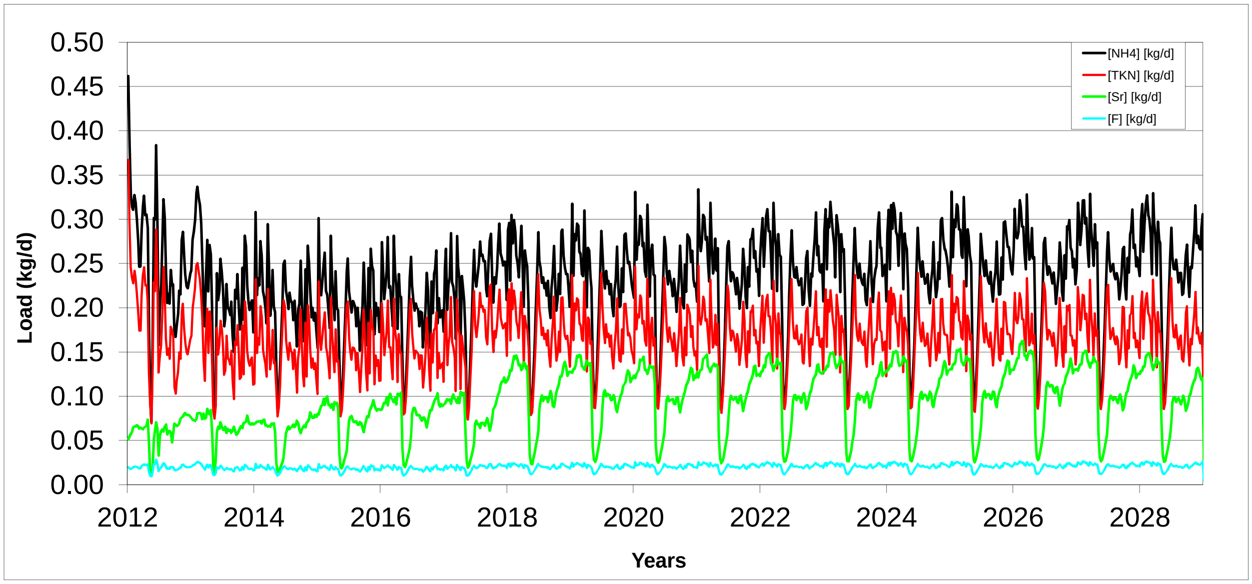
Date: December, 2013
Project: 12-1337-0001

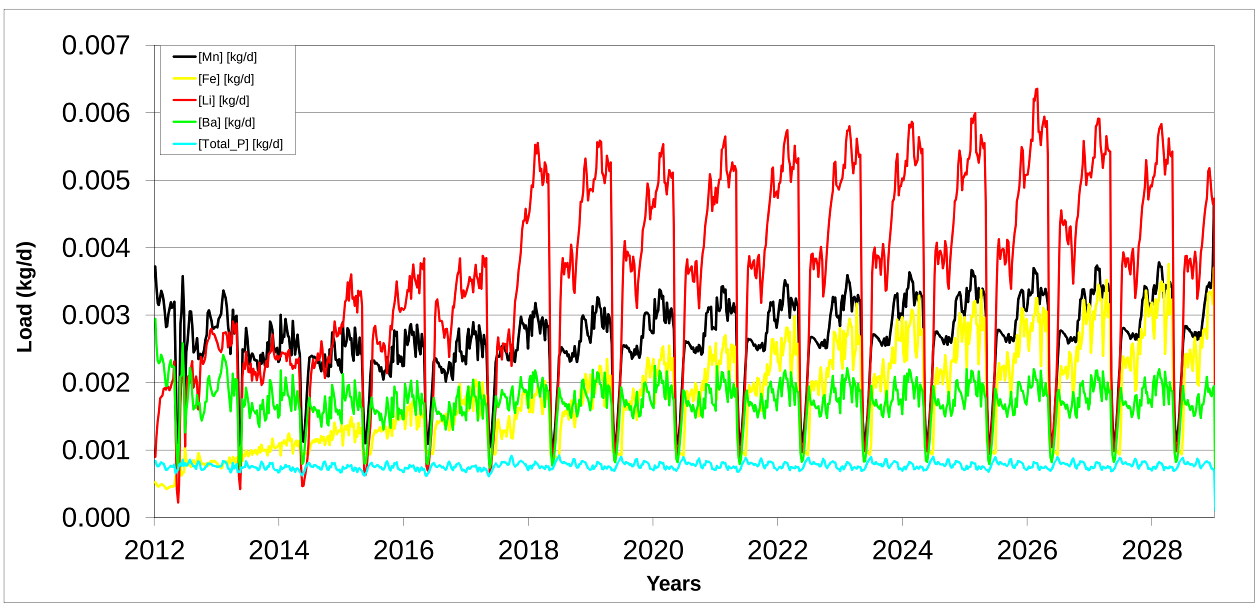
Drawn KAS
Chkd KJD

De Beers Canada Inc.

Water Management Pond Seepage Dissolved Load

FIGURE VIII-12b





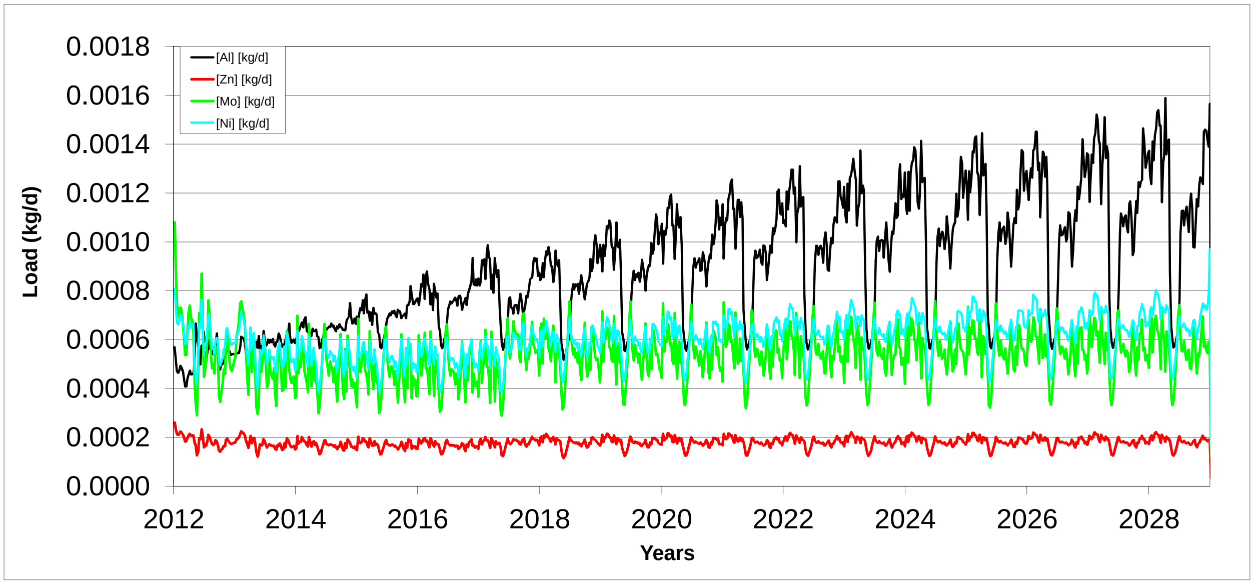
Date: December, 2013
Project: 12-1337-0001

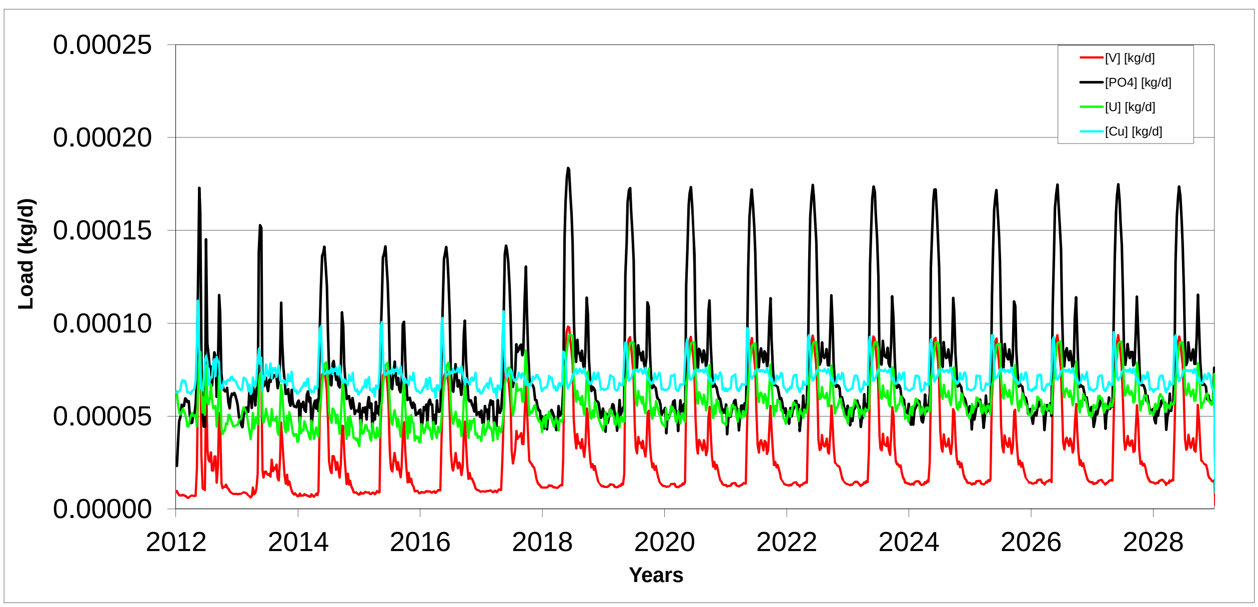
Drawn KAS
Chkd KJD

De Beers Canada Inc.

Water Management Pond Seepage Dissolved Load

FIGURE VIII-12c





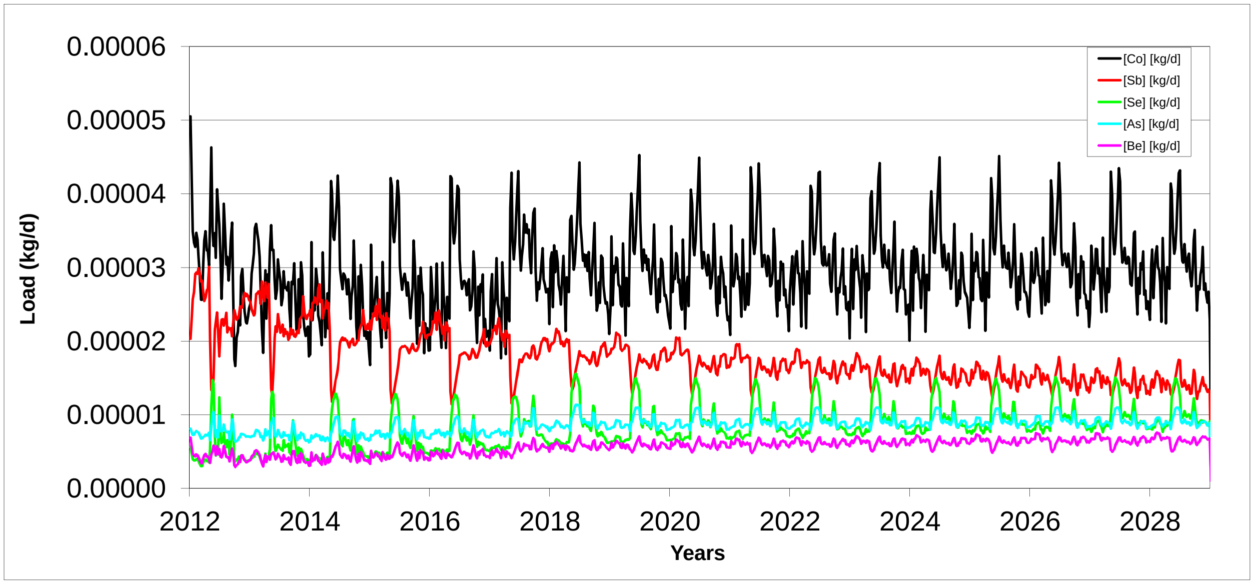
Date: December, 2013
Project: 12-1337-0001

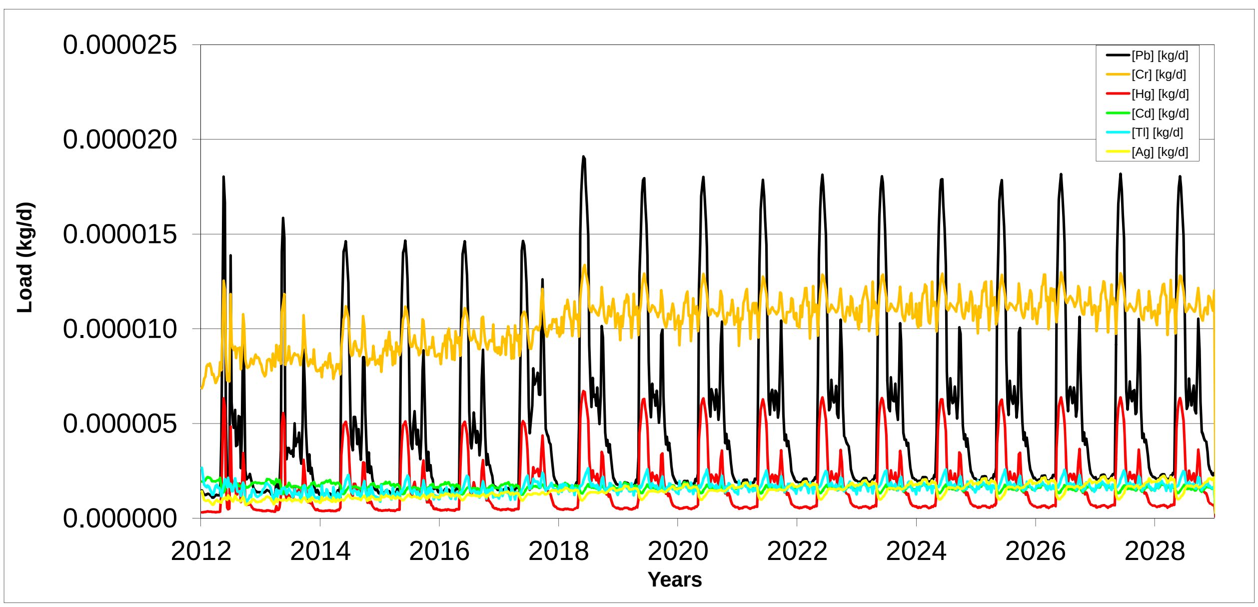
Drawn KAS
Chkd KJD

De Beers Canada Inc.

Water Management Pond Seepage Dissolved Load

FIGURE VIII-12d





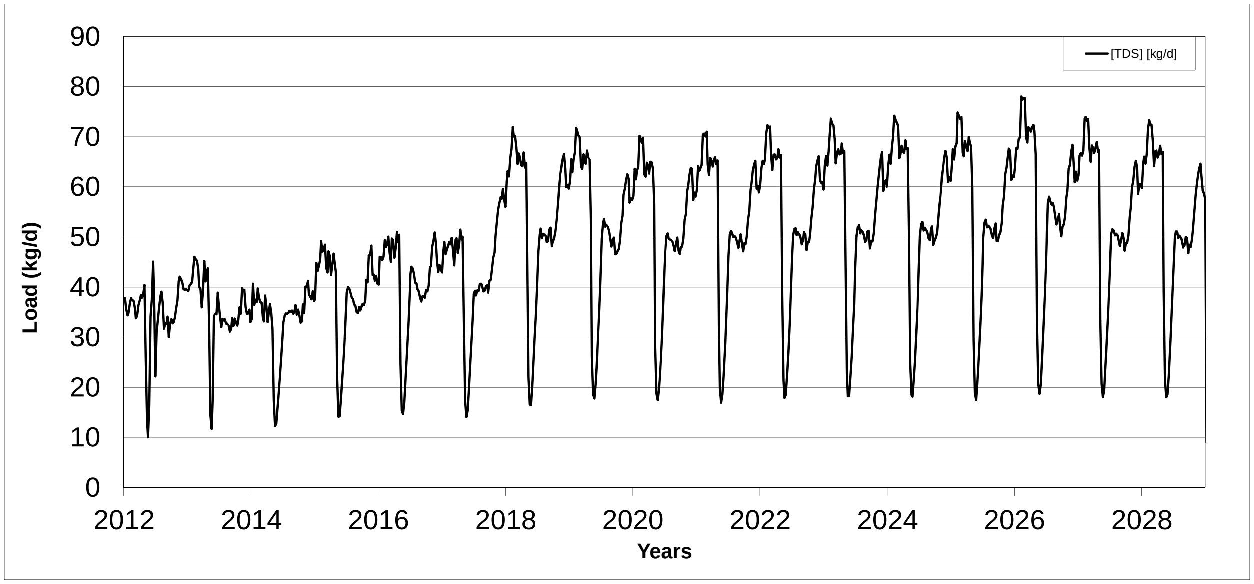
Date: December, 2013
Project: 12-1337-0001

Drawn KAS
Chkd KJD

De Beers Canada Inc.

Water Management Pond Seepage Dissolved Load

FIGURE VIII-12e

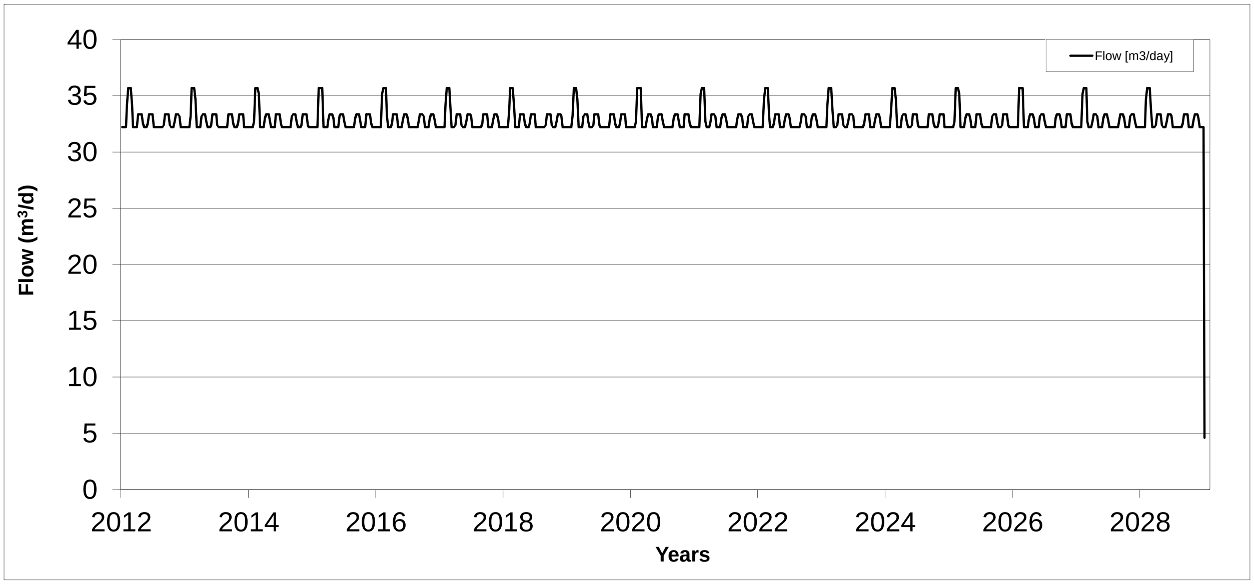


Date: December, 2013
Project: 12-1337-0001

Drawn KAS
Chkd KJD

De Beers Canada Inc.

Water Management Pond Seepage Dissolved Load FLOW	FIGURE VIII-12f



Date: December, 2013
Project: 12-1337-0001

Drawn KAS
Chkd KJD

De Beers Canada Inc.

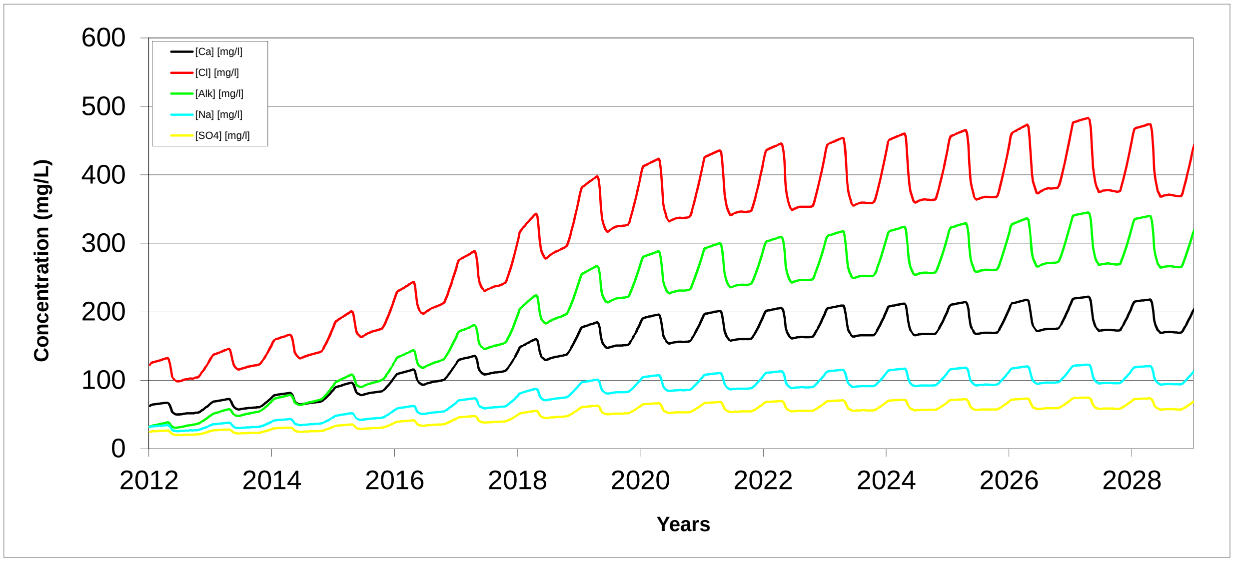
APPENDIX IX

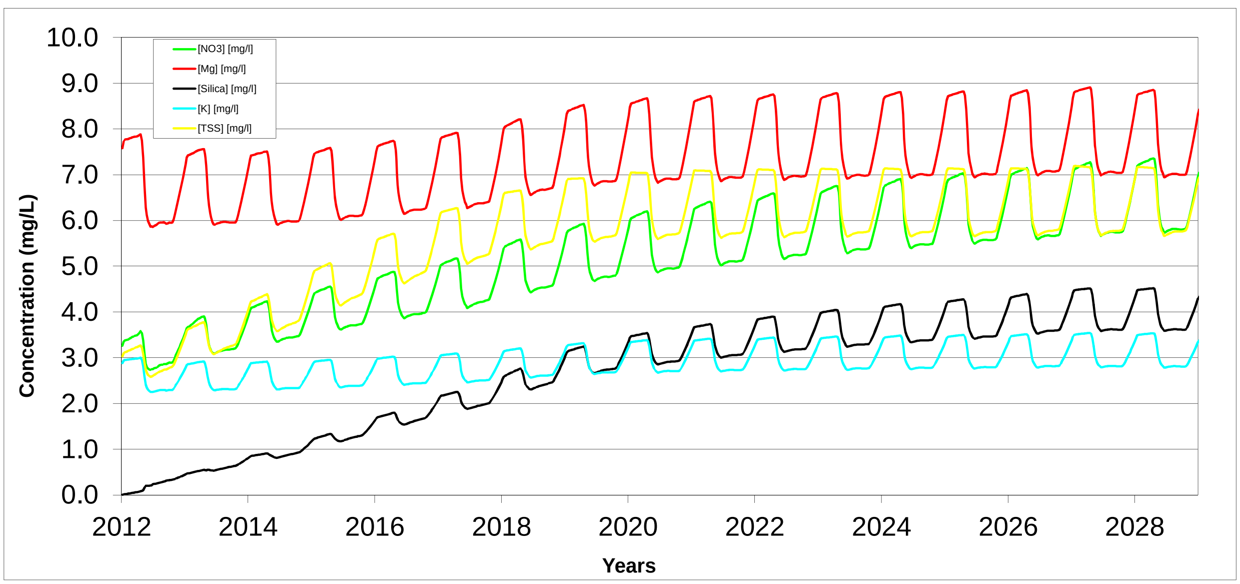
UPPER BOUND SCENARIO B

December 2013

Snap Lake Outflow Dissolved Concentrations

FIGURE IX-1a



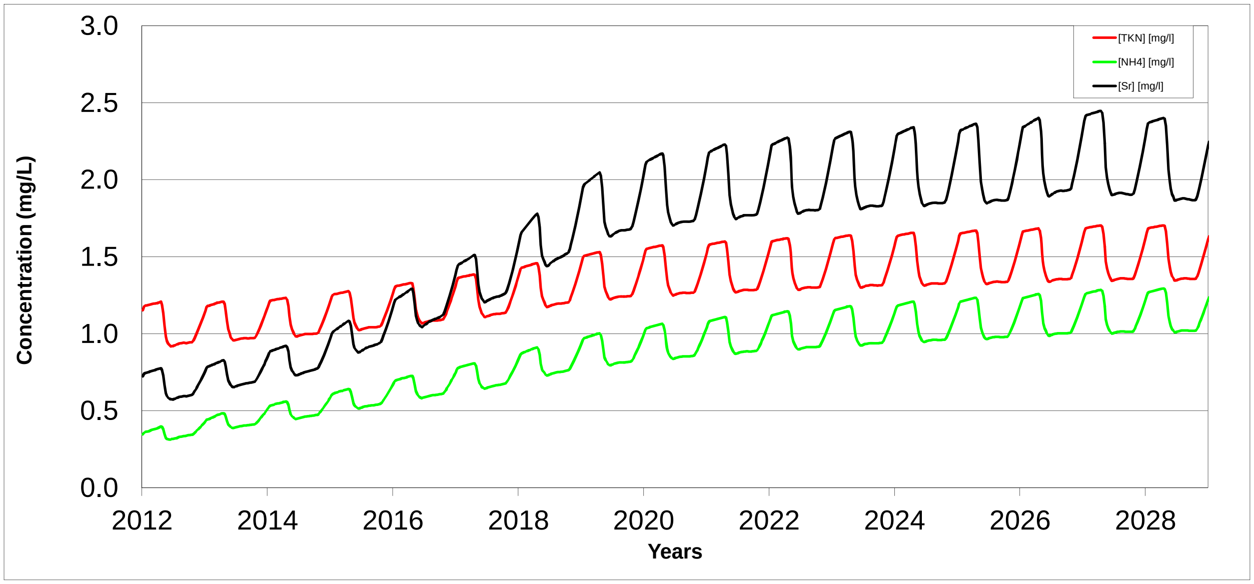


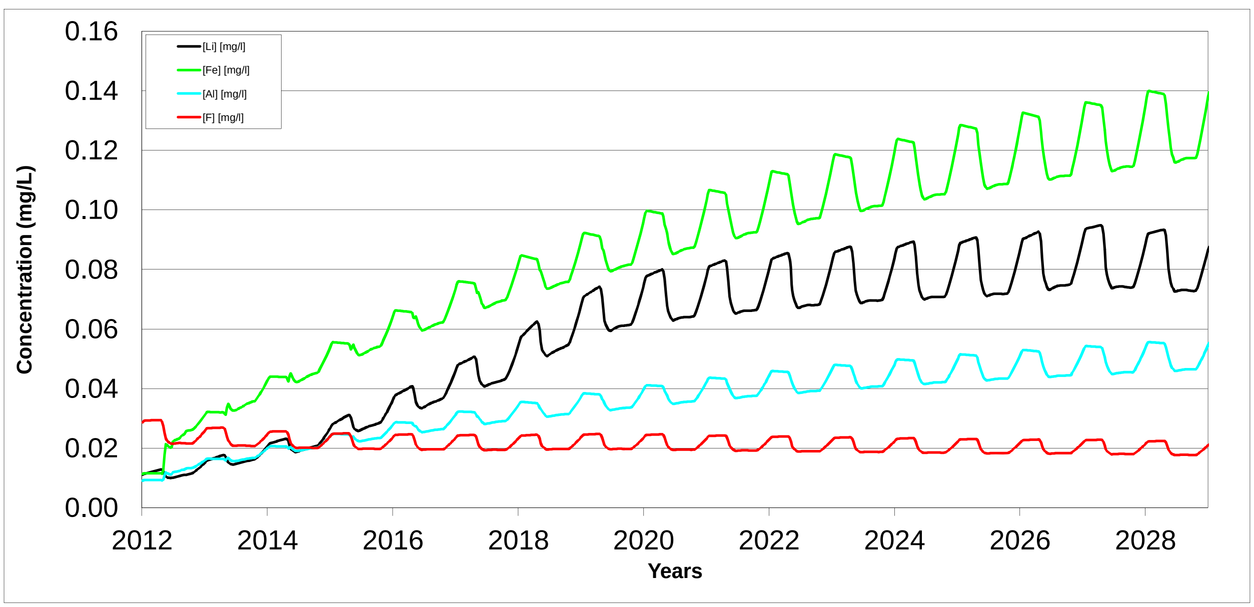
Date: December, 2013
Project: 12-1337-0001

Drawn KAS
Chkd KJD

De Beers Canada Inc.

Snap Lake Outflow Dissolved Concentrations	FIGURE IX-1b



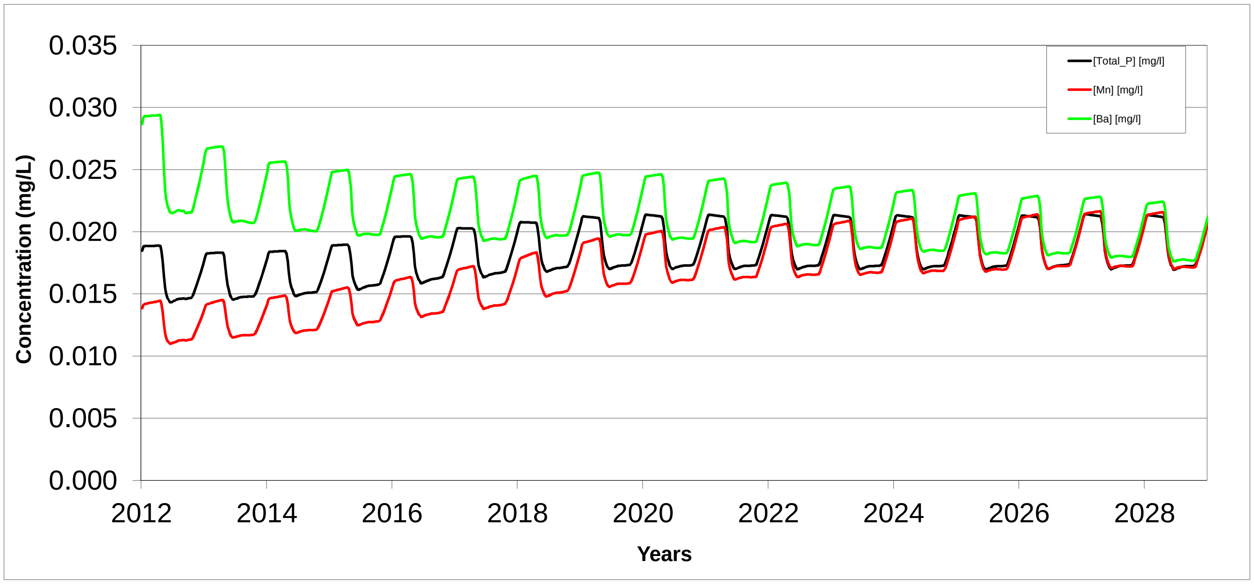


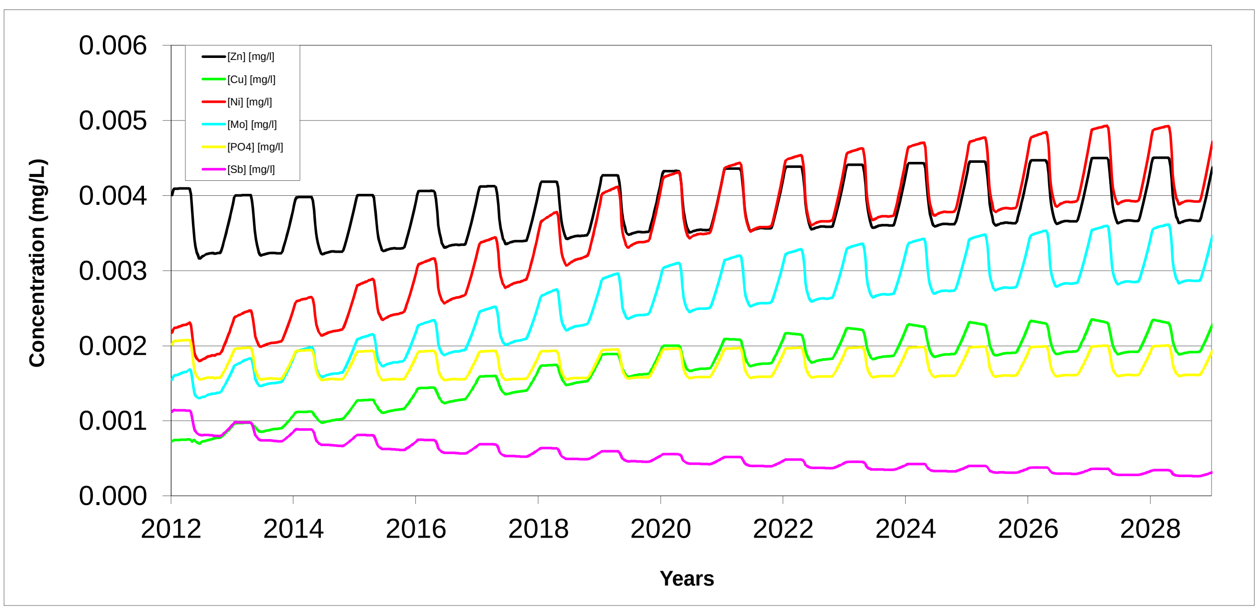
Date: December, 2013
Project: 12-1337-0001

Drawn KAS
Chkd KJD

De Beers Canada Inc.

Snap Lake Outflow Dissolved Concentrations	FIGURE IX-1c





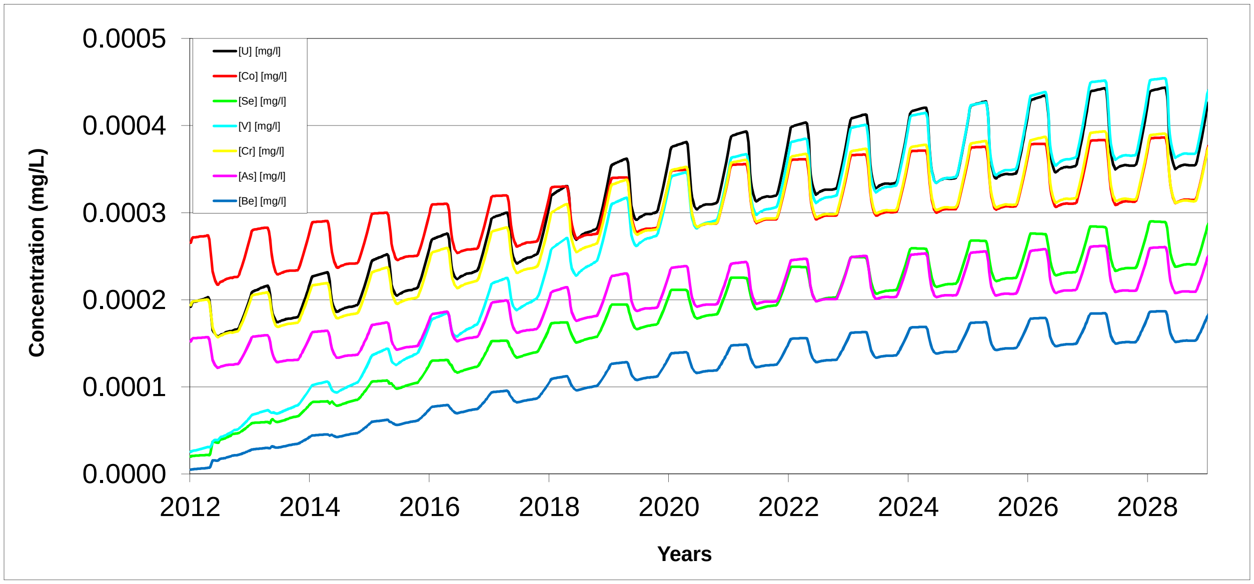
Date: December, 2013
Project: 12-1337-0001

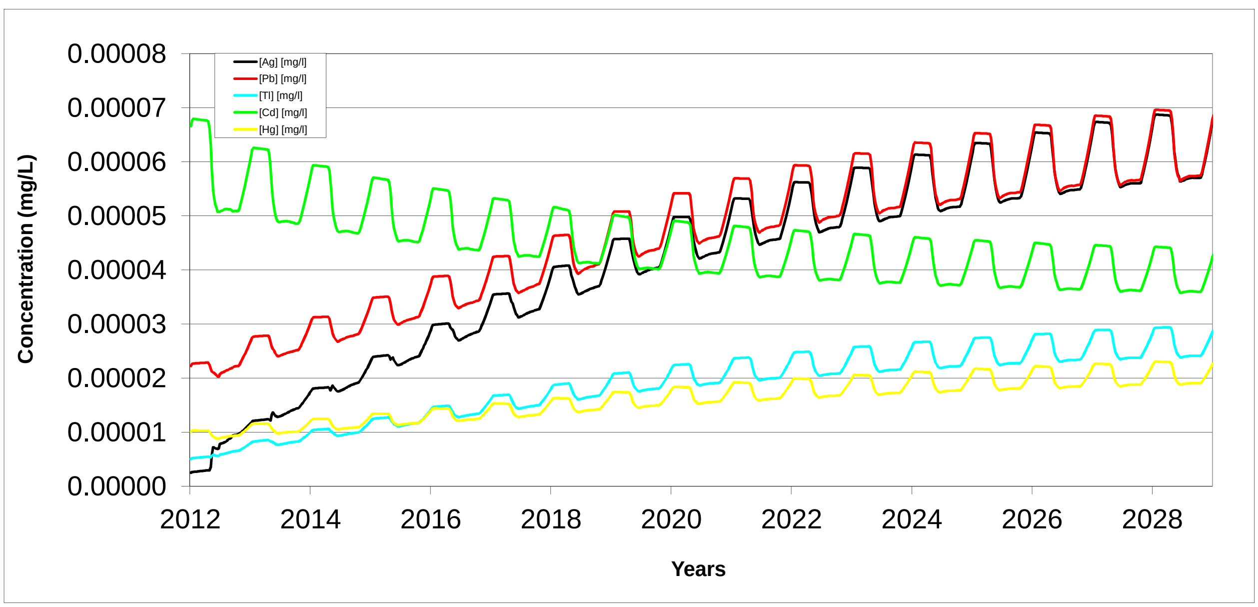
Drawn KAS
Chkd KJD

De Beers Canada Inc.

Snap Lake Outflow Dissolved Concentrations

FIGURE IX-1d





Date: December, 2013
Project: 12-1337-0001

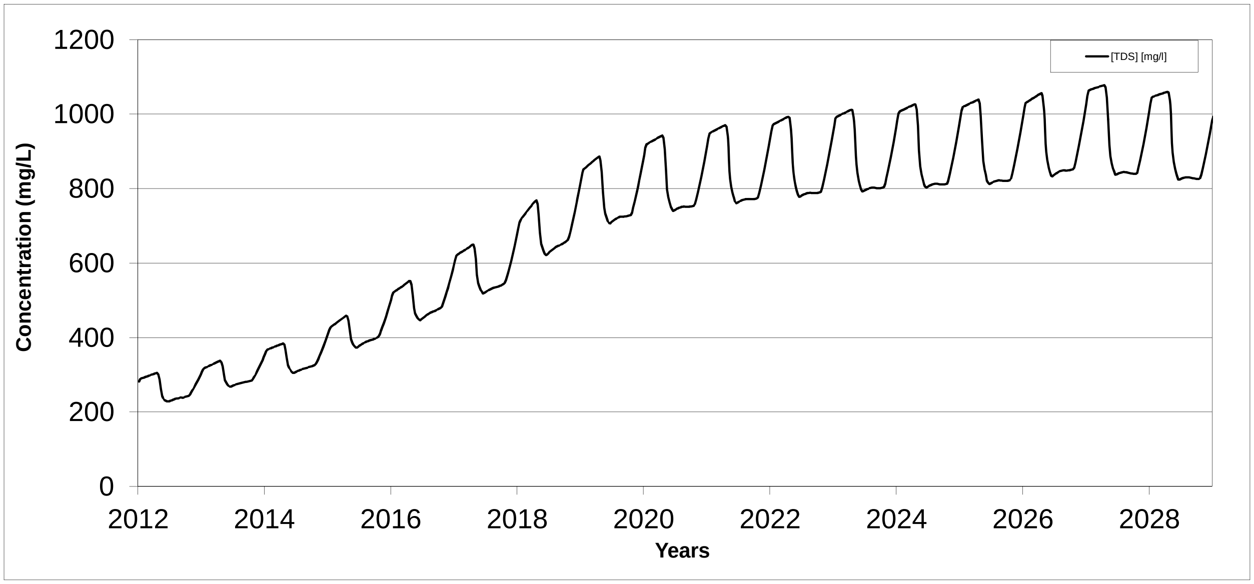
Drawn KAS
Chkd KJD

De Beers Canada Inc.

