Atlantic Gold

Appendix B.7

Final – Hydrological and SW Quality Modelling Assessments for WaterCourse12
Technical Memo, Golder Associates

TECHNICAL MEMORANDUM

DATE October 1, 2019 **Project No.** 1895674-027-TM-Rev0

TO Meghan Milloy
McCallum Environmental Ltd.

CC Jim Millard, Atlantic Mining NS Corp

FROM Steve Kaufman, Natalie Korczak **EMAIL Steve_Kaufman@golder.com**

HYDROLOGICAL AND SURFACE WATER QUALITY MODELLING ASSESSMENTS FOR WATERCOURSE 12
ATLANTIC MINING NS CORP
FIFTEEN MILE STREAM PROJECT

1.0 INTRODUCTION

Atlantic Mining NS Corp (AMNS), a wholly owned subsidiary of St. Barbara Ltd., is planning to develop the Fifteen Mile Stream Gold Project (the Project) located approximately 115 km east of Halifax, in Halifax County, in the province of Nova Scotia. As part of the Environmental Impact Statement (EIS) for the Project, Golder Associates Ltd. (Golder) has prepared hydrology and water quality models for the operations and closure phases of the Project (Golder 2019a, Golder 2019b). The key objective of the modelling was to estimate the changes in the surface water flow system and water quality in the receiving surface water environment, that may occur as a result of the Project.

To supplement the ongoing EIS assessments and specifically to support the aquatics and wetland habitat assessments, additional hydrological and water quality modelling was conducted for a tributary of the Seloam Brook, located to the north of the planned tailings management facility (TMF). This tributary is designated in EIS assessments as Watercourse 12, referred to herein as WC12.

The objectives of the additional hydrological and water quality modelling were as follows:

1) To further delineate the WC12 watershed under existing conditions, the operations phase and the closure phase.

2) To simulate the effect of the proposed open pit berm/stream realignment on the potential for changes in discharge and water level along WC12.

3) To assess the potential effect of TMF seepage on the water quality at WC12 for the operations phase and closure phase.

2.0 BACKGROUND

The WC12 flow system drains an area of approximately 3 km^2. The watercourse is generally low gradient and collects water from the watershed before discharging to the west and becoming a part of Seloam Brook, which flows from Seloam Reservoir and ultimately discharges to Fifteen Mile Stream (Figure 1).

Following construction of the Project, WC12 will parallel the northern boundary of the TMF and will become an inflow to the redirected flows around the northern and western limits of the Open Pit. The re-alignment of Fifteen Mile Stream around Project infrastructure will require the construction of berms and/or channels; the dynamics of the flows through WC12 and the confluence with Seloam Brook; therefore, required additional analysis that was not necessary for the larger flow systems described in the EIS.

3.0 METHODOLOGY

3.1 Hydrology

For WC12, the EIS hydrological model (GoldSim Version 12.1) was modified and supplemented with a site-specific hydraulic model for WC12 (Hydraulic Engineering Centre -River Analysis System; HEC-RAS). The hydrology model was intended to allow for integration with water quality (as per EIS methodology) while the hydraulic model was intended to further detail the potential change in water level, as a consequence of the confluence with Seloam Brook and the realignment feature.

3.1.1 Hydrological Modelling

The existing Fifteen Mile Stream EIS hydrological model was modified to simulate the runoff from the WC12 watershed for existing, operations, and closure phases of the Project. The EIS climatic conditions and modelling methods were utilized with updates to the watershed area and surficial geology considered for WC12. For further details on the development of the hydrological model, refer to Golder (2019).

3.1.1.1 Watershed Delineation

The sub watershed area for the WC12 catchment was delineated based on existing conditions. For the Operations and Closure phases, Knight Piésold (KP) developed water management plans and the facility footprints associated with these water management features. These details were provided by KP and were removed or redistributed from the existing conditions watershed (Table 1).

Table 1: WC12 Watershed Drainage Areas

Watershed ID	Watershed Description	Existing Condition Drainage Area (m^2)	Operations and Closure Drainage Area (m^2)
WC12	Watercourse 12	3,011,400	2,163,700

3.1.1.2 Surficial Geology

Based on the delineated watershed, the surficial soil properties (KP 2018; Nova Scotia 2006) were characterized for the WC12 component (Table 2).

Table 2: WC12 Watershed Surficial Geology

Project Phase	Stony Till Plain (m^2)	Wetland (m^2)	Alluvial Floodplain (m^2)	Kettle Hole (m^2)	Total (m^2)
Existing Conditions (WC12)	2,522,600	454,900	30,300	3,600	3,011,400
Operations and Closure Conditions (WC12)	1,777,900	353,600	30,300	2,000	2,163,700

3.1.2 Hydraulic Modelling

Cross sections along WC12 and Seloam Brook were developed for input to the HEC-RAS model, based on available topographic data and the conceptual design of the realignment berms. Topographic data and imagery were utilized to estimate channel slopes and edge boundaries in WC12, and monthly discharge simulated from the hydrological model for the Existing, Operations, and Closure phases was utilized as the discharge inflow to the hydraulic model.

3.2 Water Quality

3.2.1 Modelling Approach

In support of the assessment of water quality impacts at WC12, water quality models were developed for the Project using GoldSim Version 12.1. GoldSim is a graphical, object-oriented mathematical model where the input parameters and functions are defined by the user and are built as individual objects or elements linked together by mathematical expressions. The object-based nature of the model is designed to facilitate understanding of the various factors that influence an engineered or natural system, which allows for estimating the potential changes to surface water quality.

The modelling approach used for the surface water quality predictions is a mass-balance mixing cell model for site-specific components, consisting of both natural components (e.g., natural runoff, rainfall) and Project components (e.g., TMF seepage), that are linked together to form a series of mixing cells. Each mixing cell has two or more sources of mass load that are combined to determine a “mixed” or combined water quality. The surface water quality model was constructed by building upon the GoldSim hydrology model, whereby, geochemical source-terms and baseline water quality inputs were integrated with flow rates to calculate mass loading rates. The flow logic, which forms the basis of the water balance interconnectivity, is used to configure the model linkages, including determining the direction of mass movement along the flow paths and defining the location of mass mixing points. The flow rates were used with baseline water quality and geochemistry inputs to derive mass loading rates for each of the model components. The mass mixing can be represented by the following equation:

$$C_x = \frac{\sum_{i=1}^{n} C_i Q_i}{\sum_{i=1}^{n} Q_i}$$

where:
C_x = predicted concentration of constituent ‘x’ at a given location
C_i = concentration of constituent ‘x’ in inflow ‘i’ discharging to a given location
Q_i = flow rate of inflow ‘i’
n = number of inflows to the location in question

Each flow rate is multiplied by the corresponding input concentration value, and the sum of all these calculations is divided by the sum of each flow rate to predict the final concentration of each parameter in the waterbody.

3.2.2 Project Site Components

During the operations phase, process water will be discharged from the plant site to the TMF pond. Water that infiltrates into the subsurface will, in part, become groundwater and flow toward the perimeter of the TMF. A seepage collection system, including the north and east seepage collection ponds, will be constructed to capture seepage and returns the water back into the TMF pond via a pumpback system. During the post-closure stage of the closure phase, the TMF seepage collection system will remain in place.

The water quality model for the operations phase assumed that 15% of the total seepage that exits from the TMF at perimeter locations, will bypass the perimeter seepage collection system and enter the adjacent surface water environment (14% to the north toward the WC12 watershed and 1% to the south toward the SW15 watershed). It should be noted that while the groundwater modelling results indicate that seepage will not report to the receiving environment during the planned duration of the operations phase, the operations phase water quality model conservatively applies the seepage mass load to the receivers.

The water quality model for the post-closure stage of the closure phase also assumed that 15% of the total seepage that exits from the TMF at perimeter locations, will bypass the perimeter seepage collection system and enter the adjacent surface water environment (14% at the WC12 watershed and 1% at the SW15 watershed).

During the operations and post-closure phases, drainage from the topsoil stockpile area will also report to the WC12 watershed.

3.2.3 Water Quality Model Inputs

3.2.3.1 Project Site Components

Geochemical source terms were provided for the operations (end-of-mine life) and post-closure phases of the Project and are summarized in Table 3 (base case) and Table 4 (upper case). As described in Lorax (2019), the base case source terms are based on the 50th percentile results from applicable humidity cell testing data, while the upper-case source terms are based on the 90th percentile.

Table 3: Base Case Geochemical Source Terms

Parameter	Geochemical Source Terms (1)		
	Topsoil Stockpile	Process Water	Pore Water
	EOM (2) /PC (3)	EOM	PC
Aluminum	0.07	0.026	0.0055
Antimony	0.00005	0.00031	0.000009
Arsenic	0.0025	0.012	0.053
Boron	0.005	0.021	0.052
Cadmium	0.00003	0.000005	0.000011
Calcium	0.95	25	42
Chromium	0.00076	0.0001	0.0001
Cobalt	0.00069	0.000009	0.000005
Copper	0.00095	0.0001	0.00016
Iron	0.23	0.001	0.00063
Lead	0.00013	0.000005	0.000003
Magnesium	2.2	3.5	6.6
Manganese	0.41	0.018	0.22
Mercury	0.000030	0.000005	0.000005
Molybdenum	0.00005	0.016	0.04
Nickel	0.0014	0.00076	0.00073
Potassium	0.67	32	40

Parameter	Geochemical Source Terms [1]		
	Topsoil Stockpile	Process Water	Pore Water
	EOM [2] /PC [3]	EOM	PC
Selenium	0.00077	0.00028	0.00017
Silver	0.00003	0.000005	0.000005
Sodium	1.4	63	89
Sulphate	1.7	135	225
Thallium	0.00005	0.000006	0.000004
Uranium	0.00008	0.00016	0.00023
Zinc	0.005	0.01	0.00021

Notes
[1] Base case geochemical source terms provided by Lorax (2019).
[2] EOM = end of mining; operations phase.
[3] PC = post-closure phase.

Table 4: Upper Case Geochemical Source Terms

Parameter	Geochemical Source Terms [1]	
	Topsoil Stockpile	Pore Water
	EOM [2] /PC [3]	PC
Sulphate	2	244
Aluminum	0.55	0.01
Antimony	0.00005	0.00014
Arsenic	0.007	0.11
Boron	0.005	0.053
Cadmium	0.00006	0.000022
Calcium	1.1	44
Chromium	0.0011	0.0001

Parameter	Geochemical Source Terms [1]	
	Topsoil Stockpile	Pore Water
	EOM [2] /PC [3]	PC
Cobalt	0.00096	0.000007
Copper	0.0027	0.00029
Iron	0.42	0.0011
Lead	0.00094	0.000005
Magnesium	0.53	7.3
Manganese	0.11	0.39
Mercury	0.000030	0.000005
Molybdenum	0.00005	0.055
Nickel	0.0017	0.0012
Potassium	1.4	45
Selenium	0.00096	0.00031
Silver	0.00003	0.000005
Sodium	2.1	92
Thallium	0.00005	0.000006
Uranium	0.0001	0.00025
Zinc	0.0099	0.00028

Notes
[1] Upper case geochemical source terms provided by Lorax (2019). No upper case source term was provided for process water.
[2] EOM = end of mining; operations phase.
[3] PC = post-closure phase.

The model inputs for the quality of the TMF seepage bypassing the seepage collection system and reporting to the WC12 watershed are as follows:

- The process water geochemical source term is used for the operations phase (only a base case source term was developed).

- The pore water geochemical source term (base case and upper case) is used for the post-closure phase.

The water quality model input for the quality of the topsoil stockpile area, reporting to the WC12 watershed, is the topsoil geochemical source term (base case and upper case) for both the operations and post-closure phases.

3.2.3.2 Natural Runoff

Baseline surface water quality monitoring has been conducted at various watercourses in the vicinity of the Project site since 2017. Additional details on the baseline surface water quality monitoring program and results are summarized in Golder (2019c). Baseline water quality data is not available for WC12; as such, the baseline dataset for SW2 is used to represent the quality of natural runoff associated with the WC12 watershed (Table 5). Analytical results for total metals were used to derive water quality model inputs.

Table 5: Natural Runoff Input Quality

Parameter	Average Surface Water Baseline Concentration (mg/L) (1)
	SW2
Aluminum	0.13
Ammonia (total)	0.025
Antimony	0.00050
Arsenic	0.00050
Boron	0.025
Cadmium	0.000013
Calcium	0.51
Chromium	0.00056
Cobalt	0.00020
Copper	0.00083
Iron	0.14
Lead	0.00025
Magnesium	0.31
Manganese	0.045
Mercury	0.0000065
Molybdenum	0.0010
Nickel	0.0010
Nitrate	0.0050
Nitrite	0.0050
Potassium	0.26
Selenium	0.00050

Parameter	Average Surface Water Baseline Concentration (mg/L) [(1)]
	SW2
Silver	0.000050
Sodium	2.2
Sulphate	1.0
Thallium	0.000050
Uranium	0.000050
Zinc	0.0025

Notes
[1] Average calculated from the available surface water quality baseline dataset (June 2017 to June 2019).

3.2.4 Water Quality Comparison Criteria

Effluent discharges from the site will be required to adhere to the MDMER maximum allowable concentration limits. For the purposes of comparison and evaluating the overall Project site water quality, the predicted water qualities of the Project site components are compared to the MDMER maximum allowable monthly mean concentration.

The surface water quality predictions for the receiving environment are compared to the following federal and provincial criteria:

- Canadian Council of Ministers of the Environment (CCME), Canadian Environmental Quality Guidelines, Canadian Water Quality Guidelines for the Protection of Aquatic Life (CWQGs)
- Nova Scotia Environmental Quality Standards (NSEQS) for Contaminated Sites (Tier 1) for Surface Water (Fresh Water)
- Environment Canada Federal Environmental Quality Guideline (FEQG) for cobalt

In addition to the guidelines above, a site-specific water quality objective (SSWQO) for arsenic of 0.03 mg/L has been developed as an aquatic risk-based comparator (Intrinsik 2019).

The surface water quality predictions are also compared to the 95th percentile baseline concentrations measured at SW2.

4.0 RESULTS

4.1 Hydrology

4.1.1 Hydrological Model Results

Results for the average, 5th percentile, and 95th percentile surface water discharge through WC12 are presented in Table 6 through Table 8 for Existing, Operations, and Post-Closure Phases of the Project. The predicted potential change in discharge is generally within the existing flow intra-annual flow regime of the waterway, with the exception of July, when average daily discharge was estimated to decrease to below the intra-annual variability by less than 10%.

Table 6: Simulated Average Discharge, WC12

Month	Existing (m^3/day)	Operations (m^3/day)	Closure/ Reclamation (m^3/day)	Closure/ Post Closure (m^3/day)
January	10,000	7,400	7,400	7,600
February	9,100	6,700	6,700	7,000
March	15,000	11,100	11,100	11,300
April	13,800	10,200	10,200	10,400
May	4,600	3,500	3,500	3,700
June	2,200	1,800	1,800	2,000
July	1,300	1,200	1,200	1,300
August	1,500	1,300	1,300	1,500
September	1,700	1,500	1,500	1,700
October	4,200	3,200	3,200	3,400
November	10,800	7,800	7,800	8,100
December	12,000	8,700	8,700	9,000

Table 7: 95th Percentile Simulated Discharge, WC12

Month	Existing (m^3/day)	Operations (m^3/day)	Closure/ Reclamation (m^3/day)	Closure/ Post Closure (m^3/day)
January	22,100	16,200	16,200	16,400
February	19,500	14,300	14,300	14,500
March	25,500	18,600	18,600	18,800
April	29,000	21,200	21,200	21,500
May	14,600	10,700	10,700	11,000
June	9,000	6,600	6,600	6,800
July	3,700	2,600	2,600	2,800
August	5,300	3,600	3,600	4,000
September	6,800	4,600	4,600	5,000
October	14,700	10,600	10,600	11,000
November	22,000	15,600	15,600	16,100
December	23,700	17,300	17,300	17,500

Table 8: 5th Percentile Simulated Discharge, WC12

Month	Existing (m^3/day)	Operations (m^3/day)	Closure/ Reclamation (m^3/day)	Closure/ Post Closure (m^3/day)
January	3,200	2,400	2,400	2,600
February	3,000	2,200	2,200	2,400
March	7,400	5,500	5,500	5,700
April	4,600	3,500	3,500	3,700
May	900	900	900	1,000
June	900	900	900	1,000
July	900	900	900	1,000

Month	Existing (m^3/day)	Operations (m^3/day)	Closure/ Reclamation (m^3/day)	Closure/ Post Closure (m^3/day)
August	900	900	900	1,000
September	900	900	900	1,000
October	900	900	900	1,000
November	2,000	1,700	1,700	1,900
December	3,900	2,700	2,700	3,000

4.1.2 Hydraulic Model Results

Simulated water elevations for the Operations and Post-Closure Phases of the Project are provided in Appendix A. To provide a temporal context, these figures were developed for spring runoff (March) and dry season (July) flow conditions. Regardless of season, these simulations of the WC12/Seloam Brook show the influence of the realignment berms has the potential to create a backwatered effect (i.e., a raised water level, relative to the Existing Conditions) that will facilitate the discharge of water along the natural gradient, along the northern boundary of the Open Pit.

4.2 Water Quality

4.2.1 Project Site Components

The water quality model for the operations phase assumed that seepage bypassing the TMF seepage collection system is represented by the geochemical source term for process water (Table 3 and 4); these concentrations are lower than the MDMERs for all parameters. The concentrations are also lower than the CCME CWQGs, NSEQSs, FEQG, and SSWQO with the exception of aluminum and zinc.

The water quality model for the post-closure phase assumed that seepage bypassing the TMF seepage collection system is represented by the geochemical source term for pore water (Table 3 and 4); these concentrations are lower than the MDMERs for all parameters. The concentrations are also lower than the CCME CWQGs, NSEQSs, FEQG, and SSWQO, with the exception of aluminum (using base case and upper case source terms) and arsenic (using base case and upper case source terms).