ApplX_Fig1.xls-App IX-1d

Snap Lake Outflow Dissolved Concentrations

FIGURE IX-1e

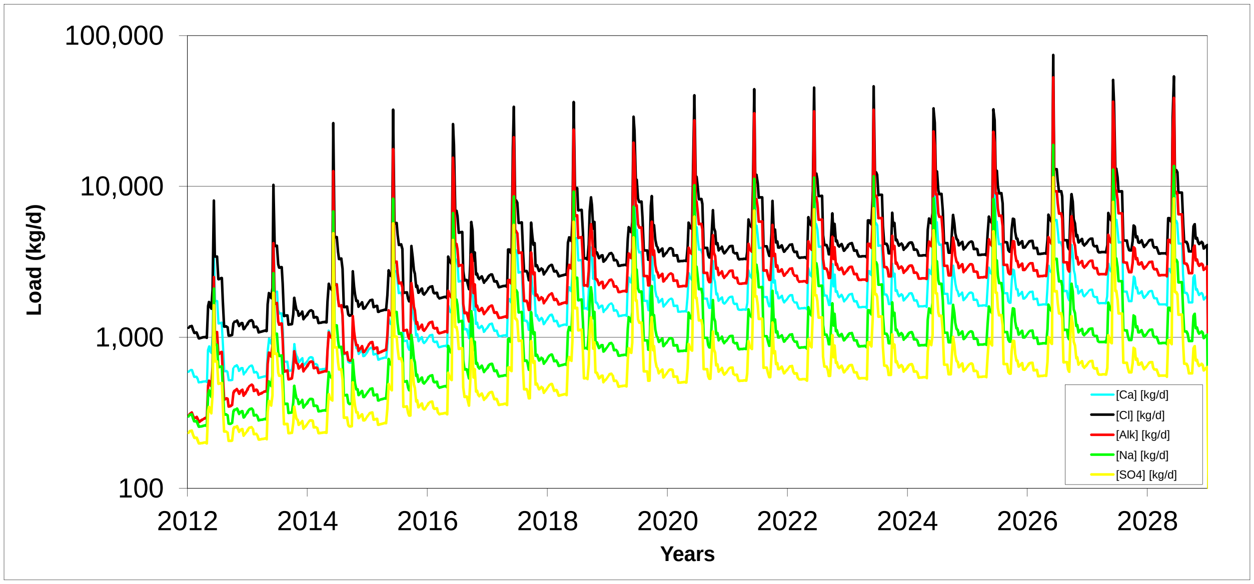


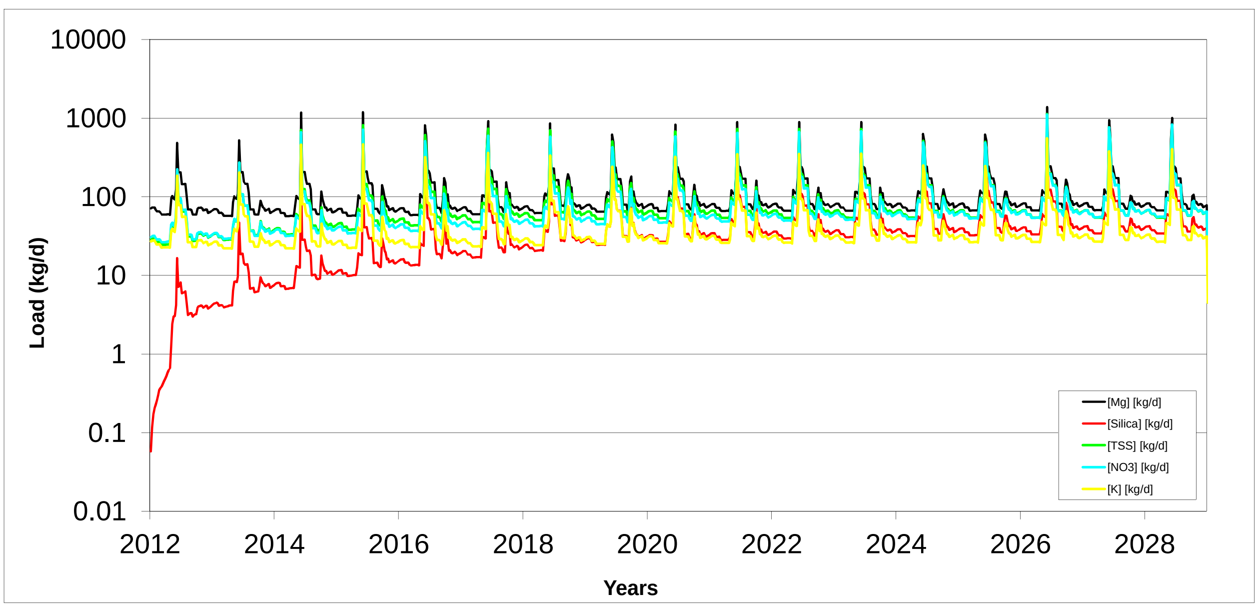
Date: December, 2013
Project: 12-1337-0001

Drawn KAS
Chkd KJD

De Beers Canada Inc.

Snap Lake Outflow Dissolved Load	FIGURE IX-2a



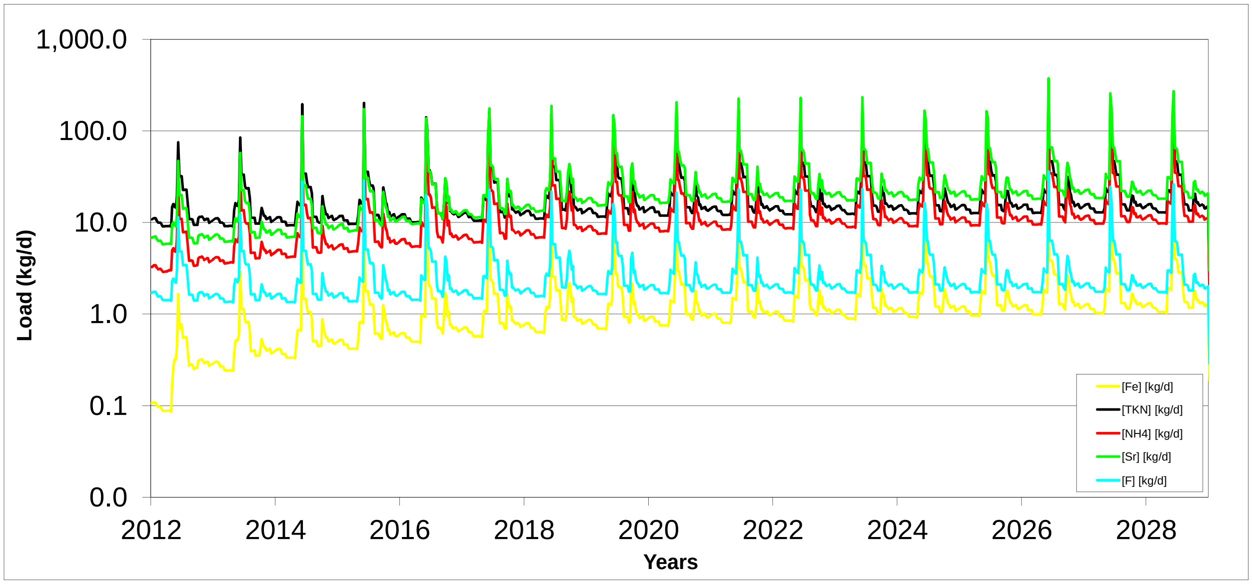


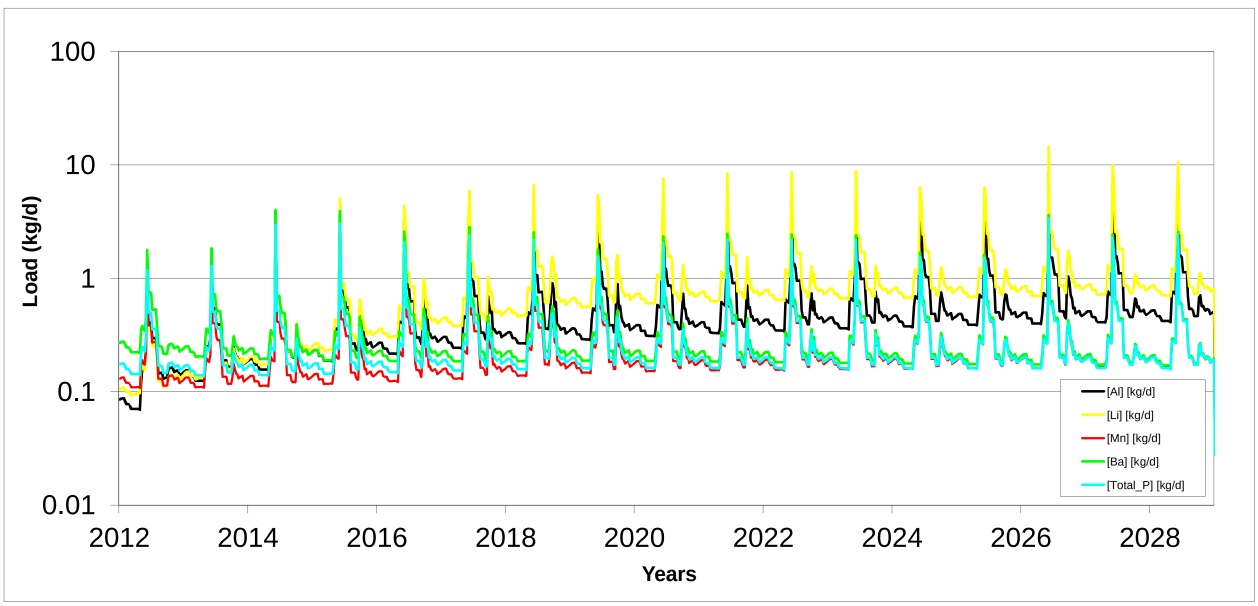
Date: December, 2013
Project: 12-1337-0001

Drawn KAS
Chkd KJD

De Beers Canada Inc.

Snap Lake Outflow Dissolved Load	FIGURE IX-2b



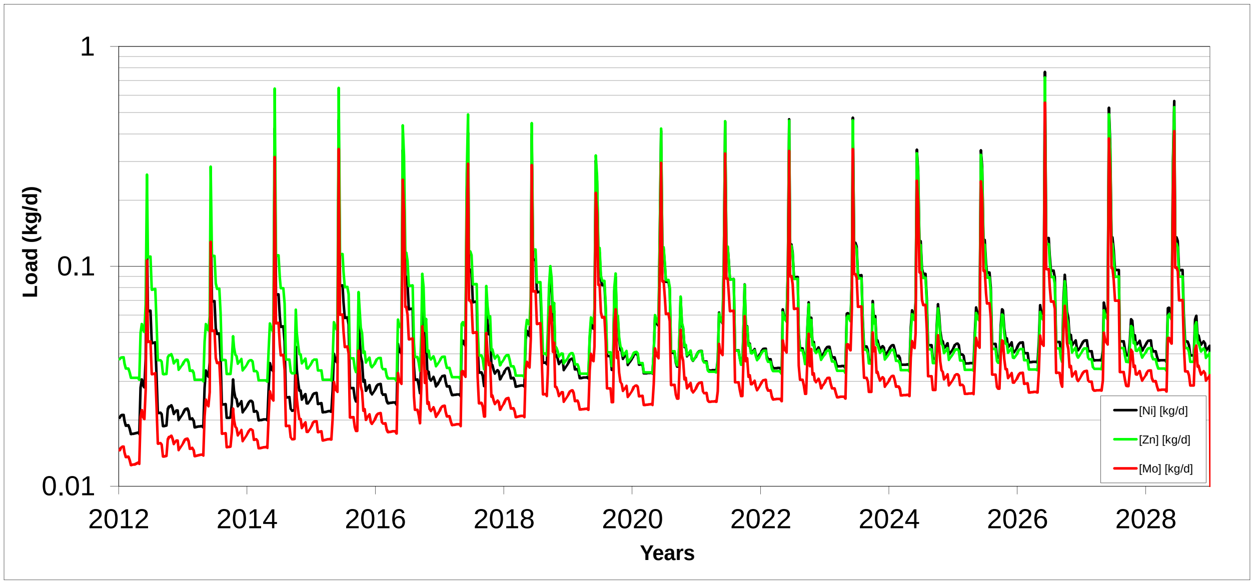


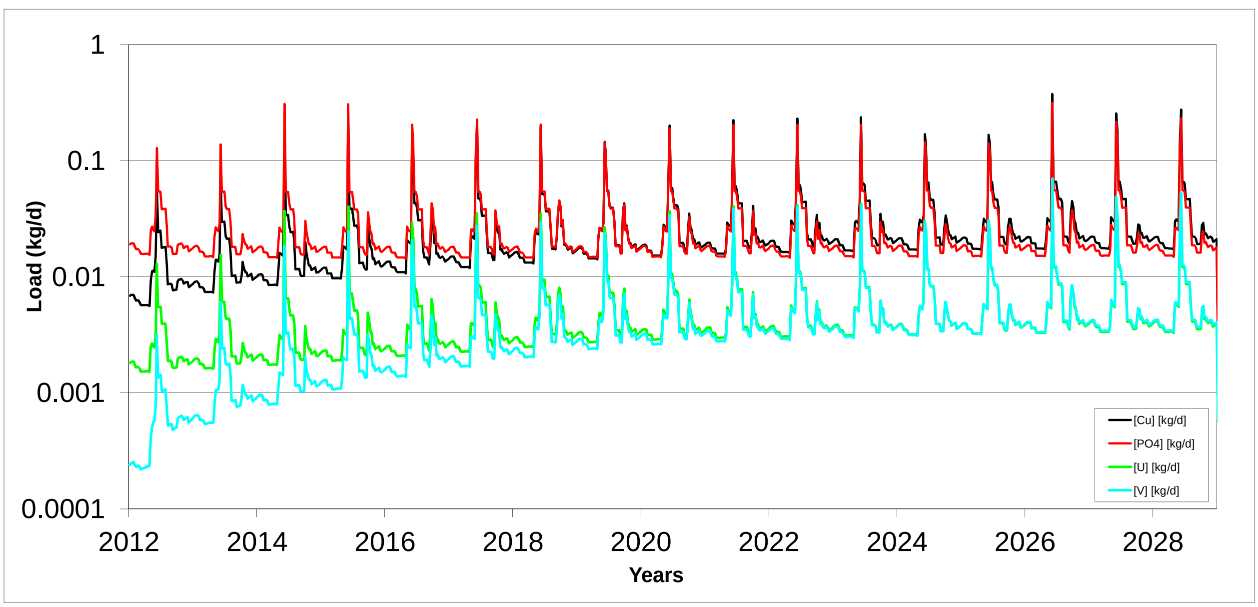
Date: December, 2013
Project: 12-1337-0001

Drawn KAS
Chkd KJD

De Beers Canada Inc.

Snap Lake Outflow Dissolved Load	FIGURE IX-2c



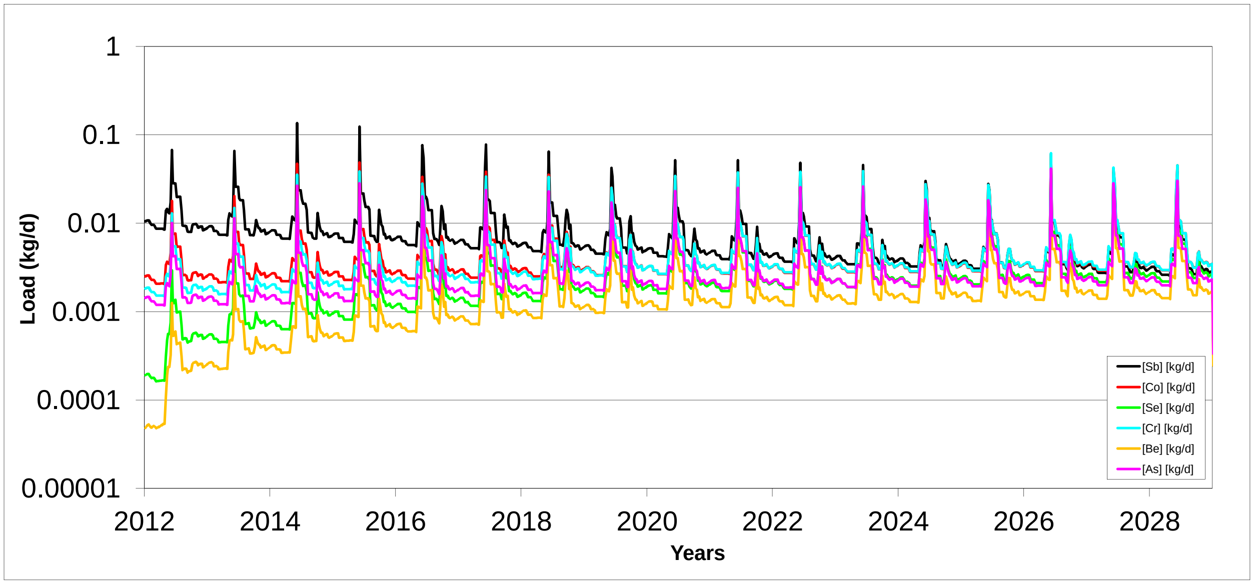


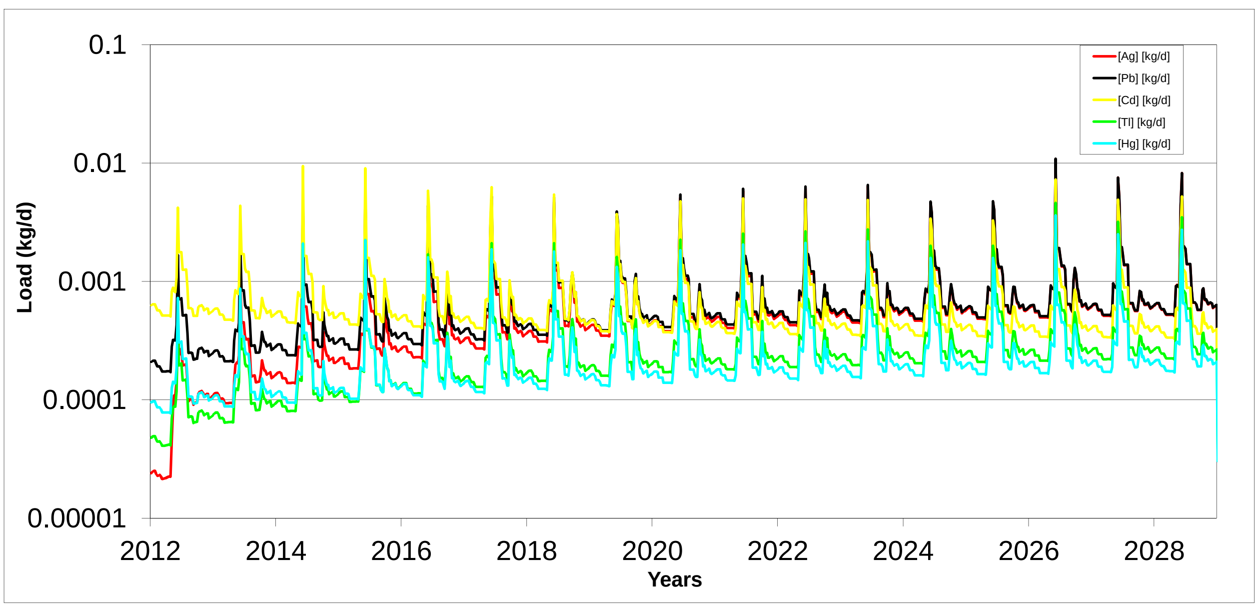
Date: December, 2013
Project: 12-1337-0001

Drawn KAS
Chkd KJD

De Beers Canada Inc.

Snap Lake Outflow Dissolved Load	FIGURE IX-2d



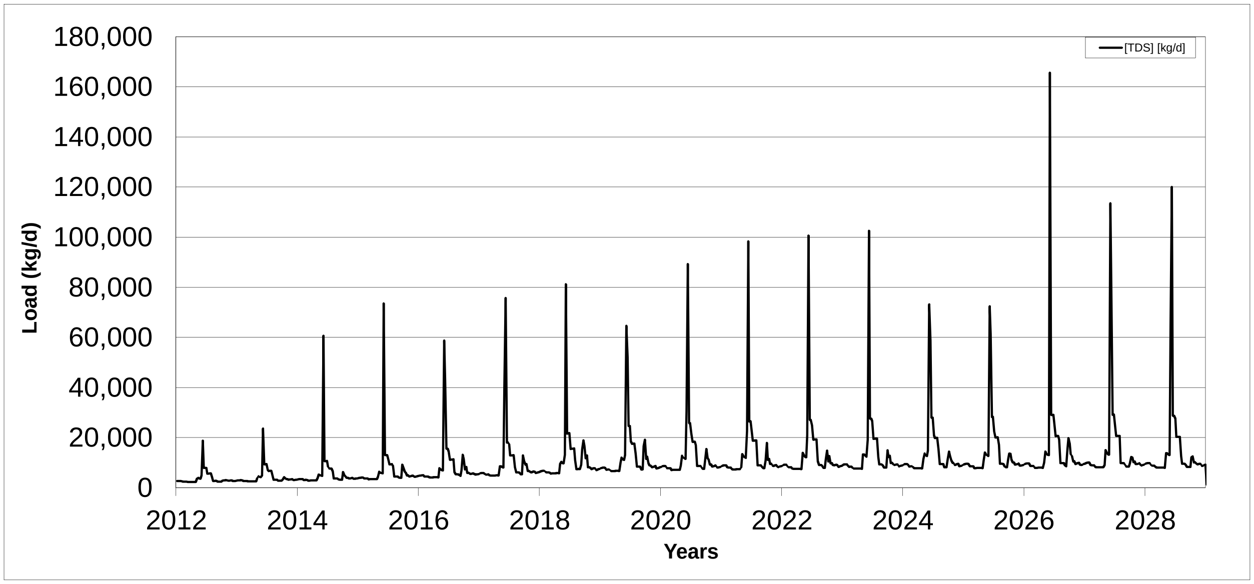


Date: December, 2013
Project: 12-1337-0001

Drawn KAS
Chkd KJD

De Beers Canada Inc.

Snap Lake Outflow Dissolved Load	FIGURE IX-2e



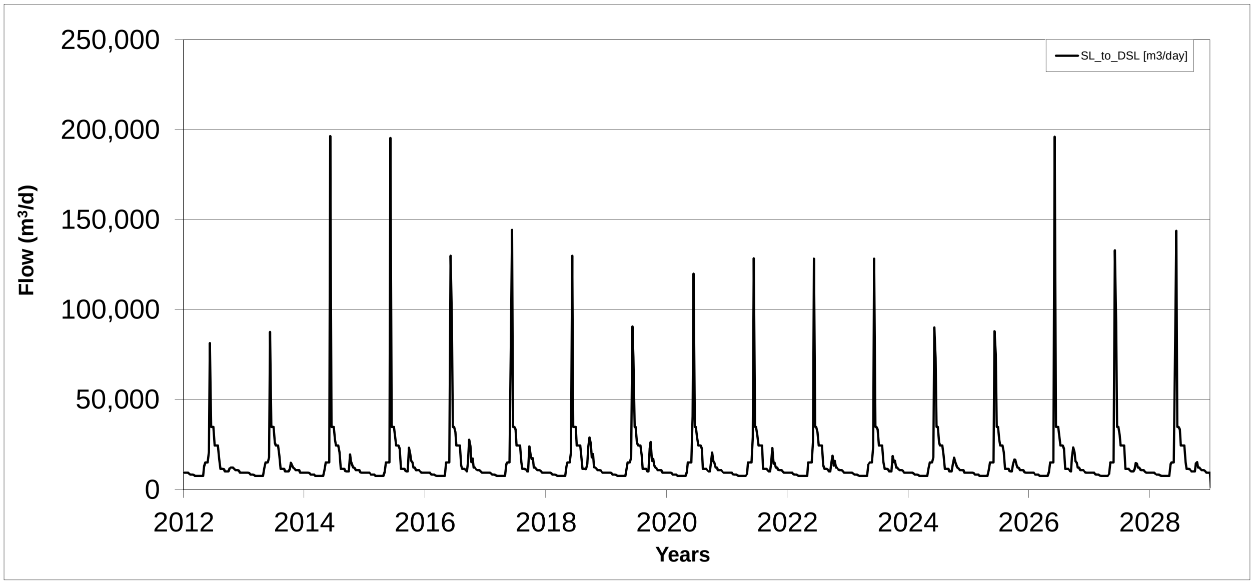
Date: December, 2013
Project: 12-1337-0001

Drawn KAS
Chkd KJD

De Beers Canada Inc.

Snap Lake Outflow Dissolved Load FLOW

FIGURE IX-2f



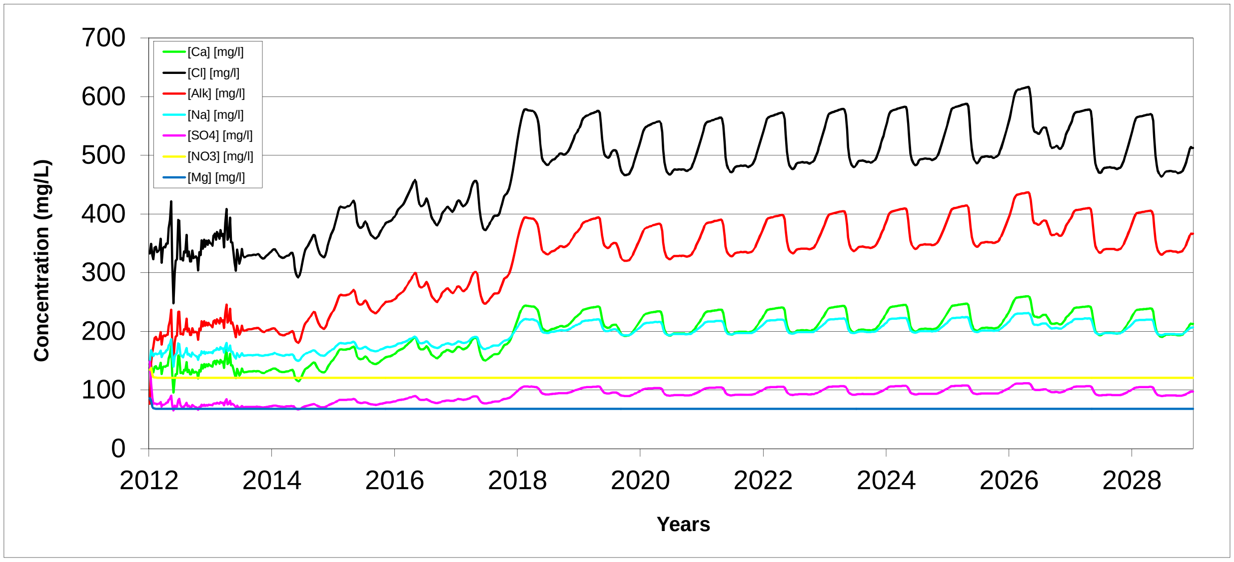
Date: December, 2013
Project: 12-1337-0001

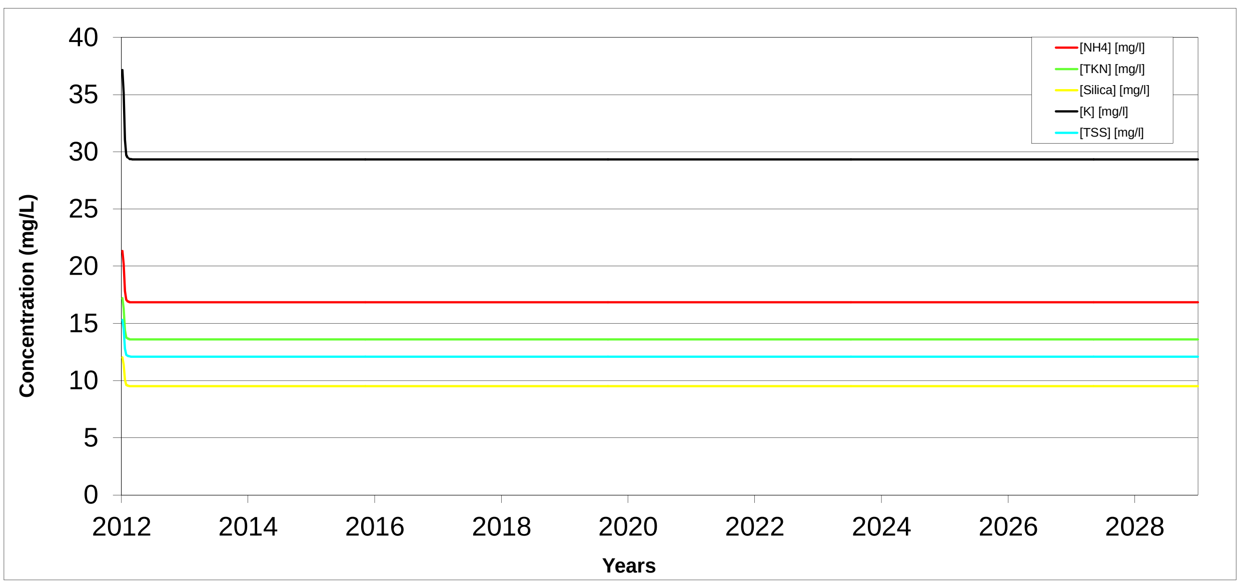
Drawn KAS
Chkd KJD

De Beers Canada Inc.

Process Water Dissolved Concentrations

FIGURE IX-3a



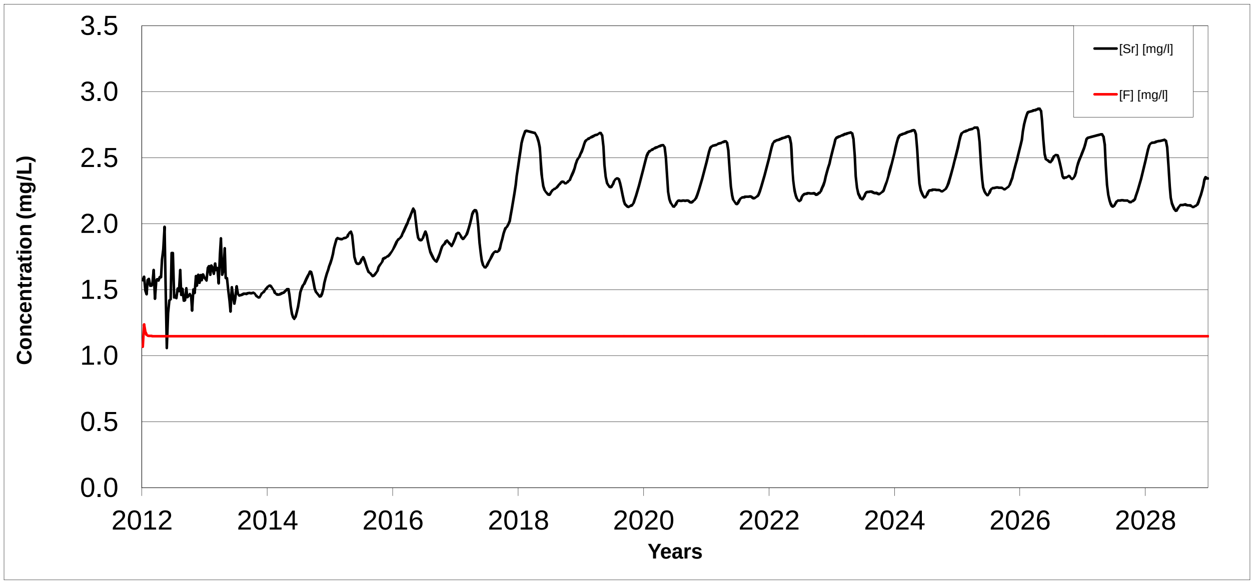


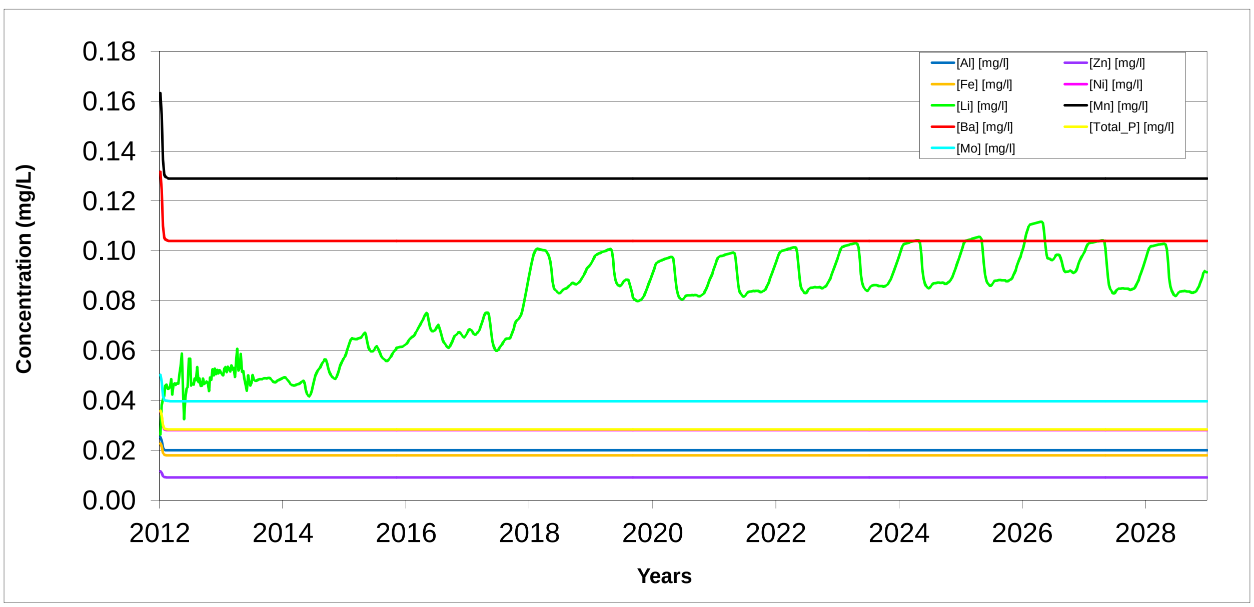
Date: December, 2013
Project: 12-1337-0001

Drawn KAS
Chkd KJD

De Beers Canada Inc.

Process Water Dissolved Concentrations	FIGURE IX-3b





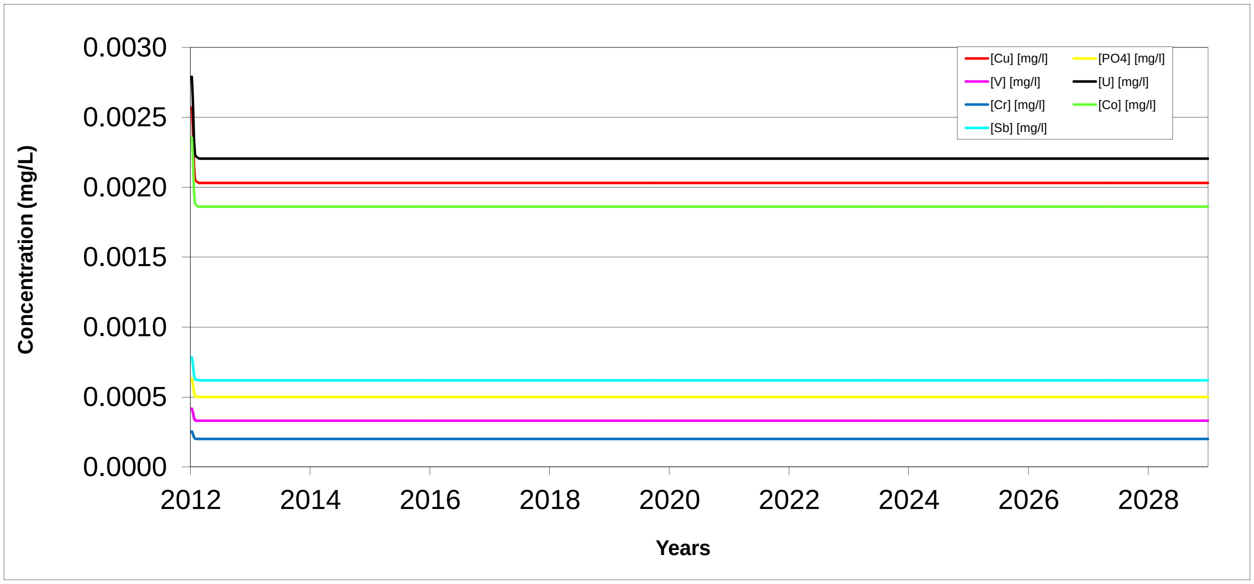
Date: December, 2013
Project: 12-1337-0001

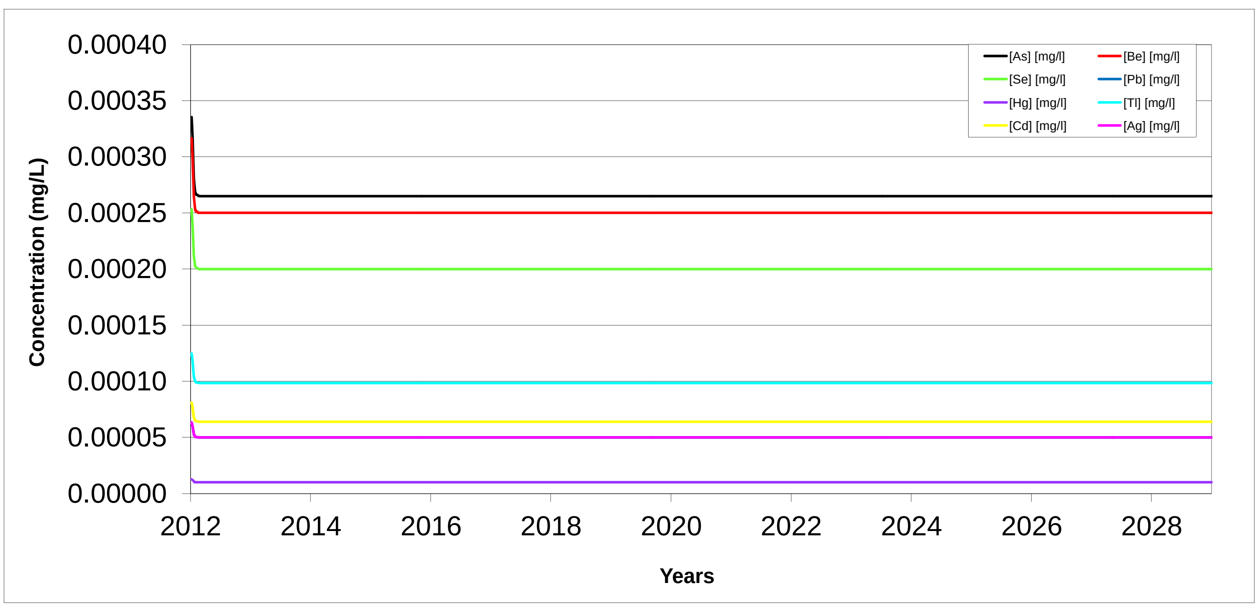
Drawn KAS
Chkd KJD

De Beers Canada Inc.

Process Water Dissolved Concentrations

FIGURE IX-3c





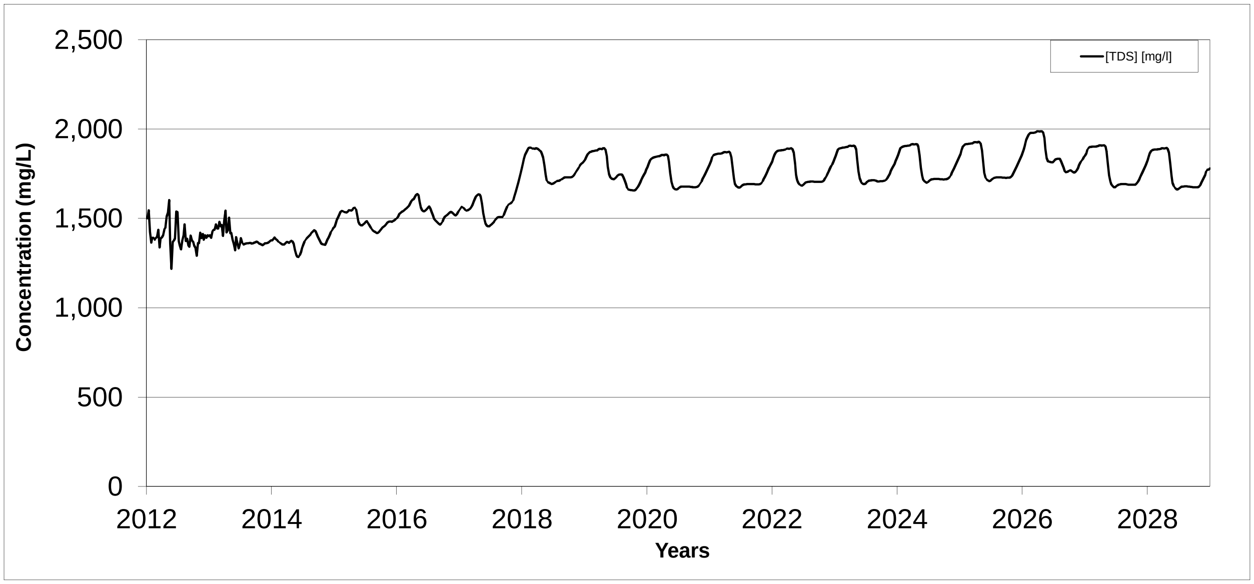
Date: December, 2013
Project: 12-1337-0001

Drawn KAS
Chkd KJD

De Beers Canada Inc.

Process Water Dissolved Concentrations

FIGURE IX-3d



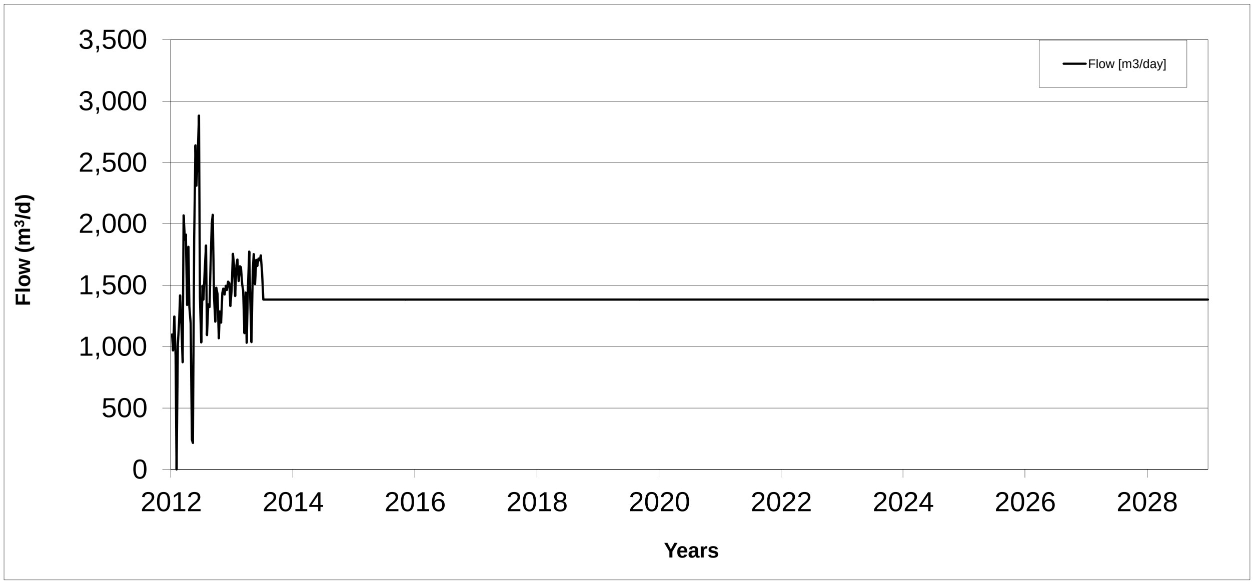
Date: December, 2013
Project: 12-1337-0001

Drawn KAS
Chkd KJD

De Beers Canada Inc.

Process Water Dissolved Concentrations

FIGURE IX-3e



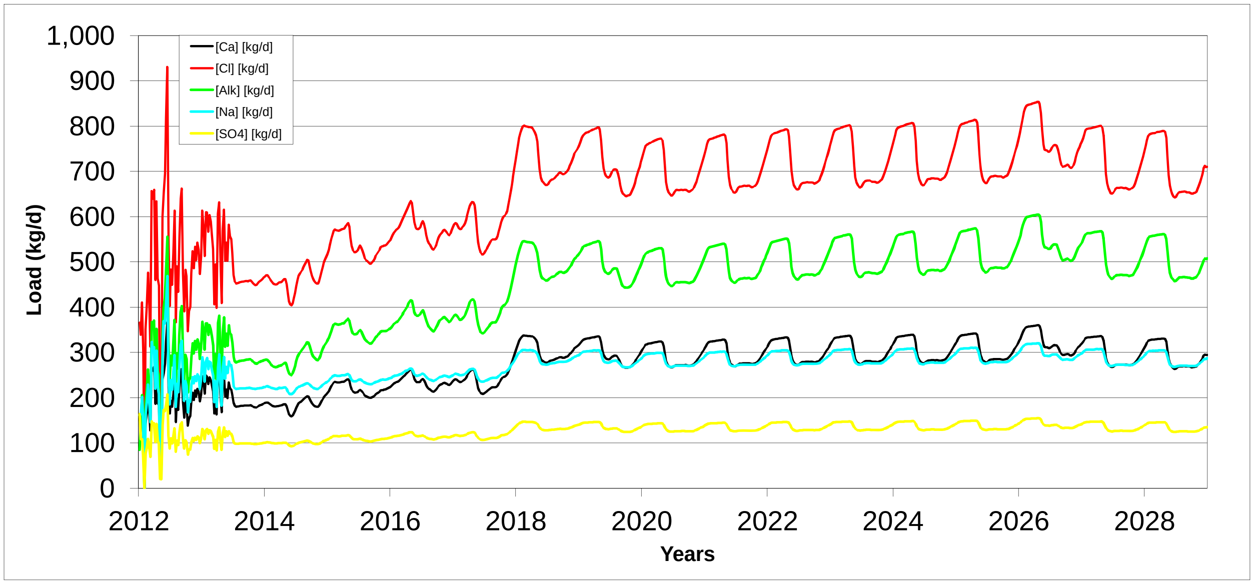
Date: December, 2013
Project: 12-1337-0001

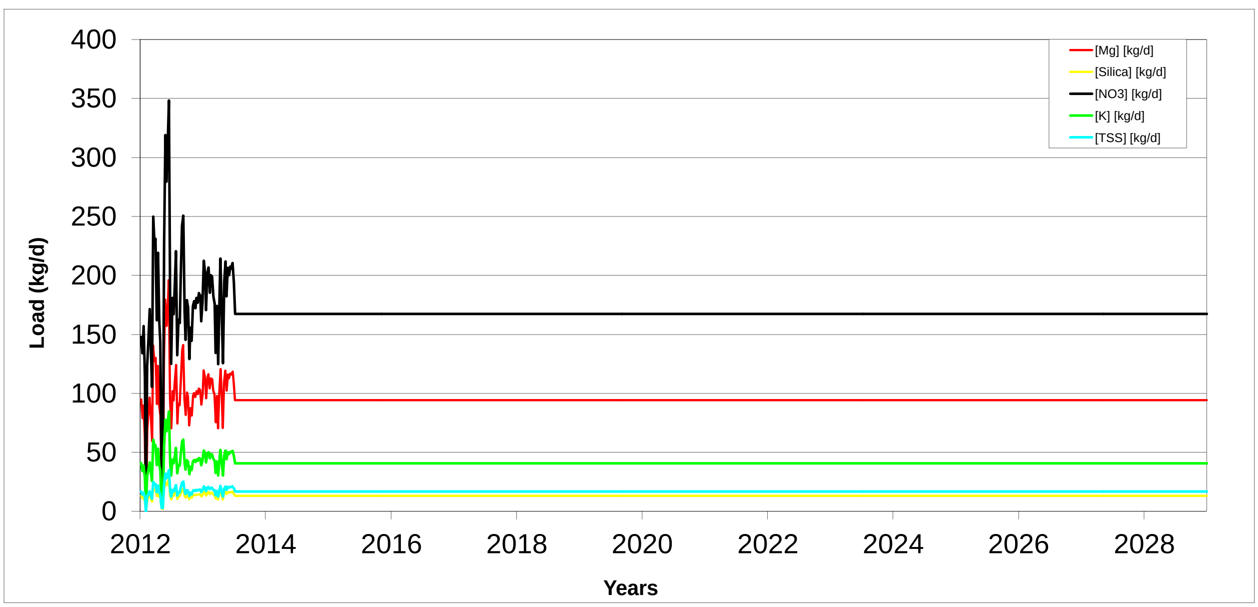
Drawn KAS
Chkd KJD

De Beers Canada Inc.

Process Water Dissolved Load

FIGURE IX-4a





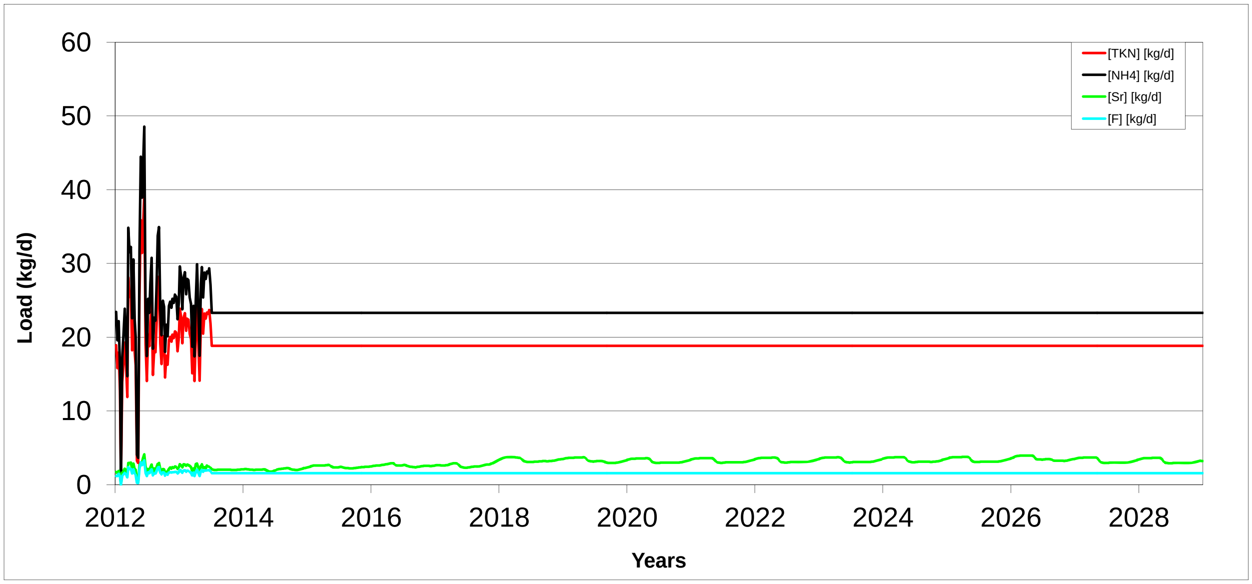
Date: December, 2013
Project: 12-1337-0001

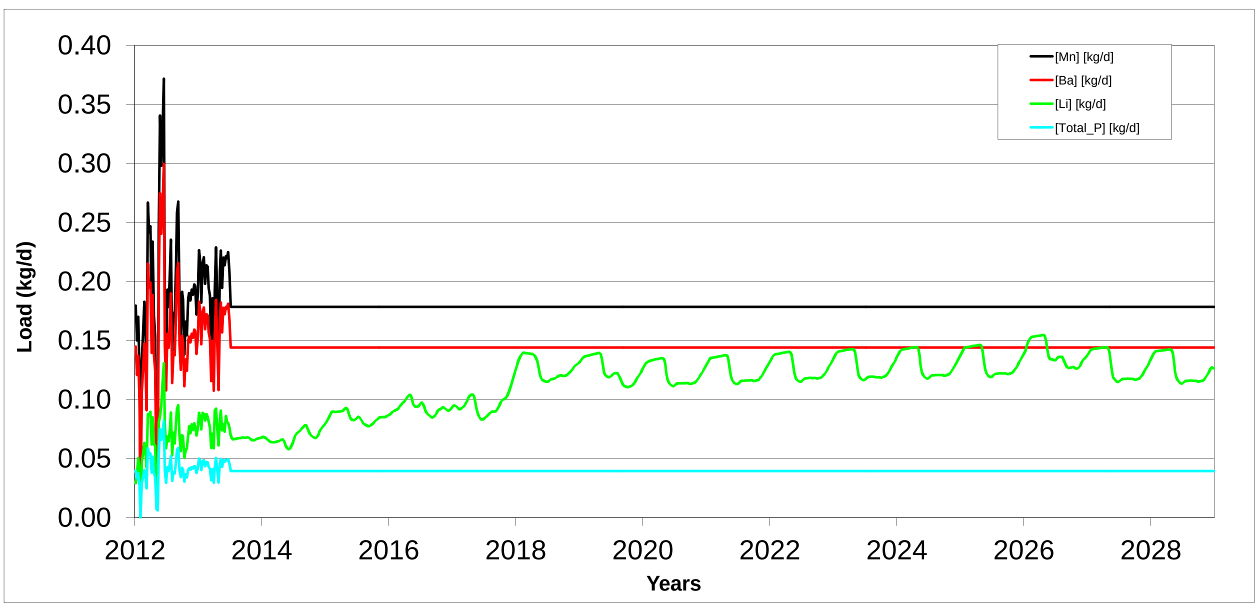
Drawn KAS
Chkd KJD

De Beers Canada Inc.

ApplX_Fig4.xls-App IX-4a

Process Water Dissolved Load	FIGURE IX-4b





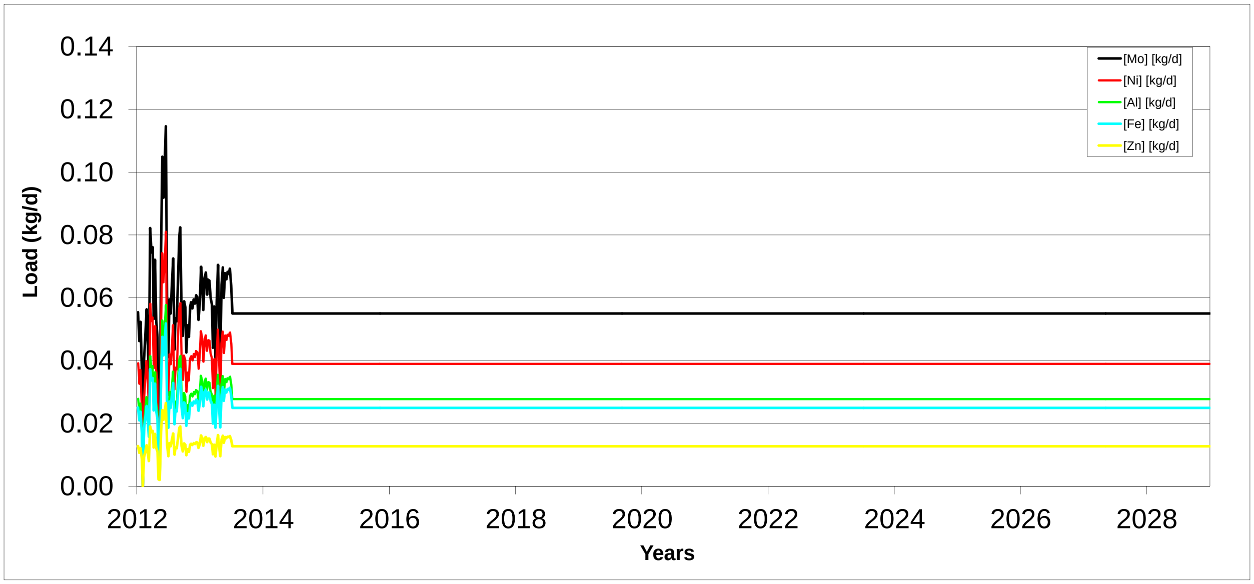
Date: December, 2013
Project: 12-1337-0001

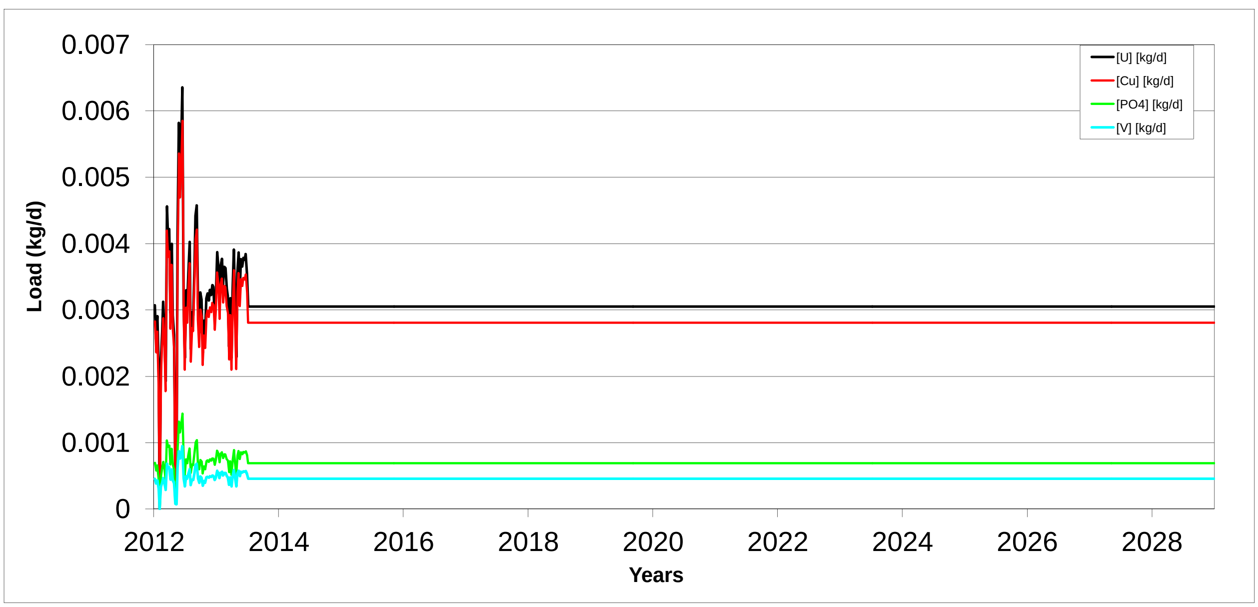
Drawn KAS
Chkd KJD

De Beers Canada Inc.

Process Water Dissolved Load

FIGURE IX-4c



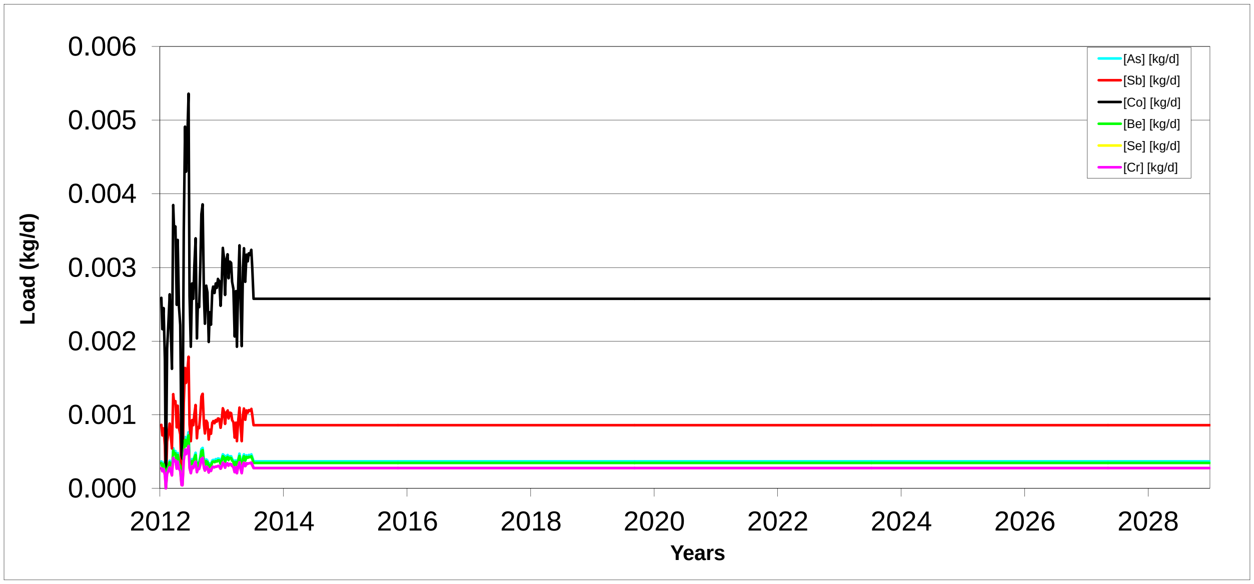


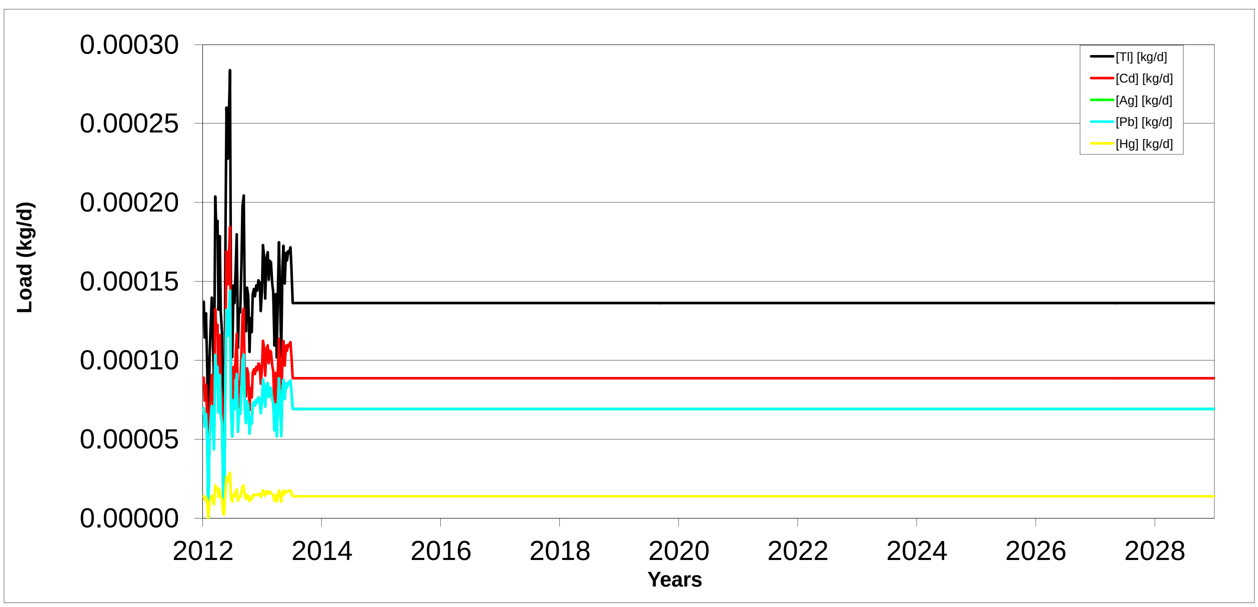
Date: December, 2013
Project: 12-1337-0001

Drawn KAS
Chkd KJD

De Beers Canada Inc.

Process Water Dissolved Load	FIGURE IX-4d



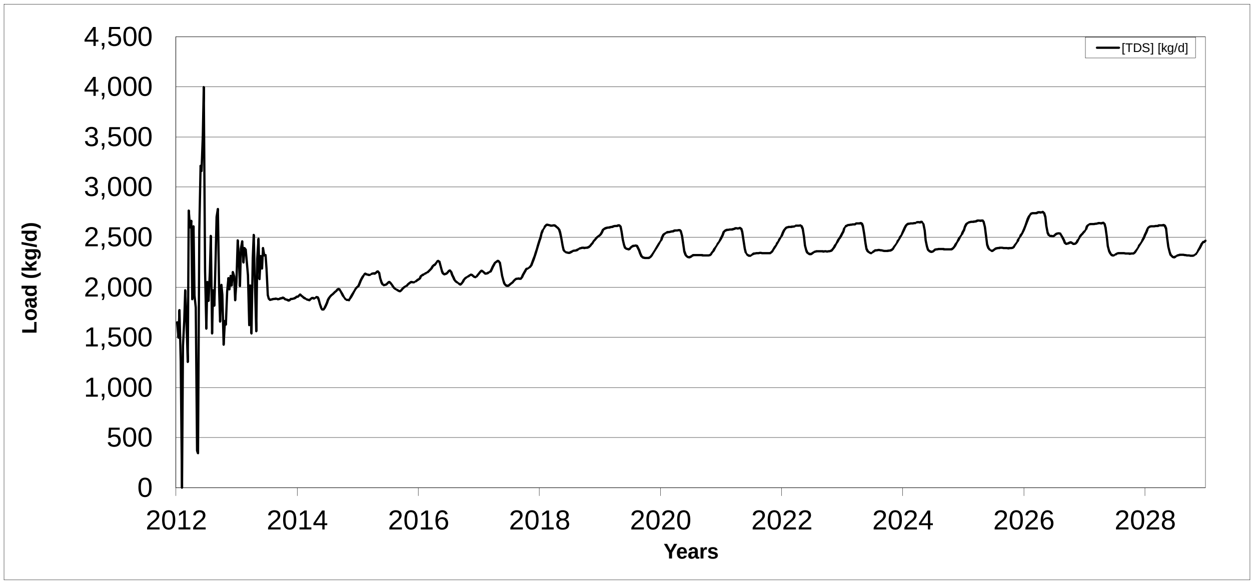


Date: December, 2013
Project: 12-1337-0001

Drawn KAS
Chkd KJD

De Beers Canada Inc.

Process Water Dissolved Load	FIGURE IX-4e

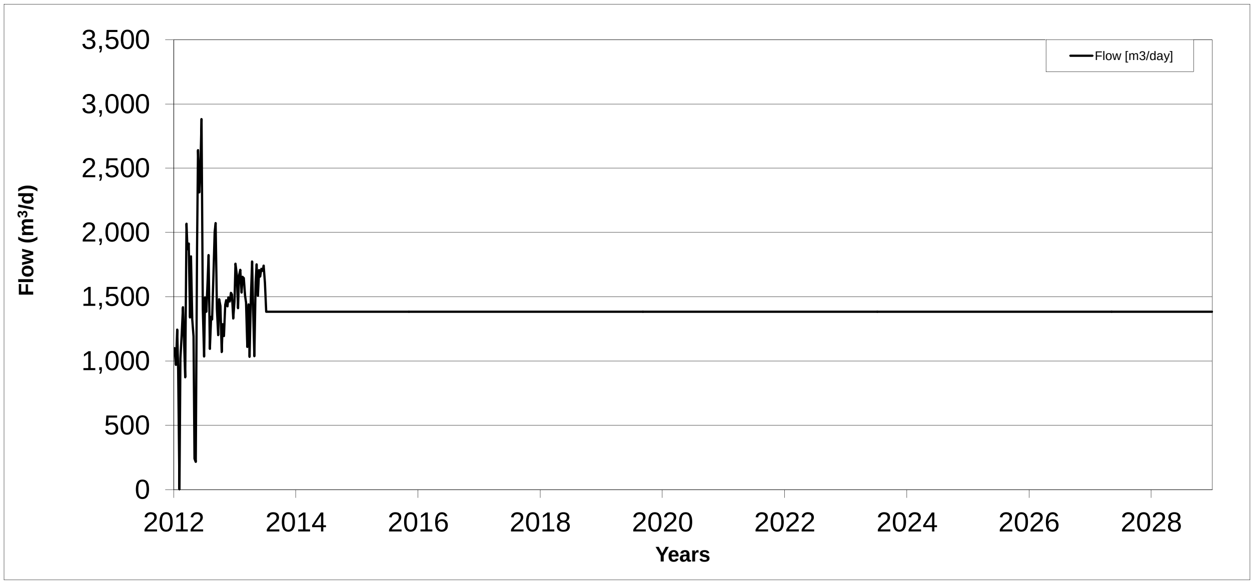


Date: December, 2013
Project: 12-1337-0001

Drawn KAS
Chkd KJD

De Beers Canada Inc.

Process Water Dissolved Load FLOW	FIGURE IX-4f

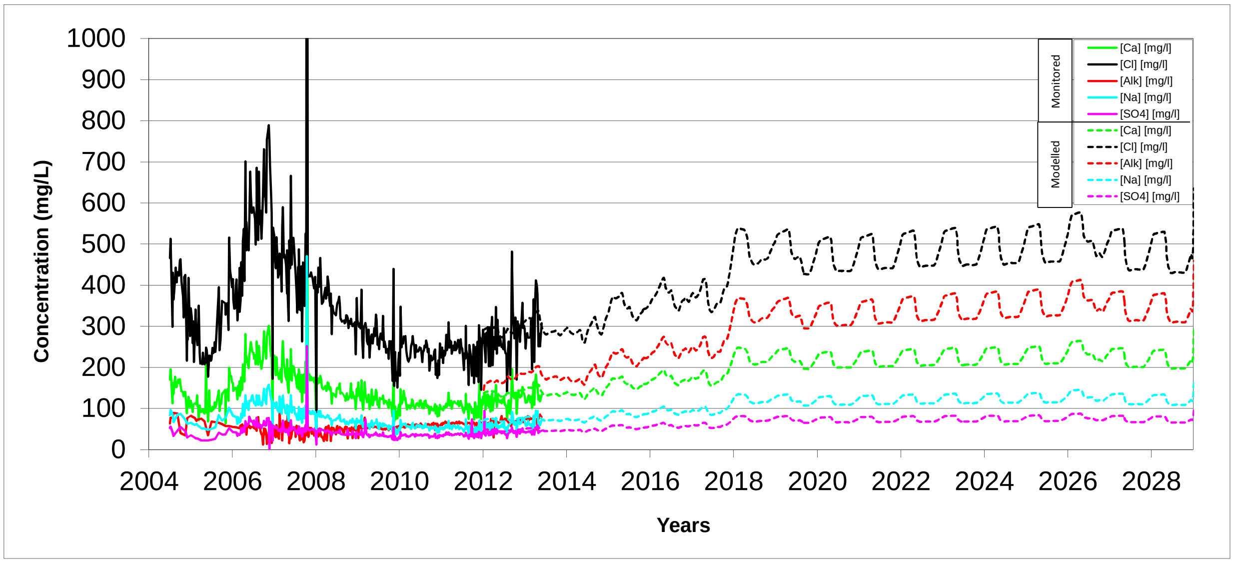


Date: December, 2013
Project: 12-1337-0001

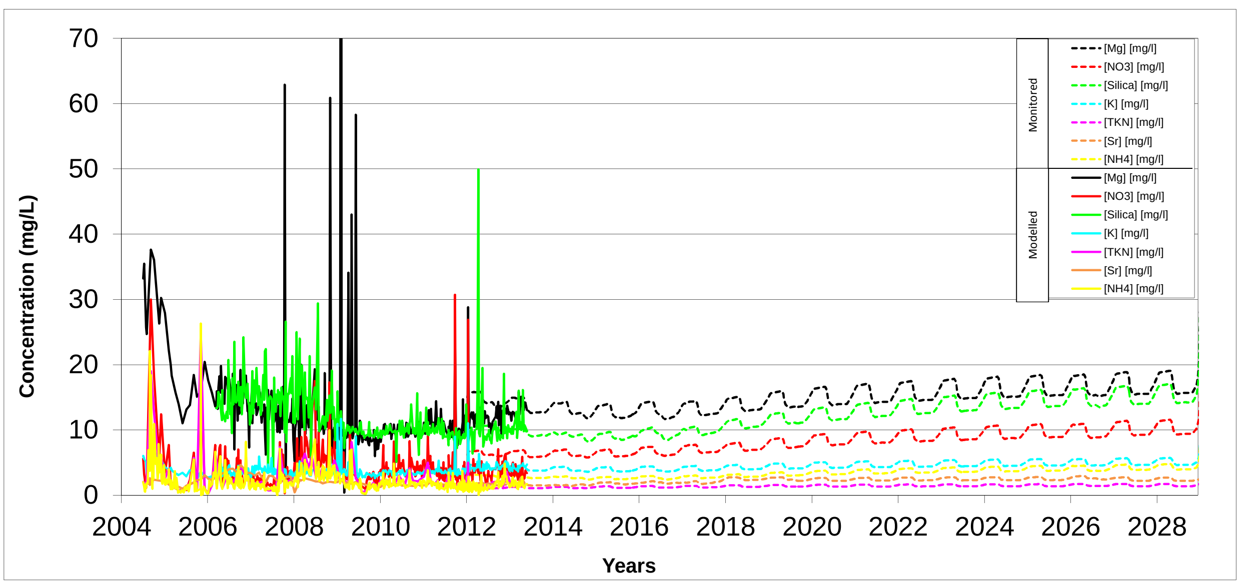
Drawn KAS
Chkd KJD

De Beers Canada Inc.

Mine Water (SNP 02-01) Dissolved Concentrations	FIGURE IX-5a



Note: Monitoring values above 1000 mg/L are not shown.



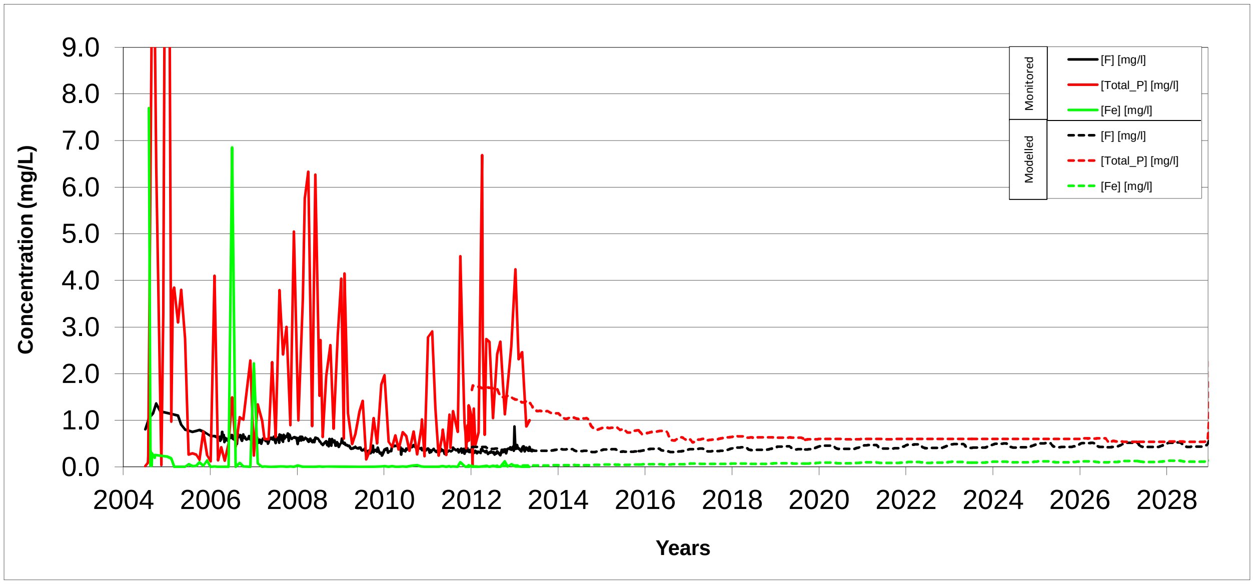
Note: Monitoring values above 70 mg/L are not shown.

Date: December, 2013
Project: 12-1337-0001

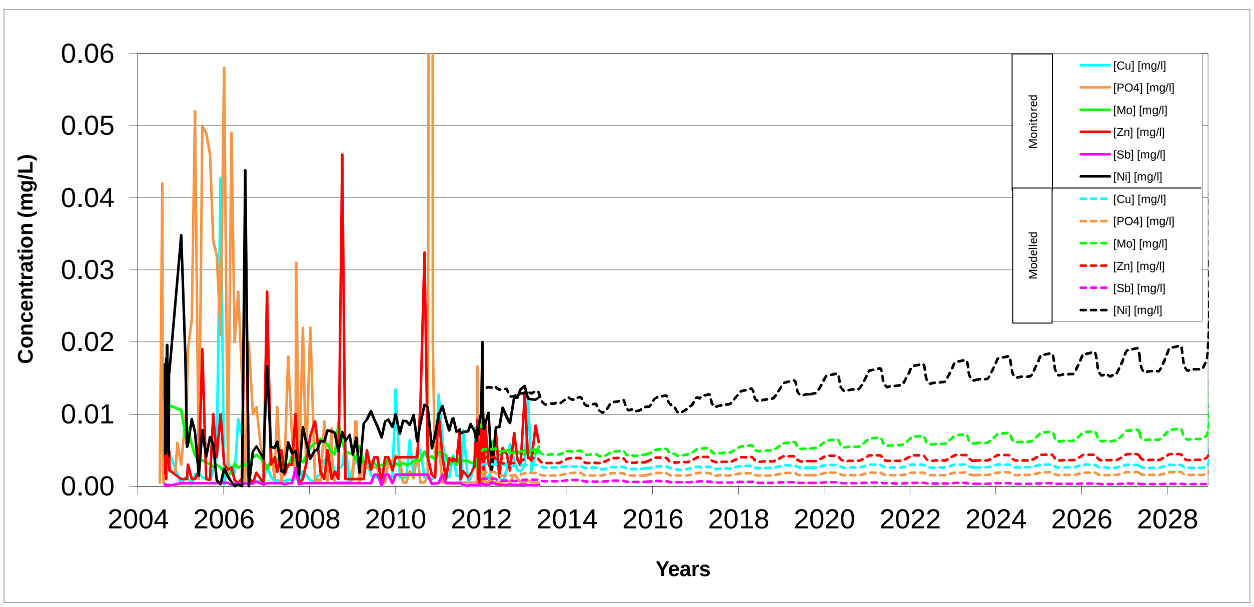
Drawn KAS
Chkd KJD

De Beers Canada Inc.

Mine Water (SNP 02-01) Dissolved Concentrations	FIGURE IX-5b



Note: Monitored values above 9.0 mg/L are not shown.



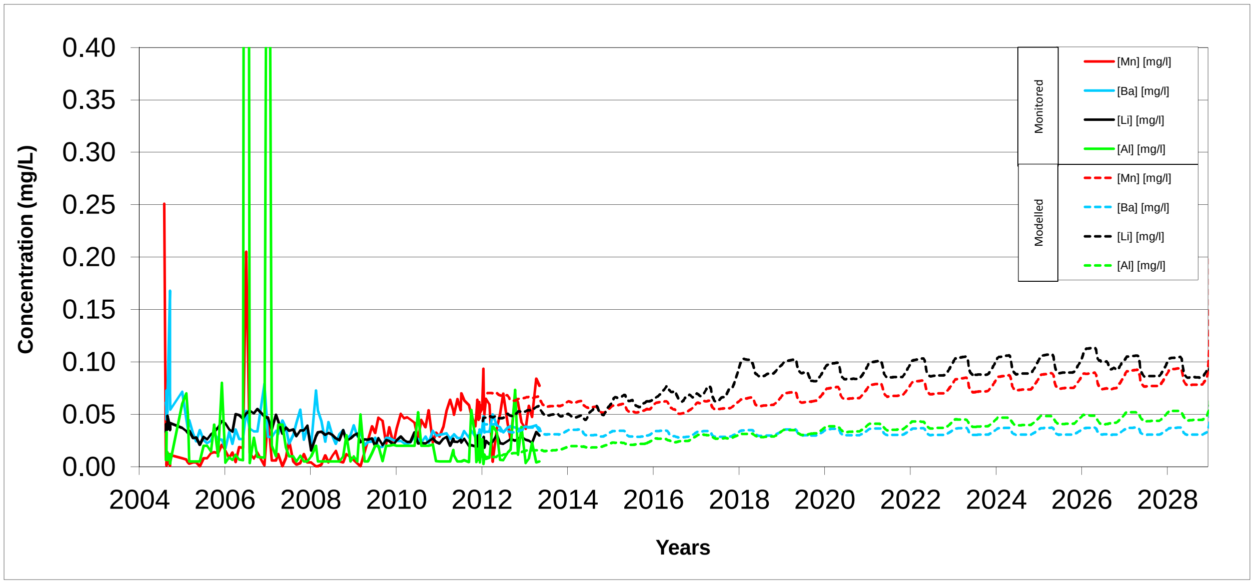
Note: Monitoring values above 0.06 mg/L are not shown.