The quality of the drainage from the topsoil stockpile area is assumed to be represented by the geochemical source term for the stockpile (Table 3 and 4); these concentrations are lower than the MDMERs for all parameters. The concentrations are also lower than the CCME CWQGs, NSEQSs, FEQG, and SSWQO, with the exception of aluminum (using base case and upper case source terms), mercury (using base case and upper case source terms), cadmium (using upper case source terms), cobalt (using upper case source terms), copper (using upper case source terms), iron (using upper case source terms), and zinc (using upper case source terms).

4.2.2 Watercourse 12

Predicted effects on receiving environment surface water quality for the average, 5th percentile, and 95th percentile flow were simulated by the operations phase and post-closure phase water quality models at WC12. Predicted annual concentrations of these parameters (average, 5th percentile, and 95th percentile) in the receiving surface water environment, using both base and upper case geochemical source terms, are presented in Appendix B and compared to the 95th percentile baseline concentrations and the CCME CWQGs, NSEQSs, FEQG, and SSWQO, as applicable.

In addition to the annual average statistical summary, predicted monthly concentrations (average, 5th percentile, and 95th percentile) are presented graphically in Appendix B.

4.2.2.1 Operations Phase

The annual and monthly concentrations at WC12 for the operations phase, using both the base case and upper case geochemical source terms, are predicted to be lower than the applicable CCME CWQG, NSEQS, FEQG, and SSWQO for all parameters except aluminum; however, the aluminum concentrations are lower than the 95th percentile baseline concentrations (which are also greater than the CCME CWQGs and NSEQS). The predicted concentrations are similar to the natural runoff model input, due to the small contribution of flow from project site components to the overall flow at WC12.

4.2.2.2 Post-Closure Phase

The annual and monthly concentrations at WC12 for the post-closure phase, using both the base case and upper case geochemical source terms, are predicted to be lower than the applicable CCME CWQG, NSEQS, FEQG, and SSWQO for all parameters except aluminum; however, the aluminum concentrations are lower than the 95th percentile baseline concentrations (which are also greater than the CCME CWQGs and NSEQS). The predicted concentrations are similar to the natural runoff model input, due to the small contribution of flow from project site components to the overall flow at WC12.

4.3 Discussion

The residual effect relevant to the surface water quantity and quality valued component during the operations and post-closure phases, is a change in water quantity and/or quality associated with Project activities. Based on the threshold for determination of significance of effects presented in the EIS document, the magnitude of the predicted change in surface water at WC12 as a result of change to watershed area and realignment, seepage from the TMF for the operations and post-closure phases ranges from negligible to low, depending on parameter.

5.0 REFERENCES

Golder. 2019a. Atlantic Mining NS Corp Fifteen Mile Stream Gold Project, Hydrological Modelling Assessment.

Golder. 2019b. Atlantic Mining NS Corp Fifteen Mile Stream Gold Project, Surface Water Quality Modelling Assessment.

Golder. 2019c. Atlantic Mining NS Corp Fifteen Mile Stream Gold Project, Surface Water Quality Baseline Report.

Knight Piésold Ltd. 2018. Fifteen Mile Stream Project - Desktop Terrain Analysis Study. File No. VA101-00708/02-A.01

Nova Scotia 2006. Digital Version of Nova Scotia Department of Natural Resources Map ME 1992-3, Surficial Geology Map of the Province of Nova Scotia, Scale 1:500,000, by R.R. Stea, H. Conley and Y. Brown, 1992.

6.0 CLOSURE

We trust that this technical memorandum meets your current requirements. Should you have any questions or concerns, please do not hesitate to contact the undersigned.

Golder Associates Ltd.

Signature:
Date: October 1, 2019

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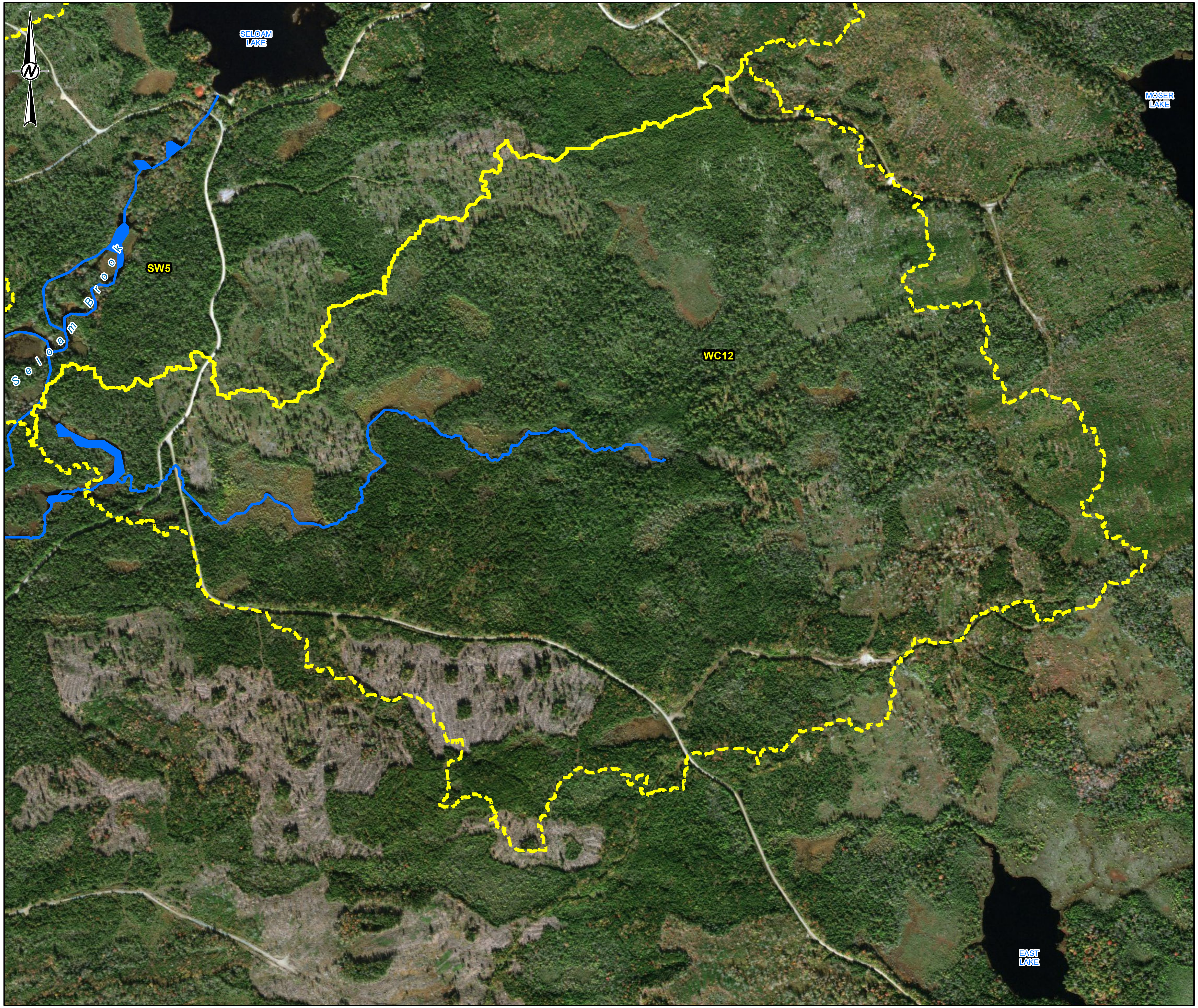
Geochemist

Steve Kaufman, M.Sc., EP
Associate, Hydrologist

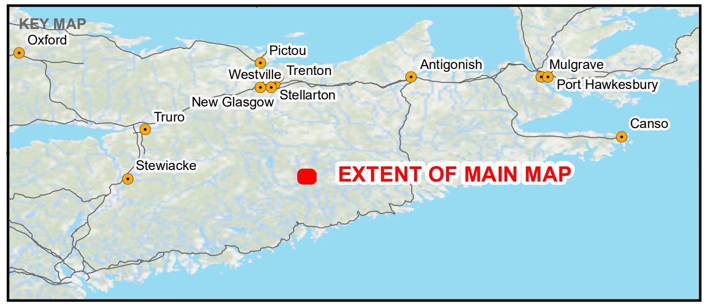
NK/SP/DB/SK/sm

https://golderassociates.sharepoint.com/sites/23819g/deliverables/1895674-027-tm-wc12 model fms/rev 0/1895674-027-tm-rev0-wc12 model fms-0110_19.docx



LEGEND

- Watercourse
- Watershed Boundary



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NOTE(S)
1. ALL LOCATIONS ARE APPROXIMATE

REFERENCE(S)
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2. MCCALLUM ENVIRONMENTAL LTD. PROPOSED INFRASTRUCTURE, (VER.190620, RECEIVED 2019-06-28).
PROJECTION: TRANSVERSE MERCATOR DATUM: NAD 83
COORDINATE SYSTEM: UTM ZONE 20 VERTICAL DATUM: CGVD28

CLIENT
ATLANTIC MINING NS CORP

Atlantic Gold

PROJECT
HYDROLOGICAL AND SURFACE WATER QUALITY MODELLING ASSESSMENTS FOR WATERCOURSE 12, FIFTEEN MILE STREAM PROJECT

TITLE
SITE PLAN

CONSULTANT

GOLDER

YYYY-MM-DD	2019-10-01
DESIGNED	---
PREPARED	RRD
REVIEWED	SK
APPROVED	SK

PROJECT NO.	CONTROL	REV.	FIGURE
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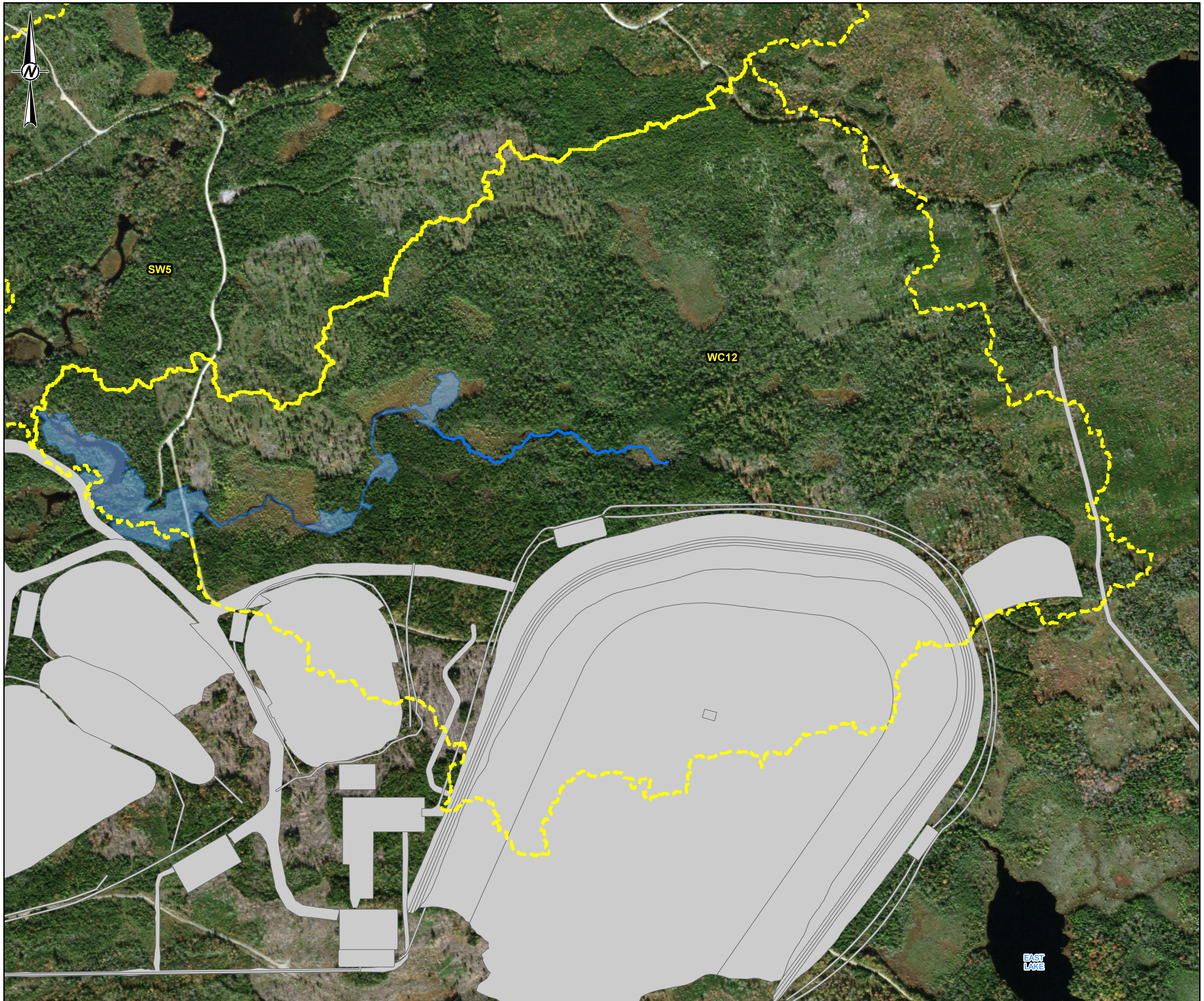
IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

APPENDIX A

WC12 Water Level Figures



LEGEND

- Flooded Extent
- Infrastructure
- Watershed Boundary

0 170 340

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NOTE(S)

1. ALL LOCATIONS ARE APPROXIMATE

REFERENCE(S)

1. MCCALLUM ENVIRONMENTAL LTD. EIS PROJECT AREA, (VER.190313, RECEIVED 2019-03-18).
2. MCCALLUM ENVIRONMENTAL LTD. PROPOSED INFRASTRUCTURE, (VER.190620, RECEIVED 2019-06-28).

PROJECTION: TRANSVERSE MERCATOR DATUM: NAD 83
COORDINATE SYSTEM: UTM ZONE 20 VERTICAL DATUM: CGVD28

CLIENT

ATLANTIC MINING NS CORP

Atlantic Gold

PROJECT

HYDROLOGICAL AND SURFACE WATER QUALITY MODELLING ASSESSMENTS FOR WATERCOURSE 12, FIFTEEN MILE STREAM PROJECT

TITLE

FLOOD EXTENT
OPERATIONS PHASE MARCH FLOW

CONSULTANT

GOLDER

YYYY-MM-DD	2019-10-01
DESIGNED	---
PREPARED	RRD
REVIEWED	SK
APPROVED	SK

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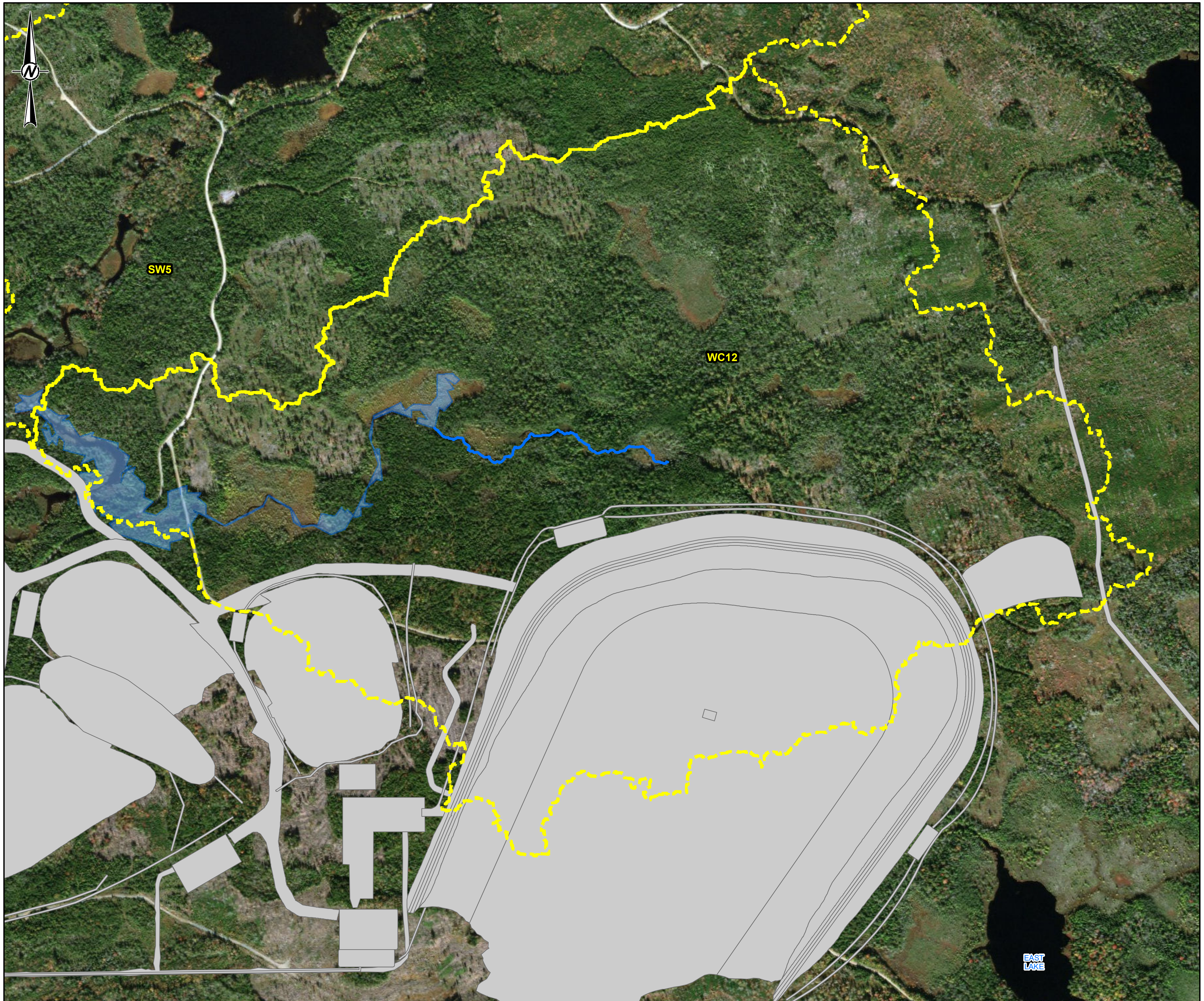