Date: December, 2013
Project: 12-1337-0001

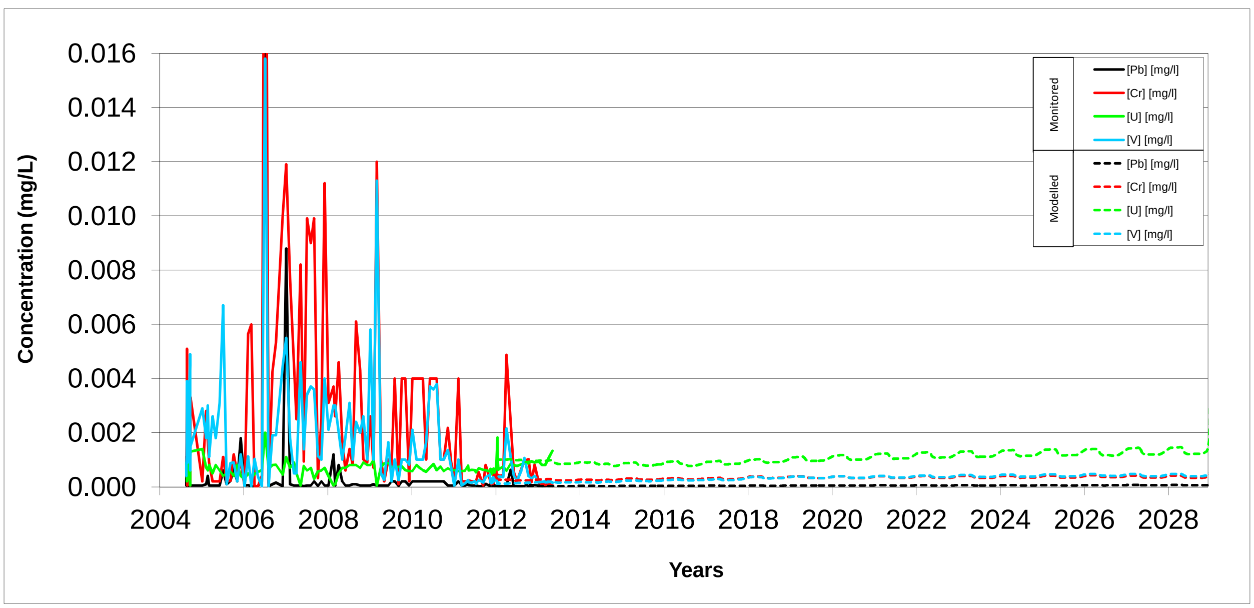
Drawn KAS
Chkd KJD

De Beers Canada Inc.

Mine Water (SNP 02-01) Dissolved Concentrations	FIGURE IX-5c



Note: Monitored values above 0.40 mg/L are not shown.



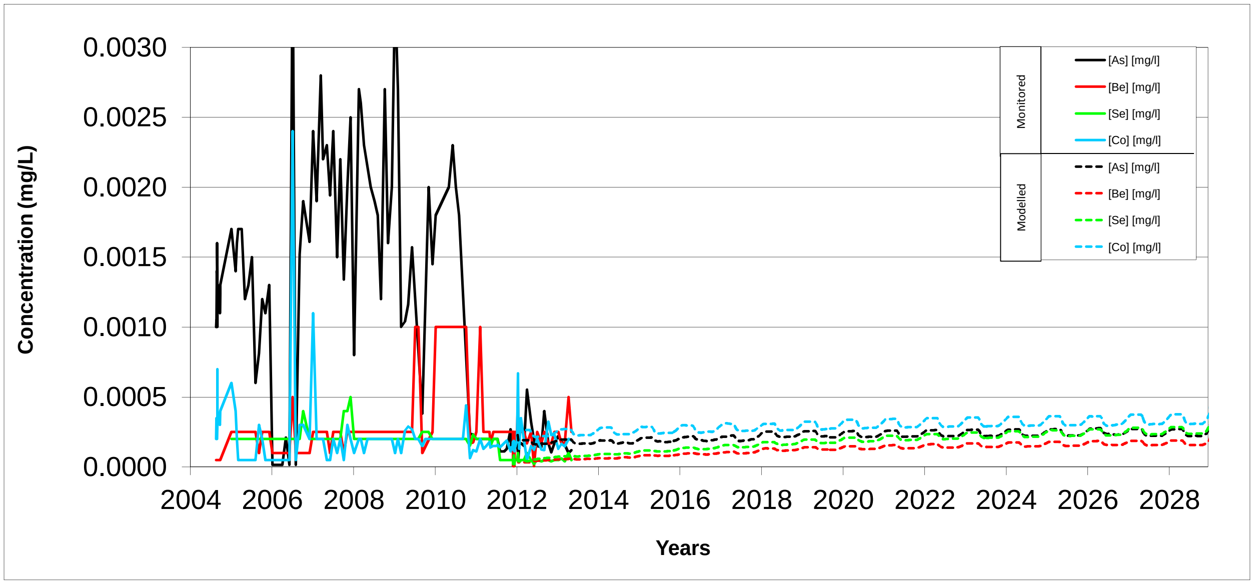
Note: Monitored values above 0.016 mg/L are not shown.

Date: December, 2013
Project: 12-1337-0001

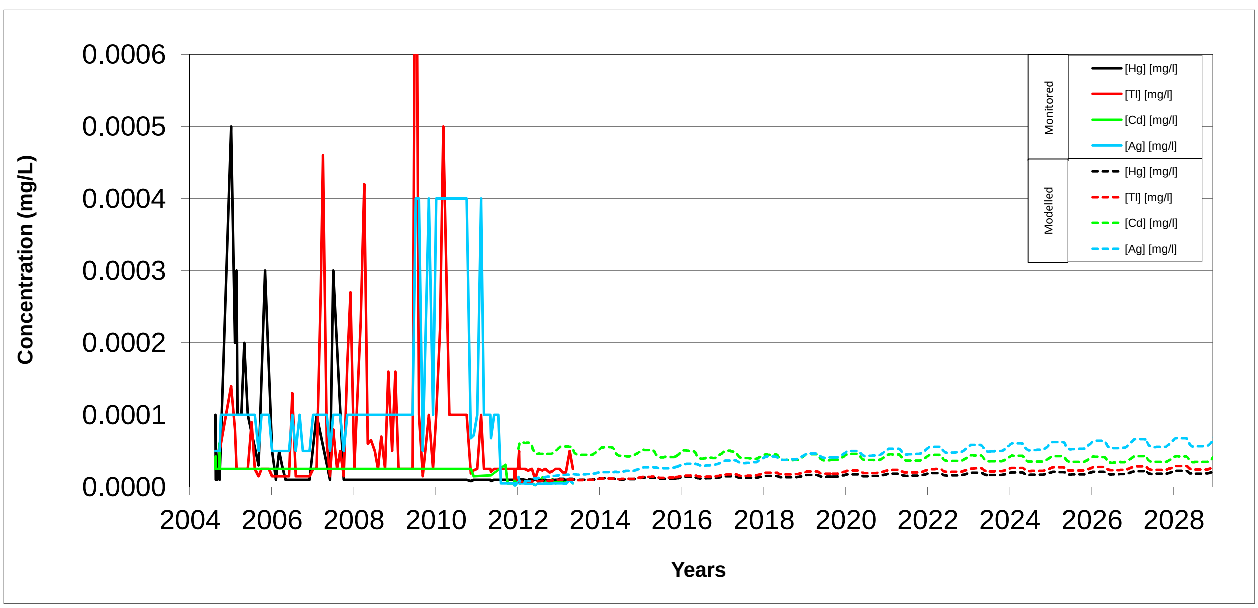
Drawn KAS
Chkd KJD

De Beers Canada Inc.

Mine Water (SNP 02-01) Dissolved Concentrations	FIGURE IX-5d



Note: Monitored values above 0.0030 mg/L are not shown.



Note: Monitored values above 0.0006 mg/L are not shown.

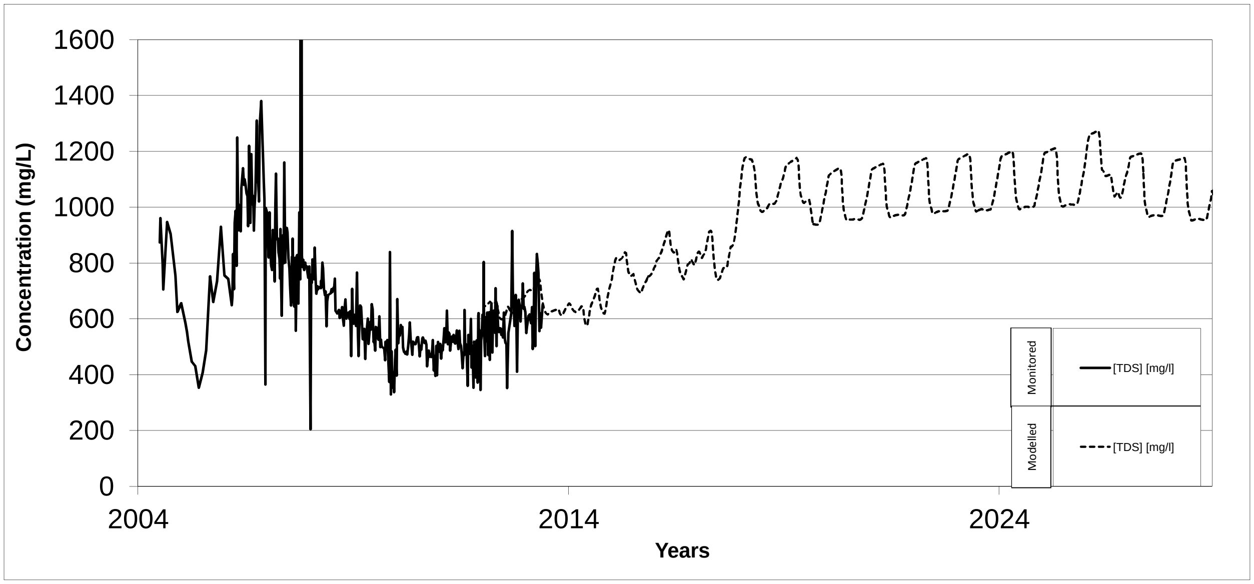
Date: December, 2013
Project: 12-1337-0001

Drawn KAS
Chkd KJD

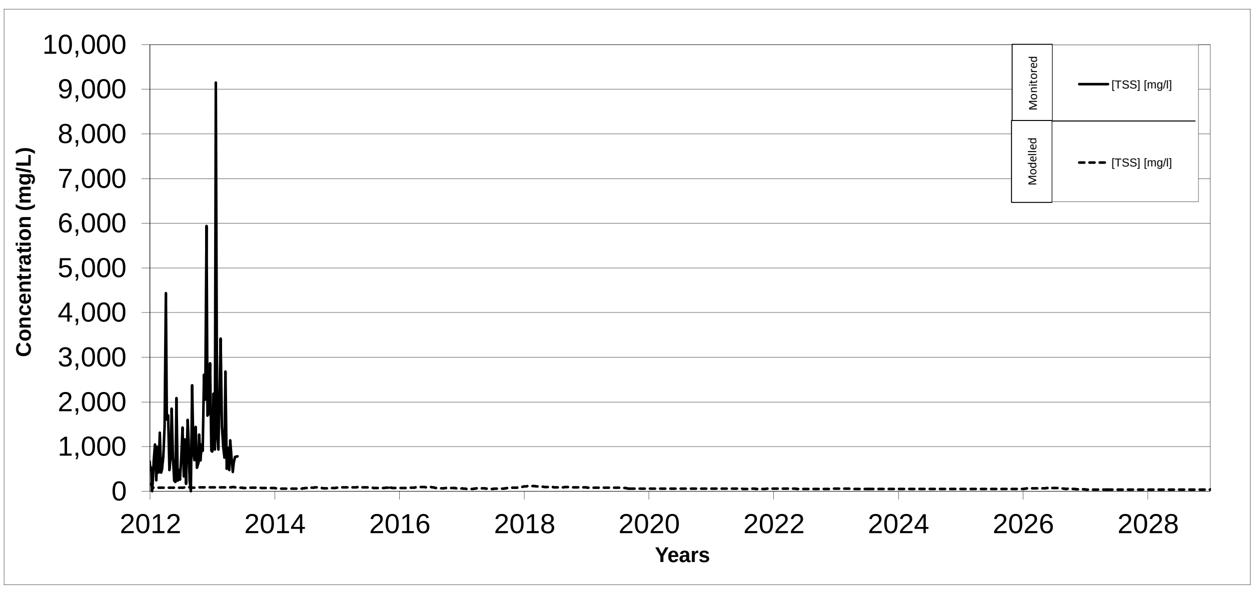
De Beers Canada Inc.

Mine Water (SNP 02-01) Dissolved Concentrations

FIGURE IX-5e



Note: Monitored values above 1600 mg/L are not shown.



Note: Monitored values above 10,000 mg/L are not shown.

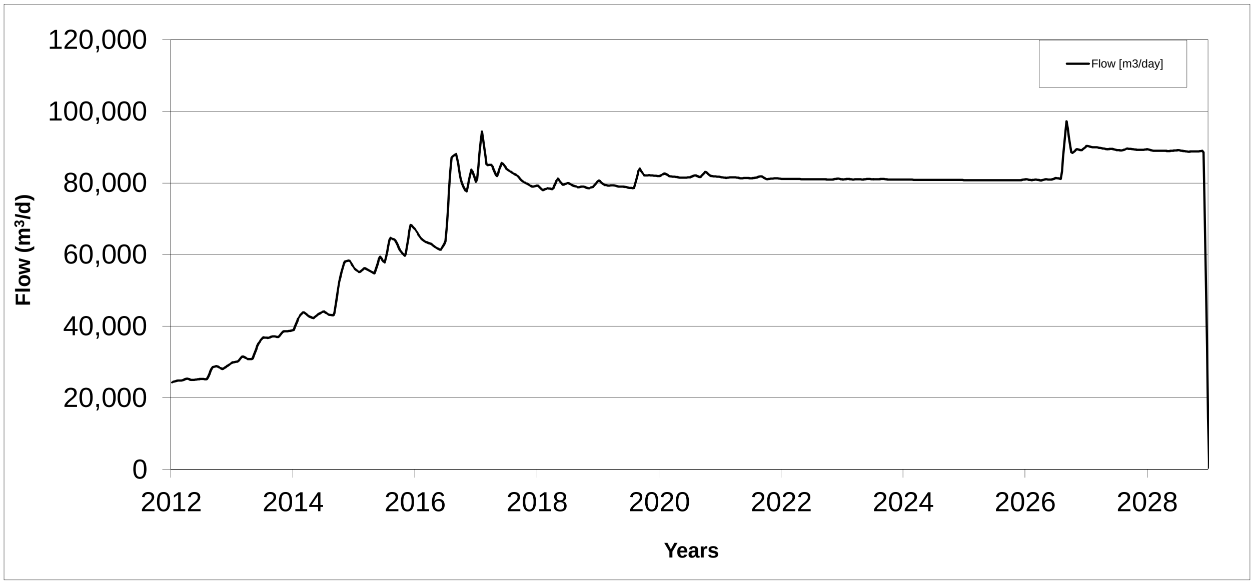
Date: December, 2013
Project: 12-1337-0001

Drawn KAS
Chkd KJD

De Beers Canada Inc.

Mine Water (SNP 02-01) Dissolved Concentrations

FIGURE IX-5f

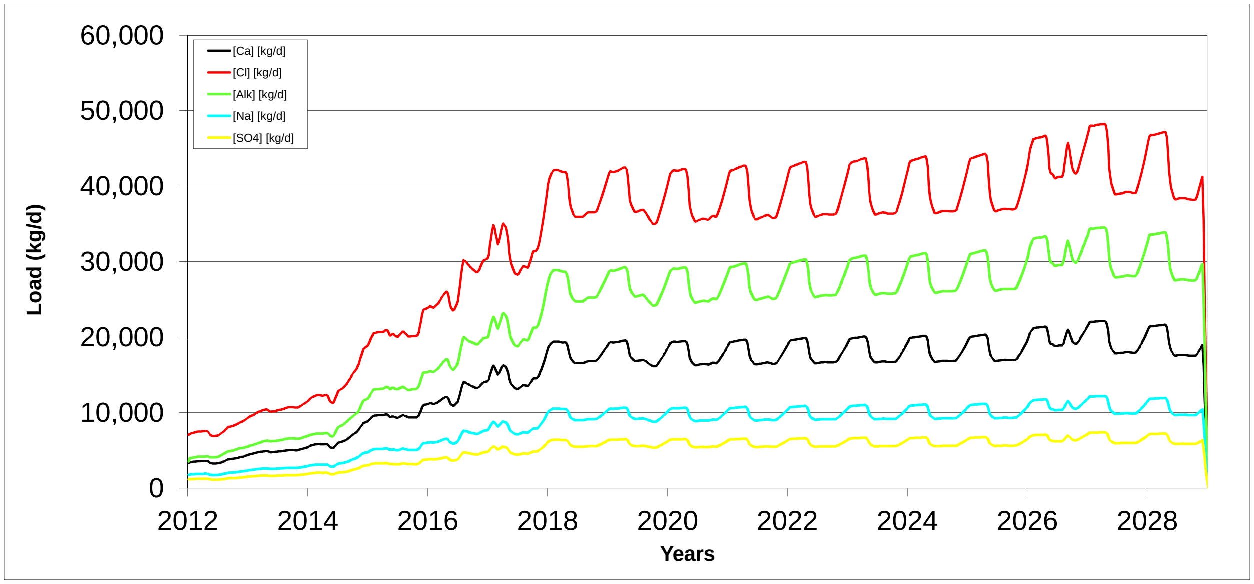


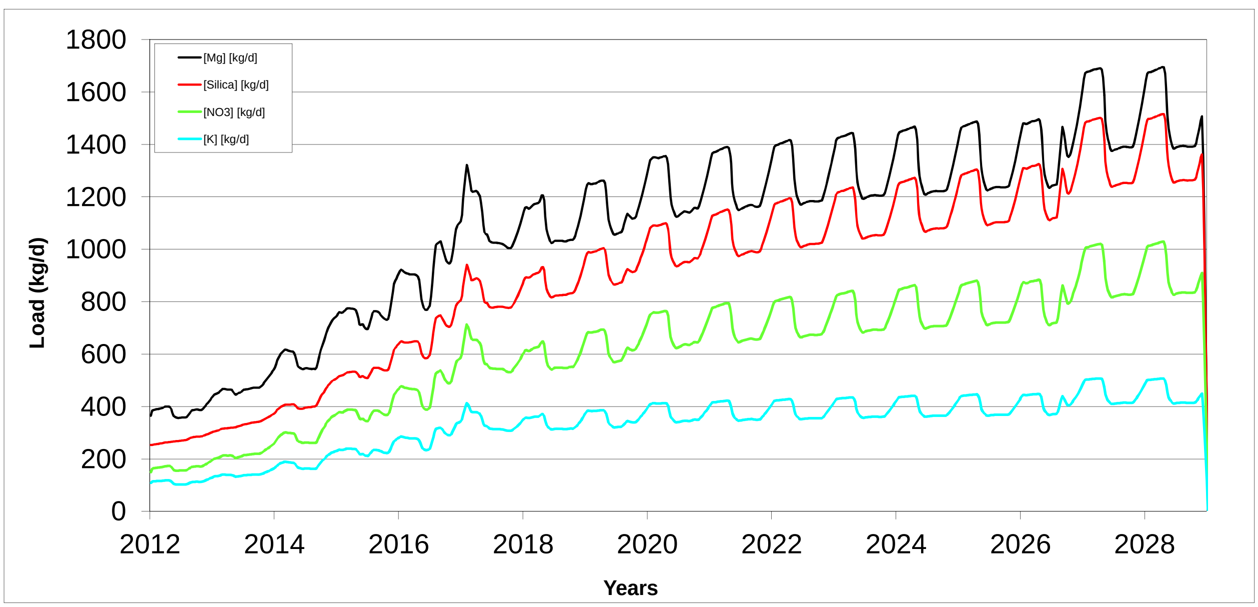
Date: December, 2013
Project: 12-1337-0001

Drawn KAS
Chkd KJD

De Beers Canada Inc.

Mine Water (SNP 02-01) Dissolved Load	FIGURE IX-6a





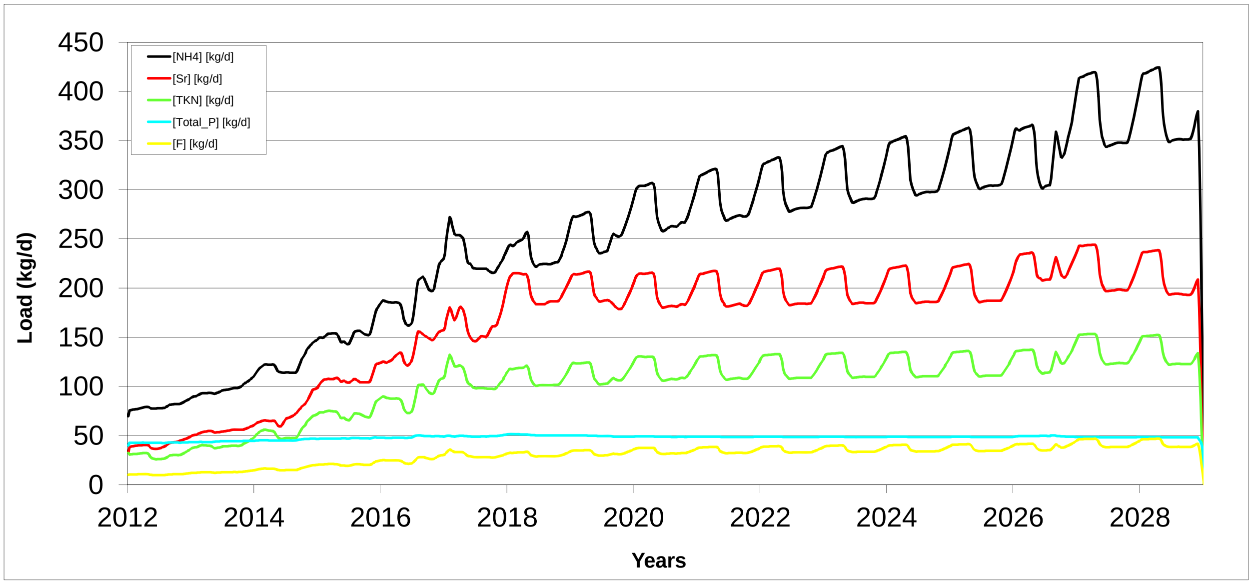
Date: December, 2013
Project: 12-1337-0001

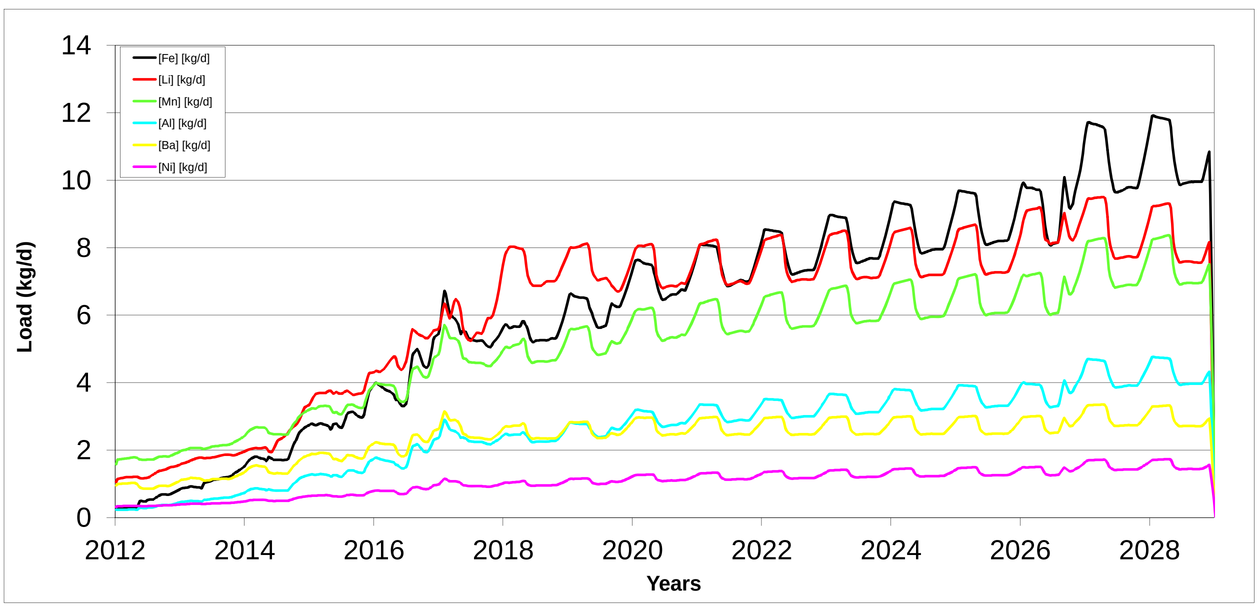
Drawn KAS
Chkd KJD

De Beers Canada Inc.

Mine Water (SNP 02-01) Dissolved Load

FIGURE IX-6b





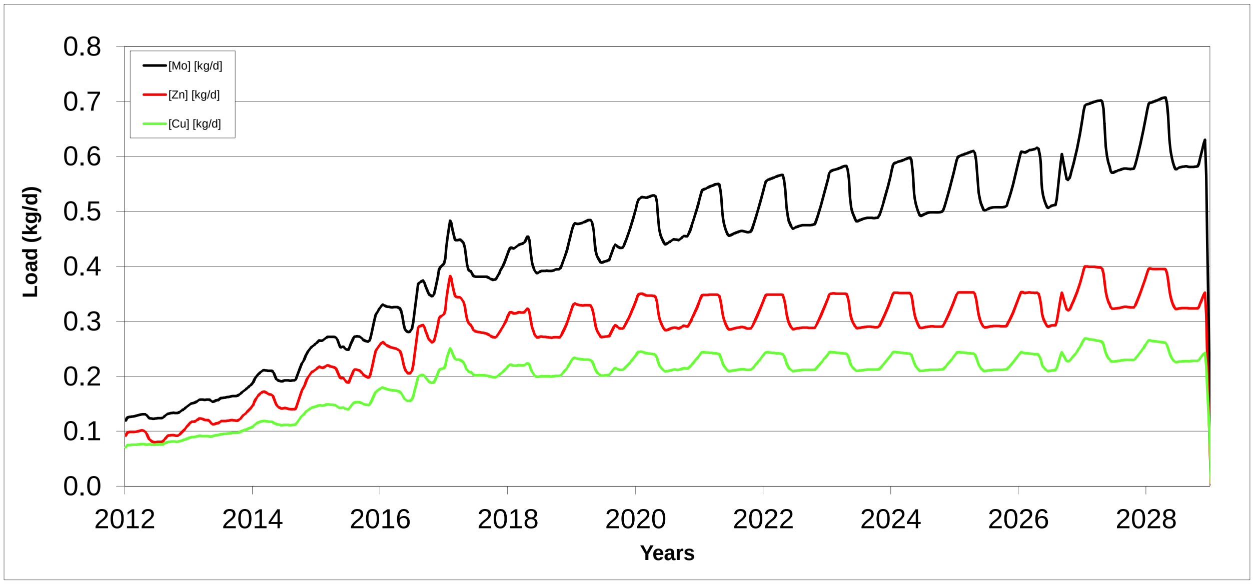
Date: December, 2013
Project: 12-1337-0001

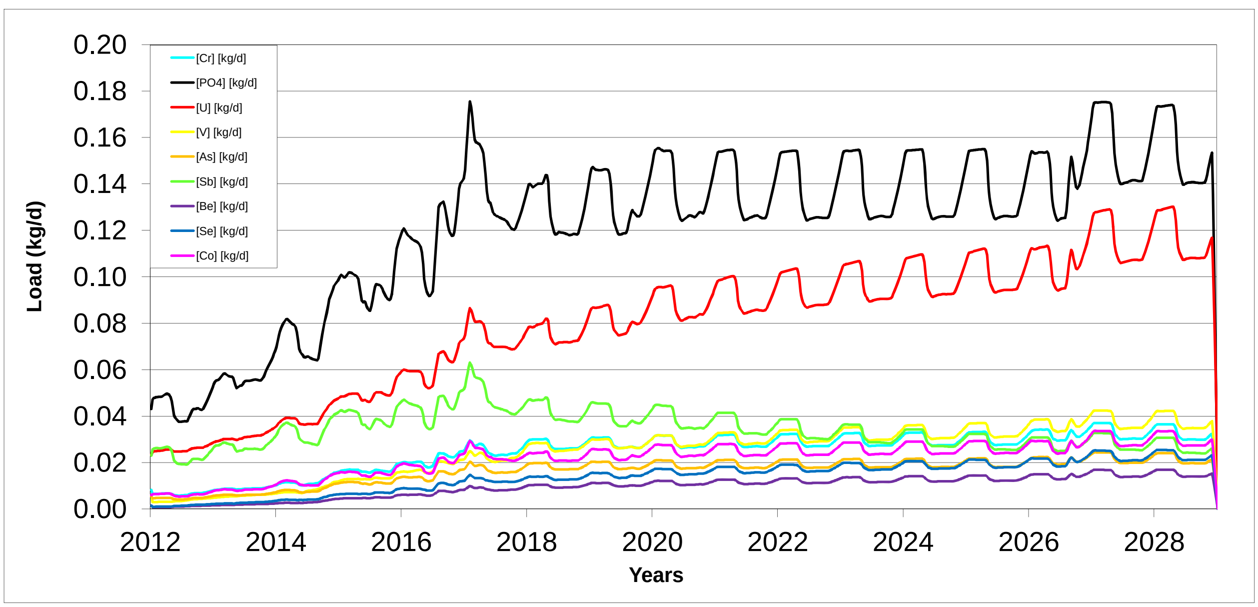
Drawn KAS
Chkd KJD

De Beers Canada Inc.

Mine Water (SNP 02-01) Dissolved Load

FIGURE IX-6c





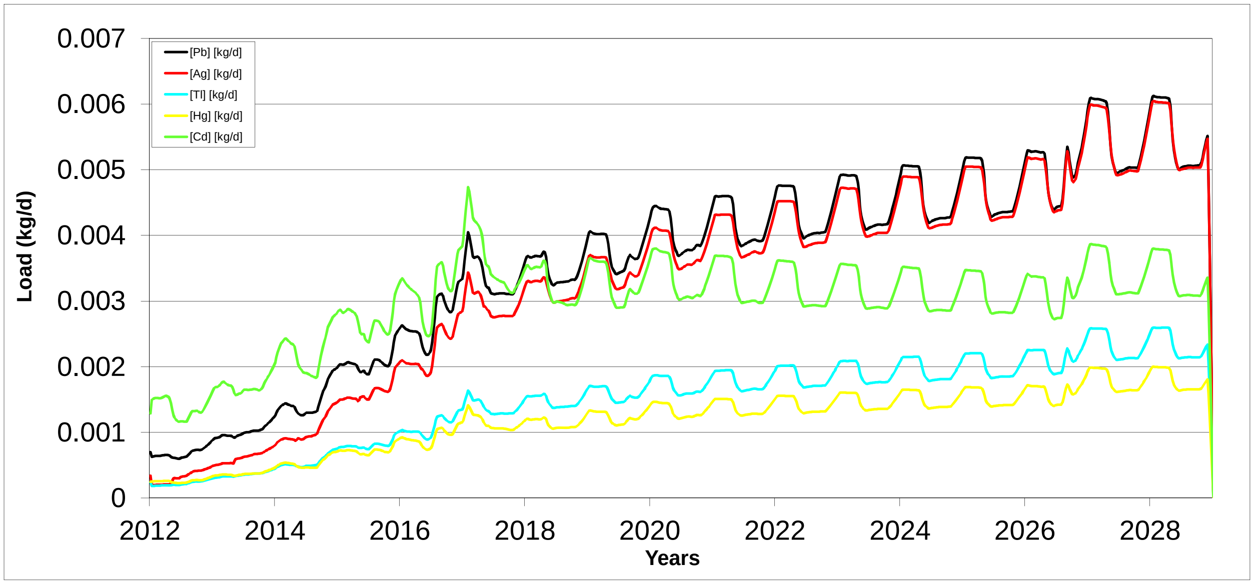
Date: December, 2013
Project: 12-1337-0001

Drawn KAS
Chkd KJD

De Beers Canada Inc.

Mine Water (SNP 02-01) Dissolved Load

FIGURE IX-6d



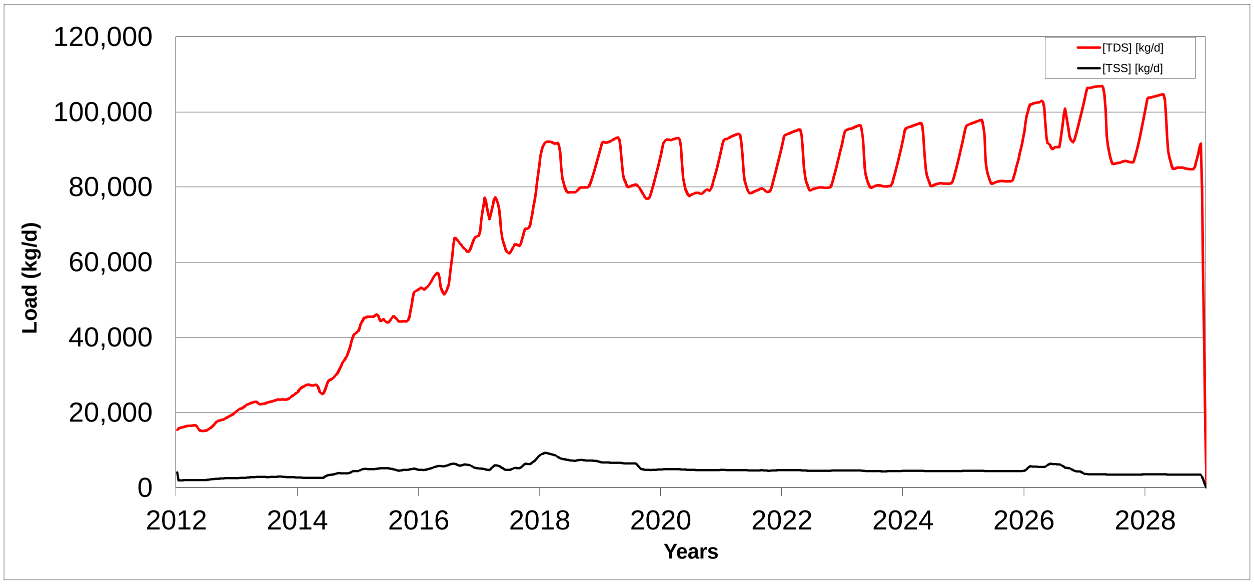
Date: December, 2013
Project: 12-1337-0001

Drawn KAS
Chkd KJD

De Beers Canada Inc.

Mine Water (SNP 02-01) Dissolved Load

FIGURE IX-6e

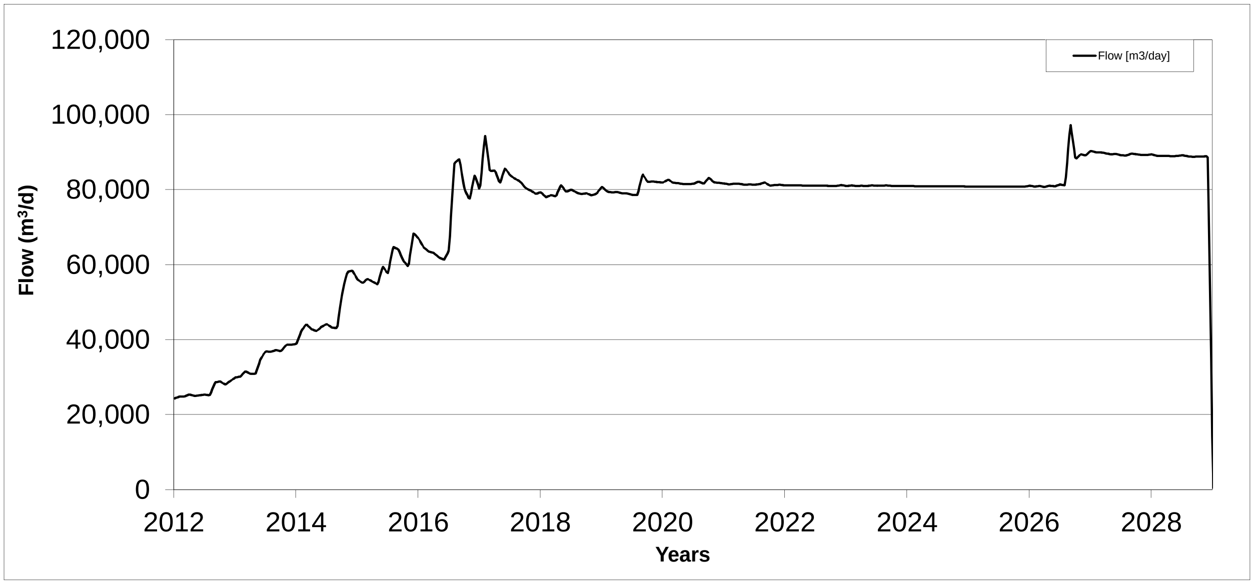


Date: December, 2013
Project: 12-1337-0001

Drawn KAS
Chkd KJD

De Beers Canada Inc.

Mine Water (SNP 02-01) Dissolved Load FLOW	FIGURE IX-6f

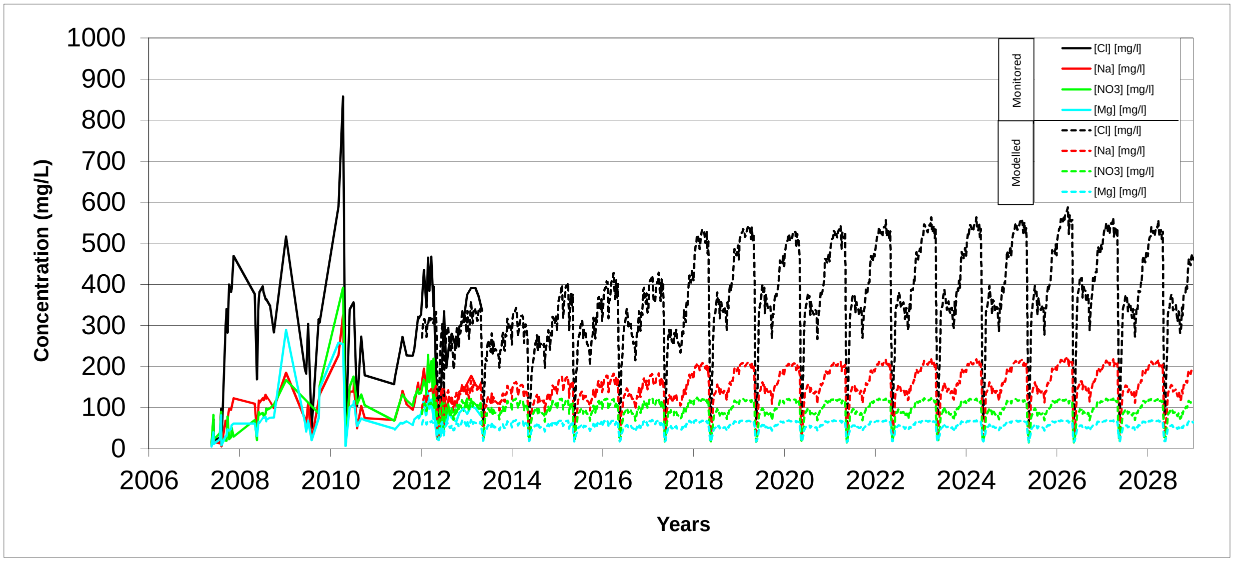


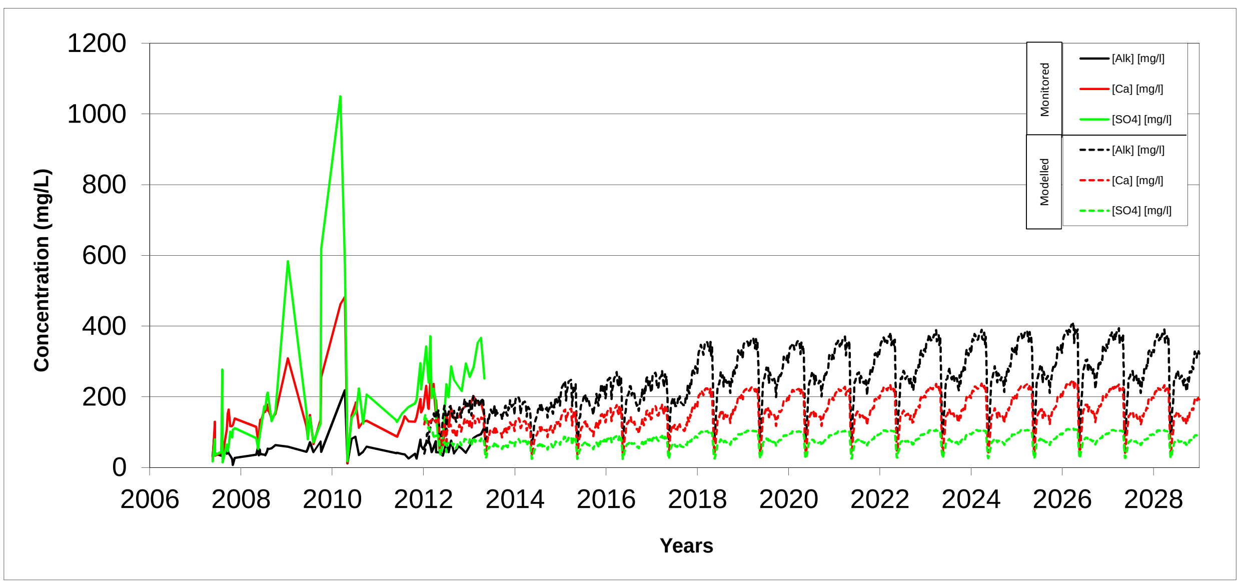
Date: December, 2013
Project: 12-1337-0001

Drawn KAS
Chkd KJD

De Beers Canada Inc.

North Pile Discharge (SNP 02-02) Dissolved Concentrations	FIGURE IX-7a



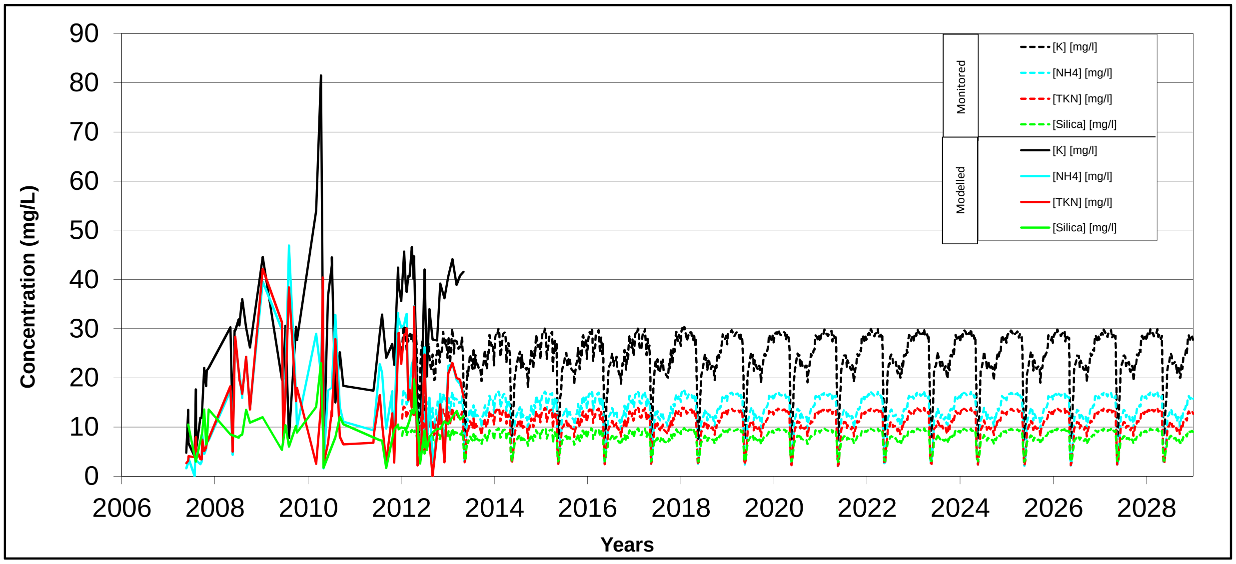


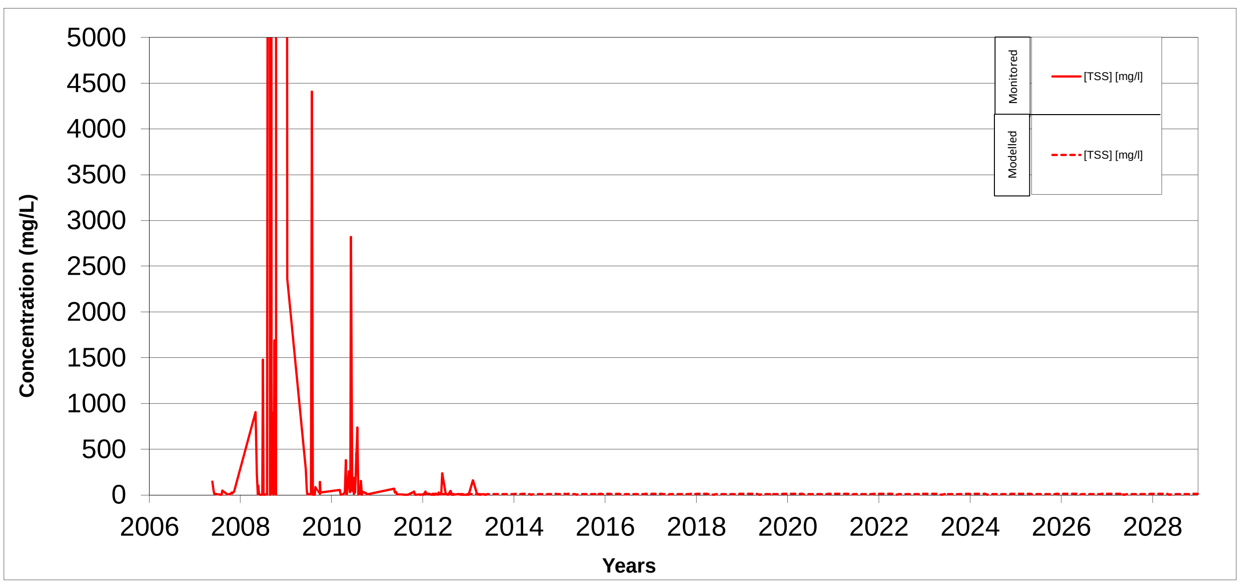
Date: December, 2013
Project: 12-1337-0001

Drawn KAS
Chkd KJD

De Beers Canada Inc.

North Pile Discharge (SNP 02-02) Dissolved Concentrations	FIGURE IX-7b





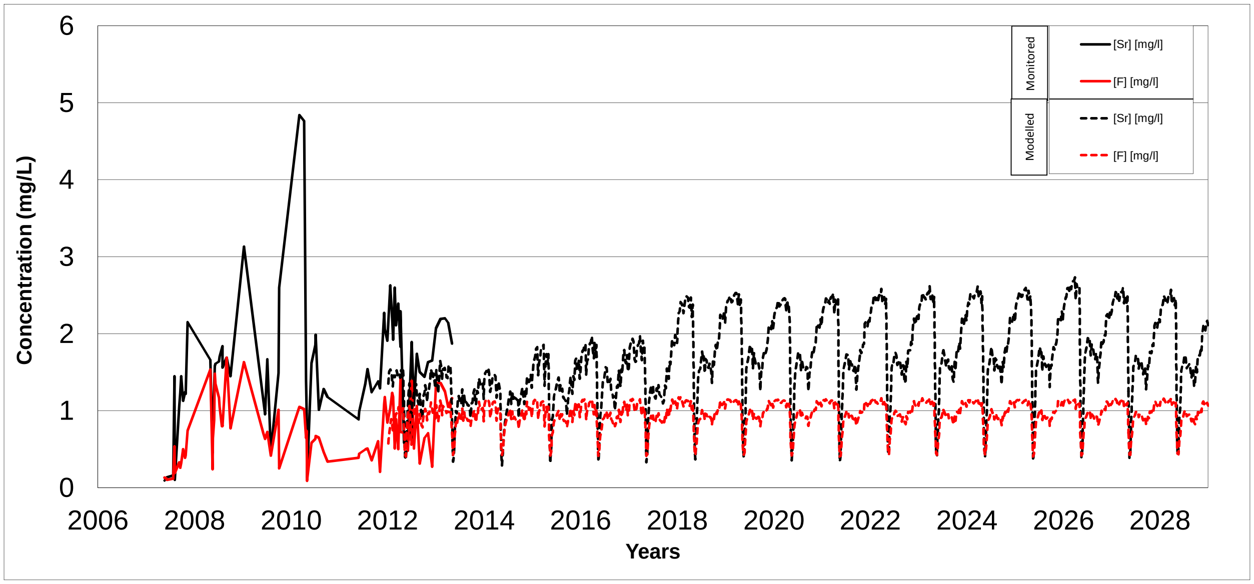
Note: Monitoring values above 5000 mg/L are not shown.

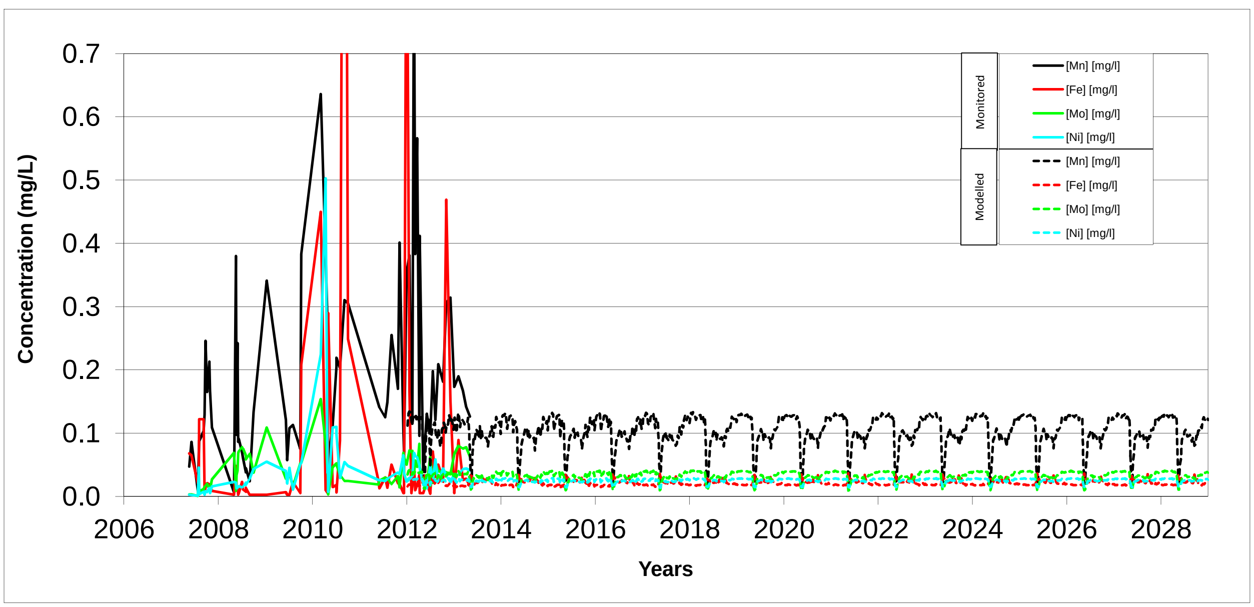
Date: December, 2013
Project: 12-1337-0001

Drawn KAS
Chkd KJD

De Beers Canada Inc.

North Pile Discharge (SNP 02-02) Dissolved Concentrations	FIGURE IX-7c





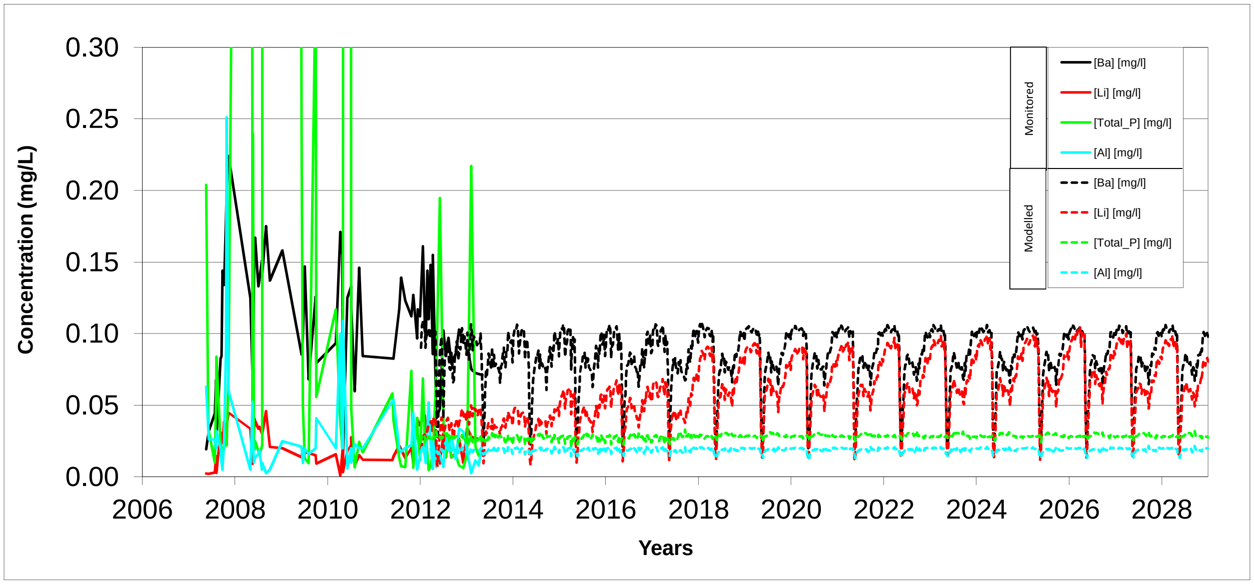
Note: Monitoring values above 0.7 mg/L are not shown.

Date: December, 2013
Project: 12-1337-0001

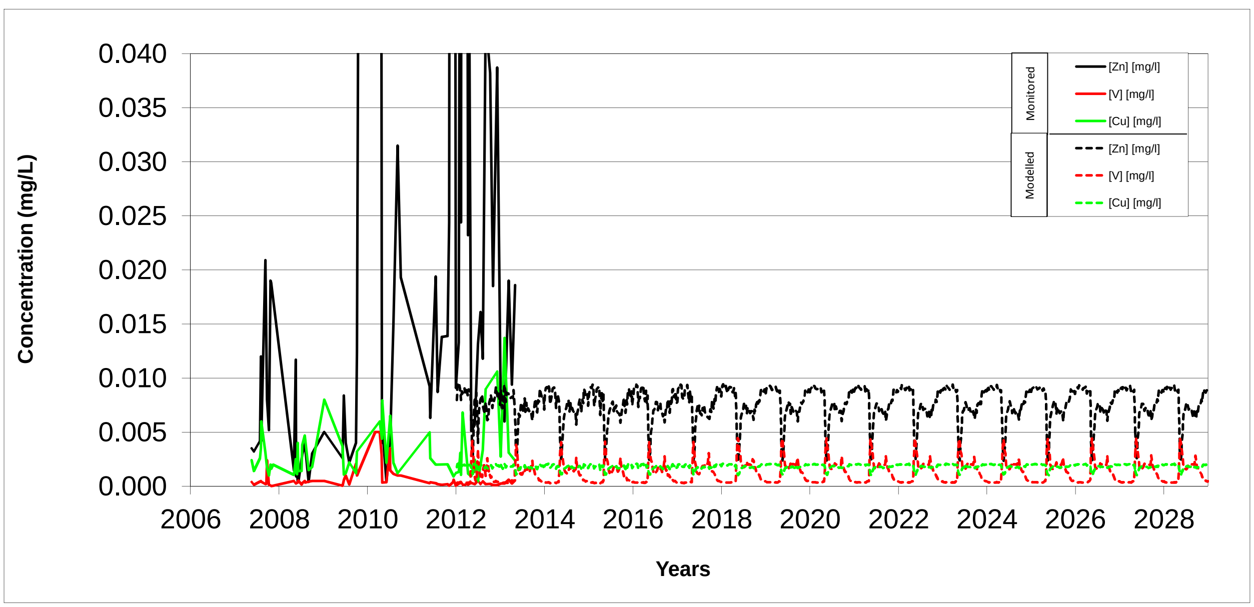
Drawn KAS
Chkd KJD

De Beers Canada Inc.

North Pile Discharge (SNP 02-02) Dissolved Concentrations	FIGURE IX-7d



Note: Monitoring values above 0.30 mg/L are not shown.



Note: Monitoring values above 0.40 mg/L are not shown.

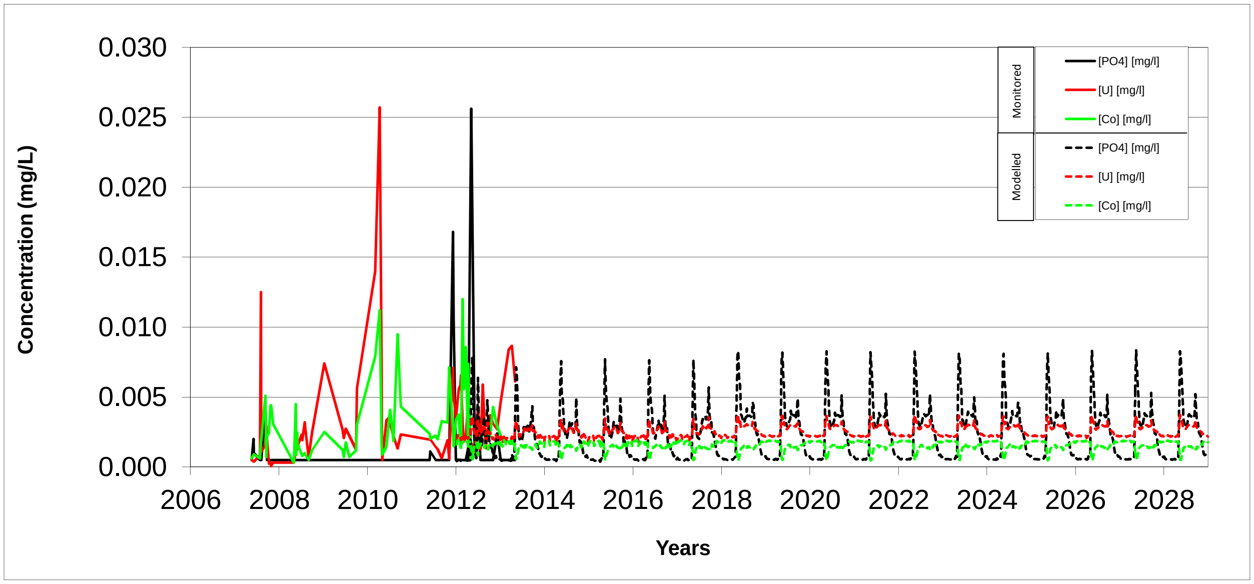
Date: December, 2013
Project: 12-1337-0001

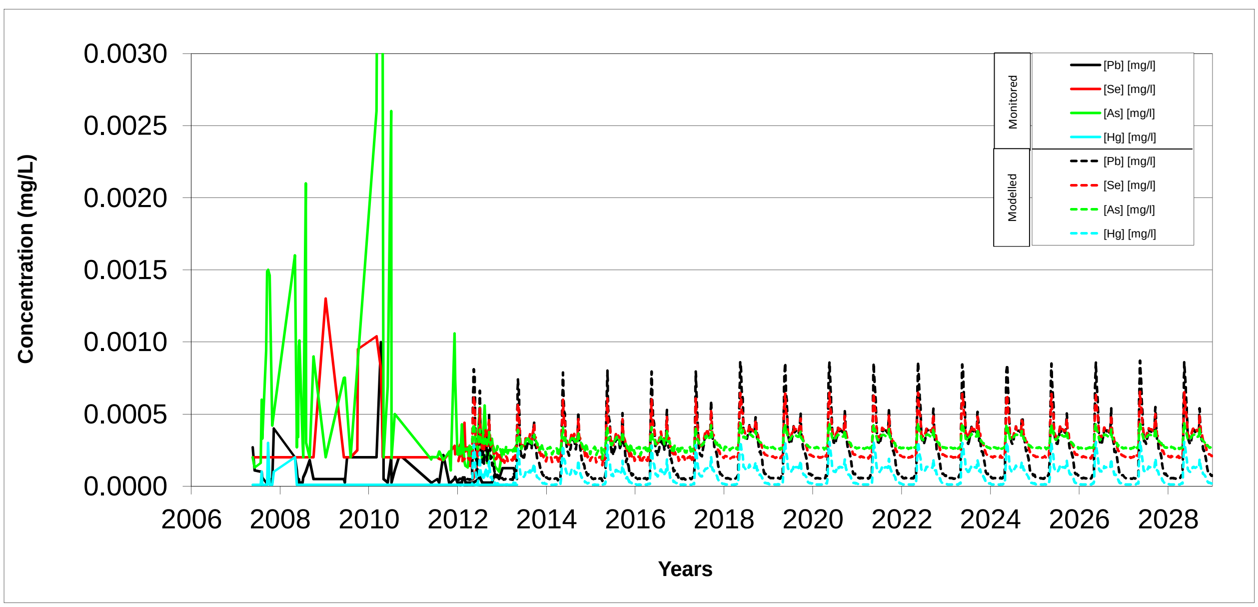
Drawn KAS
Chkd KJD

De Beers Canada Inc.

North Pile Discharge (SNP 02-02) Dissolved Concentrations

FIGURE IX-7e





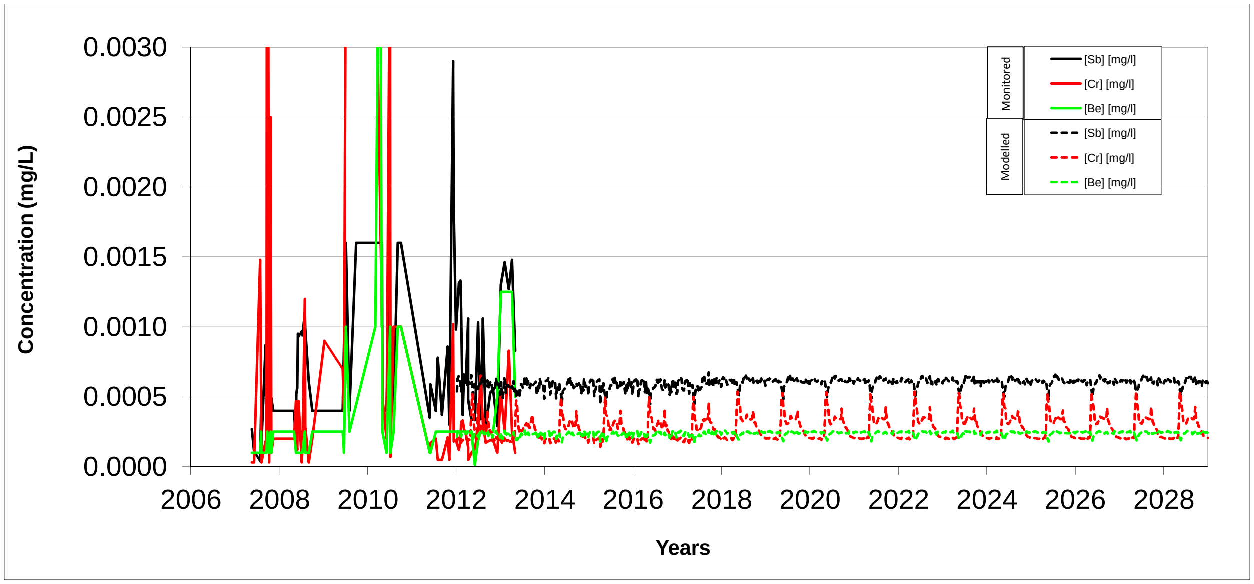
Note: Monitoring values above 0.0030 mg/L are not shown.

Date: December, 2013
Project: 12-1337-0001

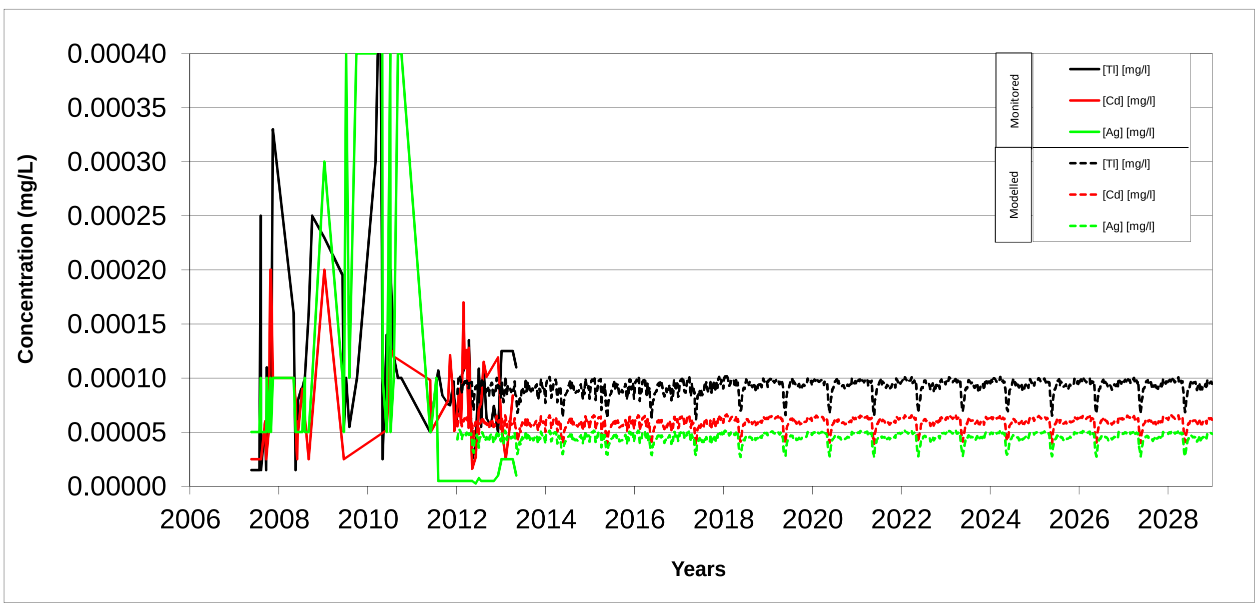
Drawn KAS
Chkd KJD

De Beers Canada Inc.

North Pile Discharge (SNP 02-02) Dissolved Concentrations	FIGURE IX-7f



Note: Monitoring values above 0.0030 mg/L are not shown.



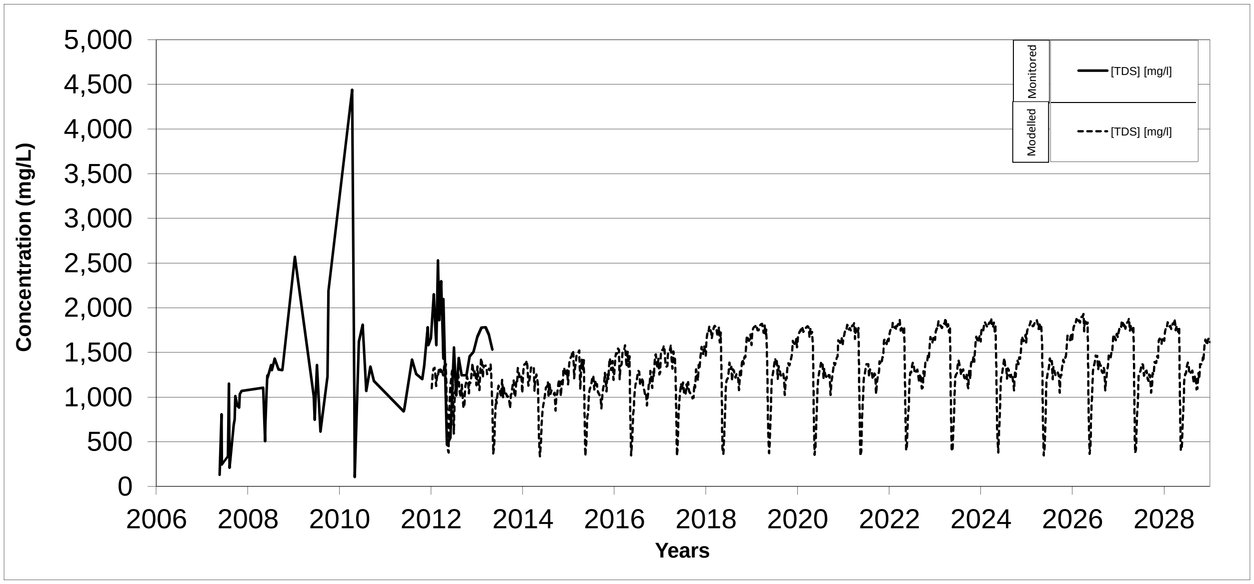
Note: Monitoring values above 0.00040 mg/L are not shown.

Date: December, 2013
Project: 12-1337-0001

Drawn KAS
Chkd KJD

De Beers Canada Inc.

North Pile Discharge (SNP 02-02) Dissolved Concentrations	FIGURE IX-7g



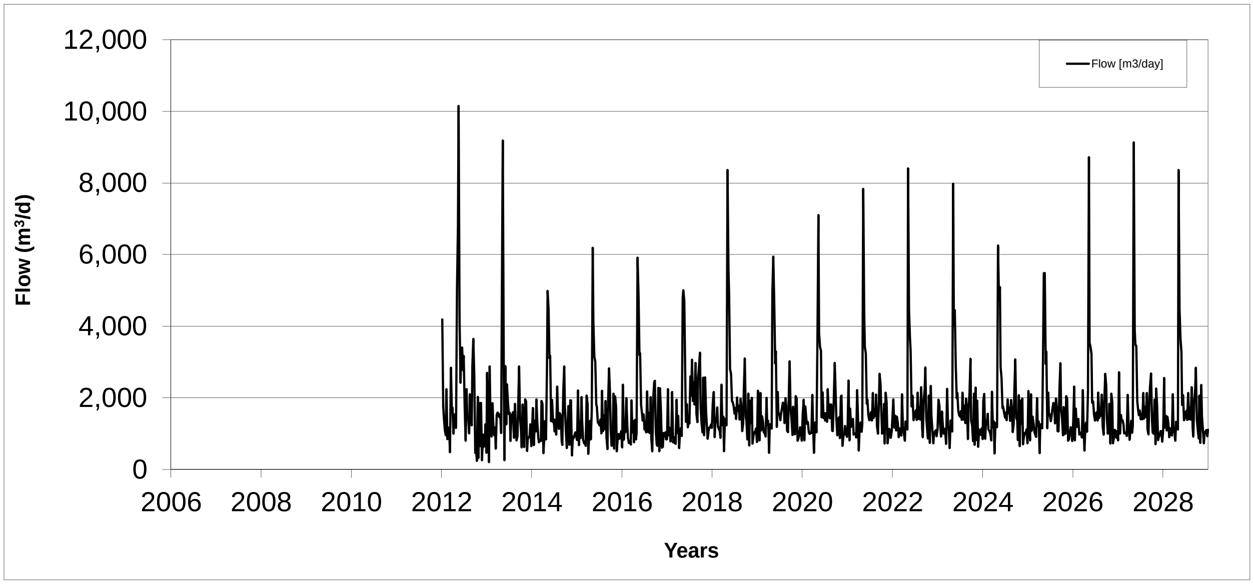
Date: December, 2013
Project: 12-1337-0001

Drawn KAS
Chkd KJD

De Beers Canada Inc.

North Pile Discharge (SNP 02-02) Dissolved Concentrations

FIGURE IX-7h



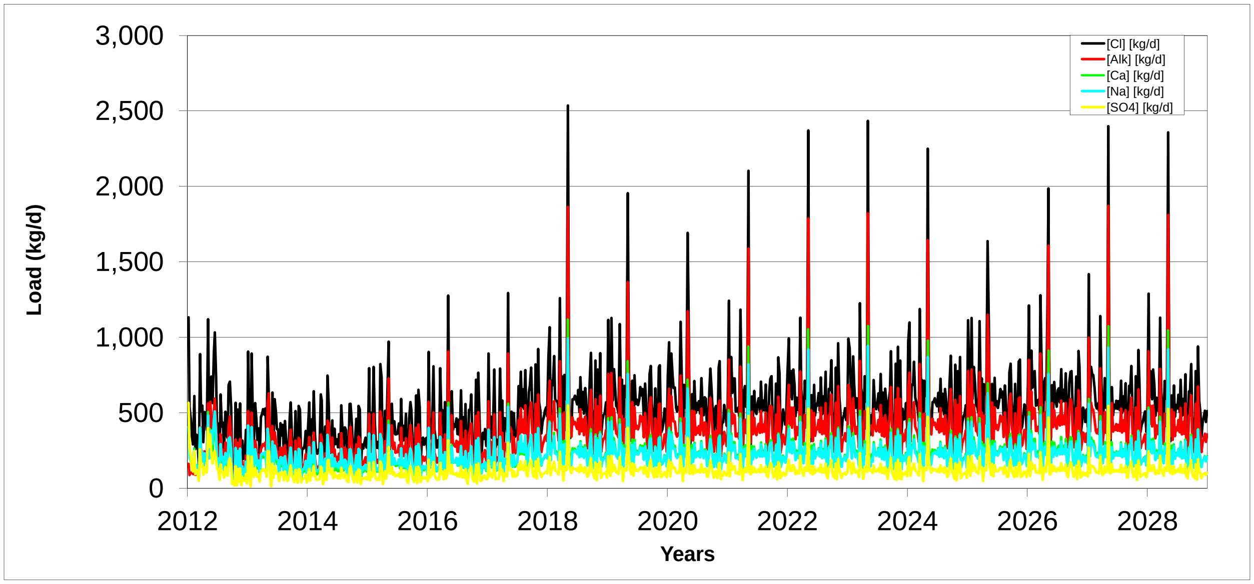
Date: December, 2013
Project: 12-1337-0001

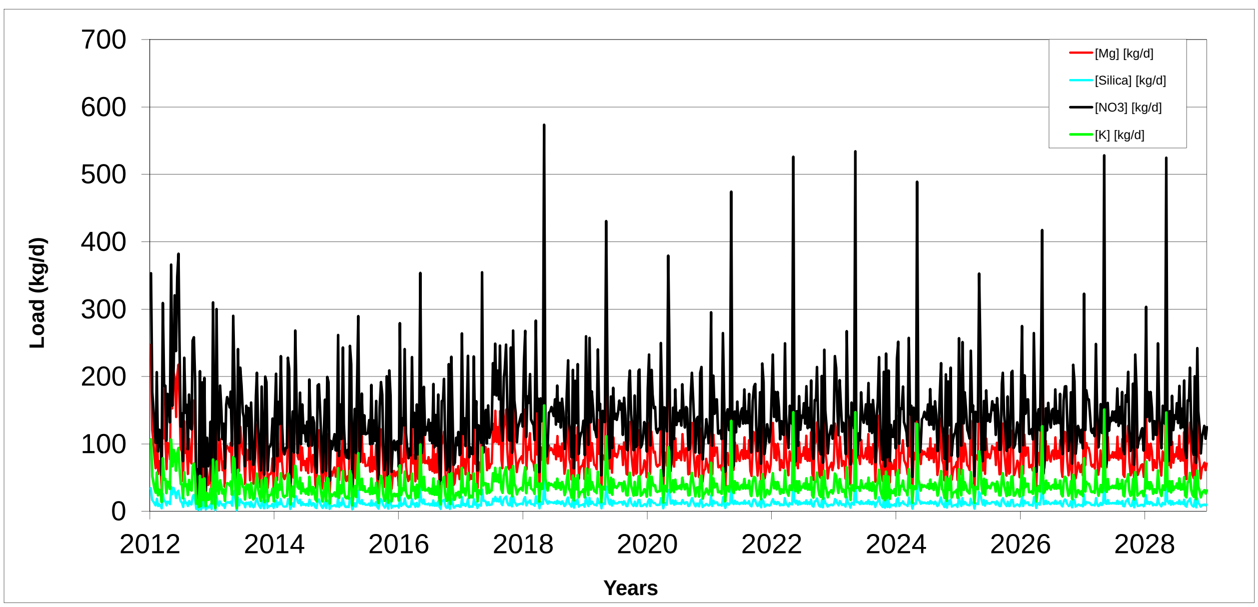
Drawn KAS
Chkd KJD

De Beers Canada Inc.

North Pile Discharge (SNP 02-02) Dissolved Load

FIGURE IX-8a



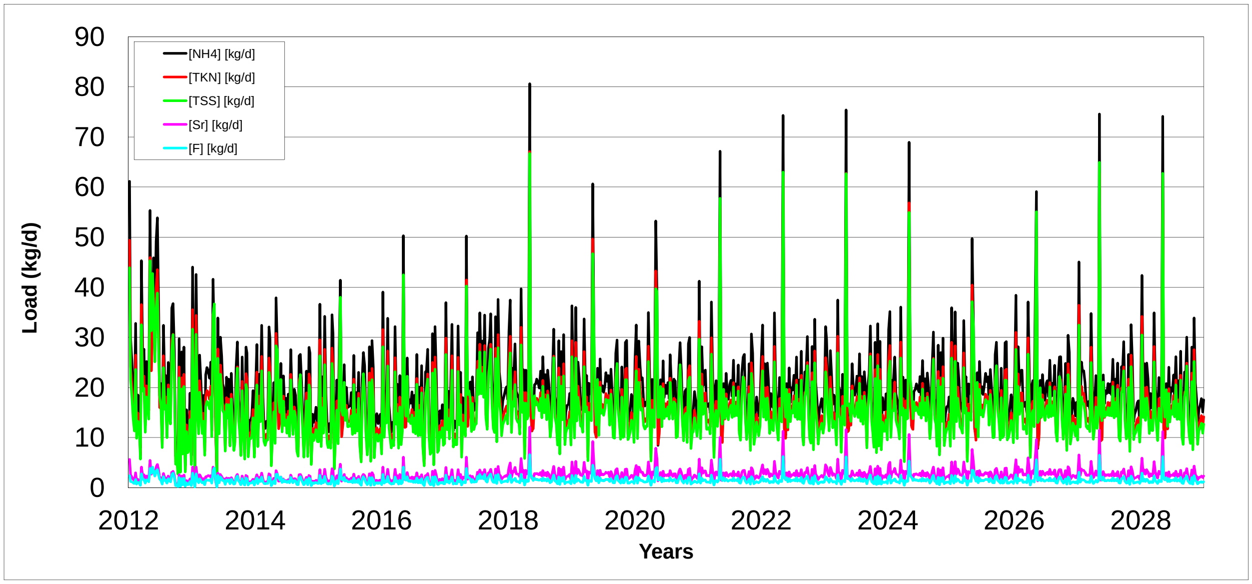


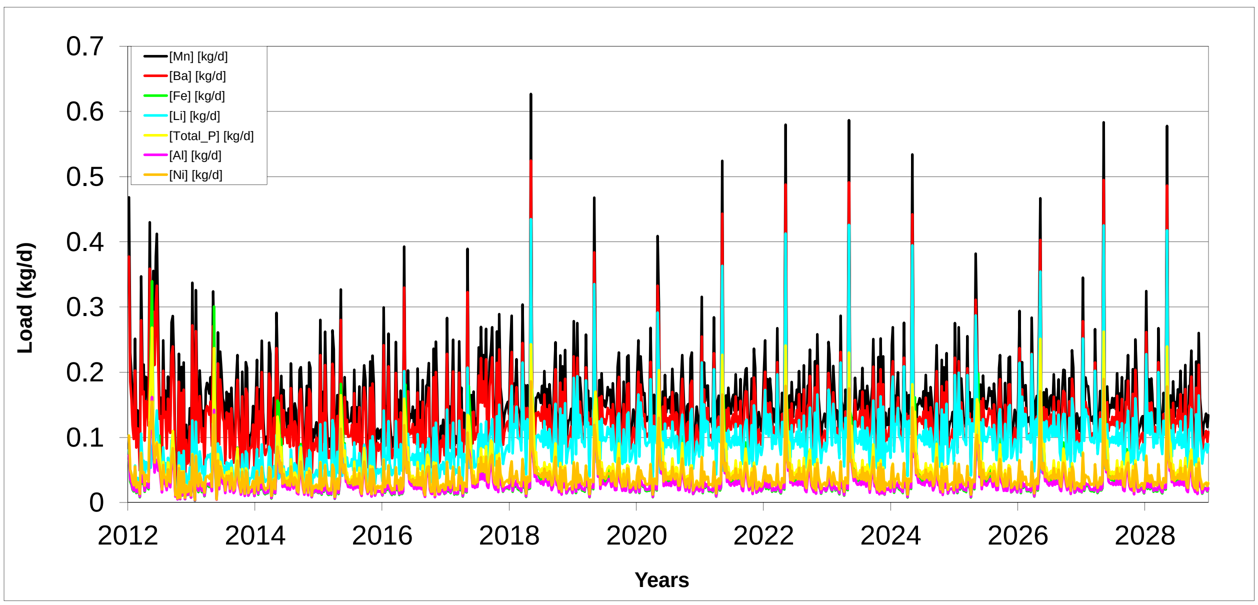
Date: December, 2013
Project: 12-1337-0001

Drawn KAS
Chkd KJD

De Beers Canada Inc.