LEGEND

- Flooded Extent
- Infrastructure
- Watershed Boundary

0 170 340

1:10,000 METRES

NOTE(S)
1. ALL LOCATIONS ARE APPROXIMATE

REFERENCE(S)
1. MCCALLUM ENVIRONMENTAL LTD. EIS PROJECT AREA, (VER.190313, RECEIVED 2019-03-18).
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PROJECTION: TRANSVERSE MERCATOR DATUM: NAD 83
COORDINATE SYSTEM: UTM ZONE 20 VERTICAL DATUM: CGVD28

CLIENT
ATLANTIC MINING NS CORP

PROJECT
HYDROLOGICAL AND SURFACE WATER QUALITY MODELLING ASSESSMENTS FOR WATERCOURSE 12, FIFTEEN MILE STREAM PROJECT

TITLE
FLOOD EXTENT
OPERATIONS PHASE JULY FLOW

CONSULTANT

YYYY-MM-DD	2019-10-01
DESIGNED	---
PREPARED	RRD
REVIEWED	SK
APPROVED	SK

PROJECT NO.	CONTROL	REV.	FIGURE
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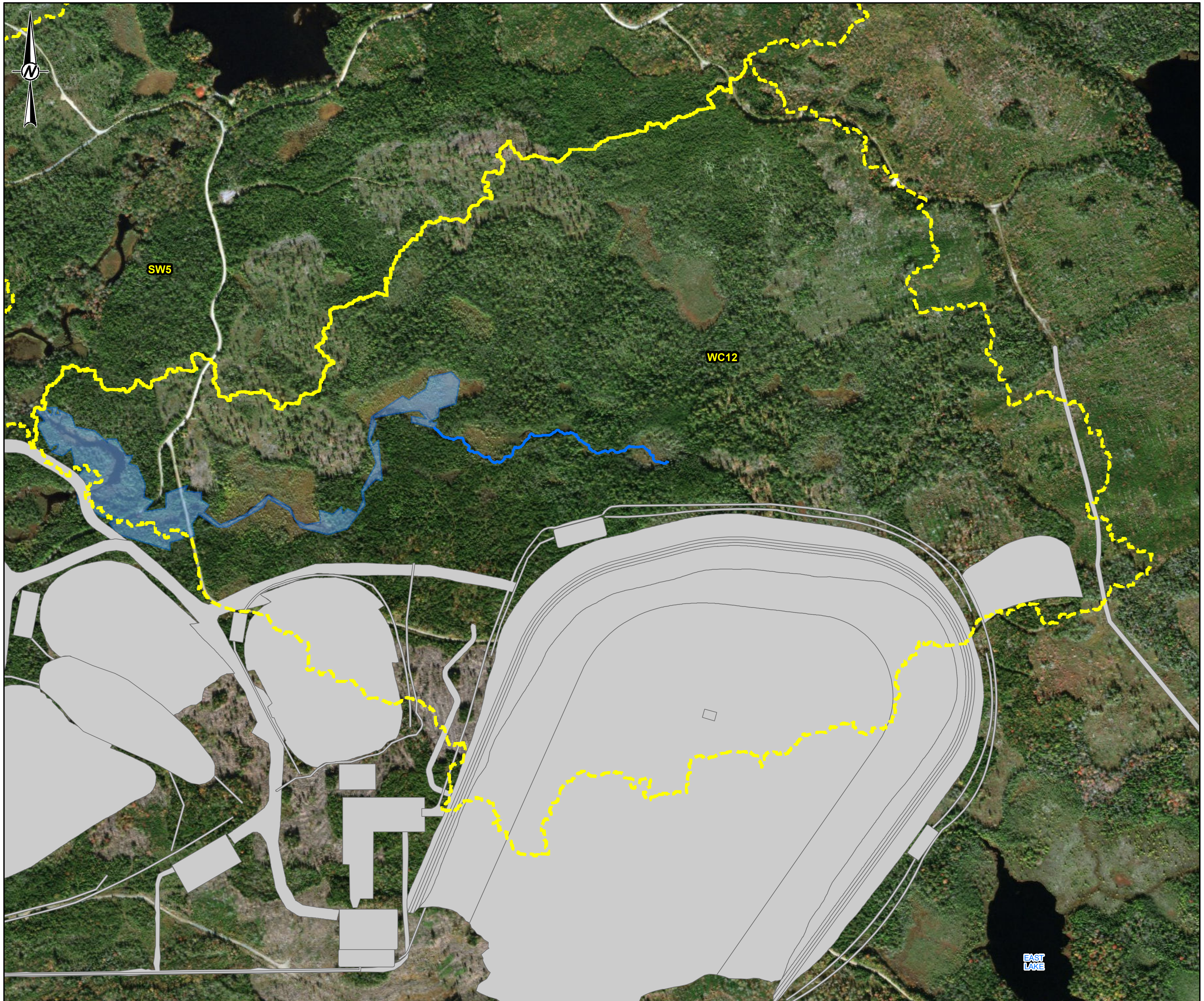


LEGEND

- Flooded Extent
- Infrastructure
- Watershed Boundary

0 170 340
1:10,000 METRES

NOTE(S)
1. ALL LOCATIONS ARE APPROXIMATE

REFERENCE(S)
1. MCCALLUM ENVIRONMENTAL LTD. EIS PROJECT AREA, (VER.190313, RECEIVED 2019-03-18).
2. MCCALLUM ENVIRONMENTAL LTD. PROPOSED INFRASTRUCTURE, (VER.190620, RECEIVED 2019-06-28).
PROJECTION: TRANSVERSE MERCATOR DATUM: NAD 83
COORDINATE SYSTEM: UTM ZONE 20 VERTICAL DATUM: CGVD28

CLIENT
ATLANTIC MINING NS CORP

Atlantic Gold

PROJECT
HYDROLOGICAL AND SURFACE WATER QUALITY MODELLING ASSESSMENTS FOR WATERCOURSE 12, FIFTEEN MILE STREAM PROJECT

TITLE
FLOOD EXTENT
CLOSURE PHASE / RECLAMATION STAGE MARCH FLOW

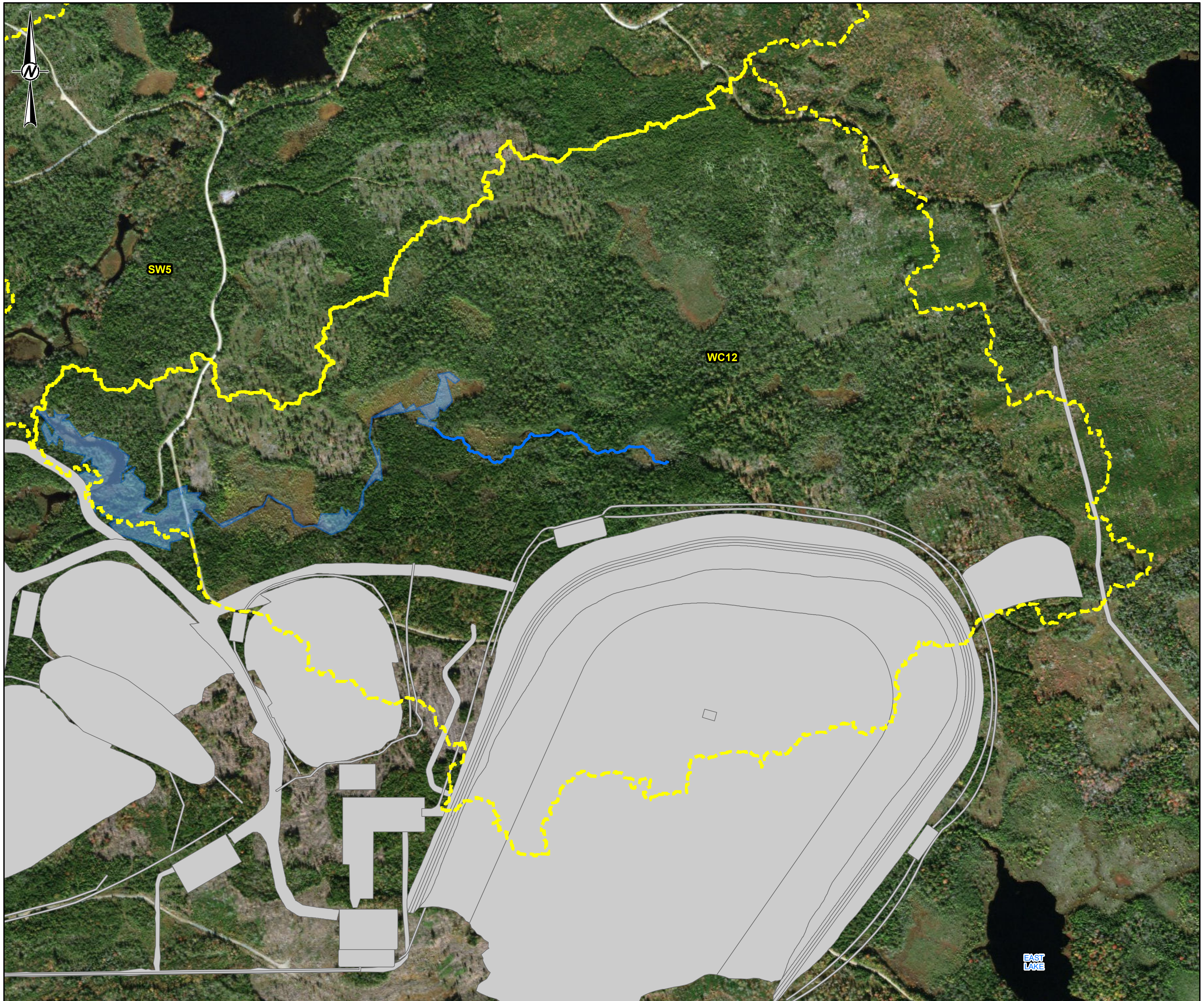
CONSULTANT
GOLDER

YYYY-MM-DD	2019-10-01
DESIGNED	---
PREPARED	RRD
REVIEWED	SK
APPROVED	SK

PROJECT NO.	CONTROL	REV.	FIGURE
1895674	0029	0	A3

PATH: A:_Clients\ATLANTIC_GOLD\FifteenMileStream_CochraneHill\99_PROJ\1895674\40_PROD\0029_FloodExtent_Sept2019\1895674-0029-CS-0001.mxd PRINTED ON: 2019-10-01 AT: 2:24:38 PM

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B
25mm



LEGEND

- Flooded Extent
- Infrastructure
- Watershed Boundary

0 170 340

1:10,000 METRES

NOTE(S)

1. ALL LOCATIONS ARE APPROXIMATE

REFERENCE(S)

1. MCCALLUM ENVIRONMENTAL LTD. EIS PROJECT AREA, (VER.190313, RECEIVED 2019-03-18).
2. MCCALLUM ENVIRONMENTAL LTD. PROPOSED INFRASTRUCTURE, (VER.190620, RECEIVED 2019-06-28).

PROJECTION: TRANSVERSE MERCATOR DATUM: NAD 83
COORDINATE SYSTEM: UTM ZONE 20 VERTICAL DATUM: CGVD28

CLIENT
ATLANTIC MINING NS CORP

Atlantic Gold

PROJECT
HYDROLOGICAL AND SURFACE WATER QUALITY MODELLING ASSESSMENTS FOR WATERCOURSE 12, FIFTEEN MILE STREAM PROJECT

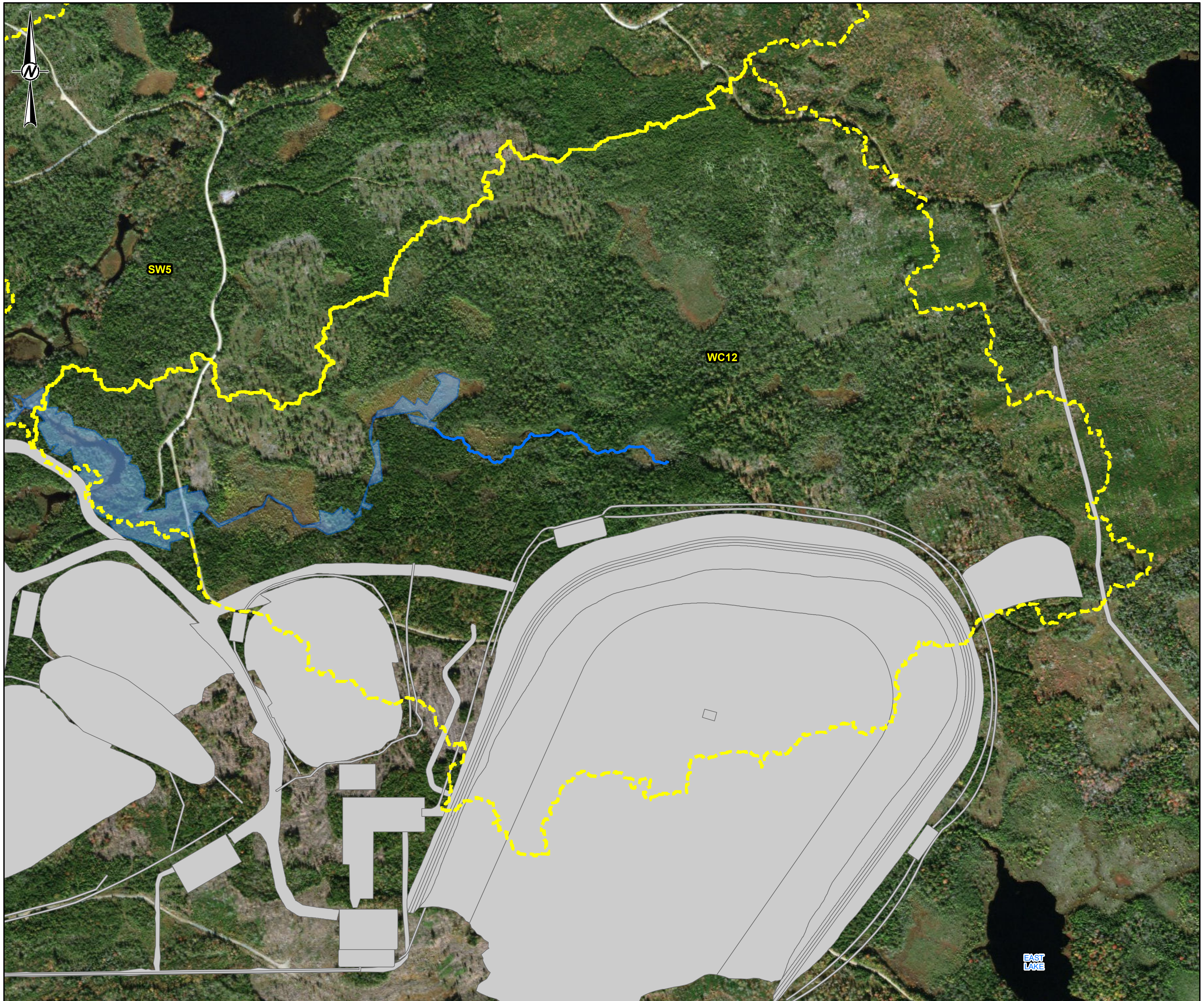
TITLE
FLOOD EXTENT
CLOSURE PHASE / RECLAMATION STAGE JULY FLOW

CONSULTANT

GOLDER

YYYY-MM-DD	2019-10-01
DESIGNED	---
PREPARED	RRD
REVIEWED	SK
APPROVED	SK

PROJECT NO.	CONTROL	REV.	FIGURE
1895674	0029	0	A4



LEGEND

- Flooded Extent
- Infrastructure
- Watershed Boundary

0 170 340
1:10,000 METRES

NOTE(S)
1. ALL LOCATIONS ARE APPROXIMATE

REFERENCE(S)
1. MCCALLUM ENVIRONMENTAL LTD. EIS PROJECT AREA, (VER.190313, RECEIVED 2019-03-18).
2. MCCALLUM ENVIRONMENTAL LTD. PROPOSED INFRASTRUCTURE, (VER.190620, RECEIVED 2019-06-28).
PROJECTION: TRANSVERSE MERCATOR DATUM: NAD 83
COORDINATE SYSTEM: UTM ZONE 20 VERTICAL DATUM: CGVD28