North Pile Discharge (SNP 02-02) Dissolved Load	FIGURE IX-8b



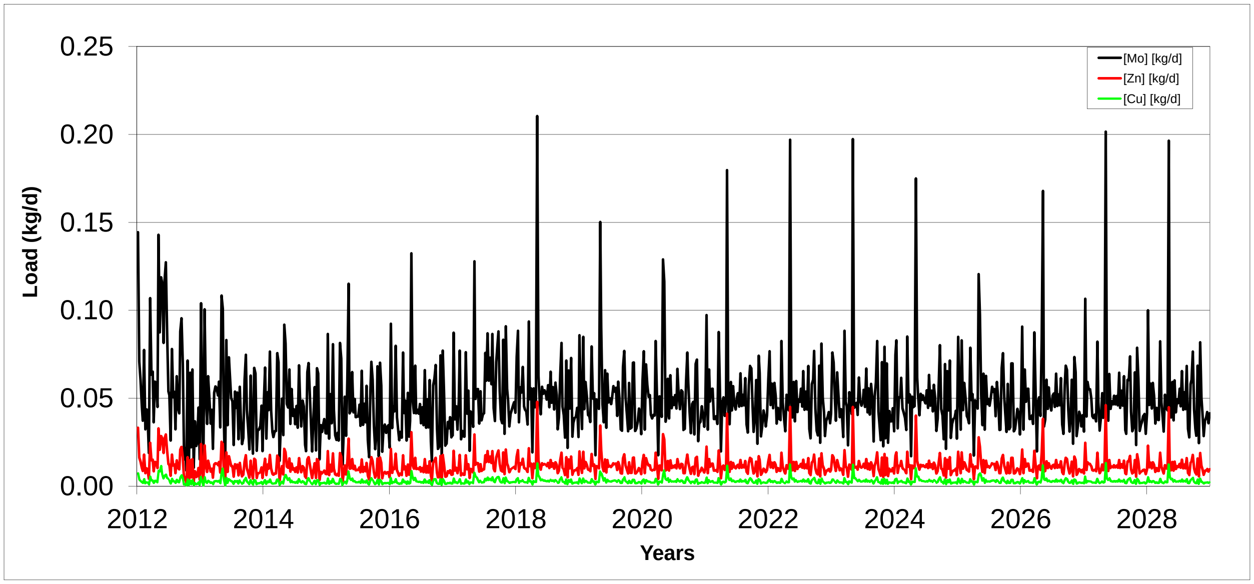


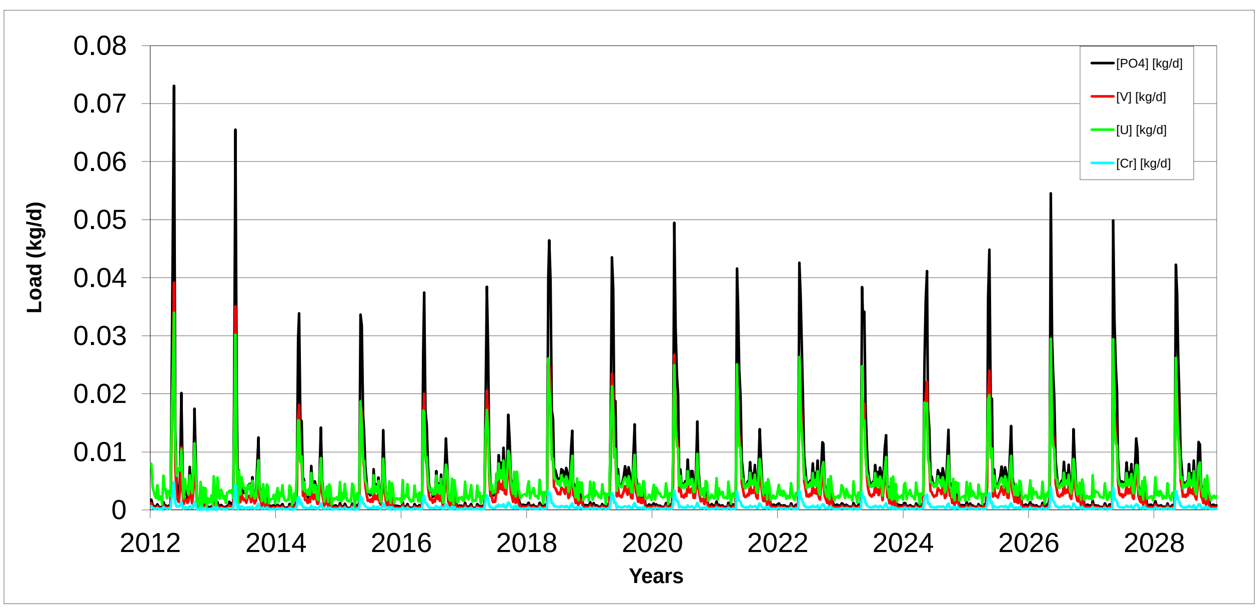
Date: December, 2013
Project: 12-1337-0001

Drawn KAS
Chkd KJD

De Beers Canada Inc.

North Pile Discharge (SNP 02-02) Dissolved Load	FIGURE IX-8c





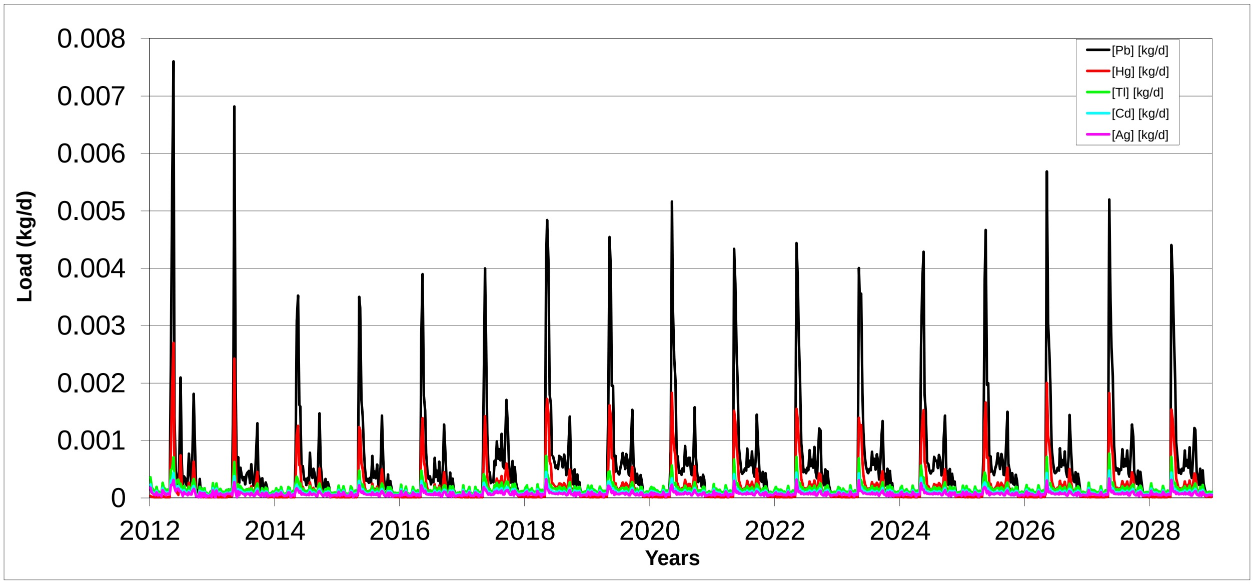
Date: December, 2013
Project: 12-1337-0001

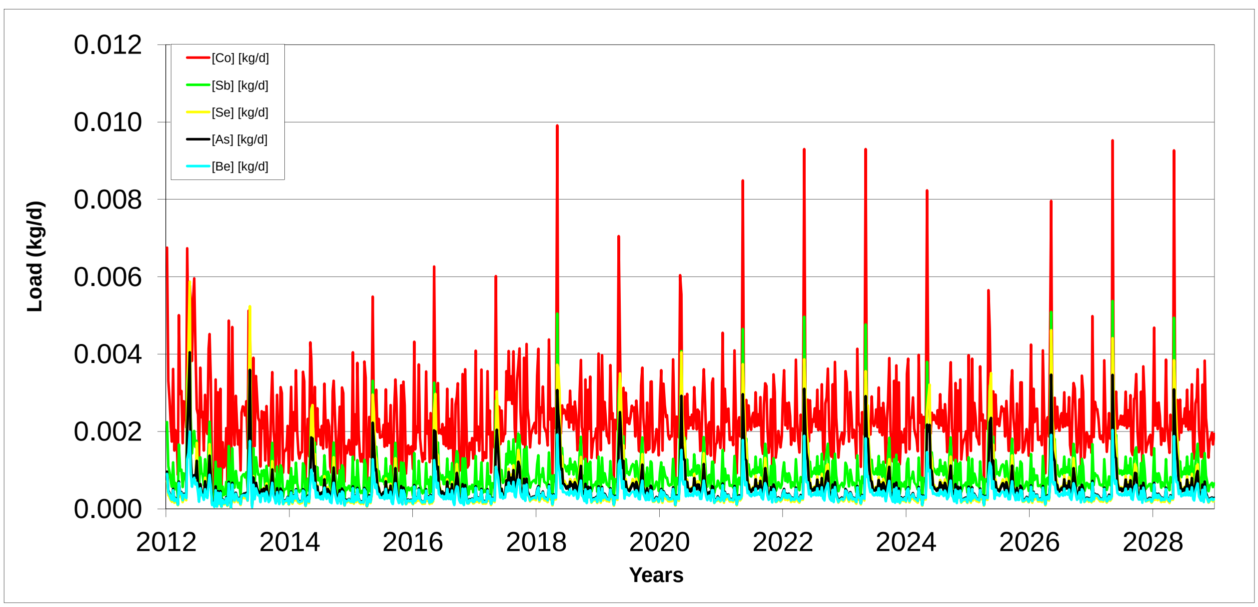
Drawn KAS
Chkd KJD

De Beers Canada Inc.

North Pile Discharge (SNP 02-02) Dissolved Load

FIGURE IX-8d



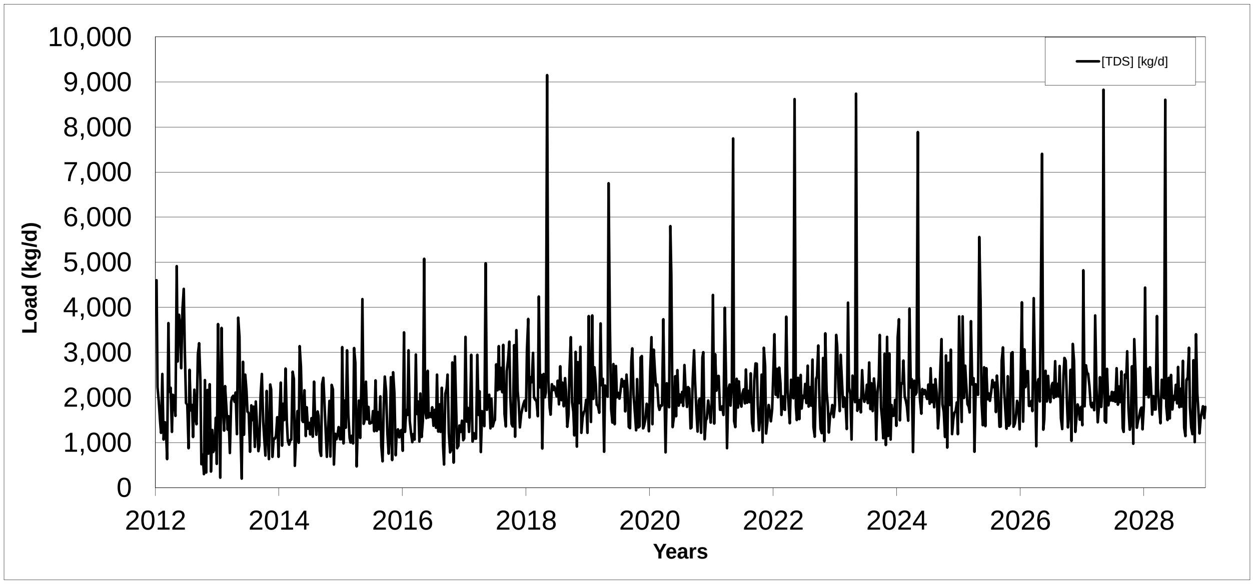


Date: December, 2013
Project: 12-1337-0001

Drawn KAS
Chkd KJD

De Beers Canada Inc.

North Pile Discharge (SNP 02-02) Dissolved Load	FIGURE IX-8e

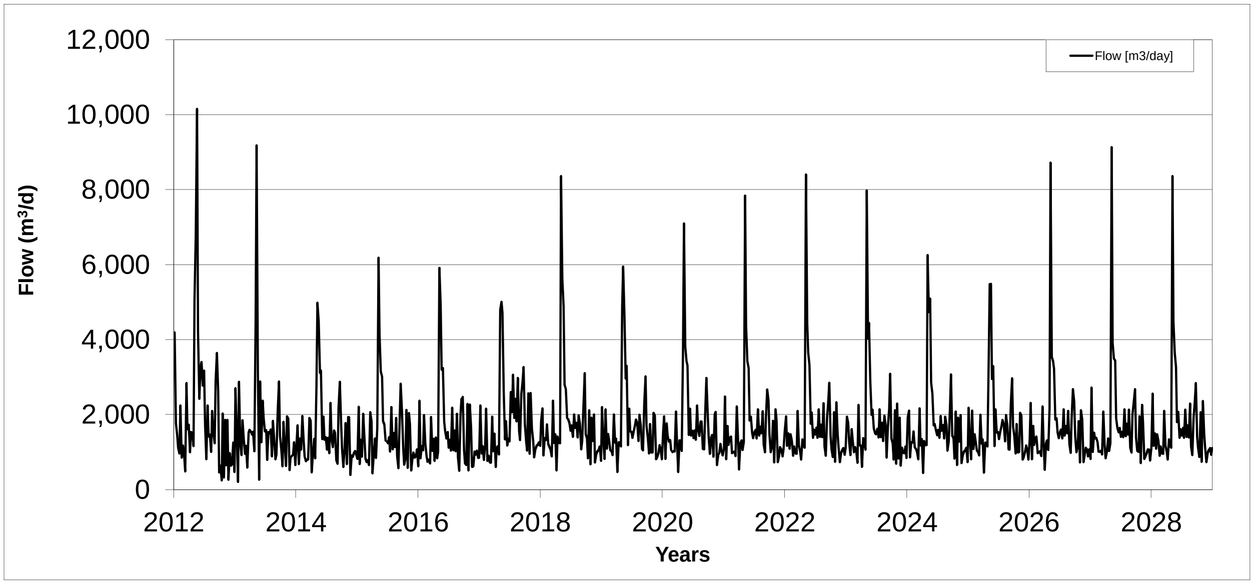


Date: December, 2013
Project: 12-1337-0001

Drawn KAS
Chkd KJD

De Beers Canada Inc.

North Pile Discharge (SNP 02-02) Dissolved Load FLOW	FIGURE IX-8f



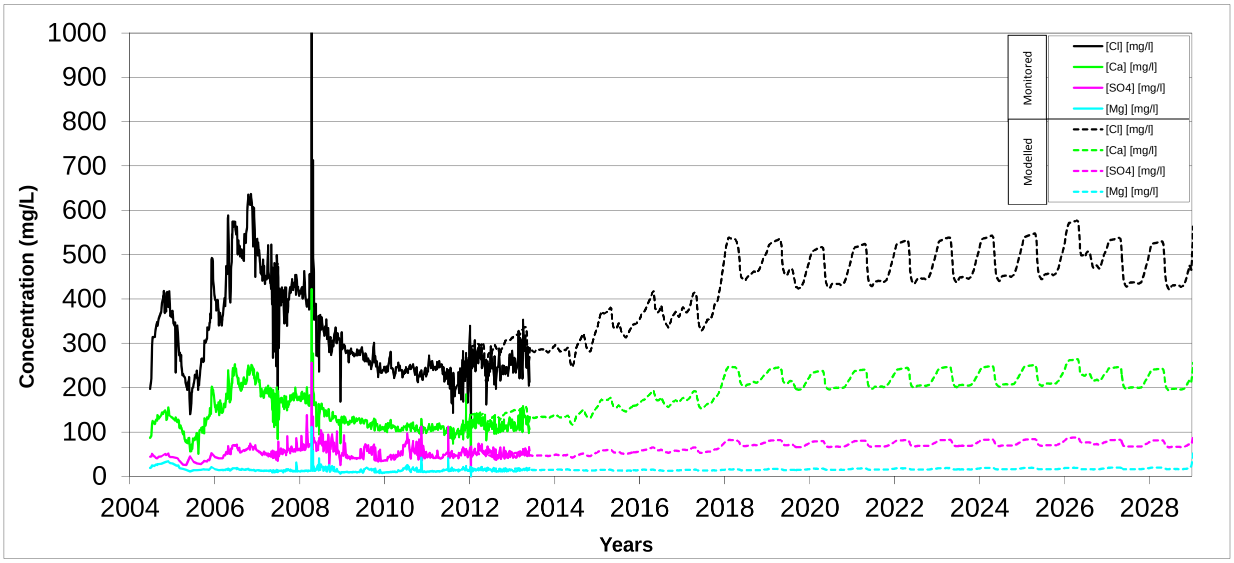
Date: December, 2013
Project: 12-1337-0001

Drawn KAS
Chkd KJD

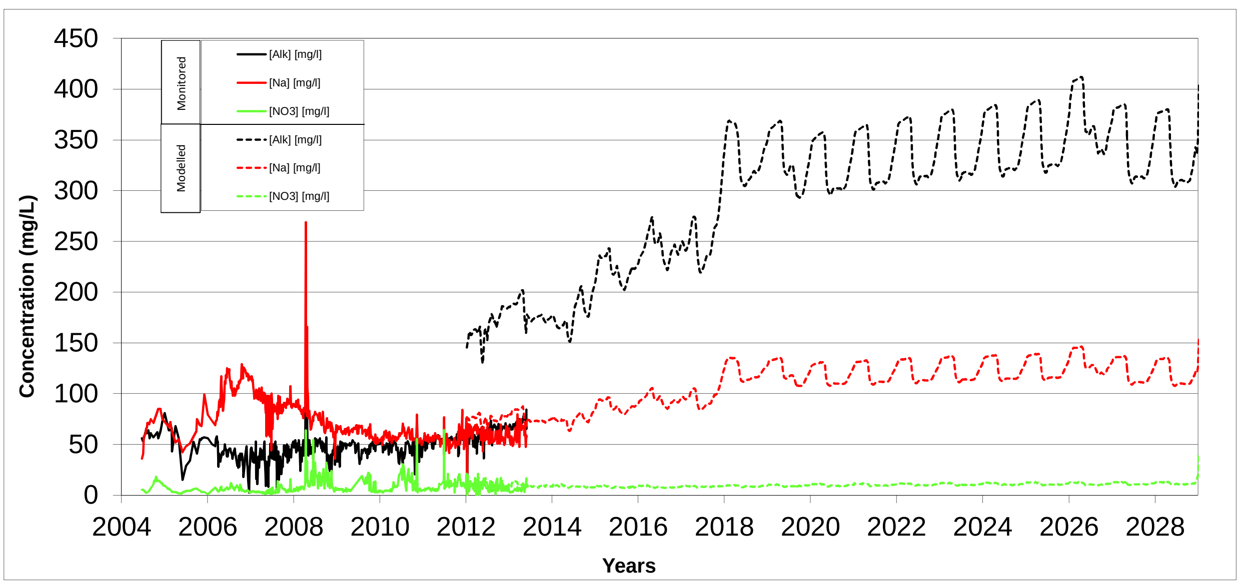
De Beers Canada Inc.

Final Discharge (SNP 02-17B) Dissolved Concentrations

FIGURE IX-9a



Note: Monitored values above 1000 mg/L are not shown.

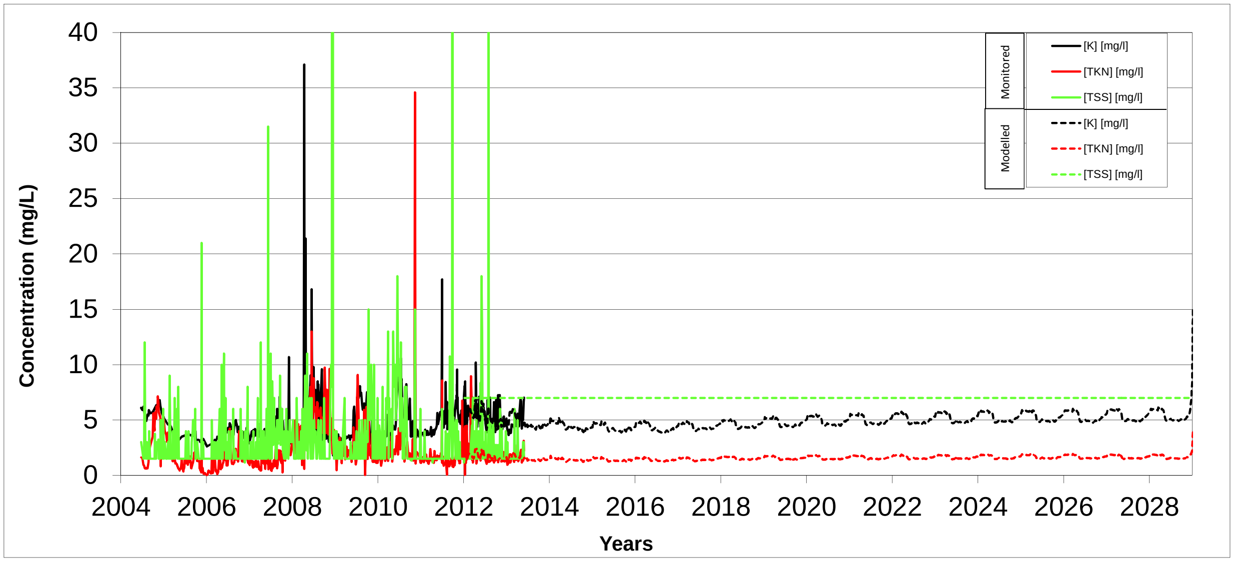


Date: December, 2013
Project: 12-1337-0001

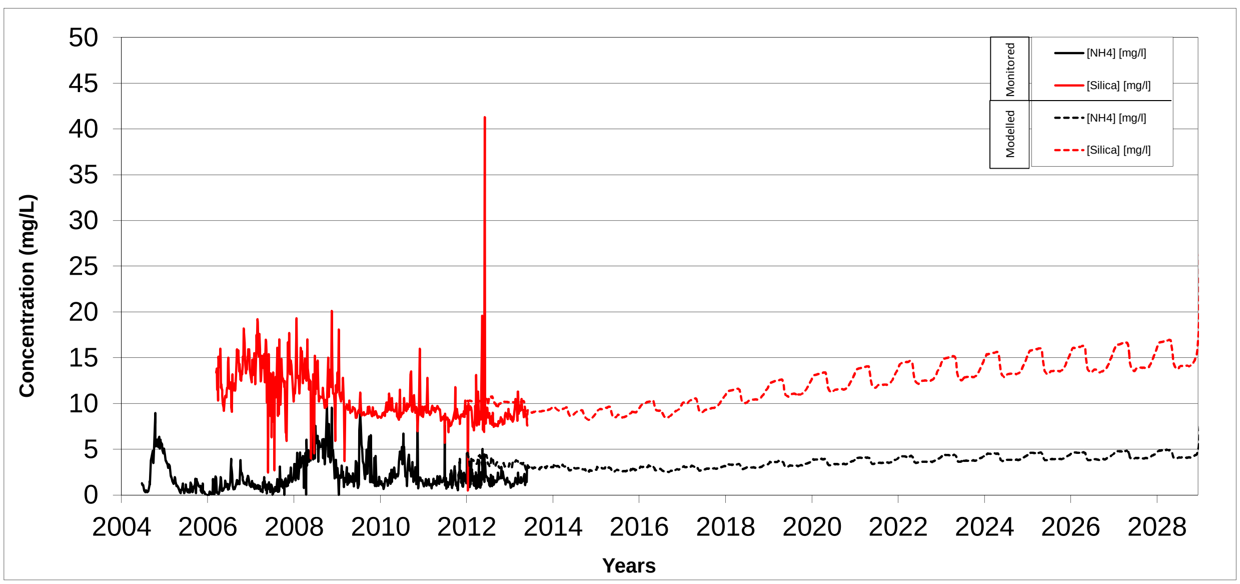
Drawn KAS
Chkd KJD

De Beers Canada Inc.

Final Discharge (SNP 02-17B) Dissolved Concentrations	FIGURE IX-9b



Note: Monitored values above 40 mg/L are not shown.

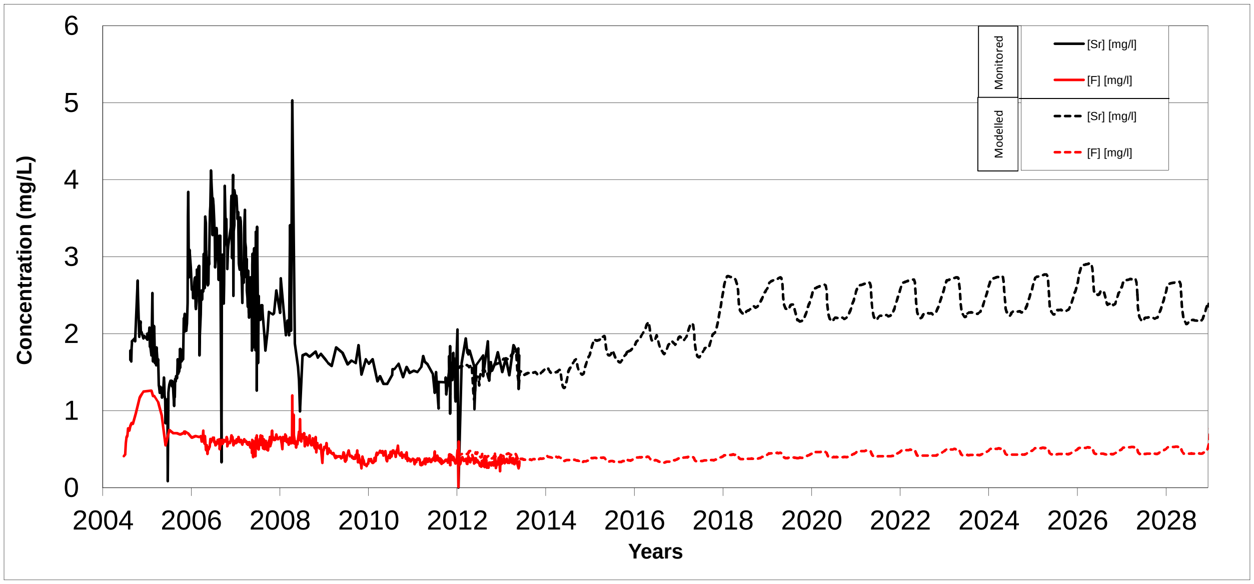


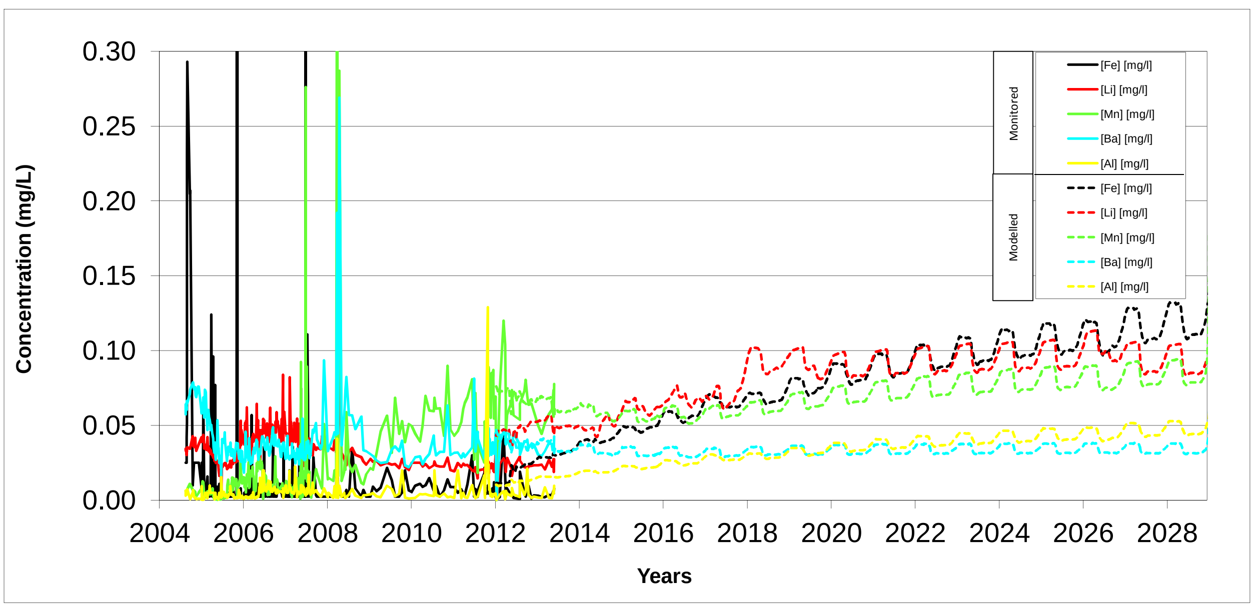
Date: December, 2013
Project: 12-1337-0001

Drawn KAS
Chkd KJD

De Beers Canada Inc.

Final Discharge (SNP 02-17B) Dissolved Concentrations	FIGURE IX-9c





Note: Monitored values above 0.3 mg/L are not shown.

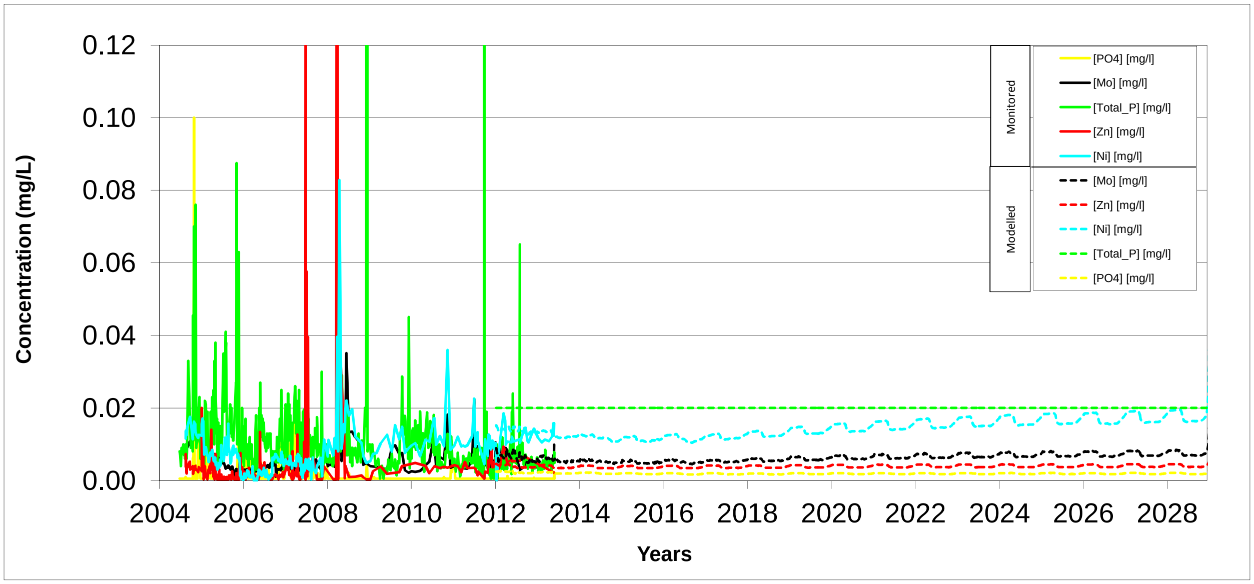
Date: December, 2013
Project: 12-1337-0001

Drawn KAS
Chkd KJD

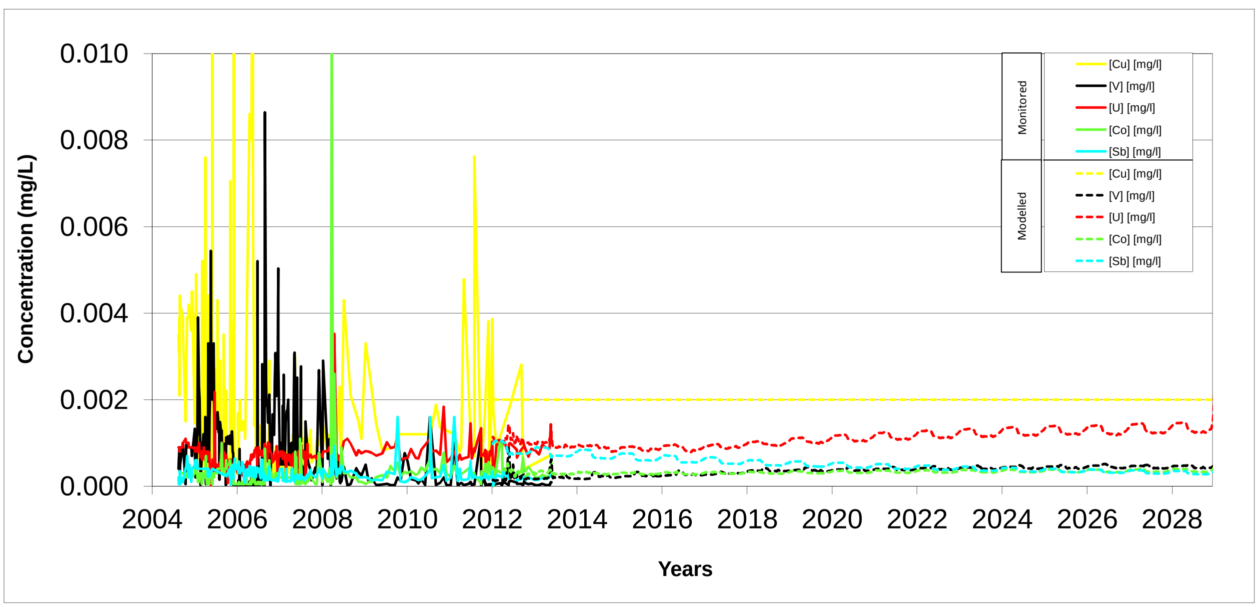
De Beers Canada Inc.

Final Discharge (SNP 02-17B) Dissolved Concentrations

FIGURE IX-9d



Note: Monitored values above 0.12 mg/L are not shown.



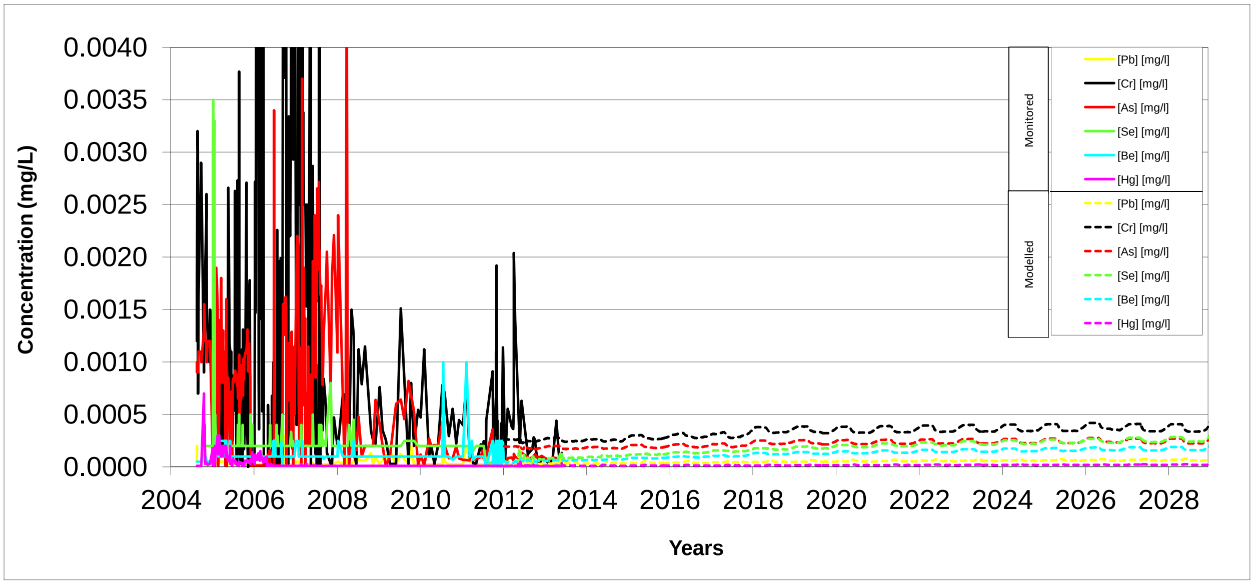
Note: Monitored values above 0.01 mg/L are not shown.

Date: December, 2013
Project: 12-1337-0001

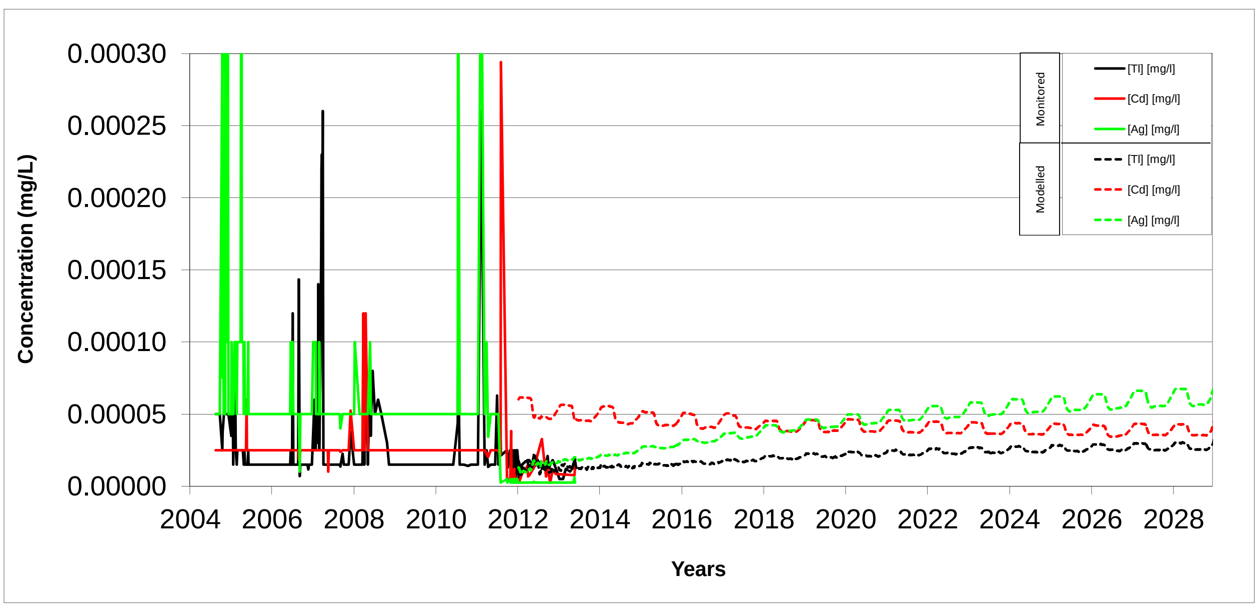
Drawn KAS
Chkd KJD

De Beers Canada Inc.

Final Discharge (SNP 02-17B) Dissolved Concentrations	FIGURE IX-9e



Note: Monitored values above 0.0040 mg/L are not shown.



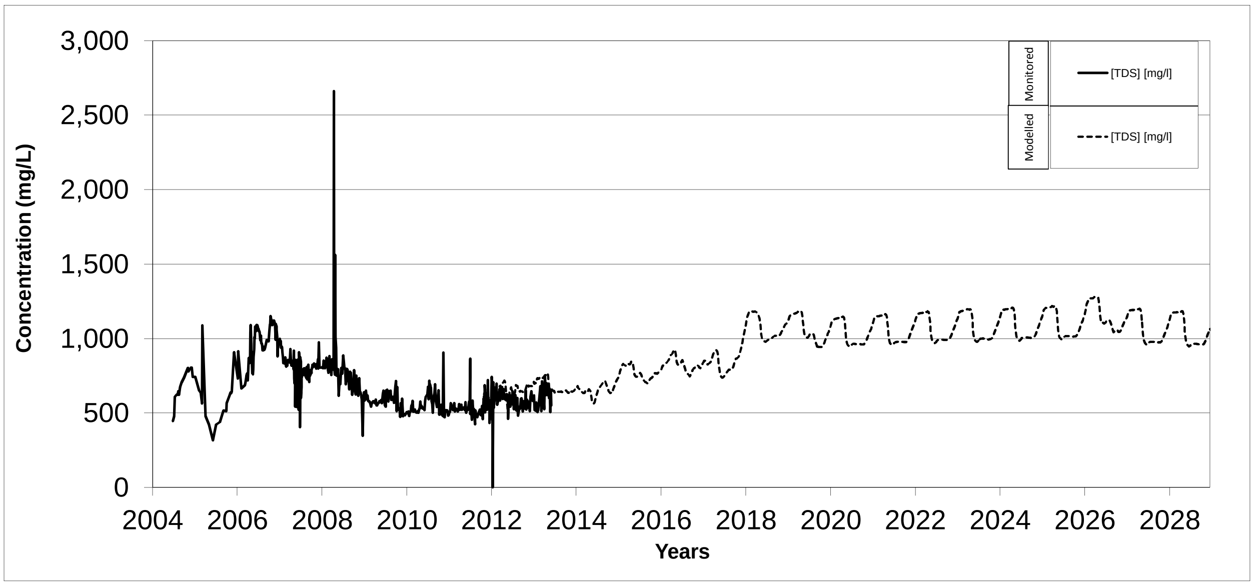
Note: Monitored values above 0.00030 mg/L are not shown.