CLIENT
ATLANTIC MINING NS CORP

Atlantic Gold

PROJECT
HYDROLOGICAL AND SURFACE WATER QUALITY MODELLING ASSESSMENTS FOR WATERCOURSE 12, FIFTEEN MILE STREAM PROJECT

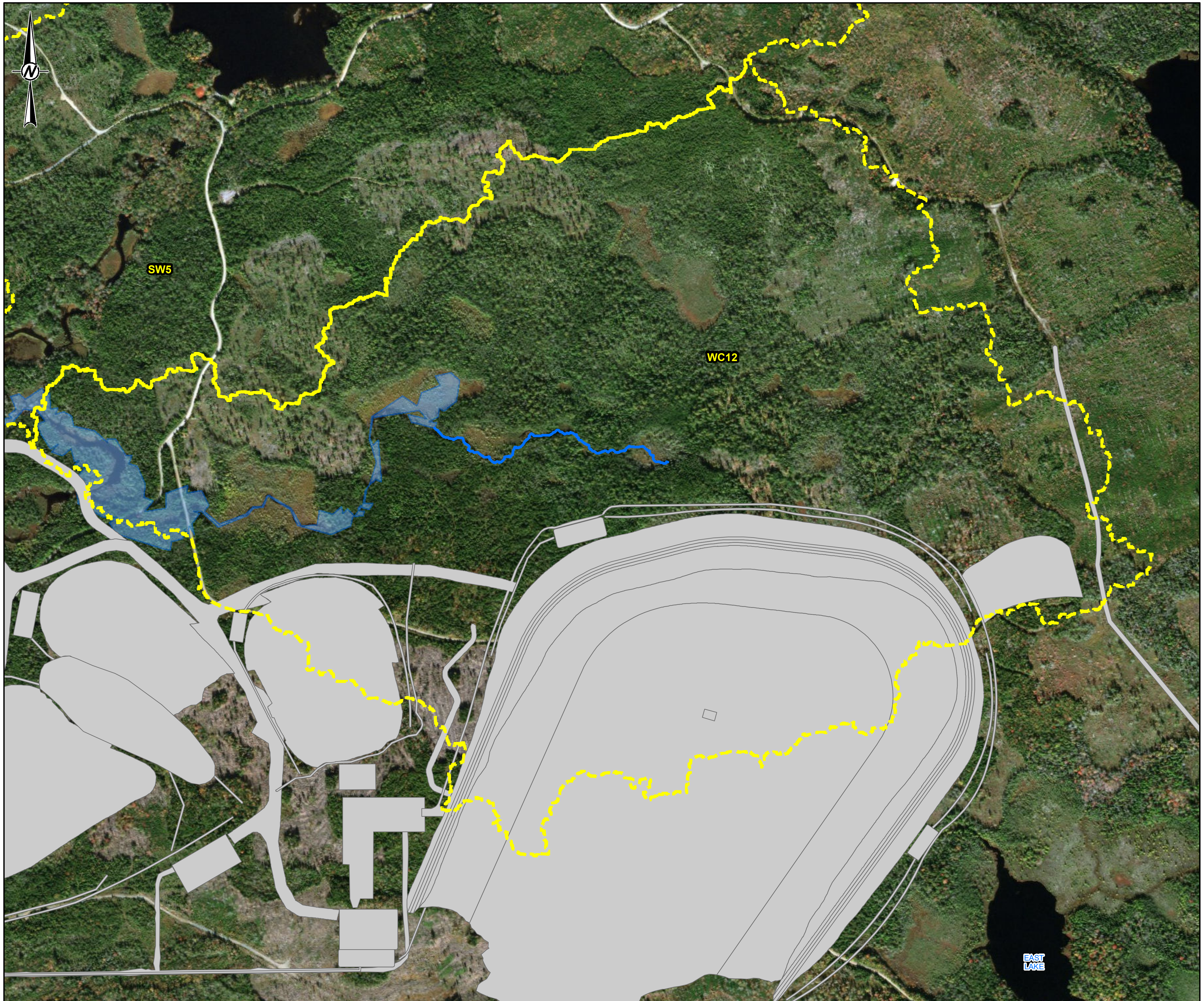
TITLE
FLOOD EXTENT
CLOSURE PHASE / POST-CLOSURE STAGE MARCH FLOW

CONSULTANT
GOLDER

YYYY-MM-DD	2019-10-01
DESIGNED	---
PREPARED	RRD
REVIEWED	SK
APPROVED	SK

PROJECT NO.	CONTROL	REV.	FIGURE
1895674	0029	0	A5

25mm
IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B



LEGEND

- Flooded Extent
- Infrastructure
- Watershed Boundary

0 170 340

1:10,000 METRES

NOTE(S)

1. ALL LOCATIONS ARE APPROXIMATE

REFERENCE(S)

1. MCCALLUM ENVIRONMENTAL LTD. EIS PROJECT AREA, (VER.190313, RECEIVED 2019-03-18).
2. MCCALLUM ENVIRONMENTAL LTD. PROPOSED INFRASTRUCTURE, (VER.190620, RECEIVED 2019-06-28).

PROJECTION: TRANSVERSE MERCATOR DATUM: NAD 83
COORDINATE SYSTEM: UTM ZONE 20 VERTICAL DATUM: CGVD28

CLIENT
ATLANTIC MINING NS CORP
Atlantic Gold

PROJECT
HYDROLOGICAL AND SURFACE WATER QUALITY MODELLING ASSESSMENTS FOR WATERCOURSE 12, FIFTEEN MILE STREAM PROJECT

TITLE
FLOOD EXTENT
CLOSURE PHASE / POST-CLOSURE STAGE JULY FLOW

CONSULTANT
GOLDER

YYYY-MM-DD	2019-10-01
DESIGNED	---
PREPARED	RRD
REVIEWED	SK
APPROVED	SK

PROJECT NO.	CONTROL	REV.	FIGURE
1895674	0029	0	A6

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

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APPENDIX B

Water Quality Results

APPENDIX B: WATER QUALITY MODEL RESULTS, OPERATIONS PHASE - PREDICTED CONCENTRATIONS IN RECEIVER WATER BODIES (USING BASE CASE SOURCE TERMS)

Parameter	CCME CWQG (1) (mg/L)	NSEQS (2) (mg/L)	FEQG (3) (mg/L)	SSWQO (4) (mg/L)	95th Percentile Baseline Concentration (mg/L) (4)	Predicted Concentration (mg/L) (5)		
					SW2	WC12		
						mean	5%	95%
Aluminum	0.0050 (7)	0.0050	-	-	**0.16**	**0.13**	**0.12**	**0.13**
Ammonia (total)	-	-	-	-	0.025	0.024	0.023	0.024
Ammonia (un-ionized)	0.019	-	-	-	0.0000208	0.00000052	0.00000051	0.00000054
Antimony	-	0.020	-	-	0.00050	0.00049	0.00048	0.00049
Arsenic	0.0050	0.0050	-	0.03	0.00050	0.00098	0.00069	0.00119
Boron	1.5	1.20	-	-	0.025	0.025	0.024	0.025
Cadmium	0.000040 (8)	- (9)	-	-	0.000019	0.000013	0.000013	0.000014
Calcium	-	-	-	-	0.58	1.5	0.86	1.9
Chromium	0.0089	-	-	-	0.00080	0.00054	0.00053	0.00055
Cobalt	-	0.010	0.00078 (10)	-	0.00020	0.00020	0.00019	0.00021
Copper	0.0020 (10)	0.0020	-	-	0.0010	0.00080	0.00079	0.00082
Iron	0.30	0.30	-	-	0.20	0.13	0.13	0.14
Lead	0.0010 (10)	0.0010	-	-	0.00025	0.00024	0.00023	0.00024
Magnesium	-	-	-	-	0.36	0.44	0.36	0.50
Manganese	-	0.820	-	-	0.079	0.044	0.044	0.045
Mercury	0.000026	0.000026	-	-	0.0000065	0.0000067	0.0000066	0.0000070
Molybdenum	0.073	0.073	-	-	0.0010	0.0016	0.0012	0.0019
Nickel	0.025 (10)	0.025	-	-	0.0010	0.0010	0.0010	0.0010
Nitrate	3	-	-	-	0.025	0.0047	0.0047	0.0049
Nitrite	0.060	-	-	-	0.0050	0.0047	0.0047	0.0049
Potassium	-	-	-	-	0.30	1.5	0.72	2.1
Selenium	0.0010	0.0010	-	-	0.00050	0.00049	0.00049	0.00050
Silver	0.00025	0.00010	-	-	0.000050	0.000048	0.000047	0.000049
Sodium	-	-	-	-	2.4	4.7	3.1	5.8
Sulphate	-	-	-	-	1.0	6.4	2.9	8.9
Thallium	0.00080	0.00080	-	-	0.000050	0.000048	0.000047	0.000049
Uranium	0.015	0.30	-	-	0.000050	0.000055	0.000052	0.000057
Zinc	0.007 (11)	0.030	-	-	0.0025	0.0028	0.0026	0.0030

Notes

(1) - Canadian Council of Ministers of the Environment (1999 updated in 2019). Canadian Environmental Quality Guidelines for the Protection of Aquatic Life. Accessed February 6, 2019.

(2) - Nova Scotia Environment Environmental Quality Standards for Surface Water, Table 3 (July 2013).

(3) - Environment Canada Federal Environmental Quality Guideline: Cobalt (May 2017).

(4) - Site-specific water quality objective for arsenic (Intrinsik 2019).

(5) - Statistics calculated from the available surface water quality baseline dataset (June 2017 to June 2019).

(6) - Predicted annual concentration calculated from the GoldSim stochastic model using the base case geochemical source terms (Lorax 2019); statistics presented are the mean, 5 th percentile and 95th percentile.

(7) - Guideline is variable and dependent on pH values. Refer to CCME (2019) for method of calculation.

(8) - Guideline is variable and dependent on hardness concentrations. Refer to CCME (2019) for method of calculation.

(9) - The NSEQS for cadmium is based on a 2007 CCME CWQG and is not considered herein; rather, the updated 2014 CCME CWQG is used as the comparison criteria.

(10) - Guideline is variable and dependent on hardness. Refer to Environment Canada (2017) for method of calculation.

(11) - Guideline is for dissolved zinc; guideline is variable and dependent on hardness, dissolved organic carbon, and pH. Refer to CCME (2019) for method of calculation.

0.1	Bolding indicates a concentration greater than the CCME CWQG.
0.1	Grey shading indicates a concentration greater than the NSEQS.
0.1	Double outline indicates a concentration greater than the FEQG.
0.1	Bold outline indicates a concentration greater than the SSWQO.
0.1	Underlining indicates a concentration greater than the 95th percentile baseline concentration.

Parameter	CCME CWQG (1) (mg/L)	NSEQS (2) (mg/L)	FEQG (3) (mg/L)	SSWQO (4) (mg/L)	95th Percentile Baseline Concentration (mg/L) (5)	Predicted Concentration (mg/L) (6)		
						WC12		
					SW2	mean	5%	95%
Aluminum	0.0050 (7)	0.0050	-	-	**0.16**	**0.13**	**0.13**	**0.14**
Ammonia (total)	-	-	-	-	0.025	0.024	0.023	0.024
Ammonia (un-ionized)	0.019	-	-	-	0.000021	0.00000052	0.00000051	0.00000054
Antimony	-	0.020	-	-	0.00050	0.00049	0.00048	0.00049
Arsenic	0.0050	0.0050	-	0.03	0.00050	0.0010	0.00076	0.0012
Boron	1.5	1.20	-	-	0.025	0.025	0.024	0.025
Cadmium	0.000040 (8)	- (9)	-	-	0.000019	0.000014	0.000013	0.000014
Calcium	-	-	-	-	0.58	1.5	0.86	1.9
Chromium	0.0089	-	-	-	0.00080	0.00054	0.00053	0.00056
Cobalt	-	0.010	0.00078 (10)	-	0.00020	0.00020	0.00019	0.00021
Copper	0.0020 (10)	0.0020	-	-	0.0010	0.00082	0.00081	0.00086
Iron	0.30	0.30	-	-	0.20	0.14	0.13	0.14
Lead	0.0010 (10)	0.0010	-	-	0.00025	0.00025	0.00024	0.00026
Magnesium	-	-	-	-	0.36	0.44	0.36	0.50
Manganese	-	0.820	-	-	0.079	0.045	0.044	0.046
Mercury	0.000026	0.000026	-	-	0.0000065	0.0000067	0.0000066	0.0000070
Molybdenum	0.073	0.073	-	-	0.0010	0.0016	0.0012	0.0019
Nickel	0.025 (10)	0.025	-	-	0.0010	0.0010	0.0010	0.0010
Nitrate	3	-	-	-	0.025	0.0047	0.0047	0.0049
Nitrite	0.060	-	-	-	0.0050	0.0047	0.0047	0.0049
Potassium	-	-	-	-	0.30	1.6	0.73	2.1
Selenium	0.0010	0.0010	-	-	0.00050	0.00050	0.00049	0.00051
Silver	0.00025	0.00010	-	-	0.000050	0.000048	0.000047	0.000049
Sodium	-	-	-	-	2.4	4.7	3.1	5.8
Sulphate	-	-	-	-	1.0	6.4	2.9	8.9
Thallium	0.00080	0.00080	-	-	0.000050	0.000048	0.000047	0.000049
Uranium	0.015	0.30	-	-	0.000050	0.000055	0.000052	0.000057
Zinc	0.007 (11)	0.030	-	-	0.0025	0.0029	0.0027	0.0030

Notes

(1) - Canadian Council of Ministers of the Environment (1999 updated in 2019). Canadian Environmental Quality Guidelines for the Protection of Aquatic Life. Accessed February 6, 2019.

(2) - Nova Scotia Environment Environmental Quality Standards for Surface Water, Table 3 (July 2013).

(3) - Environment Canada Federal Environmental Quality Guideline: Cobalt (May 2017).

(4) - Site-specific water quality objective for arsenic (Intrinsik 2019).

(5) - Statistics calculated from the available surface water quality baseline dataset (June 2017 to June 2019).

(6) - Predicted annual concentration calculated from the GoldSim stochastic model using the base case geochemical source terms (Lorax 2019); statistics presented are the mean, 5th percentile and 95th percentile.

(7) - Guideline is variable and dependent on pH values. Refer to CCME (2019) for method of calculation.

(8) - Guideline is variable and dependent on hardness concentrations. Refer to CCME (2019) for method of calculation.

(9) - The NSEQS for cadmium is based on a 2007 CCME CWQG and is not considered herein; rather, the updated 2014 CCME CWQG is used as the comparison criteria.

(10) - Guideline is variable and dependent on hardness. Refer to Environment Canada (2017) for method of calculation.

(11) - Guideline is for dissolved zinc; guideline is variable and dependent on hardness, dissolved organic carbon, and pH. Refer to CCME (2019) for method of calculation.

0.1	Bolding indicates a concentration greater than the CCME CWQG.
0.1	Grey shading indicates a concentration greater than the NSEQS.
0.1	Double outline indicates a concentration greater than the FEQG.
0.1	Bold outline indicates a concentration greater than the SSWQO.
0.1	Underlining indicates a concentration greater than the 95th percentile baseline concentration.

APPENDIX B: WATER QUALITY MODEL RESULTS, POST-CLOSURE PHASE - PREDICTED CONCENTRATIONS IN RECEIVER WATER BODIES (USING BASE CASE SOURCE TERMS)

Parameter	CCME CWQG (1) (mg/L)	NSEQS (2) (mg/L)	FEQG (3) (mg/L)	SSWQO (4) (mg/L)	95th Percentile Baseline Concentration (mg/L) (5)	Predicted Concentration (mg/L) (6)		
					SW2	WC12		
						mean	5%	95%
Aluminum	0.0050 (7)	0.0050	-	-	**0.16**	**0.13**	**0.12**	**0.13**
Ammonia (total)	-	-	-	-	0.025	0.025	0.025	0.025
Ammonia (un-ionized)	0.019	-	-	-	0.0000208	0.00000055	0.00000055	0.00000056
Antimony	-	0.020	-	-	0.00050	0.00048	0.00047	0.00049
Arsenic	0.0050	0.0050	-	0.03	0.00050	0.0024	0.00120	0.0032
Boron	1.5	1.20	-	-	0.025	0.026	0.025	0.026
Cadmium	0.000040 (8)	-(9)	-	-	0.000019	0.000013	0.000013	0.000014
Calcium	-	-	-	-	0.58	2.0	1.1	2.7
Chromium	0.0089	-	-	-	0.00080	0.00054	0.00053	0.00055
Cobalt	-	0.010	0.00078 (10)	-	0.00020	0.00020	0.00019	0.00021
Copper	0.0020 (10)	0.0020	-	-	0.0010	0.0008	0.0008	0.0008
Iron	0.30	0.30	-	-	0.20	0.13	0.13	0.14
Lead	0.0010 (10)	0.0010	-	-	0.00025	0.00024	0.00024	0.00025
Magnesium	-	-	-	-	0.36	0.54	0.40	0.64
Manganese	-	0.820	-	-	0.079	0.052	0.048	0.055
Mercury	0.000026	0.000026	-	-	0.0000065	0.0000067	0.0000066	0.0000069
Molybdenum	0.073	0.073	-	-	0.0010	0.0024	0.0015	0.0030
Nickel	0.025 (10)	0.025	-	-	0.0010	0.0010	0.0010	0.0010
Nitrate	3	-	-	-	0.025	0.0049	0.0049	0.0050
Nitrite	0.060	-	-	-	0.0050	0.0049	0.0049	0.0050
Potassium	-	-	-	-	0.30	1.7	0.78	2.3
Selenium	0.0010	0.0010	-	-	0.00050	0.00049	0.00049	0.00050
Silver	0.00025	0.00010	-	-	0.000050	0.000048	0.000048	0.000049
Sodium	-	-	-	-	2.4	5.3	3.3	6.7
Sulphate	-	-	-	-	1.0	8.9	3.9	12
Thallium	0.00080	0.00080	-	-	0.000050	0.000048	0.000048	0.000049
Uranium	0.015	0.30	-	-	0.000050	0.000057	0.000053	0.000060
Zinc	0.007 (11)	0.030	-	-	0.0025	0.0024	0.0024	0.0025

Notes

(1) - Canadian Council of Ministers of the Environment (1999 updated in 2019). Canadian Environmental Quality Guidelines for the Protection of Aquatic Life. Accessed February 6, 2019.

(2) - Nova Scotia Environment Environmental Quality Standards for Surface Water, Table 3 (July 2013).

(3) - Environment Canada Federal Environmental Quality Guideline: Cobalt (May 2017).

(4) - Site-specific water quality objective for arsenic (Intrinsik 2019).

(5) - Statistics calculated from the available surface water quality baseline dataset (June 2017 to June 2019).

(6) - Predicted annual concentration calculated from the GoldSim stochastic model using the base case geochemical source terms (Lorax 2019); statistics presented are the mean, 5 th percentile and 95th percentile.

(7) - Guideline is variable and dependent on pH values. Refer to CCME (2019) for method of calculation.

(8) - Guideline is variable and dependent on hardness concentrations. Refer to CCME (2019) for method of calculation.

(9) - The NSEQS for cadmium is based on a 2007 CCME CWQG and is not considered herein; rather, the updated 2014 CCME CWQG is used as the comparison criteria.

(10) - Guideline is variable and dependent on hardness. Refer to Environment Canada (2017) for method of calculation.

(11) - Guideline is for dissolved zinc; guideline is variable and dependent on hardness, dissolved organic carbon, and pH. Refer to CCME (2019) for method of calculation.

0.1	Bolding indicates a concentration greater than the CCME CWQG.
0.1	Grey shading indicates a concentration greater than the NSEQS.
0.1	Double outline indicates a concentration greater than the FEQG.
0.1	Bold outline indicates a concentration greater than the SSWQO.
0.1	Underlining indicates a concentration greater than the 95th percentile baseline concentration.

GOLDER

Parameter	CCME CWQG (1) (mg/L)	NSEQS (2) (mg/L)	FEQG (3) (mg/L)	SSWQO (4) (mg/L)	95th Percentile Baseline Concentration (mg/L) (5)	Predicted Concentration (mg/L) (6)		
					SW2	WC12		
						mean	5%	95%
Aluminum	0.0050 (7)	0.0050	-	-	**0.16**	**0.13**	**0.13**	**0.14**
Ammonia (total)	-	-	-	-	0.025	0.025	0.025	0.025
Ammonia (un-ionized)	0.019	-	-	-	0.0000208	0.00000055	0.00000055	0.00000056
Antimony	-	0.020	-	-	0.00050	0.00048	0.00048	0.00049
Arsenic	0.0050	0.0050	-	0.03	0.00050	0.0043	0.0020	**0.0060**
Boron	1.5	1.20	-	-	0.025	0.026	0.025	0.026
Cadmium	0.000040 (8)	- (9)	-	-	0.000019	0.000014	0.000014	0.000015
Calcium	-	-	-	-	0.58	2.1	1.1	2.8
Chromium	0.0089	-	-	-	0.00080	0.00055	0.00054	0.00056
Cobalt	-	0.010	0.00078 (10)	-	0.00020	0.00020	0.00020	0.00021
Copper	0.0020 (10)	0.0020	-	-	0.0010	0.00083	0.00082	0.00086
Iron	0.30	0.30	-	-	0.20	0.14	0.13	0.14
Lead	0.0010 (10)	0.0010	-	-	0.00025	0.00025	0.00024	0.00026
Magnesium	-	-	-	-	0.36	0.56	0.41	0.67
Manganese	-	0.820	-	-	0.079	0.058	0.050	0.063
Mercury	0.000026	0.000026	-	-	0.0000065	0.0000067	0.0000066	0.0000069
Molybdenum	0.073	0.073	-	-	0.0010	0.0029	0.0017	0.0038
Nickel	0.025 (10)	0.025	-	-	0.0010	0.0010	0.0010	0.0010
Nitrate	3	-	-	-	0.025	0.0057	0.0052	0.0060
Nitrite	0.060	-	-	-	0.0050	0.0049	0.0049	0.0050
Potassium	-	-	-	-	0.30	1.9	0.86	2.6
Selenium	0.0010	0.0010	-	-	0.00050	0.00050	0.00049	0.00051
Silver	0.00025	0.00010	-	-	0.000050	0.000048	0.000048	0.000049
Sodium	-	-	-	-	2.4	5.4	3.4	6.8
Sulphate	-	-	-	-	1.0	9.6	4.1	13.5
Thallium	0.00080	0.00080	-	-	0.000050	0.000048	0.000048	0.000049
Uranium	0.015	0.30	-	-	0.000050	0.000058	0.000053	0.000061
Zinc	0.007 (11)	0.030	-	-	0.0025	0.0025	0.0024	0.0026

Notes

(1) - Canadian Council of Ministers of the Environment (1999 updated in 2019). Canadian Environmental Quality Guidelines for the Protection of Aquatic Life. Accessed February 6, 2019.

(2) - Nova Scotia Environment Environmental Quality Standards for Surface Water, Table 3 (July 2013).

(3) - Environment Canada Federal Environmental Quality Guideline: Cobalt (May 2017).

(4) - Site-specific water quality objective for arsenic (Intrinsik 2019).

(5) - Statistics calculated from the available surface water quality baseline dataset (June 2017 to June 2019).

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(8) - Guideline is variable and dependent on hardness concentrations. Refer to CCME (2019) for method of calculation.

(9) - The NSEQS for cadmium is based on a 2007 CCME CWQG and is not considered herein; rather, the updated 2014 CCME CWQG is used as the comparison criteria.

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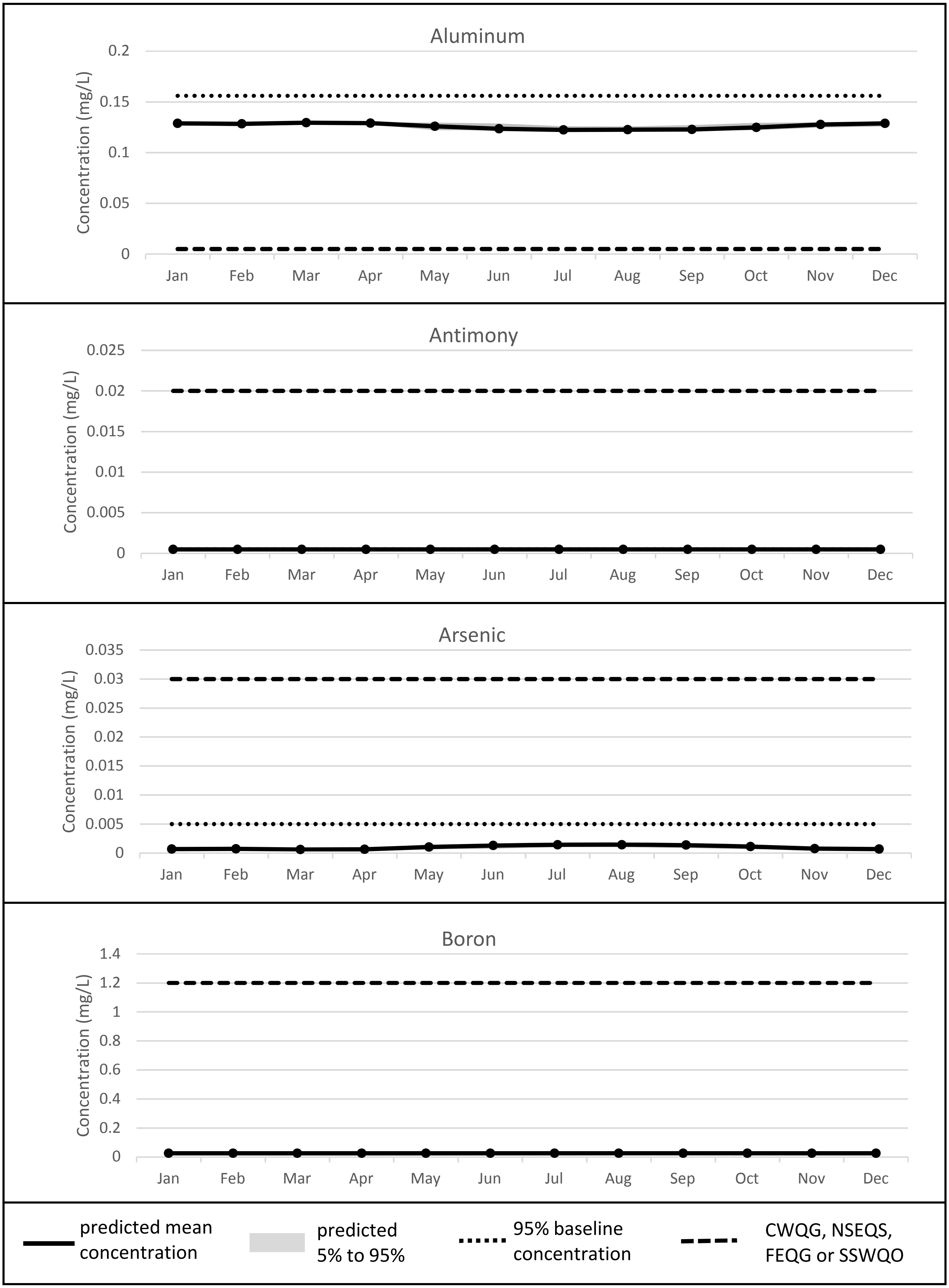
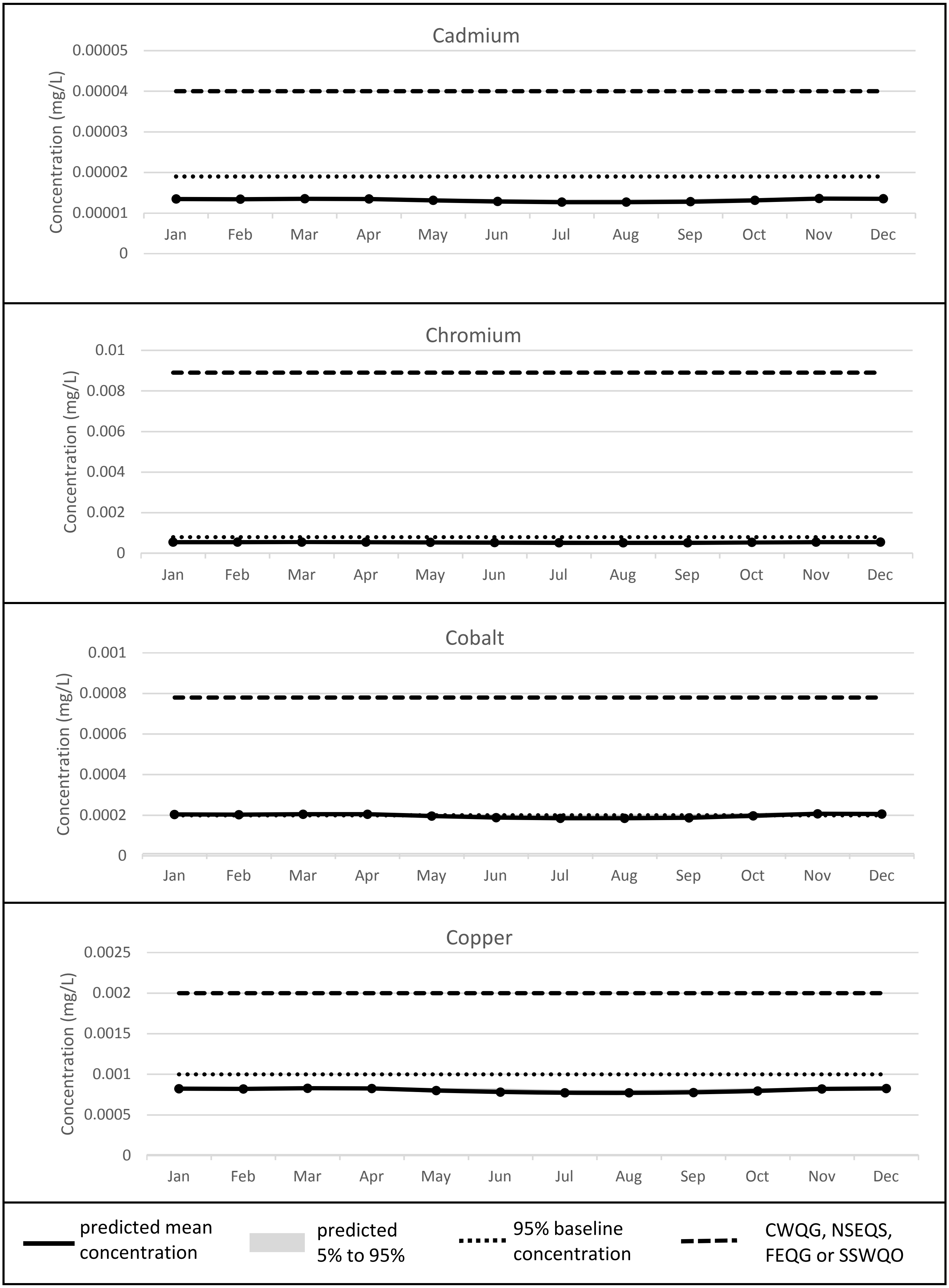
(11) - Guideline is for dissolved zinc; guideline is variable and dependent on hardness, dissolved organic carbon, and pH. Refer to CCME (2019) for method of calculation.

0.1	Bolding indicates a concentration greater than the CCME CWQG.
0.1	Grey shading indicates a concentration greater than the NSEQS.
0.1	Double outline indicates a concentration greater than the FEQG.
0.1	Bold outline indicates a concentration greater than the SSWQO.
0.1	Underlining indicates a concentration greater than the 95th percentile baseline concentration.

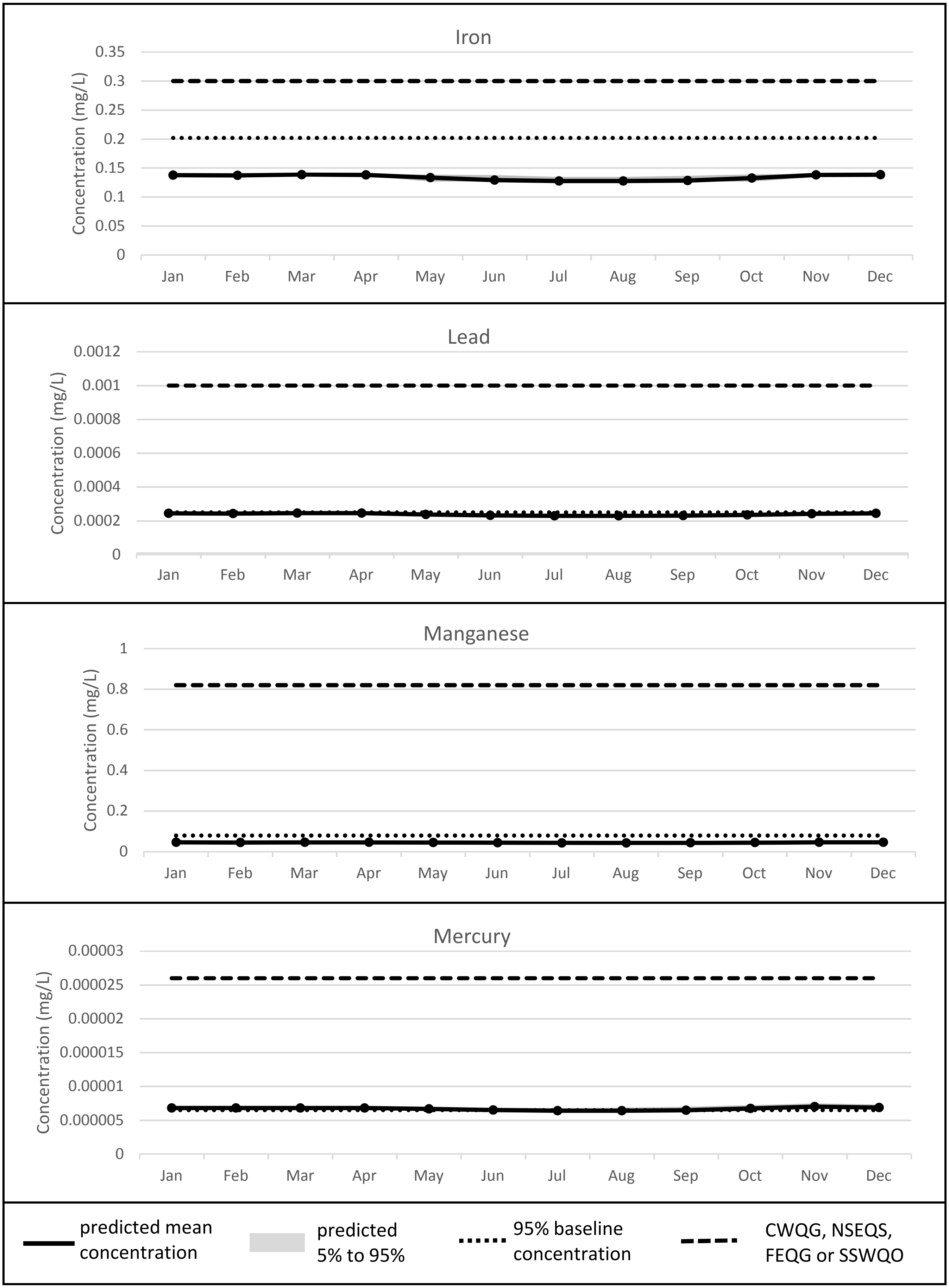
APPENDIX B: WATER QUALITY MODELLING RESULTS - OPERATIONS PHASE
PREDICTED CONCENTRATIONS AT WATERCOURSE 12 (USING BASE CASE SOURCE TERMS)