Date: December, 2013
Project: 12-1337-0001

Drawn KAS
Chkd KJD

De Beers Canada Inc.

Final Discharge (SNP 02-17B) Dissolved Concentrations	FIGURE IX-9f



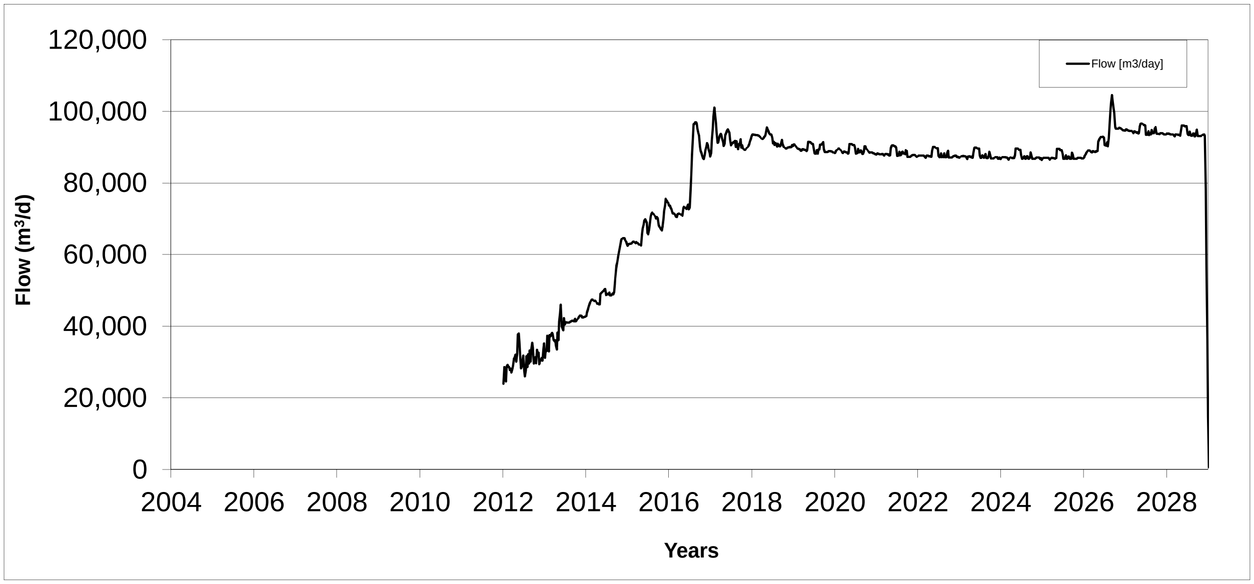
Date: December, 2013
Project: 12-1337-0001

Drawn KAS
Chkd KJD

De Beers Canada Inc.

Final Discharge (SNP 02-17B) Dissolved Concentrations

FIGURE IX-9g



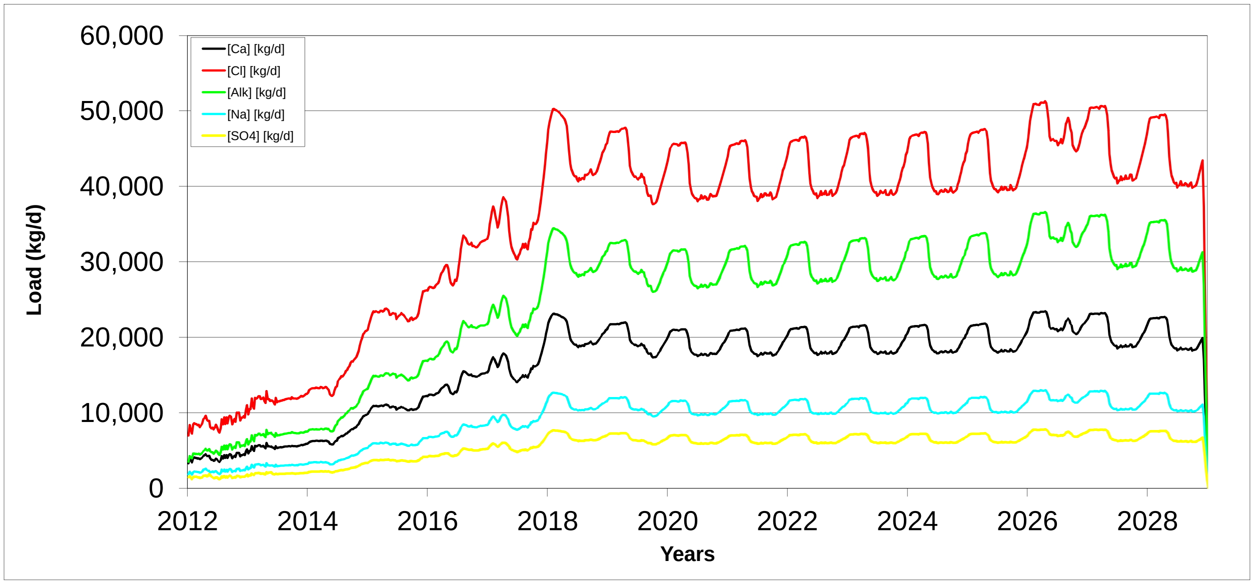
Date: December, 2013
Project: 12-1337-0001

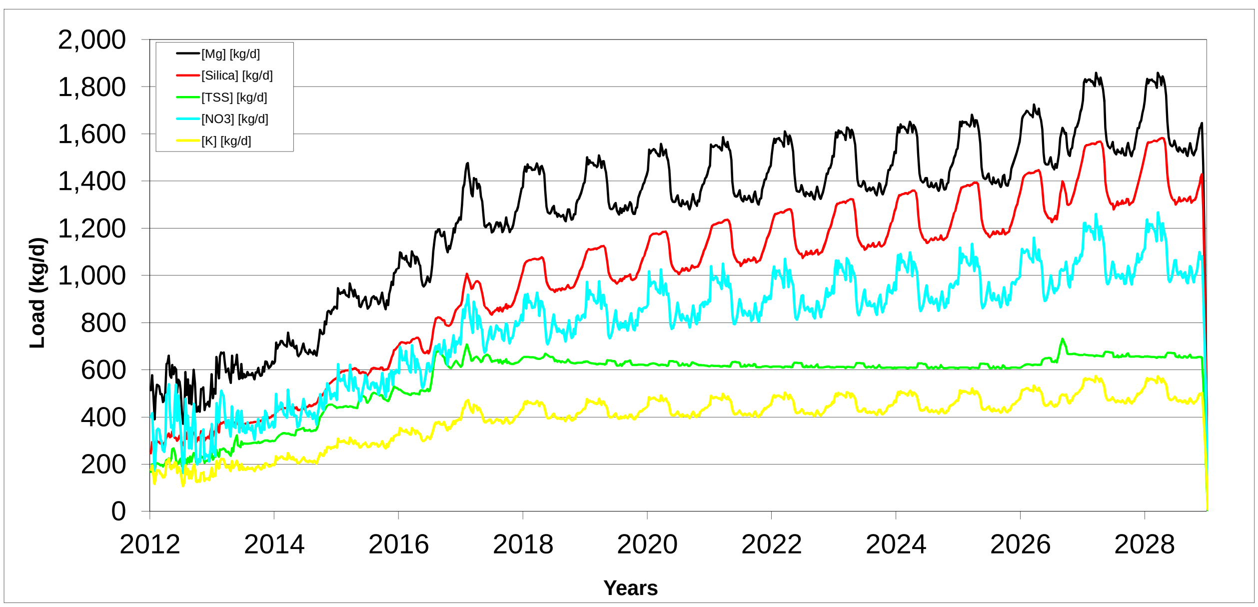
Drawn KAS
Chkd KJD

De Beers Canada Inc.

ApplX_Fig9.xls-App IX-9g

Final Discharge (SNP 02-17B) Dissolved Load	FIGURE IX-10a



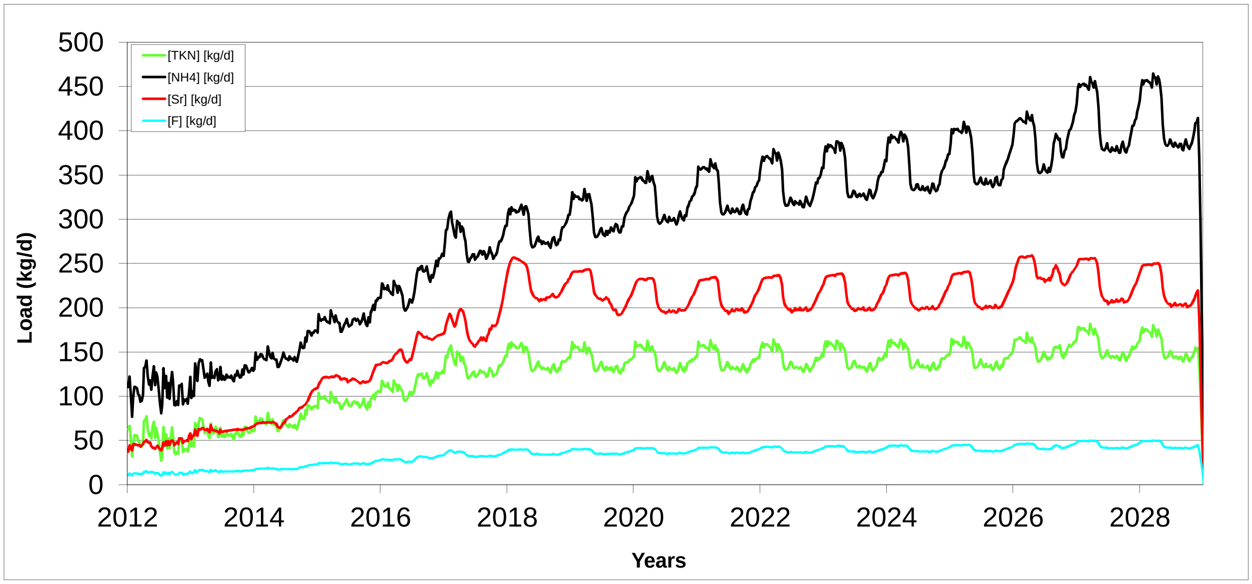


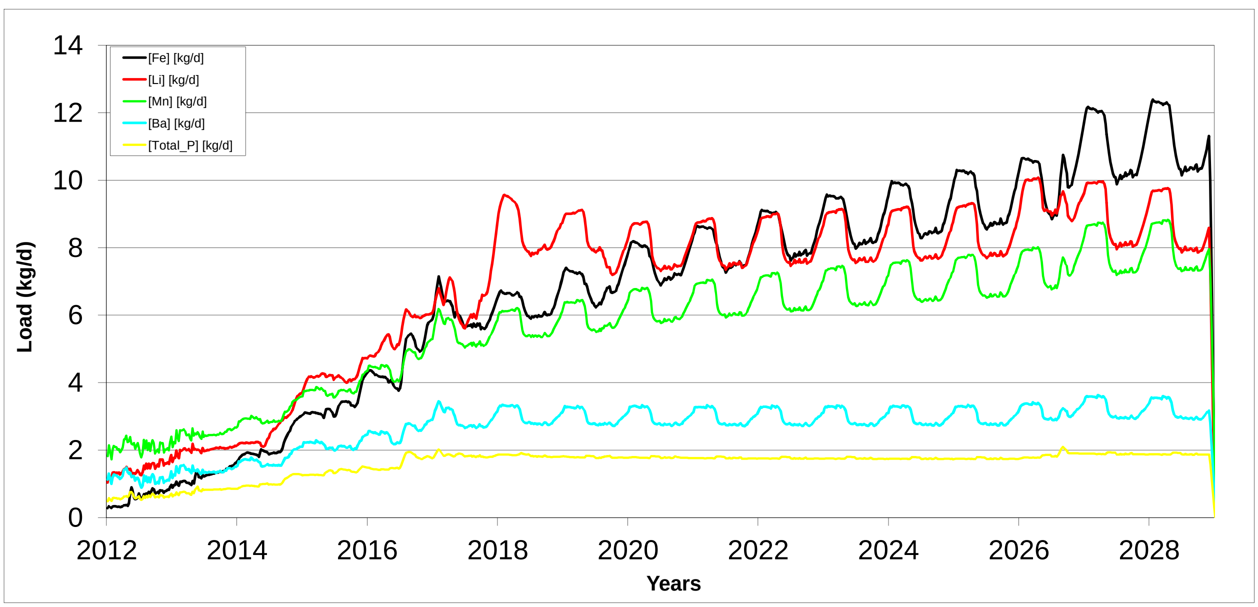
Date: December, 2013
Project: 12-1337-0001

Drawn KAS
Chkd KJD

De Beers Canada Inc.

Final Discharge (SNP 02-17B) Dissolved Load	FIGURE IX-10b





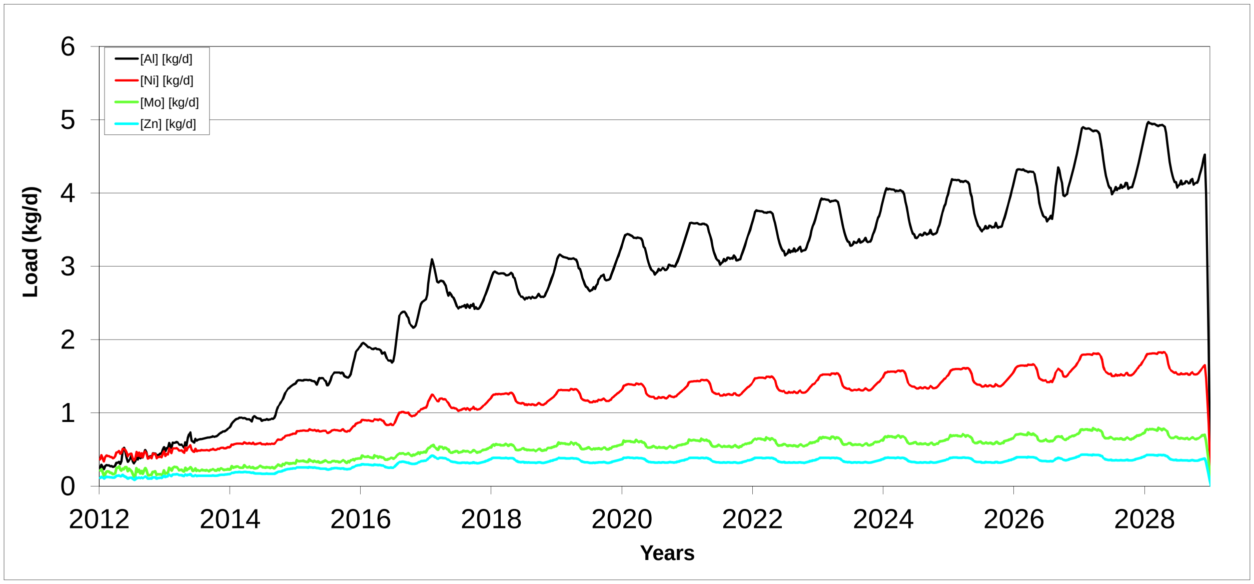
Date: December, 2013
Project: 12-1337-0001

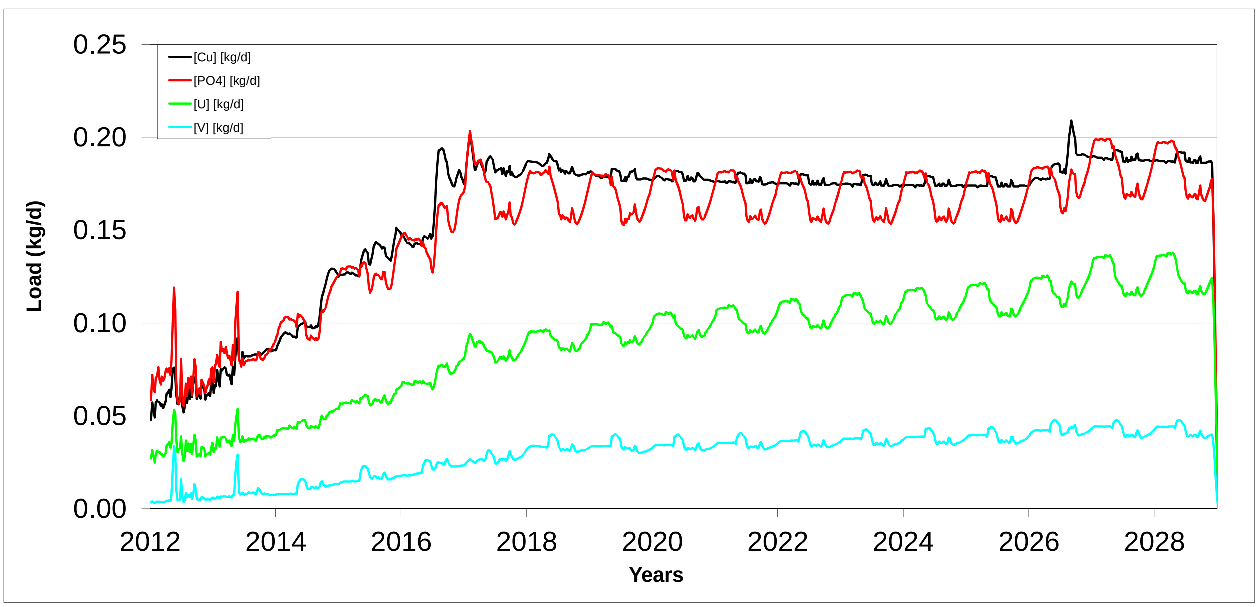
Drawn KAS
Chkd KJD

De Beers Canada Inc.

Final Discharge (SNP 02-17B) Dissolved Load

FIGURE IX-10c



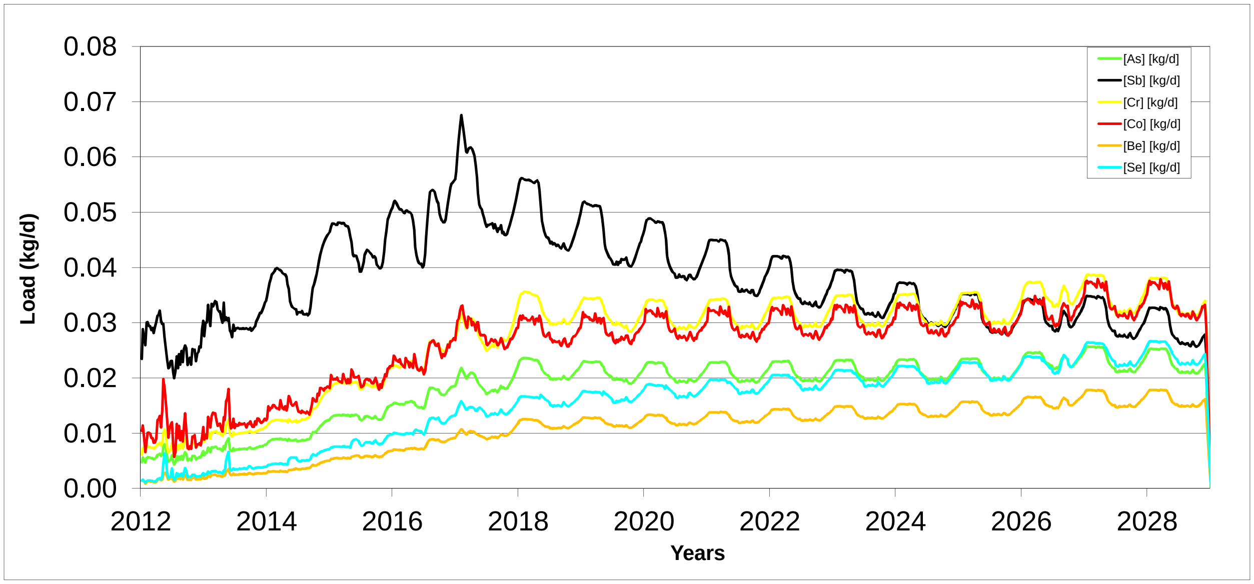


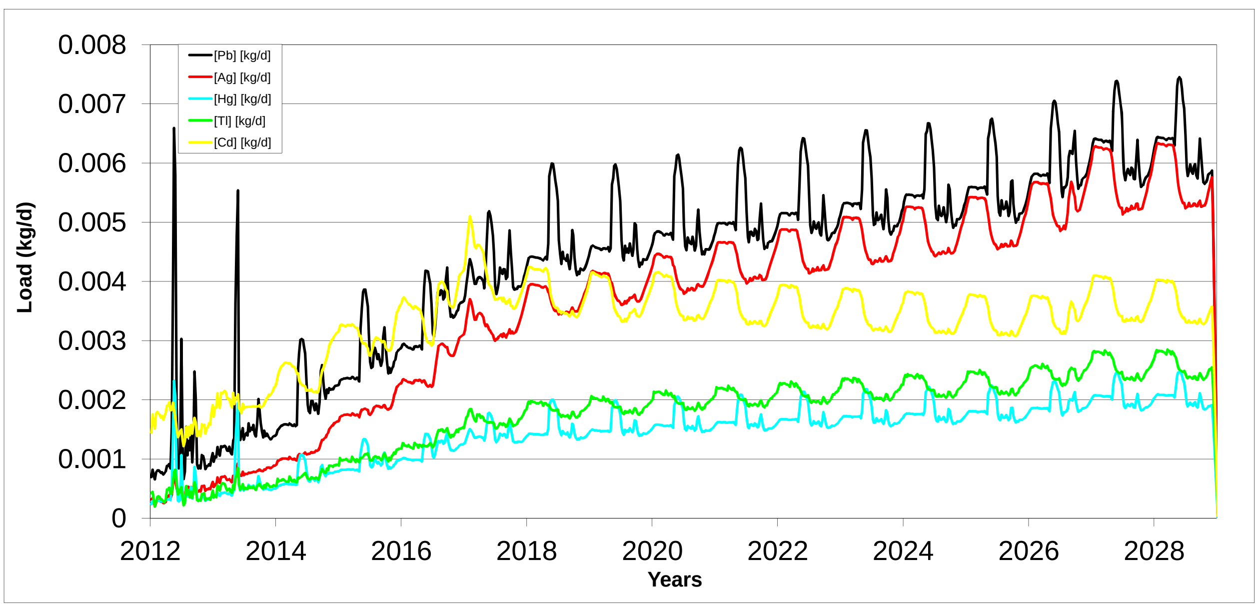
Date: December, 2013
Project: 12-1337-0001

Drawn KAS
Chkd KJD

De Beers Canada Inc.

Final Discharge (SNP 02-17B) Dissolved Load	FIGURE IX-10d





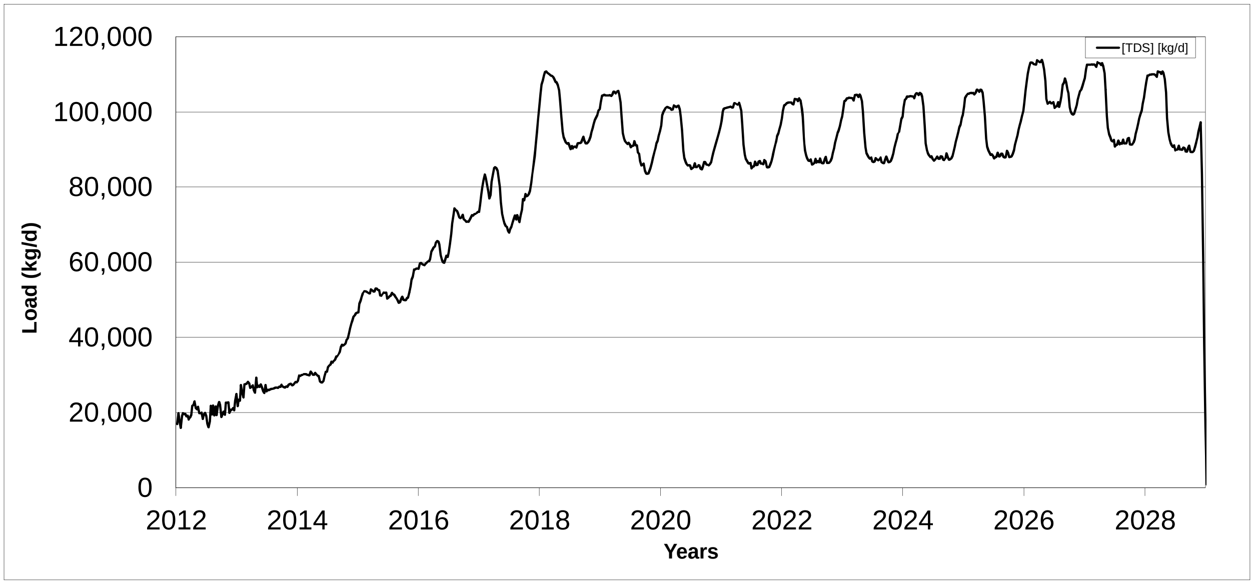
Date: December, 2013
Project: 12-1337-0001

Drawn KAS
Chkd KJD

De Beers Canada Inc.

Final Discharge (SNP 02-17B) Dissolved Load

FIGURE IX-10e



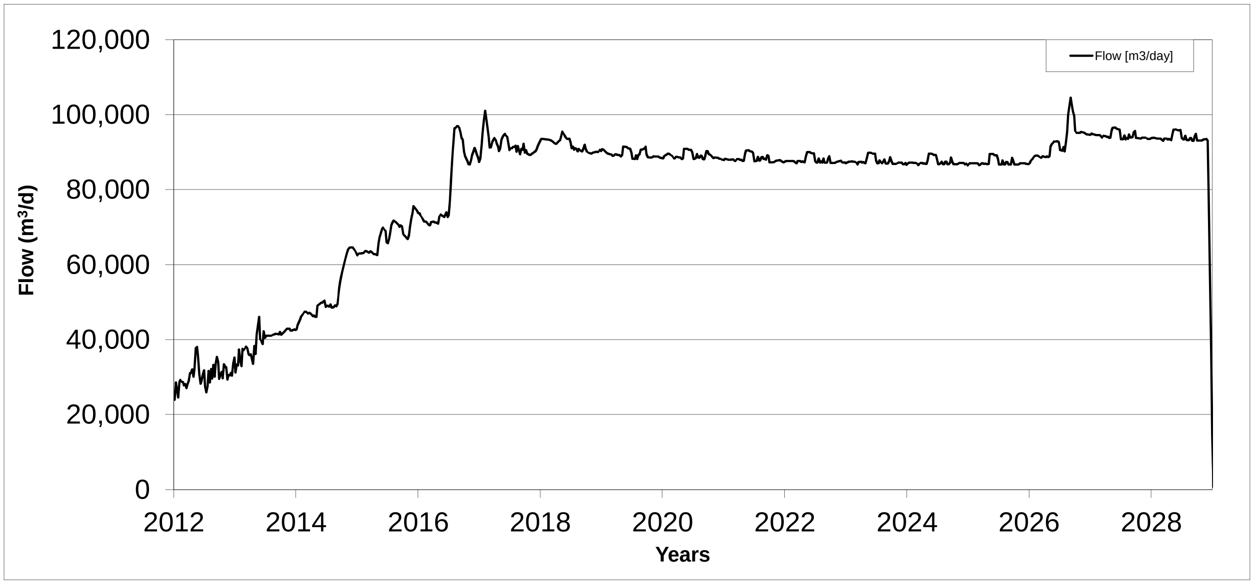
Date: December, 2013
Project: 12-1337-0001

Drawn KAS
Chkd KJD

De Beers Canada Inc.

Final Discharge (SNP 02-17B) Dissolved Load FLOW

FIGURE IX-10f



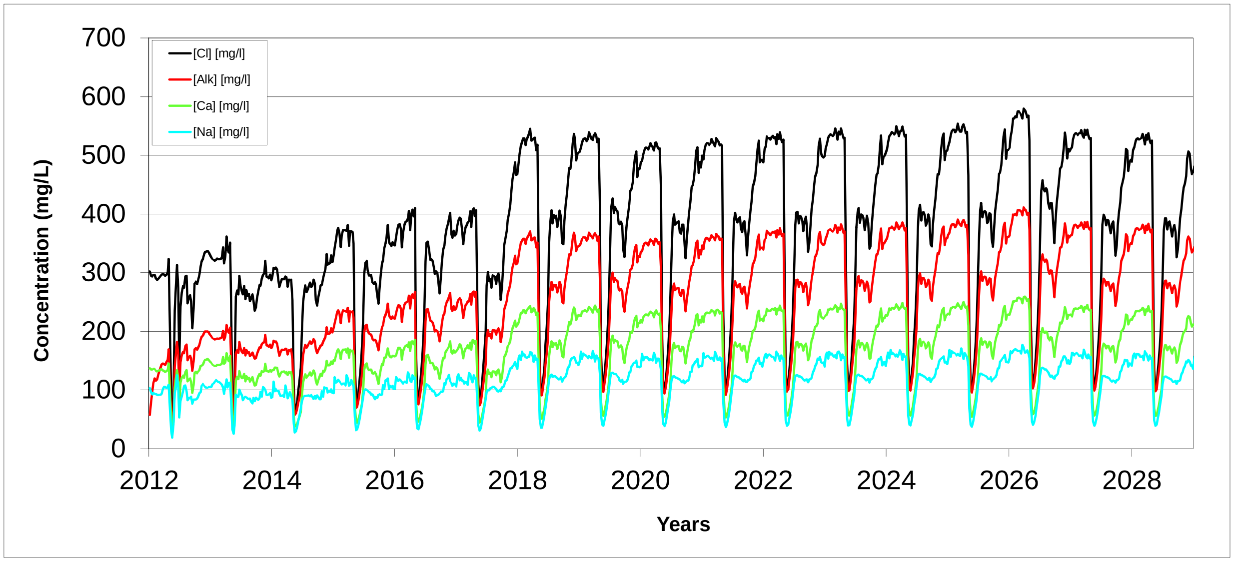
Date: December, 2013
Project: 12-1337-0001

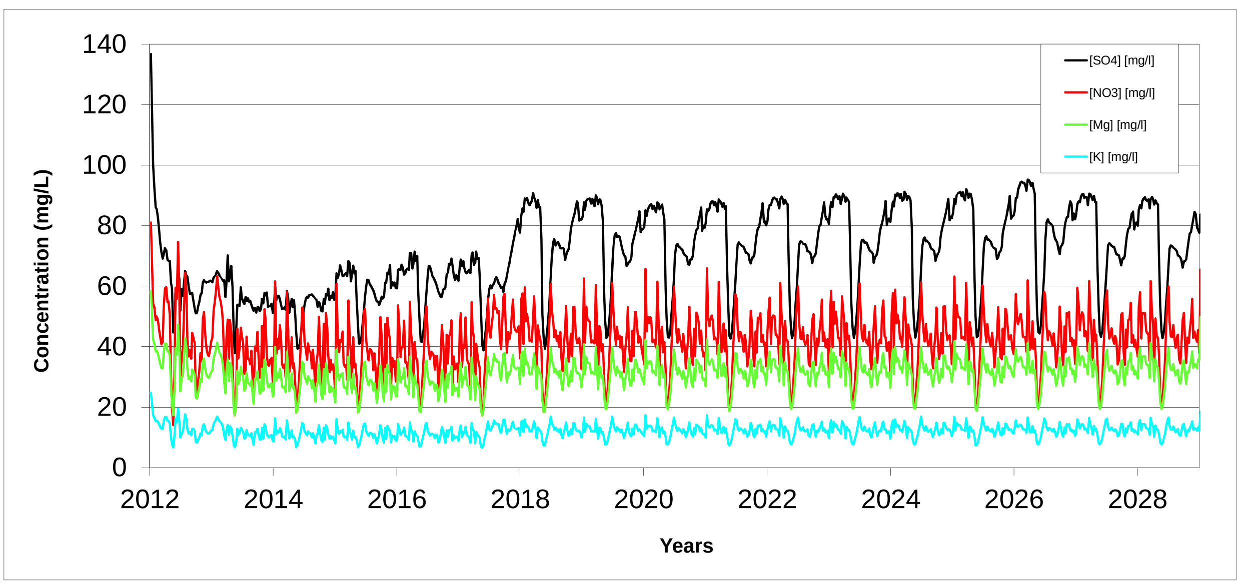
Drawn KAS
Chkd KJD

De Beers Canada Inc.

Water Management Pond Seepage Dissolved Concentrations

FIGURE IX-11a



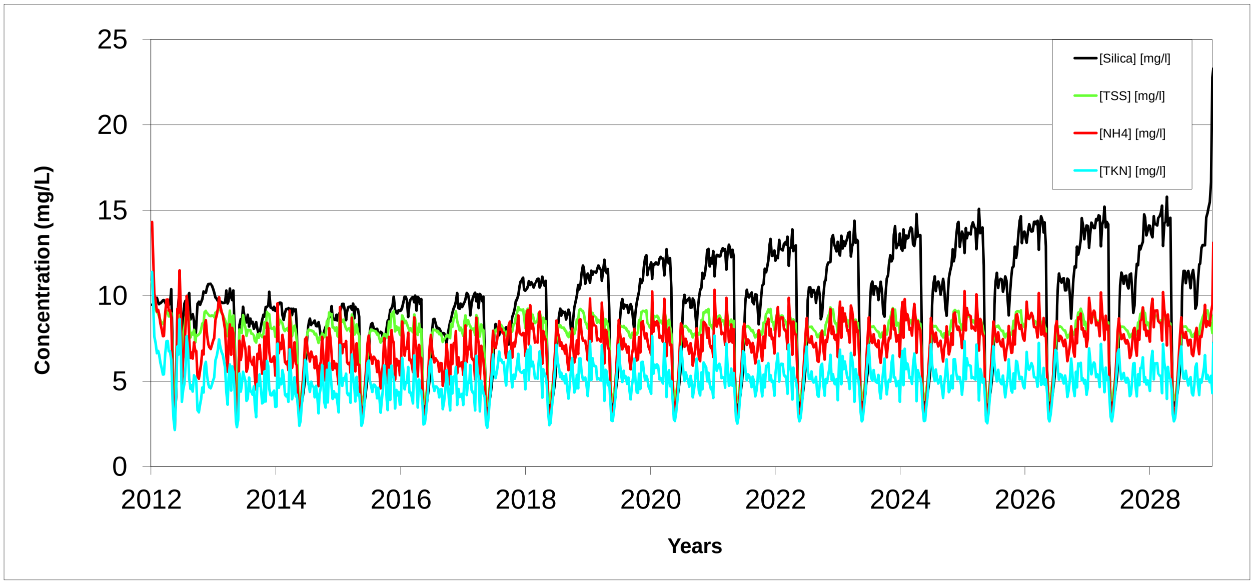


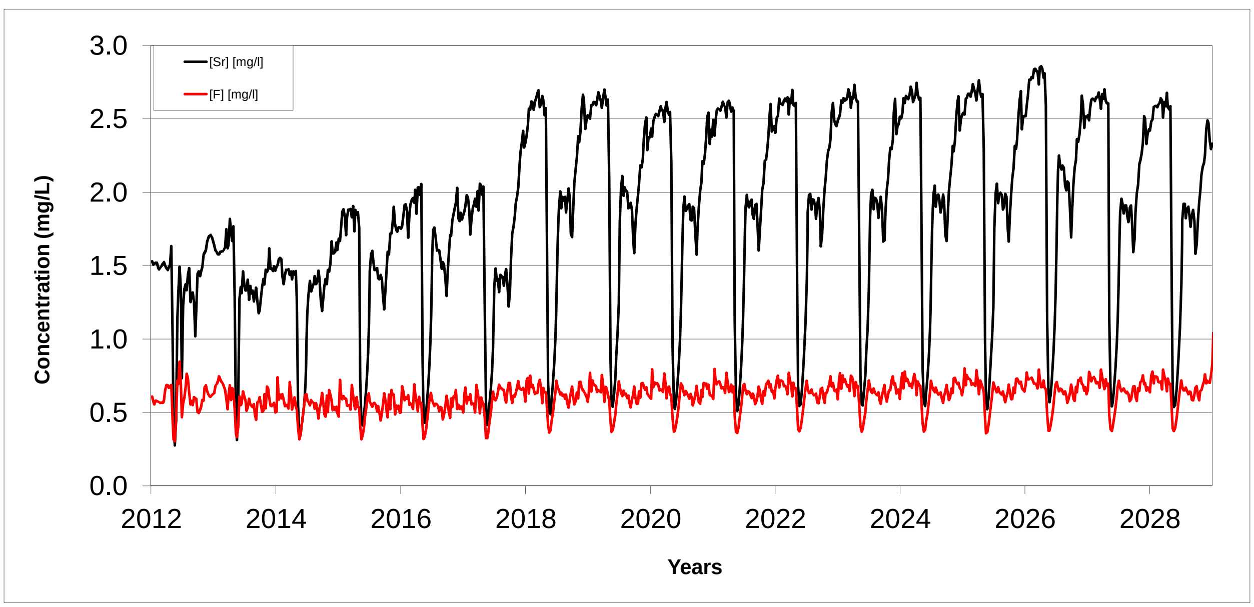
Date: December, 2013
Project: 12-1337-0001

Drawn KAS
Chkd KJD

De Beers Canada Inc.

Water Management Pond Seepage Dissolved Concentrations	FIGURE IX-11b





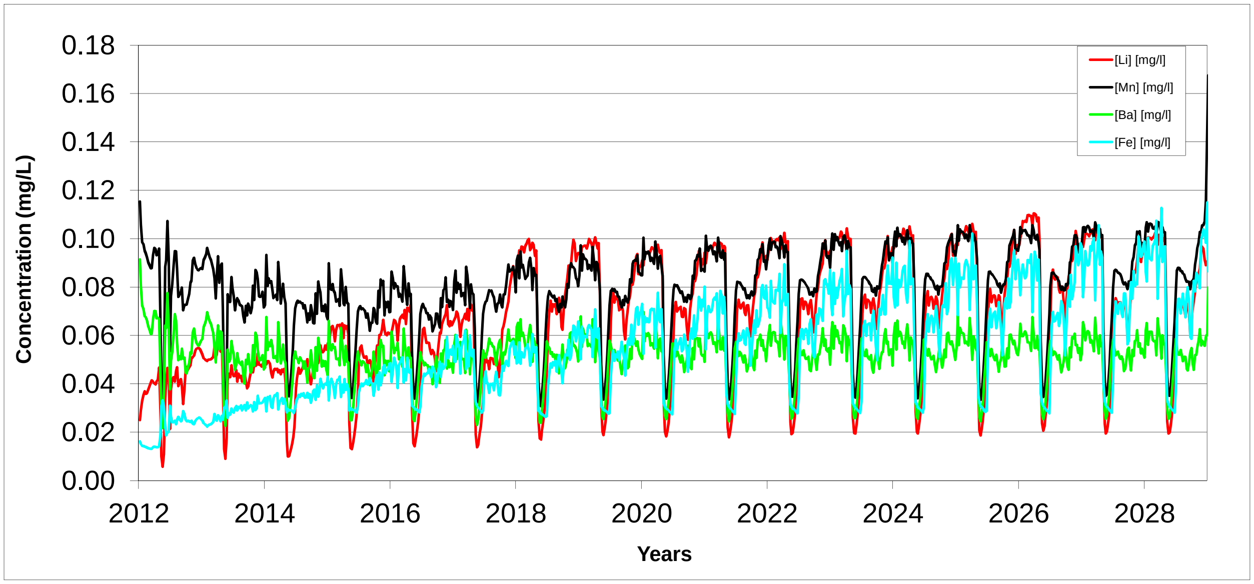
Date: December, 2013
Project: 12-1337-0001

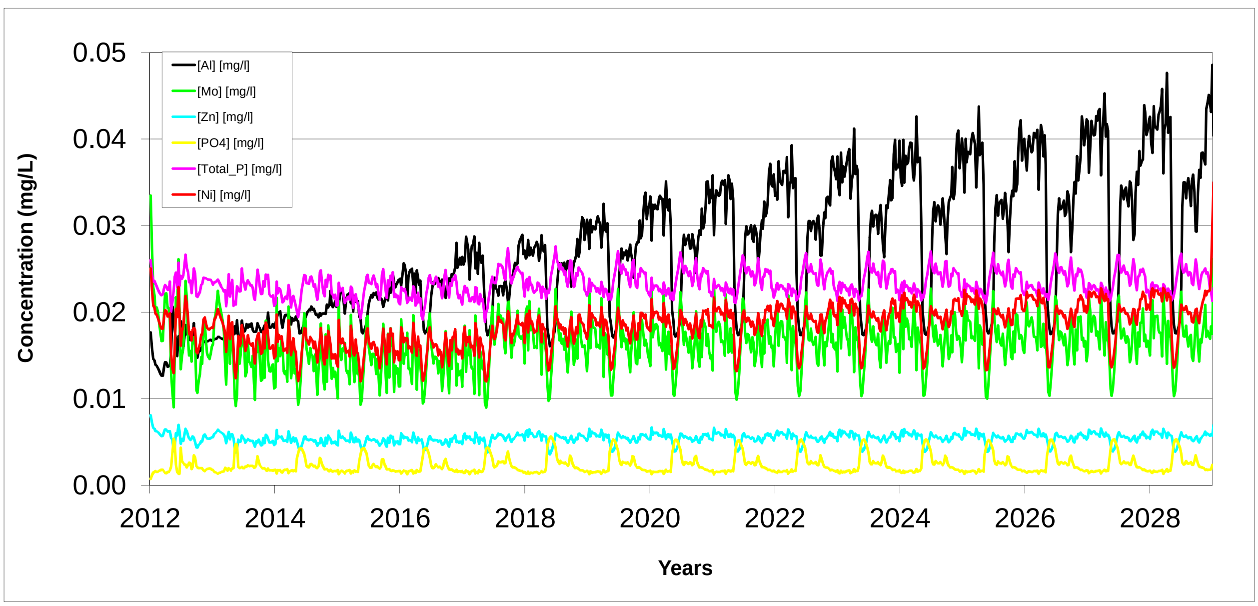
Drawn KAS
Chkd KJD

De Beers Canada Inc.

Water Management Pond Seepage Dissolved Concentrations

FIGURE IX-11c



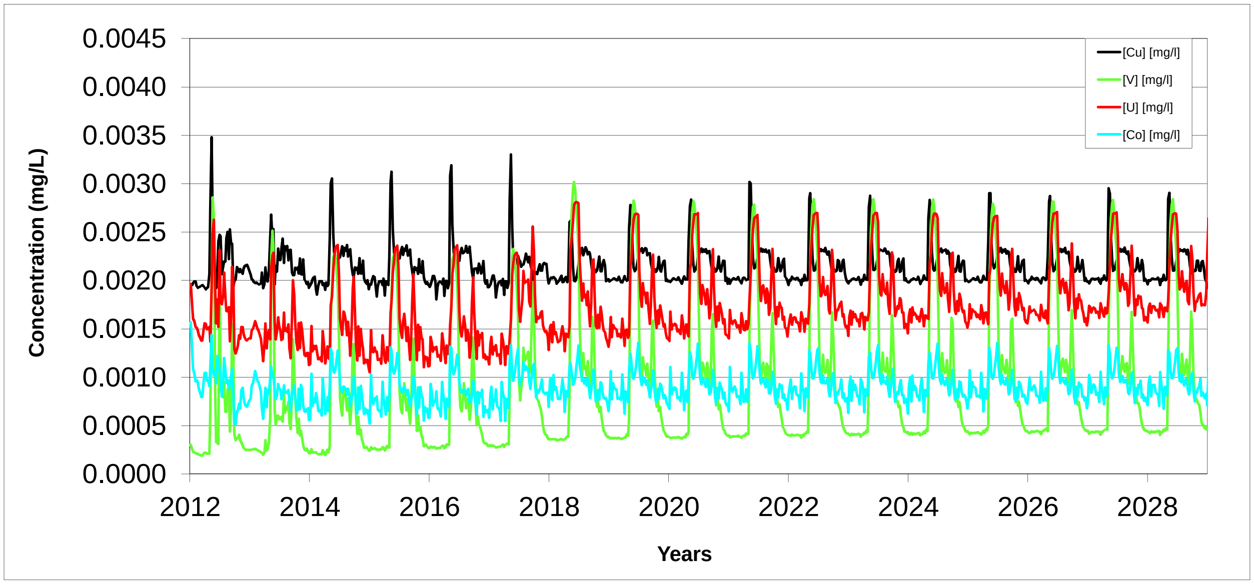


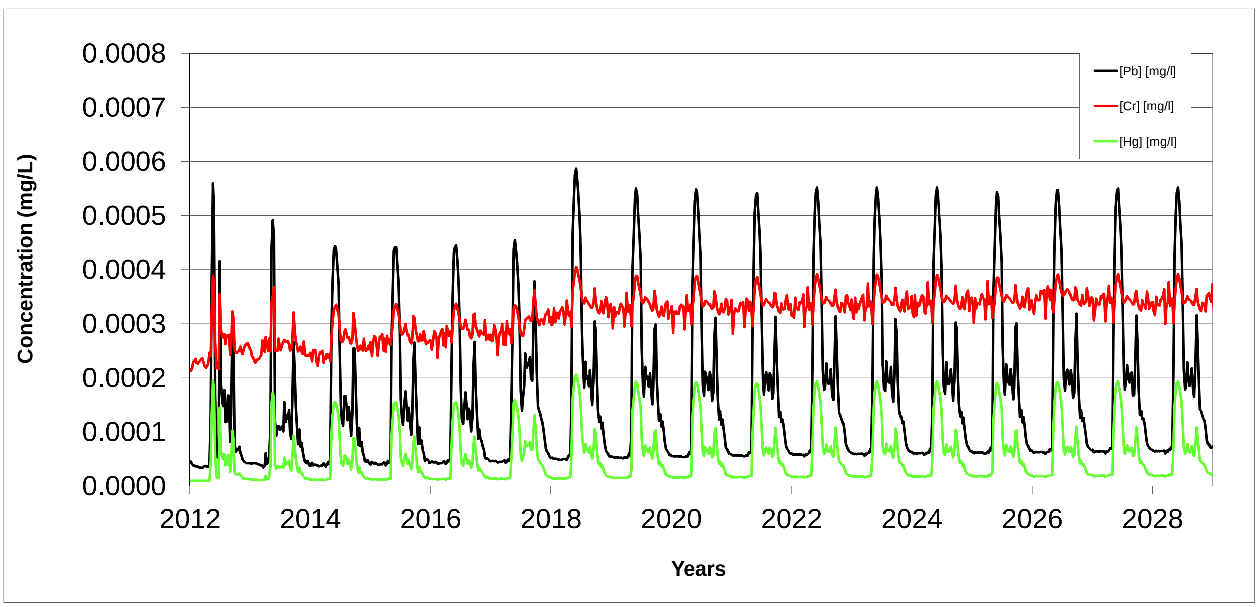
Date: December, 2013
Project: 12-1337-0001

Drawn KAS
Chkd KJD

De Beers Canada Inc.

Water Management Pond Seepage Dissolved Concentrations	FIGURE IX-11d



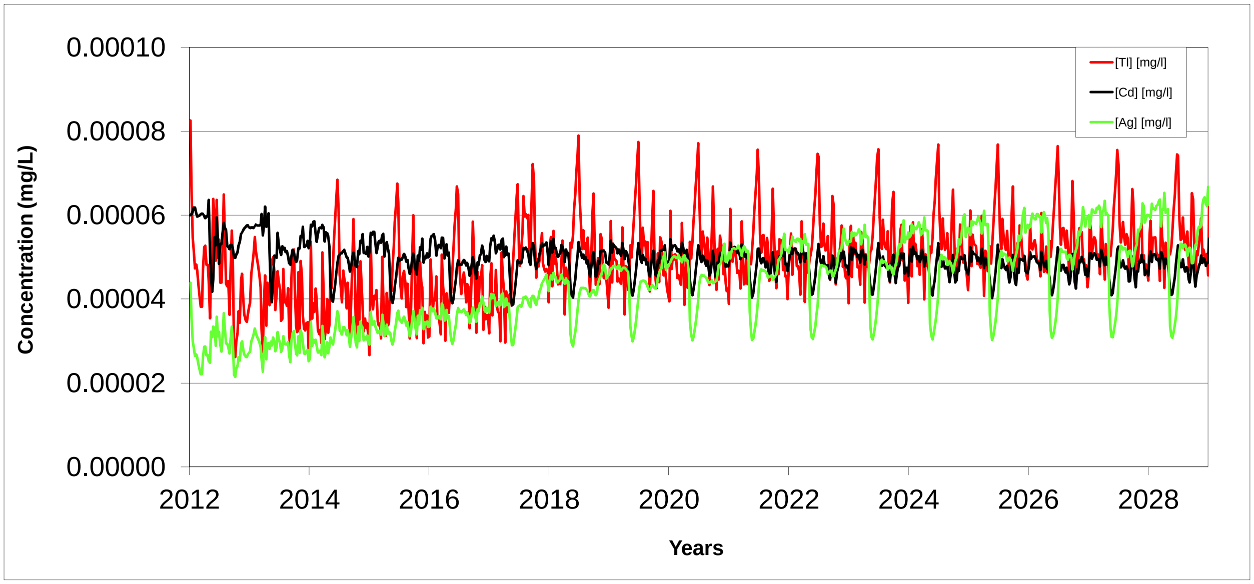


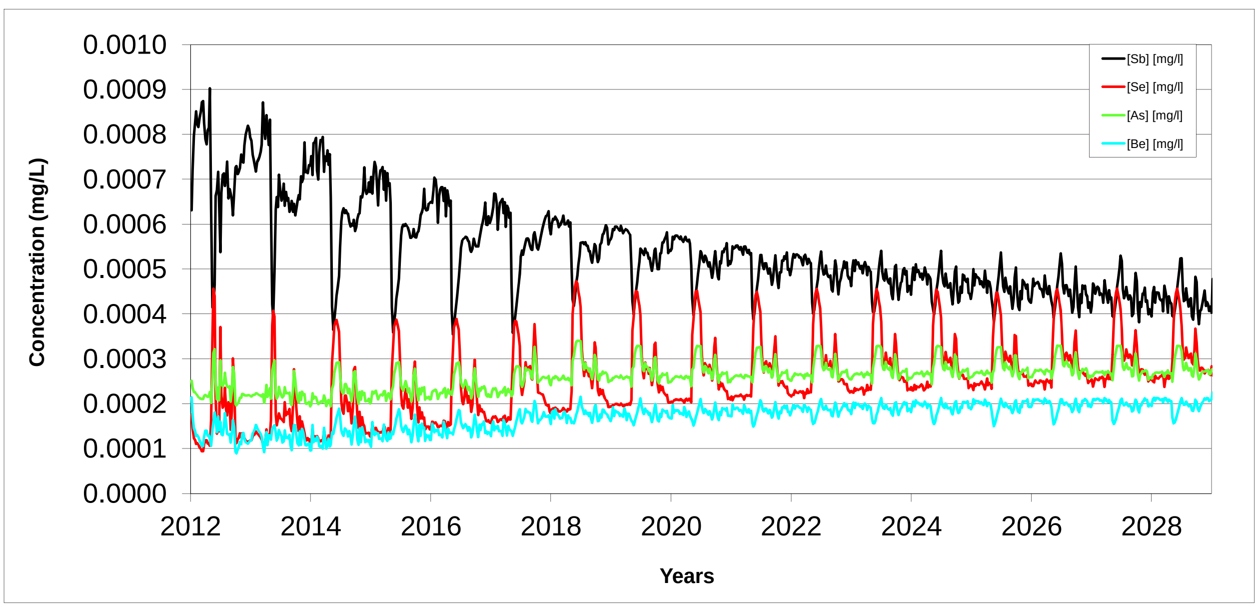
Date: December, 2013
Project: 12-1337-0001

Drawn KAS
Chkd KJD

De Beers Canada Inc.

Water Management Pond Seepage Dissolved Concentrations	FIGURE IX-11e



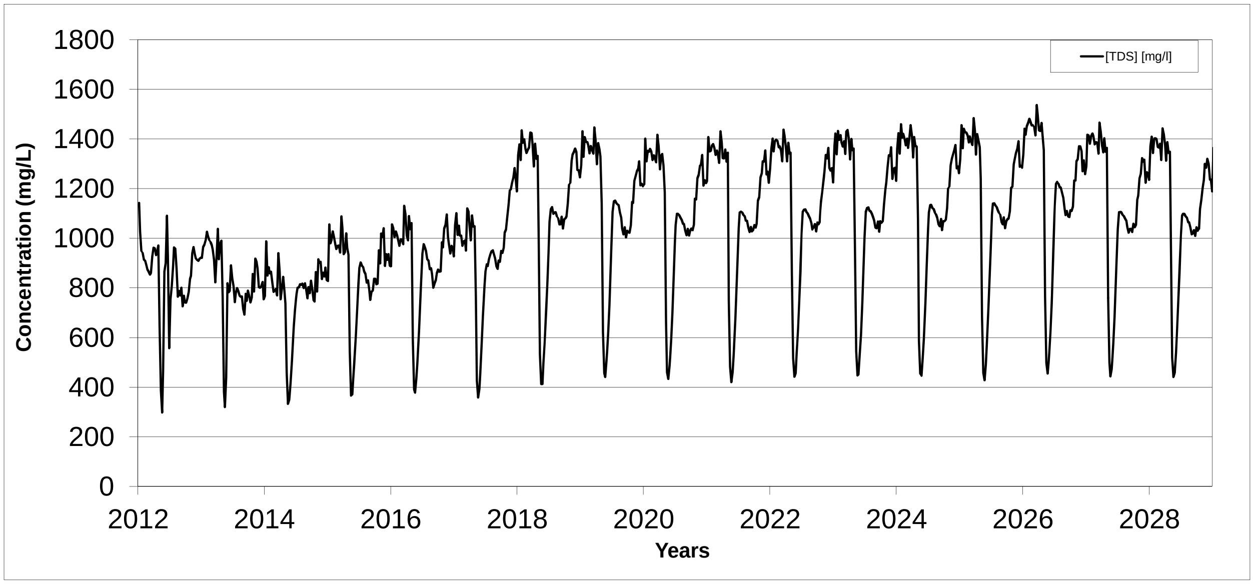


Date: December, 2013
Project: 12-1337-0001

Drawn KAS
Chkd KJD

De Beers Canada Inc.

Water Management Pond Seepage Dissolved Concentrations	FIGURE IX-11f



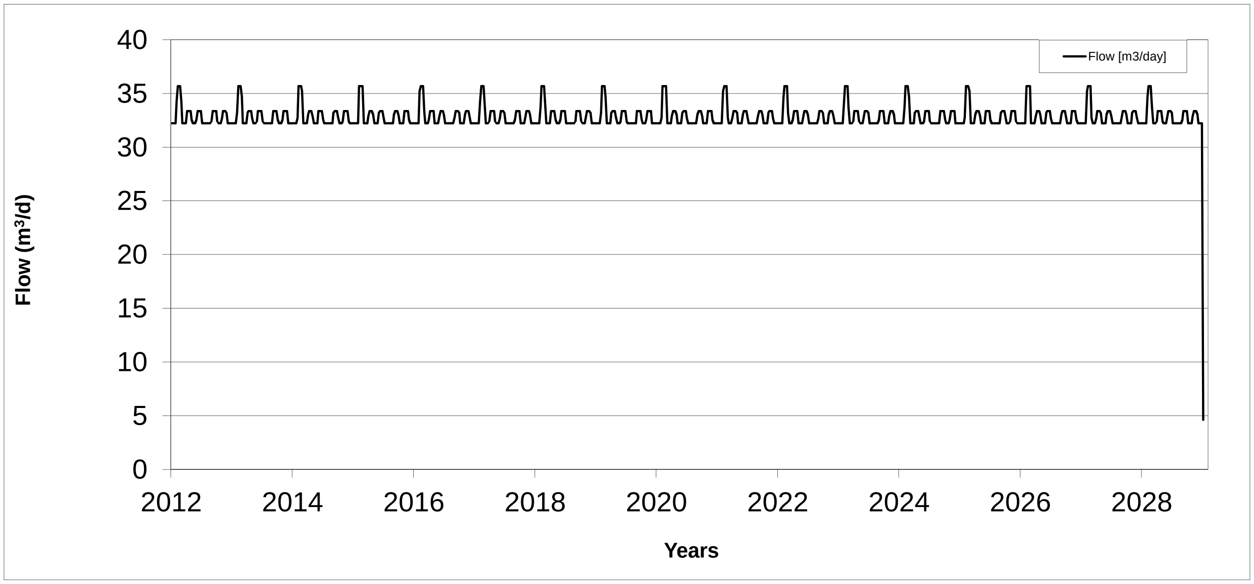
Date: December, 2013
Project: 12-1337-0001

Drawn KAS
Chkd KJD

De Beers Canada Inc.

Water Management Pond Seepage Dissolved Concentrations

FIGURE IX-11g

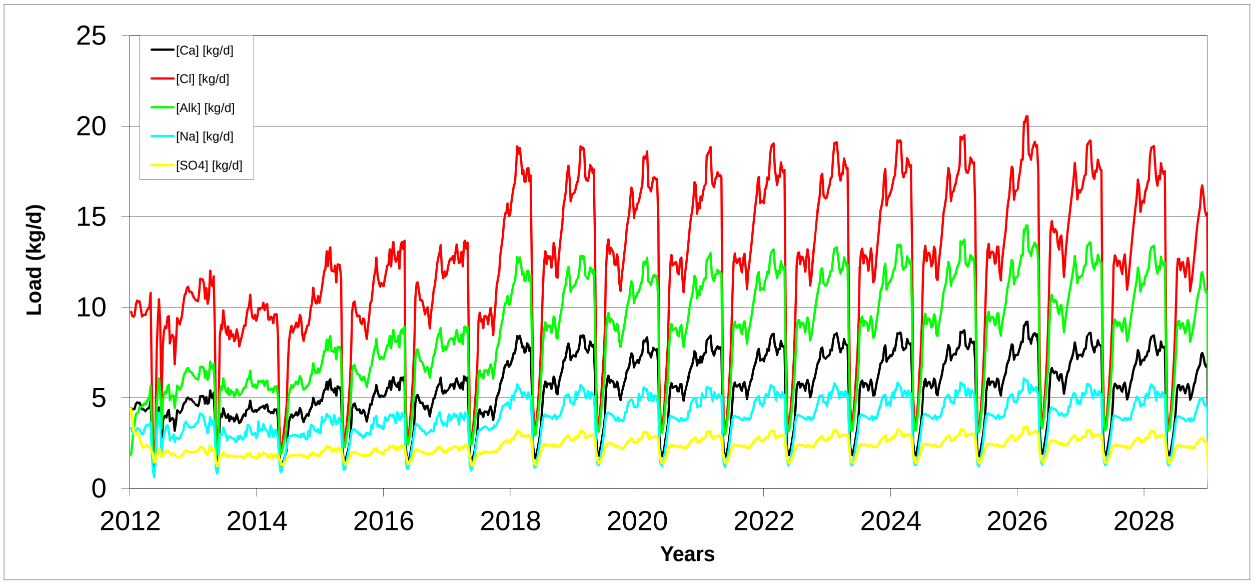


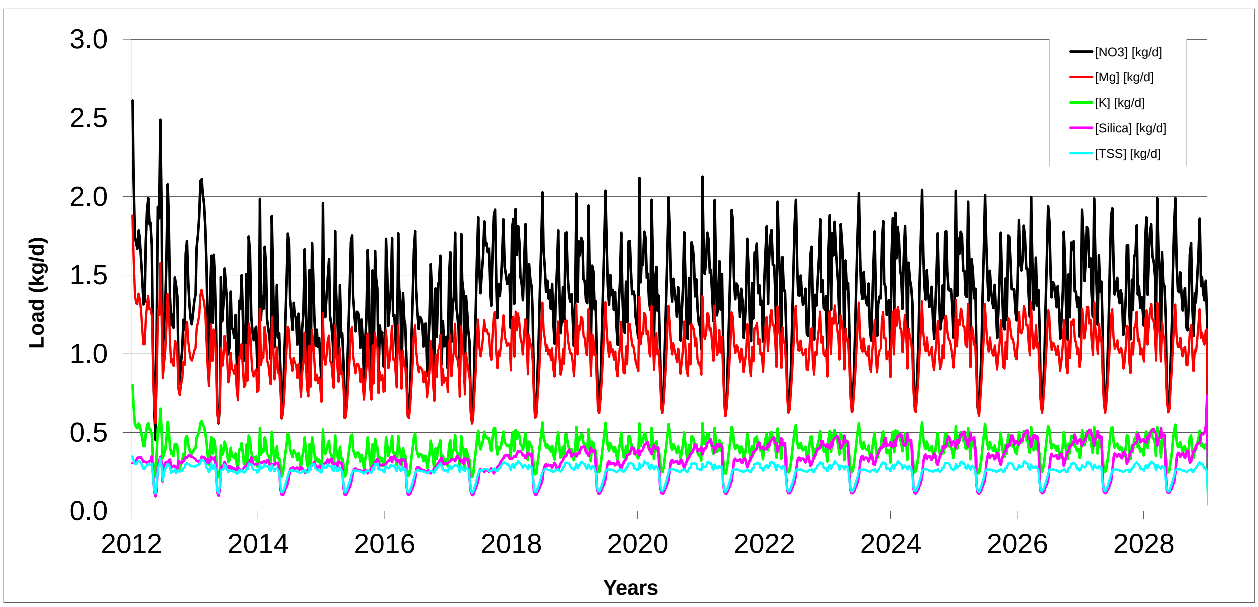
Date: December, 2013
Project: 12-1337-0001

Drawn KAS
Chkd KJD

De Beers Canada Inc.

Water Management Pond Seepage Dissolved Load	**FIGURE IX-12a**





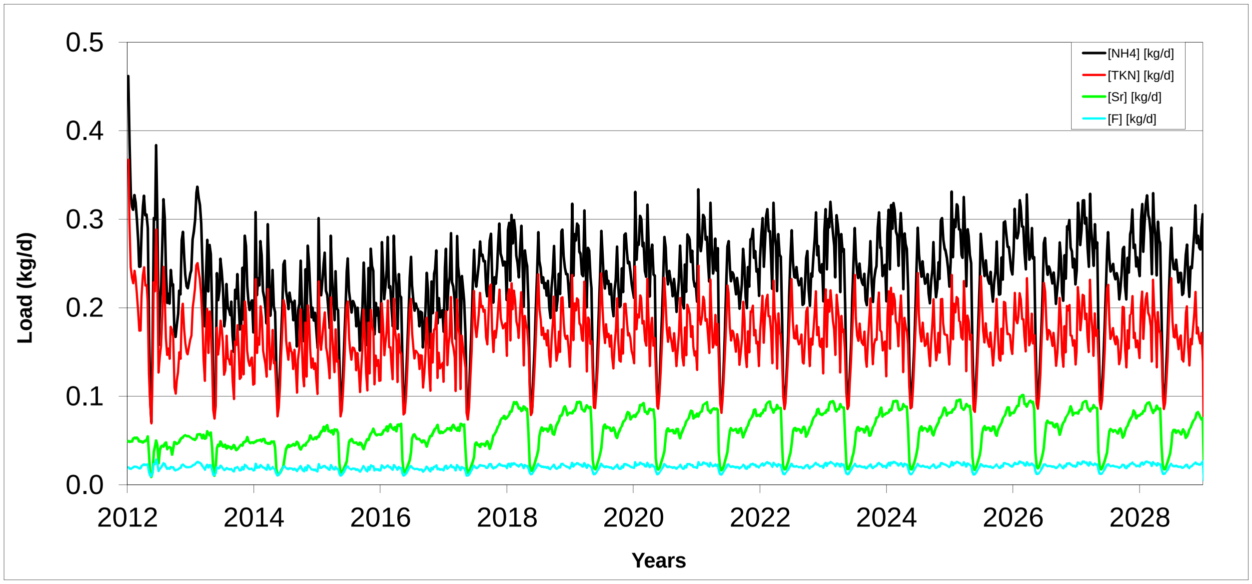
Date: December, 2013
Project: 12-1337-0001

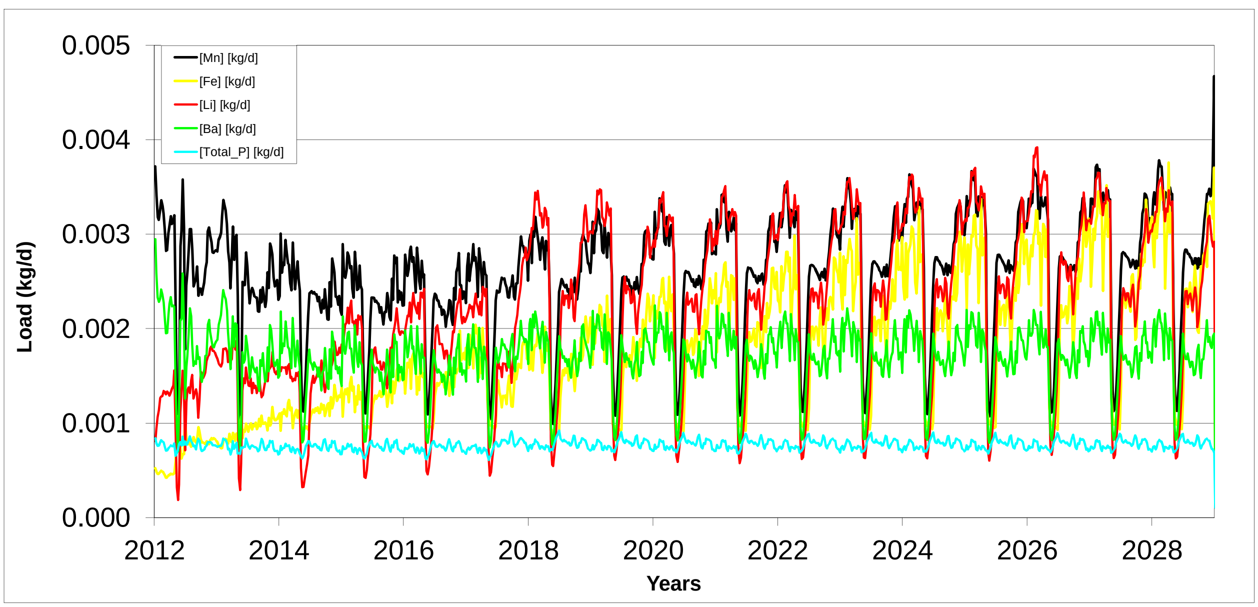
Drawn KAS
Chkd KJD

De Beers Canada Inc.

Water Management Pond Seepage Dissolved Load

FIGURE IX-12b





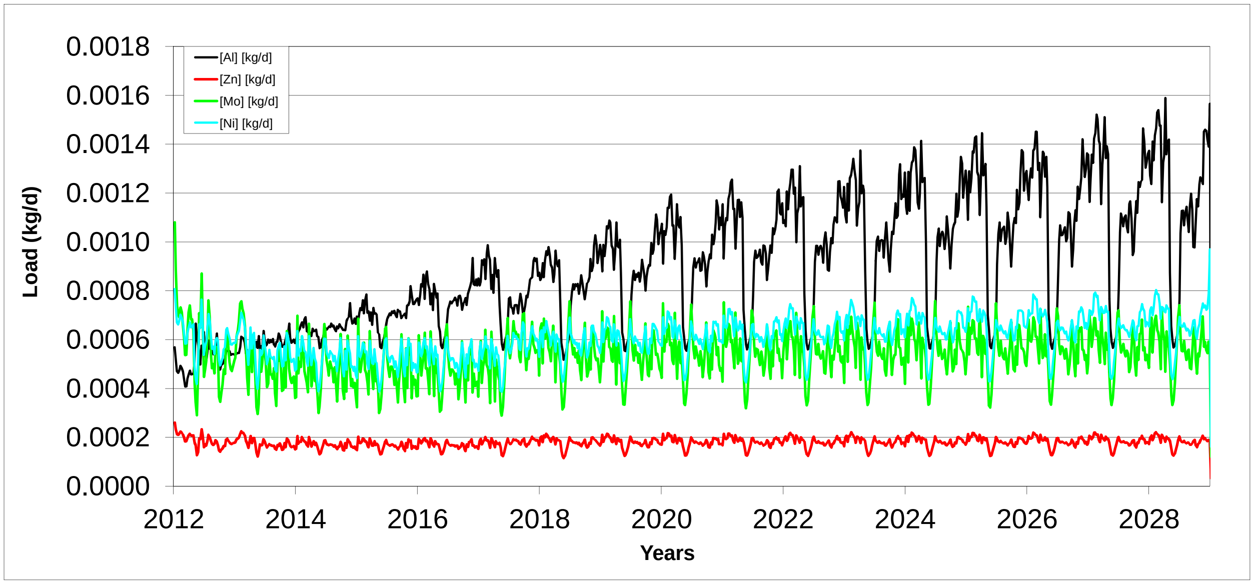
Date: December, 2013
Project: 12-1337-0001

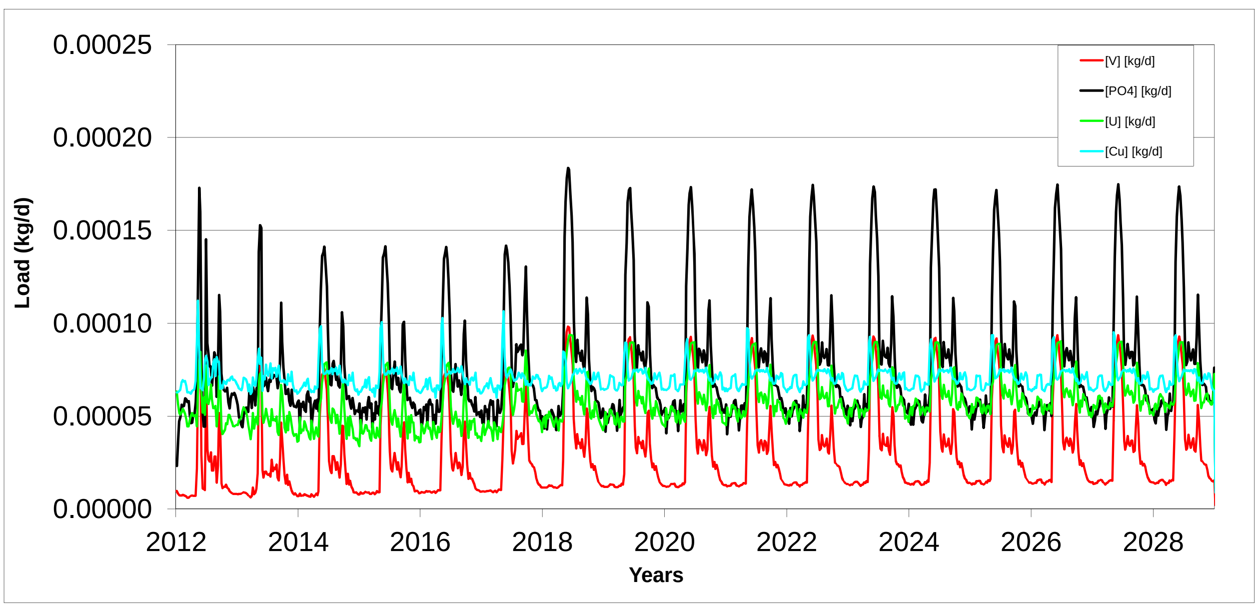
Drawn KAS
Chkd KJD

De Beers Canada Inc.

Water Management Pond Seepage Dissolved Load

FIGURE IX-12c



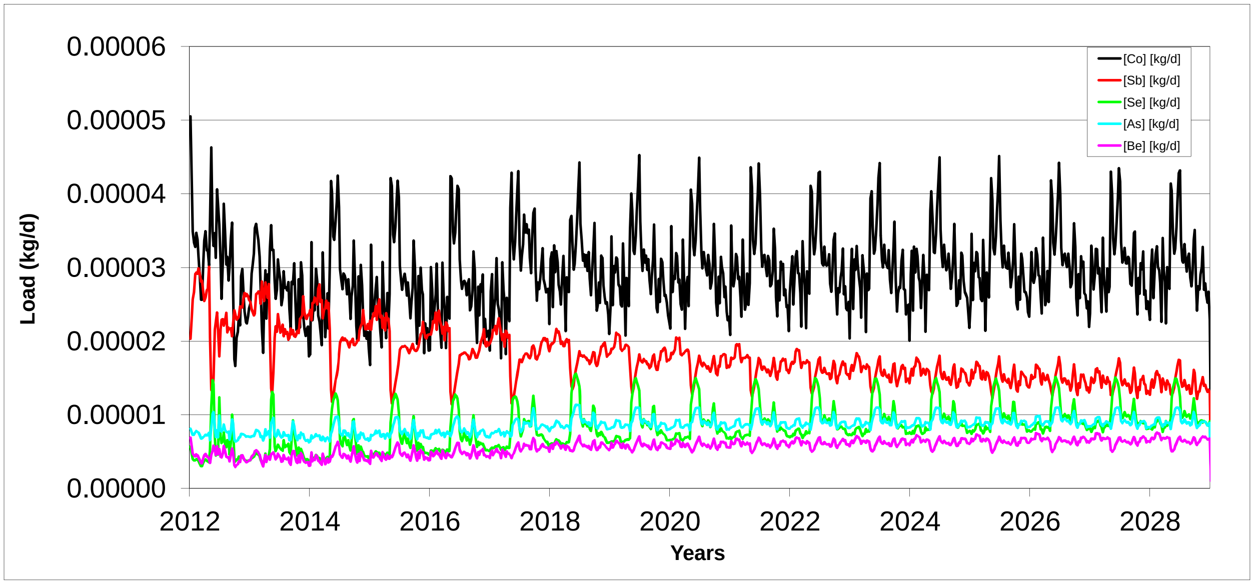


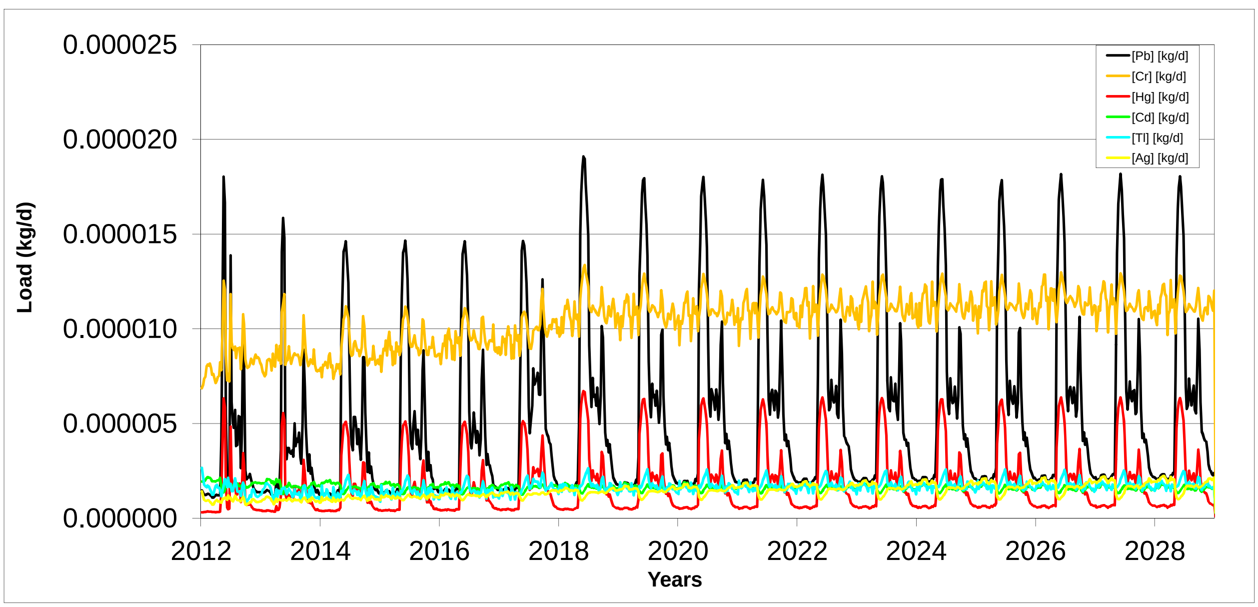
Date: December, 2013
Project: 12-1337-0001

Drawn KAS
Chkd KJD

De Beers Canada Inc.

Water Management Pond Seepage Dissolved Load	FIGURE IX-12d





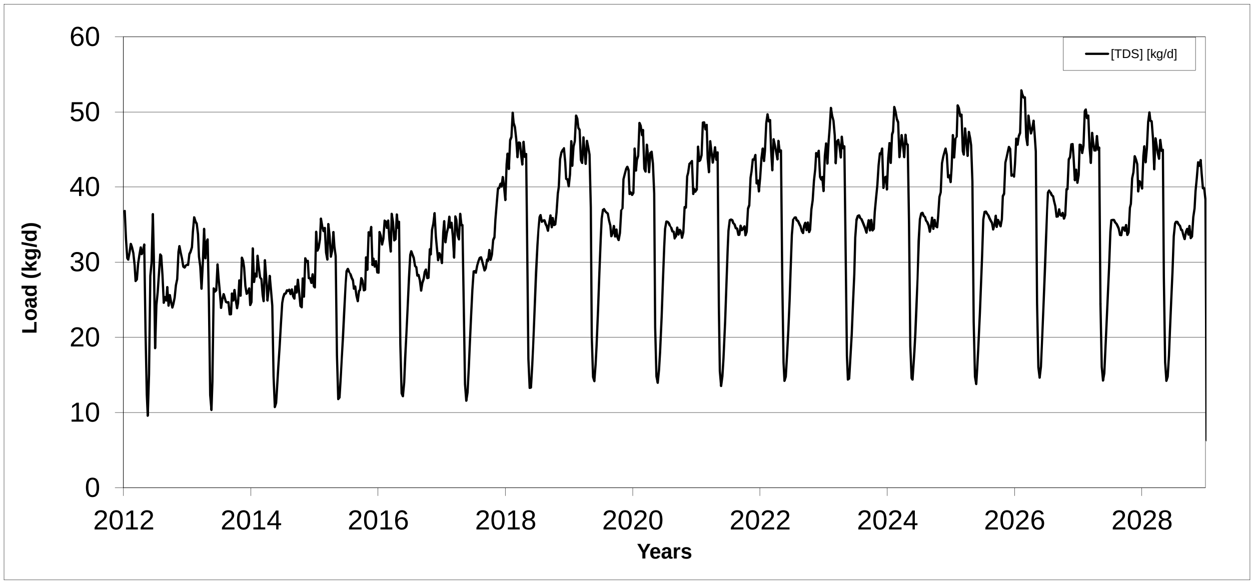
Date: December, 2013
Project: 12-1337-0001

Drawn KAS
Chkd KJD

De Beers Canada Inc.

Water Management Pond Seepage Dissolved Load

FIGURE IX-12e

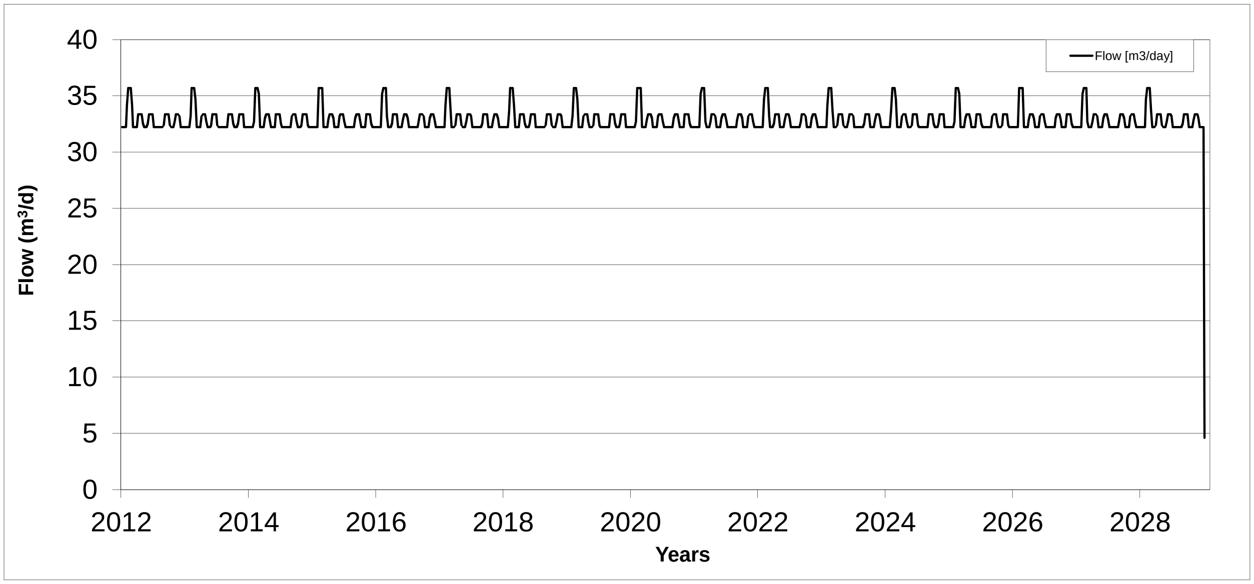


Date: December, 2013
Project: 12-1337-0001

Drawn KAS
Chkd KJD

De Beers Canada Inc.

Water Management Pond Seepage Dissolved Load FLOW	FIGURE IX-12f



Date: December, 2013
Project: 12-1337-0001

Drawn KAS
Chkd KJD

De Beers Canada Inc.