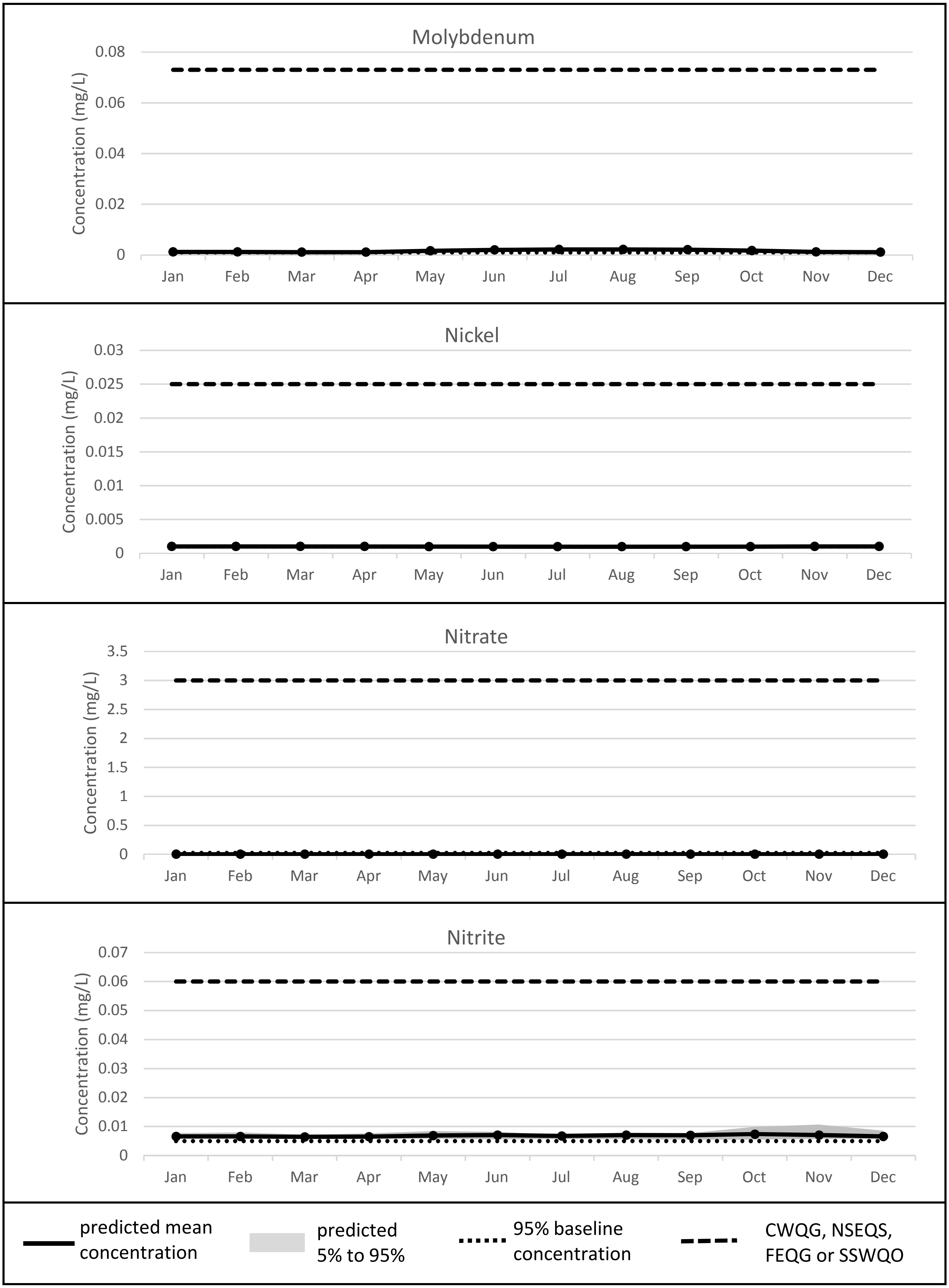
PREDICTED CONCENTRATIONS AT WATERCOURSE 12 (USING BASE CASE SOURCE TERMS)



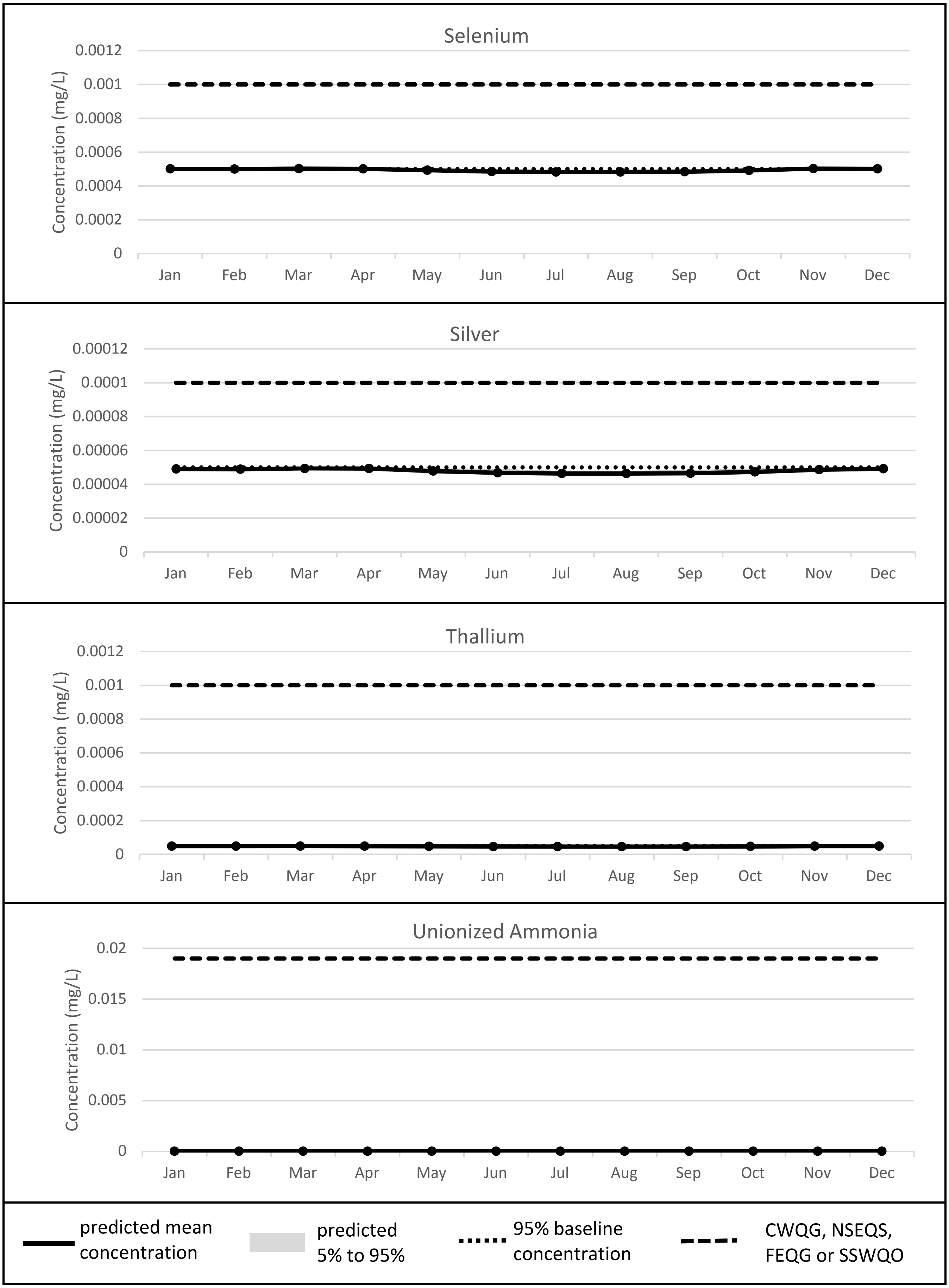
PREDICTED CONCENTRATIONS AT WATERCOURSE 12 (USING BASE CASE SOURCE TERMS)



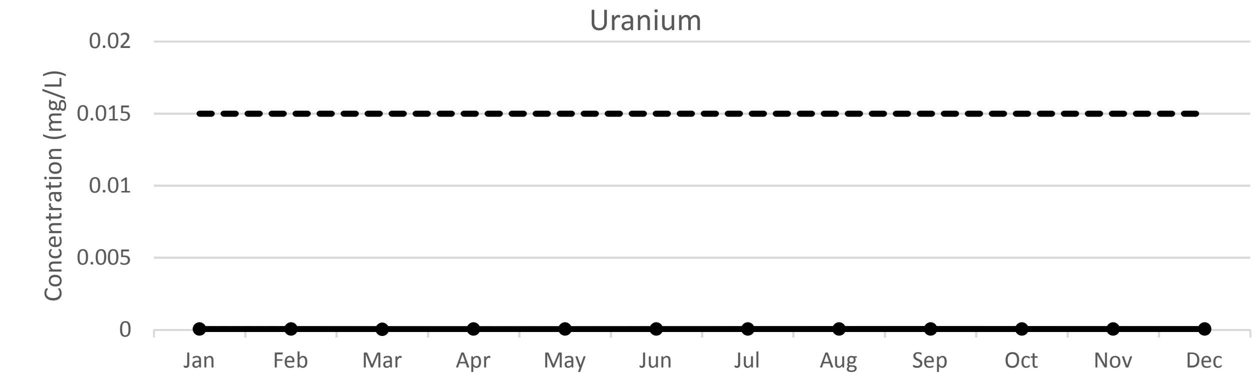
PREDICTED CONCENTRATIONS AT WATERCOURSE 12 (USING BASE CASE SOURCE TERMS)

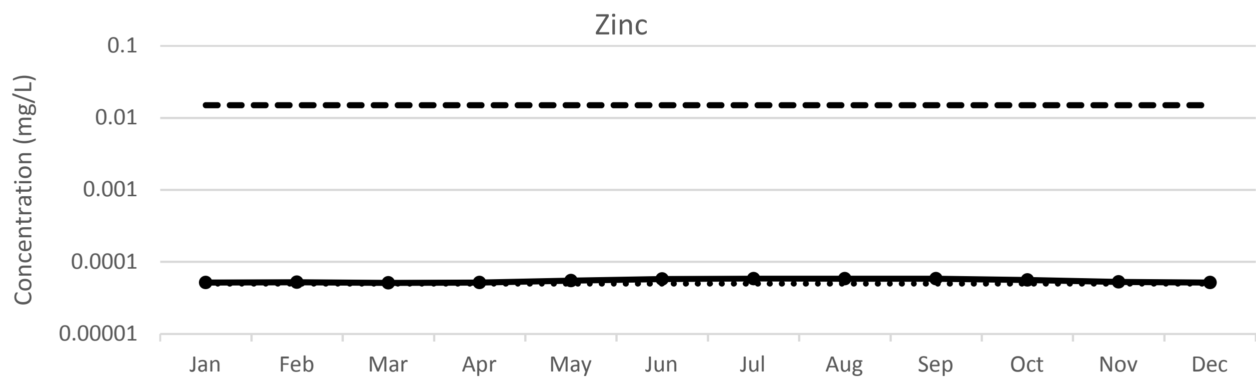


PREDICTED CONCENTRATIONS AT WATERCOURSE 12 (USING BASE CASE SOURCE TERMS)



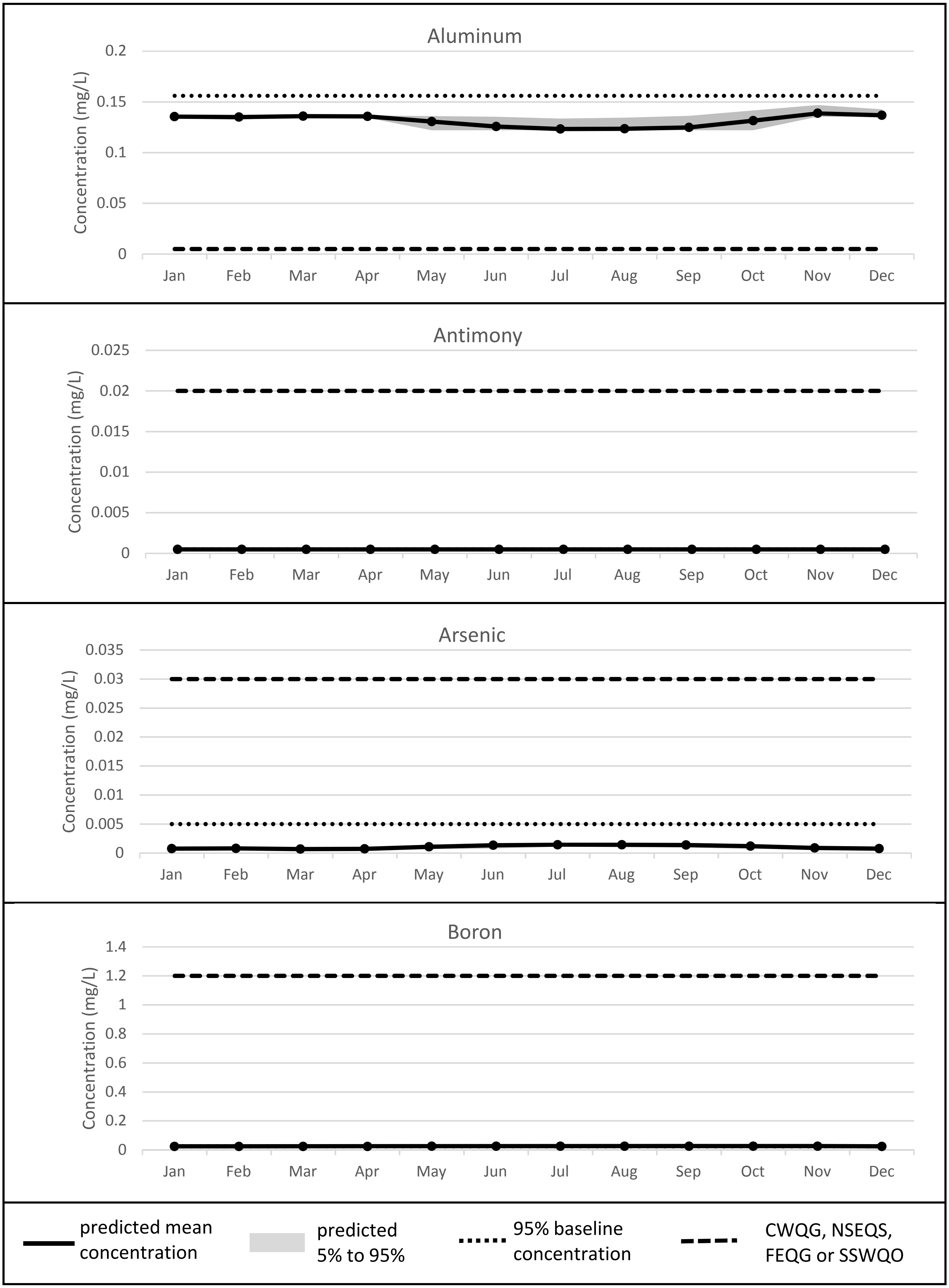
PREDICTED CONCENTRATIONS AT WATERCOURSE 12 (USING BASE CASE SOURCE TERMS)



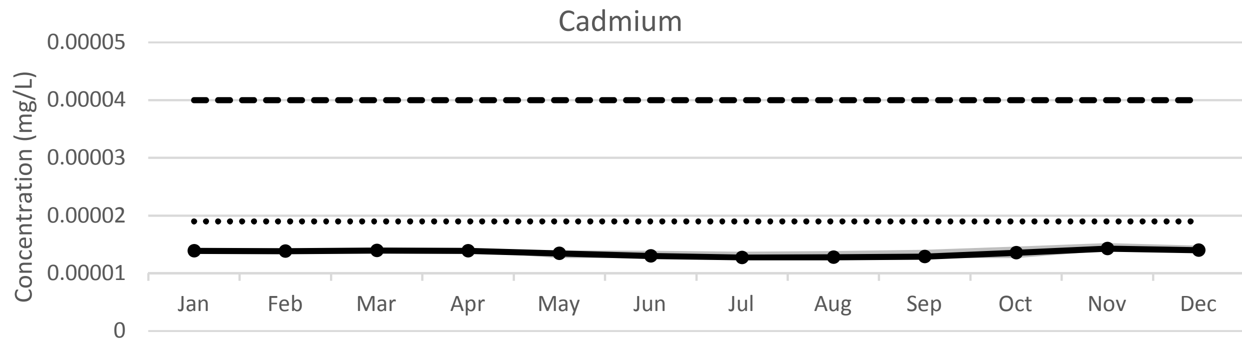


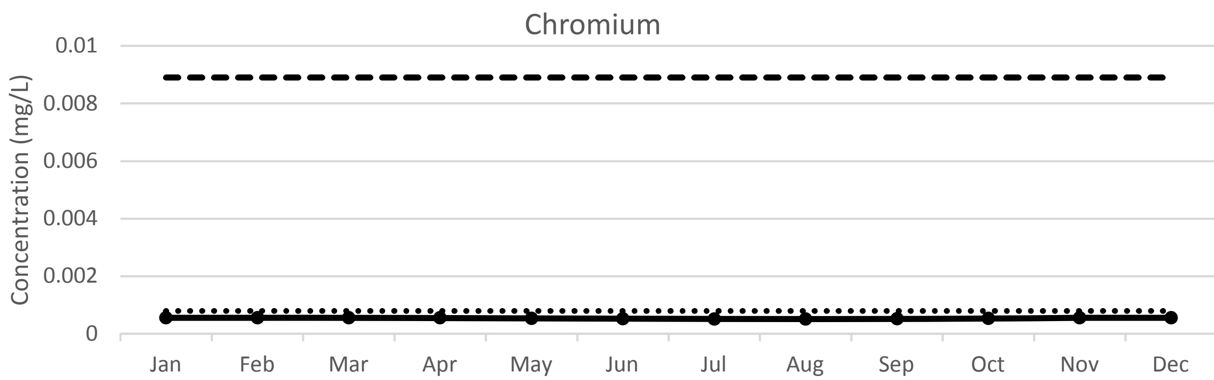
predicted mean concentration | predicted 5% to 95% | 95% baseline concentration | CWQG, NSEQS, FEQG or SSWQO

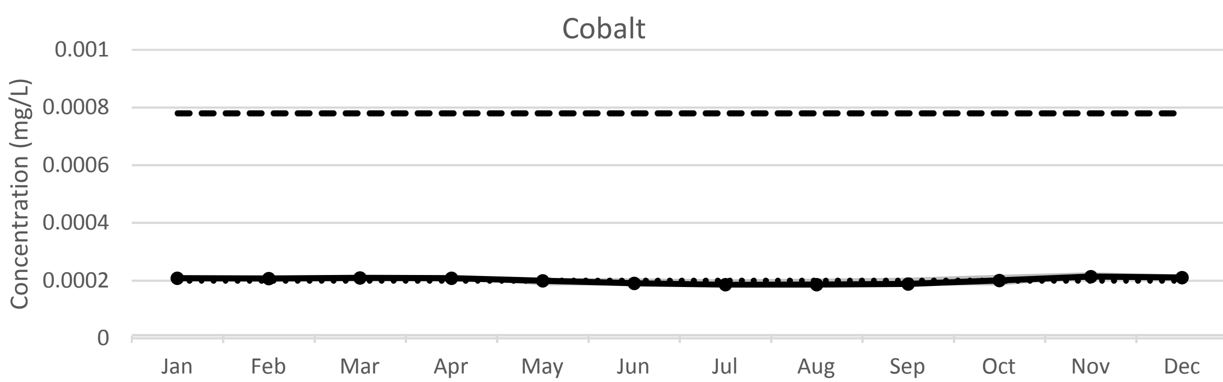
PREDICTED CONCENTRATIONS AT WATERCOURSE 12 (USING UPPER CASE SOURCE TERMS)

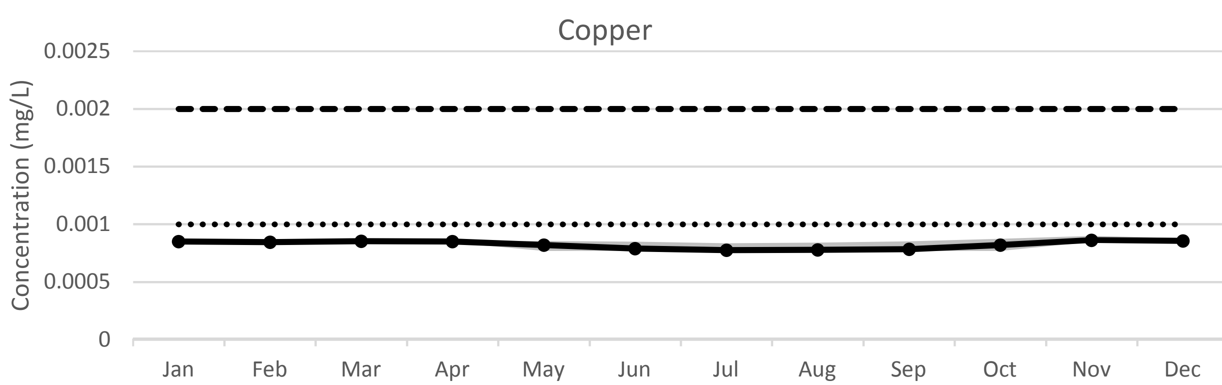


PREDICTED CONCENTRATIONS AT WATERCOURSE 12 (USING UPPER CASE SOURCE TERMS)

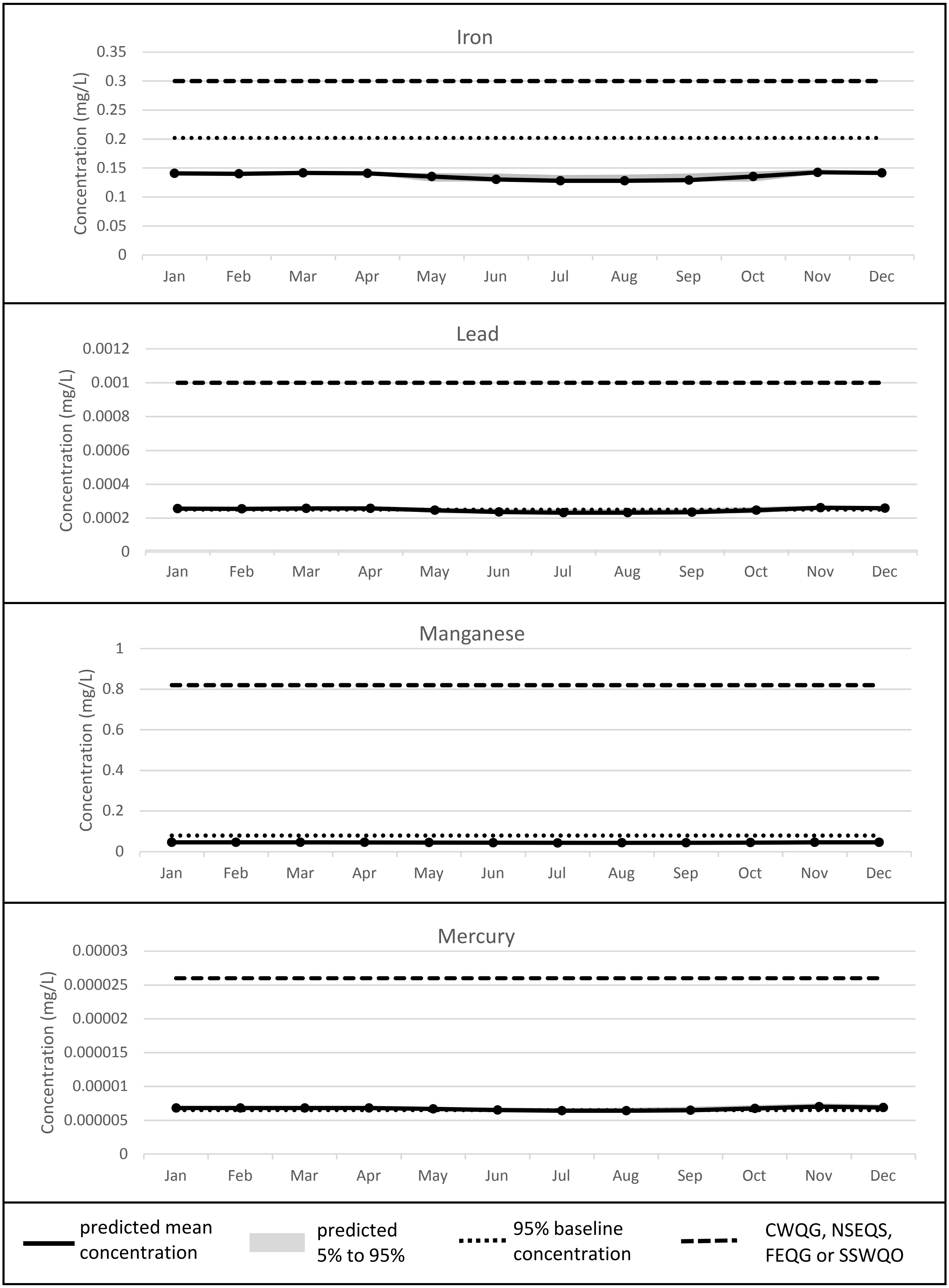




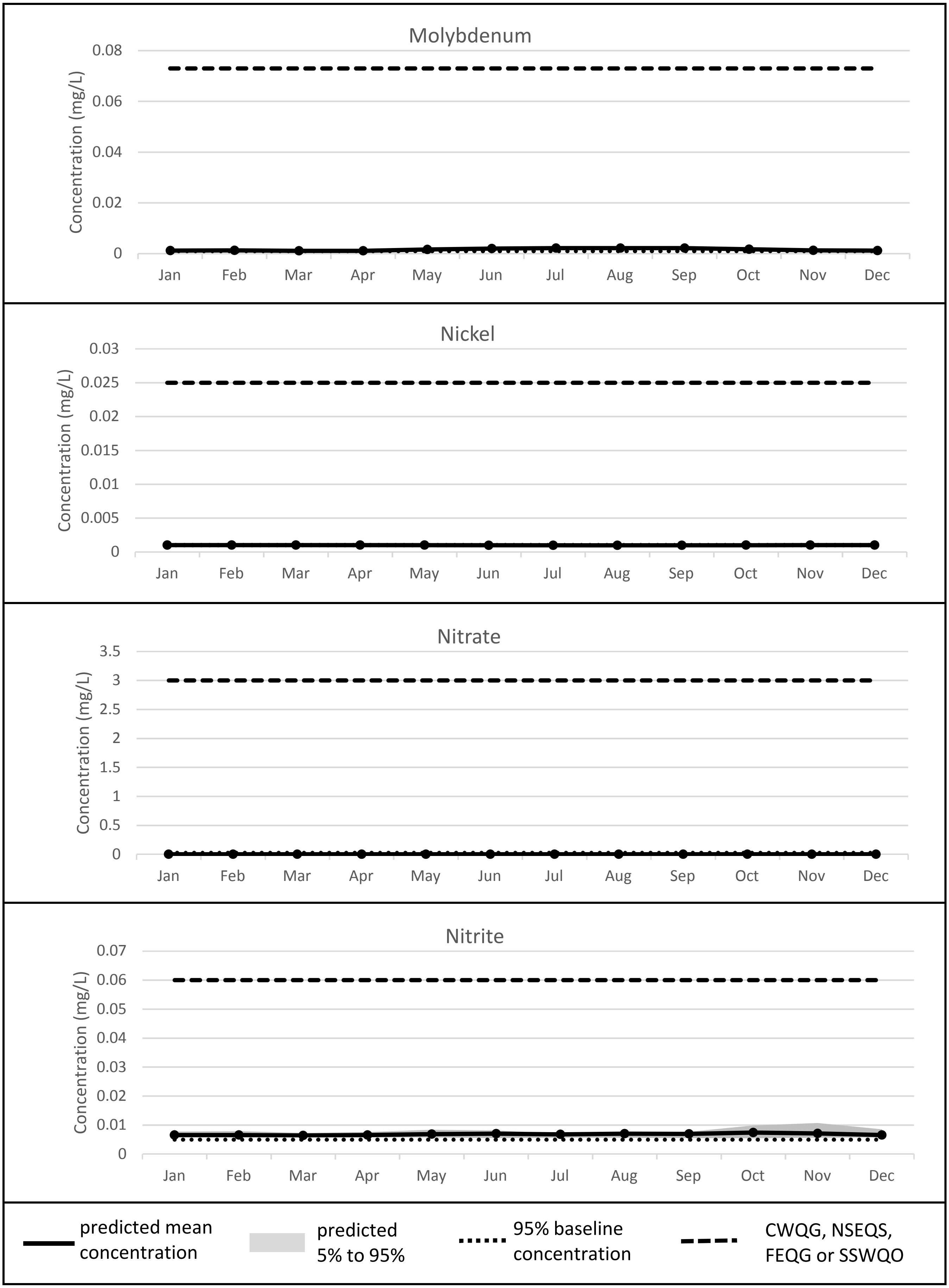




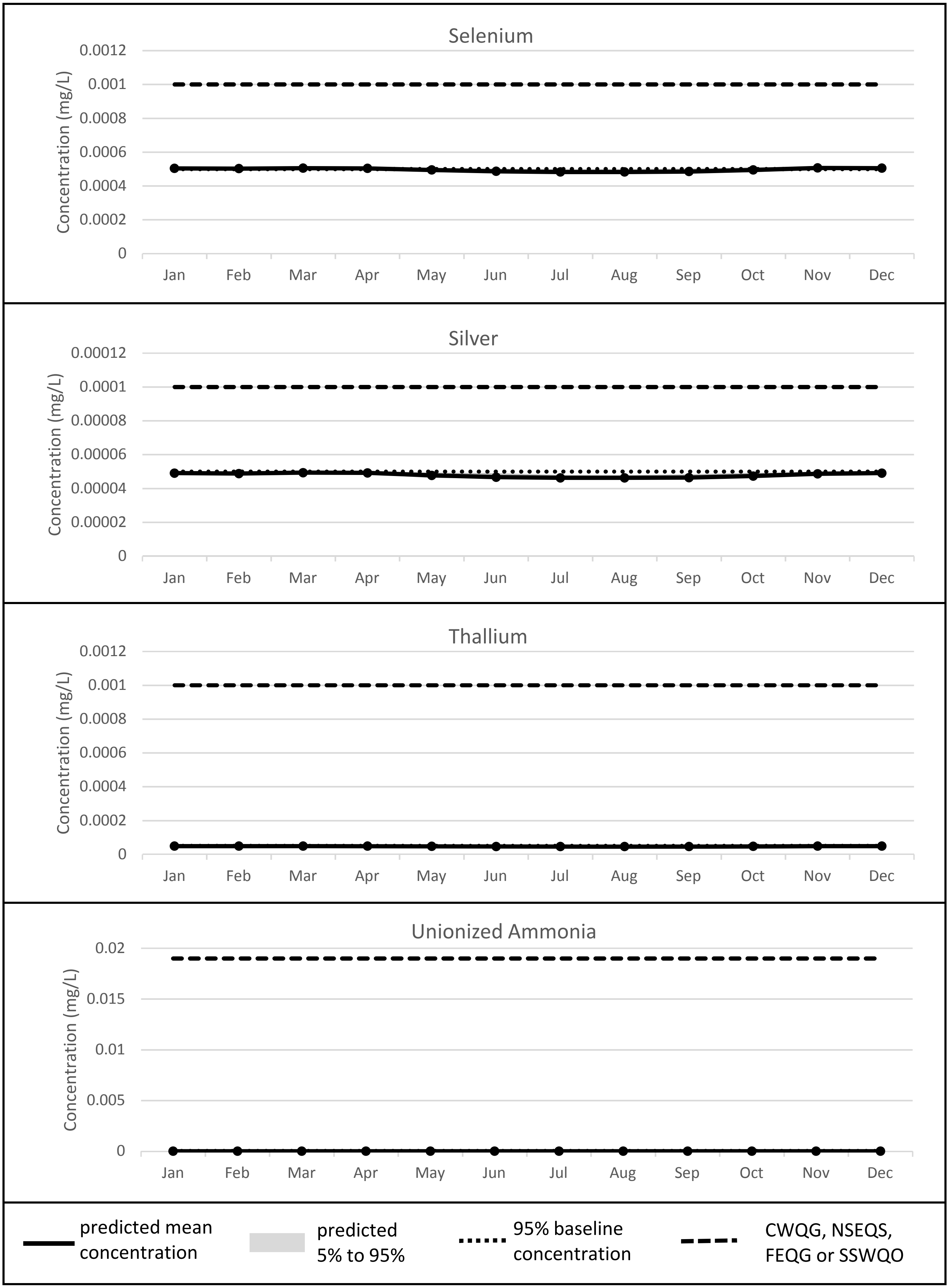
predicted mean concentration | predicted 5% to 95% | 95% baseline concentration | CWQG, NSEQS, FEQG or SSWQO


Iron
Concentration (mg/L)
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
Lead
Concentration (mg/L)
0.0012
0.001
0.0008
0.0006
0.0004
0.0002
0
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
Manganese
Concentration (mg/L)
1
0.8
0.6
0.4
0.2
0
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
Mercury
Concentration (mg/L)
0.00003
0.000025
0.00002
0.000015
0.00001
0.000005
0
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
predicted mean concentration
predicted 5% to 95%
95% baseline concentration
CWQG, NSEQS, FEQG or SSWQO

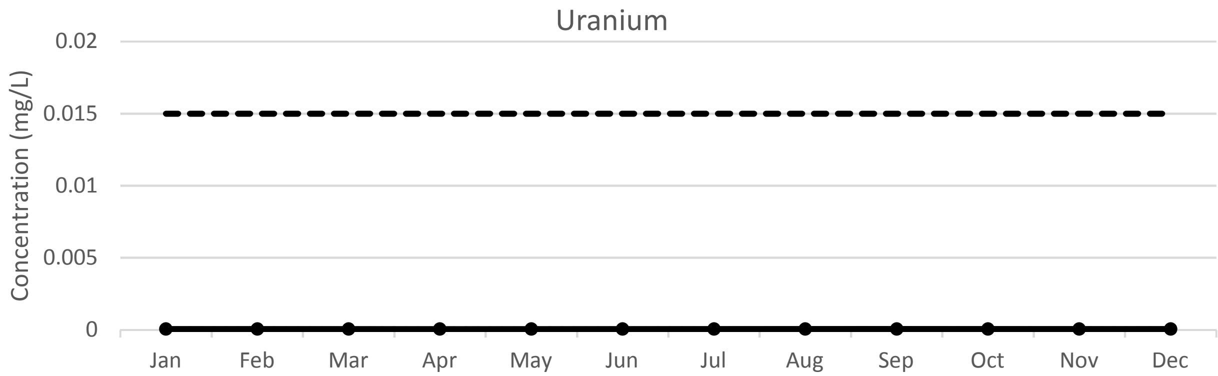
PREDICTED CONCENTRATIONS AT WATERCOURSE 12 (USING UPPER CASE SOURCE TERMS)

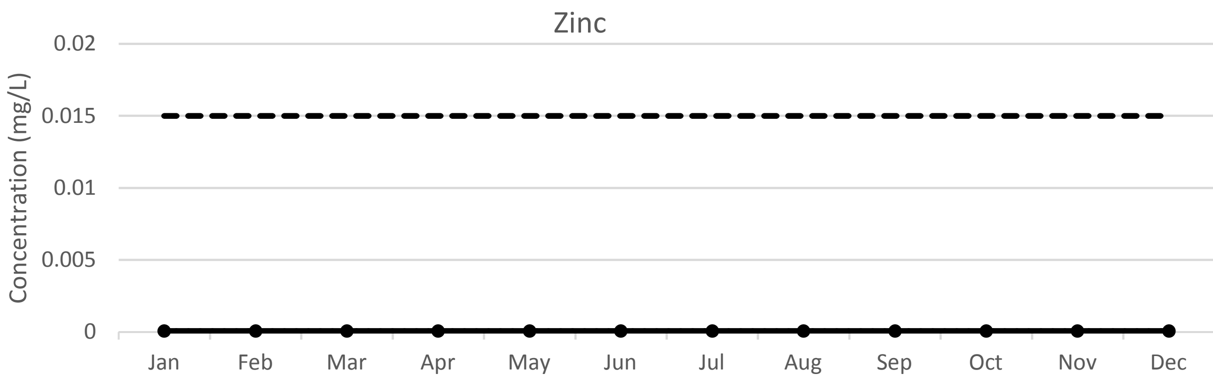


PREDICTED CONCENTRATIONS AT WATERCOURSE 12 (USING UPPER CASE SOURCE TERMS)



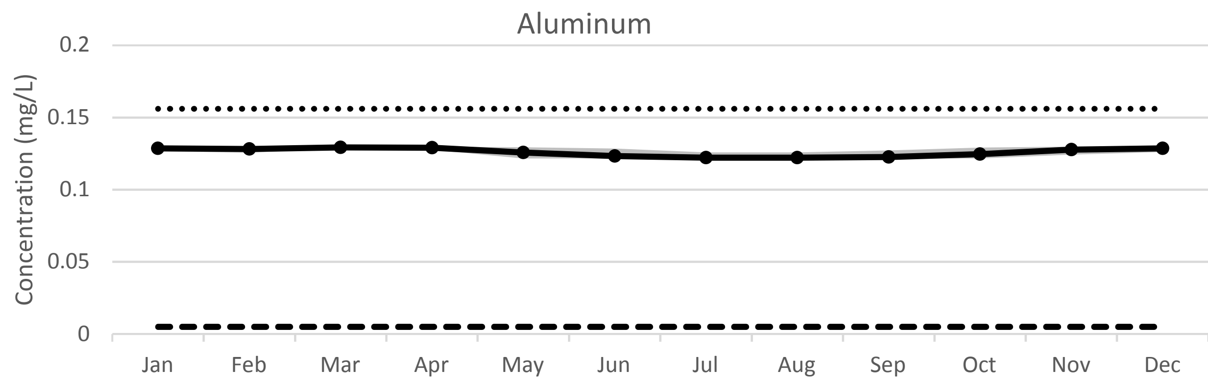
PREDICTED CONCENTRATIONS AT WATERCOURSE 12 (USING UPPER CASE SOURCE TERMS)

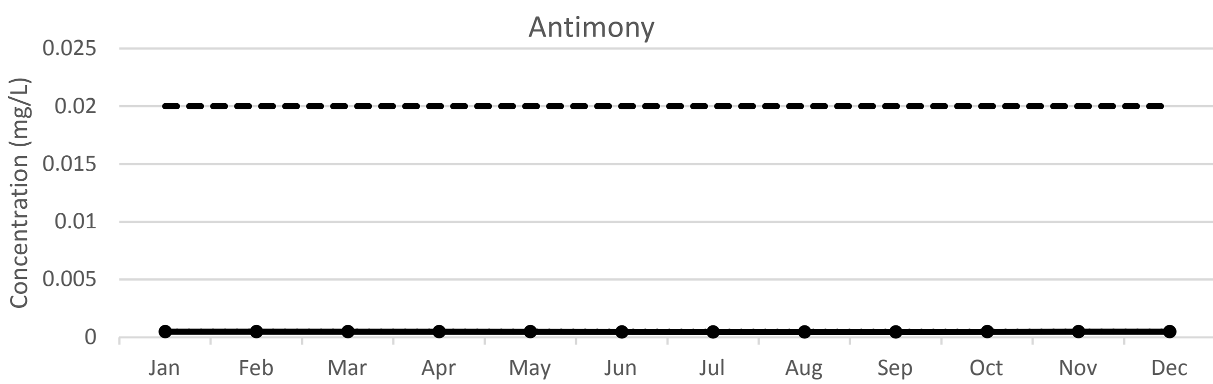


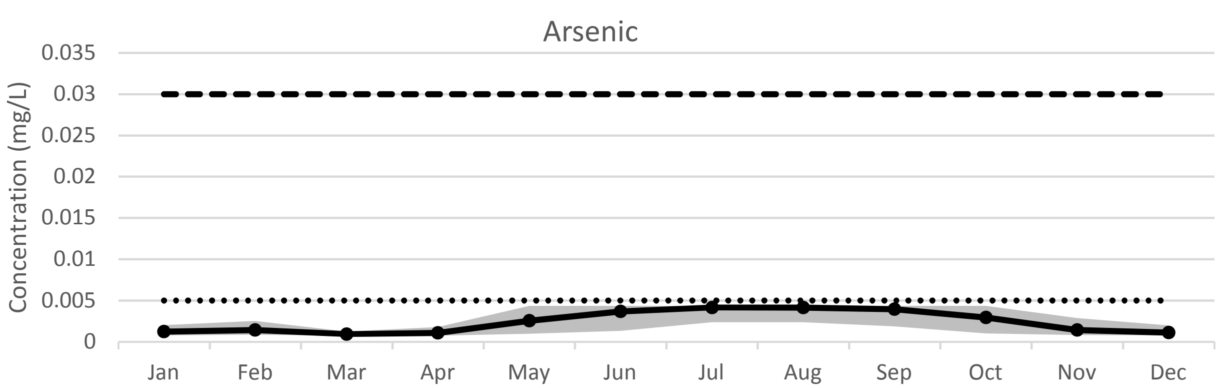


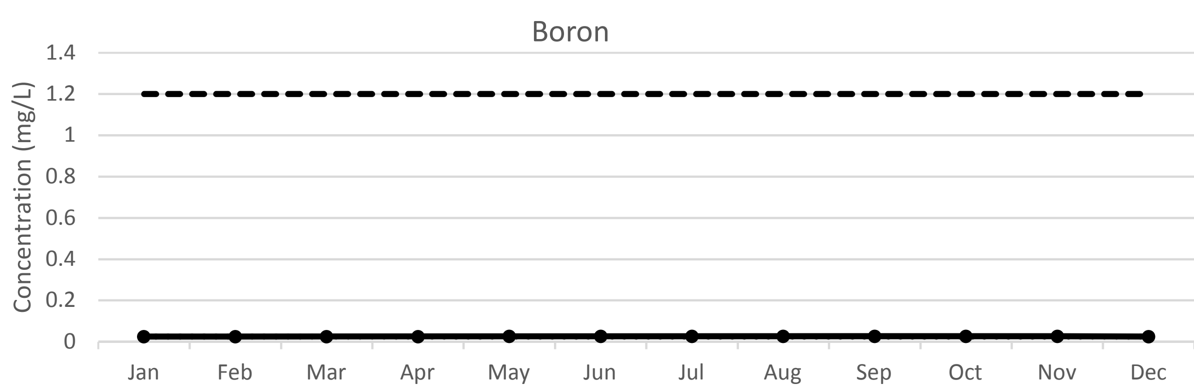
predicted mean concentration | predicted 5% to 95% | 95% baseline concentration | CWQG, NSEQS, FEQG or SSWQO

PREDICTED CONCENTRATIONS AT WATERCOURSE 12 (USING BASE CASE SOURCE TERMS)



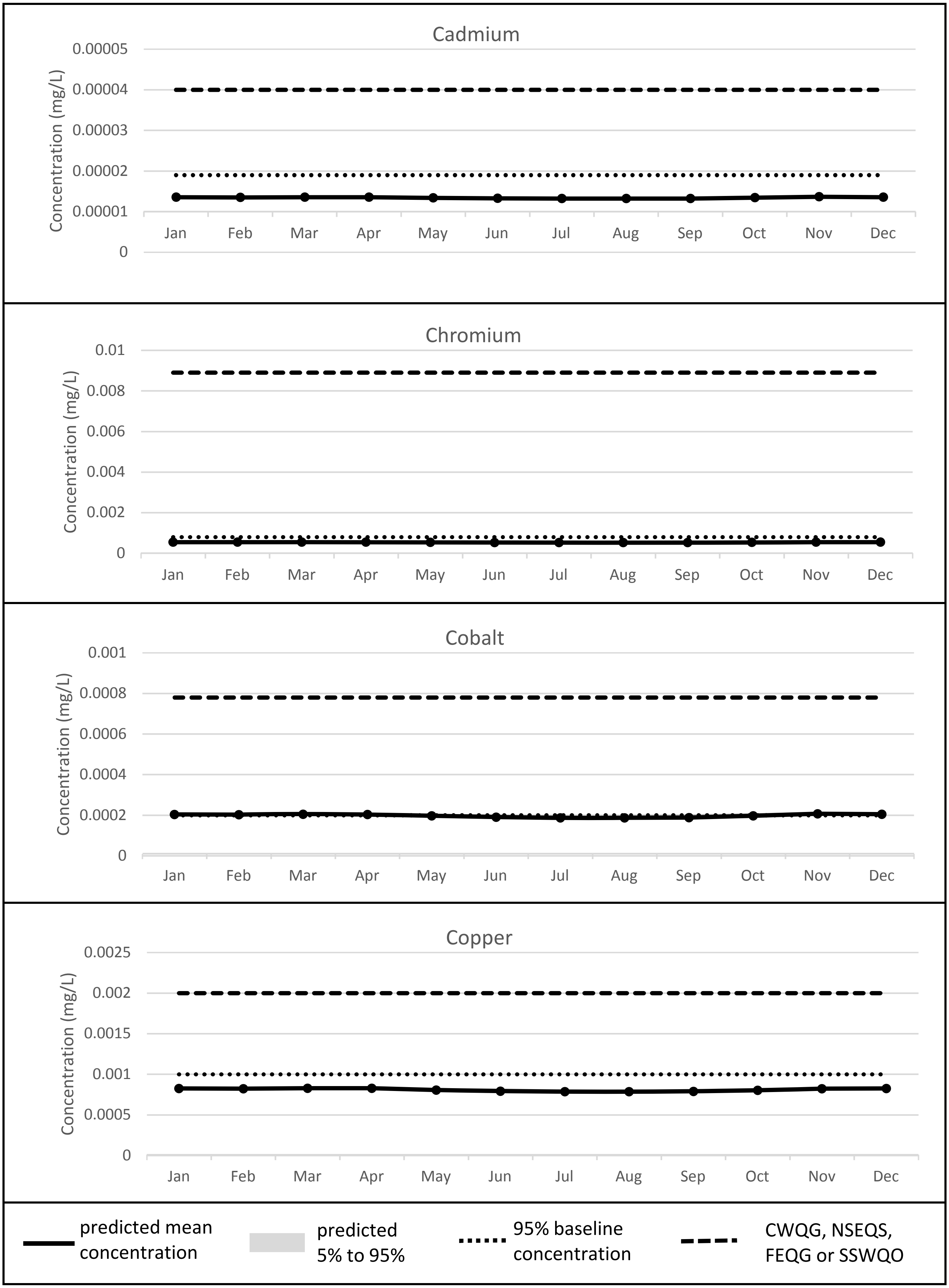




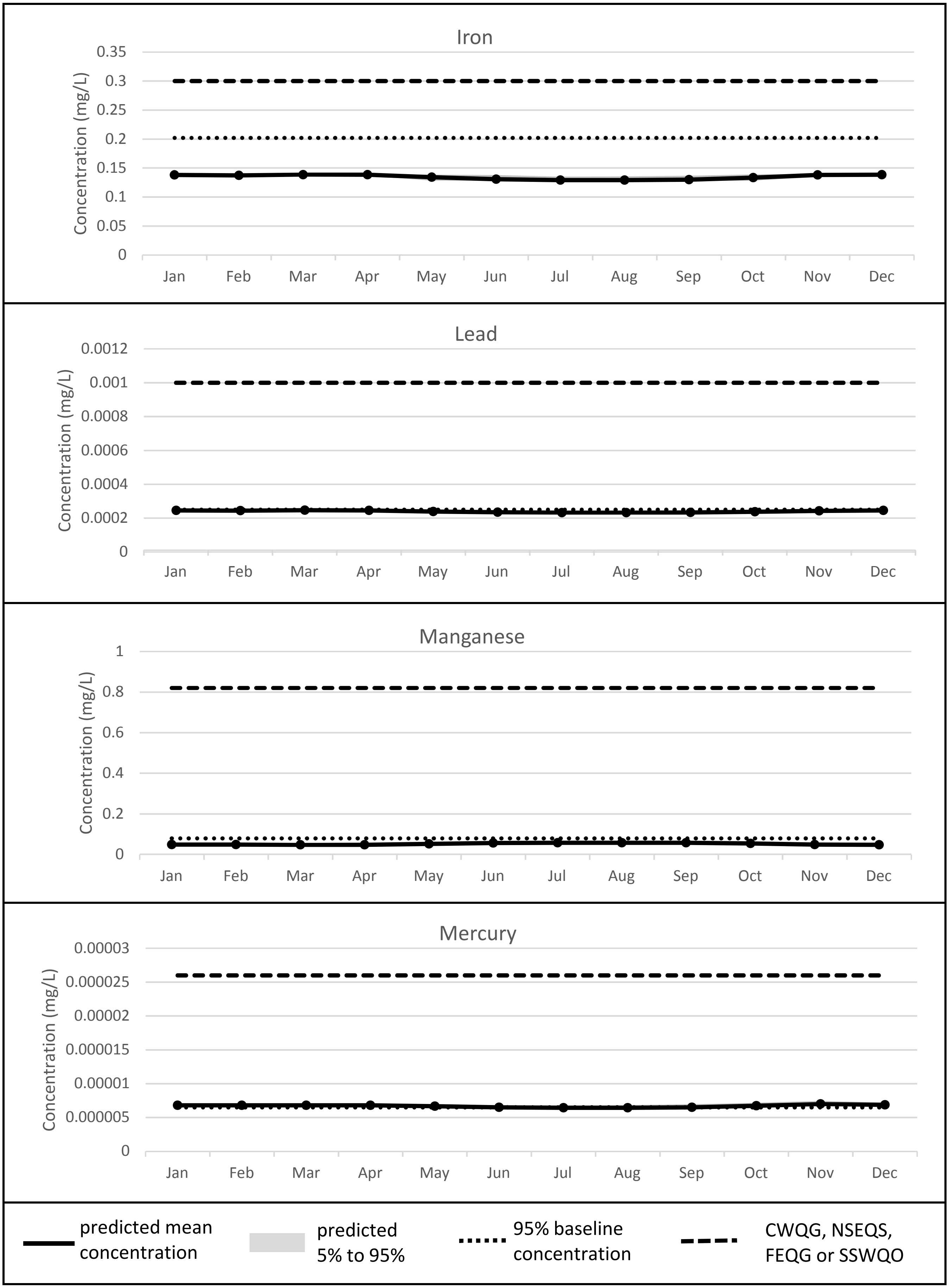


predicted mean concentration	predicted 5% to 95%	95% baseline concentration	CWQG, NSEQS, FEQG or SSWQO

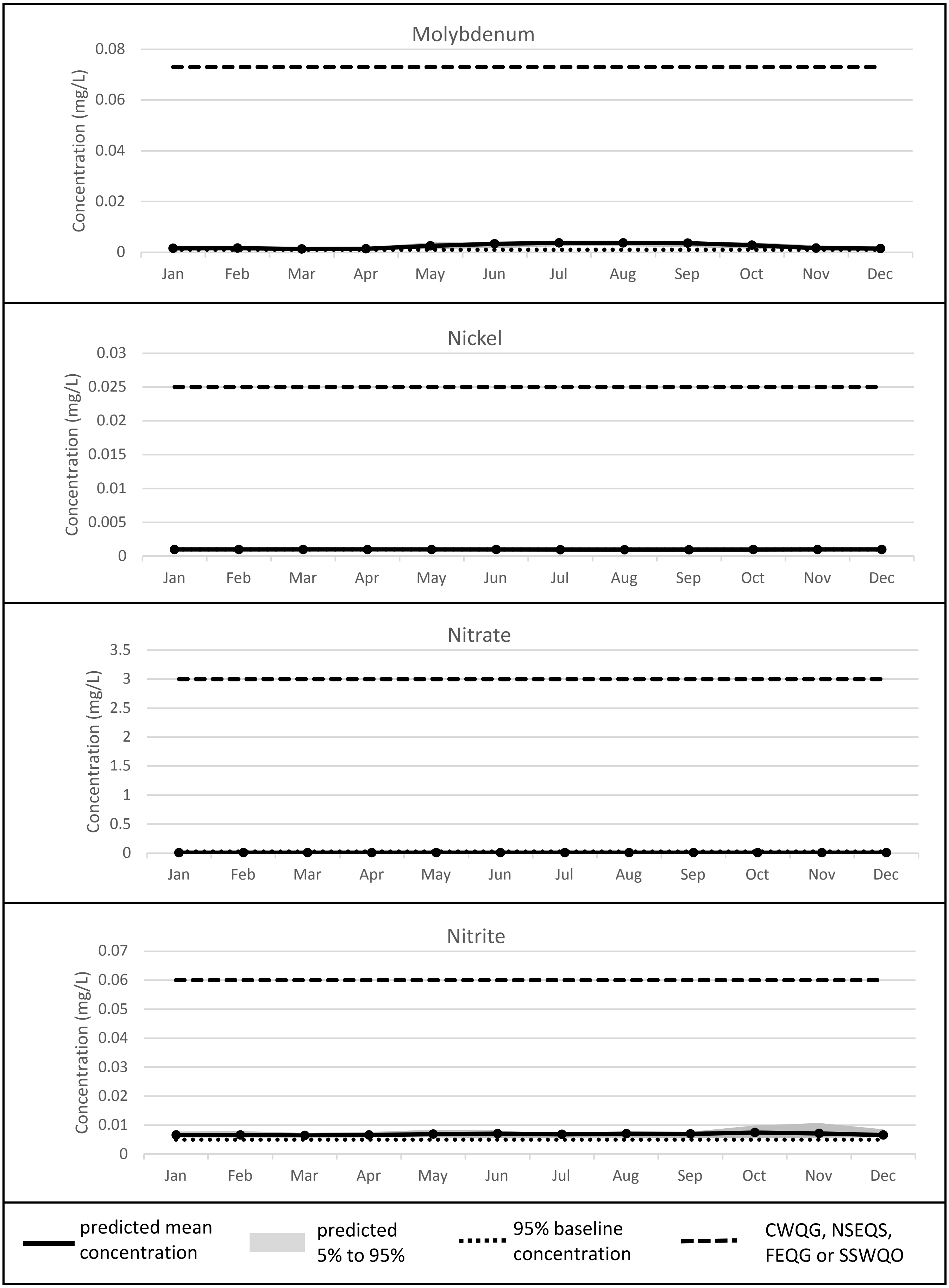
PREDICTED CONCENTRATIONS AT WATERCOURSE 12 (USING BASE CASE SOURCE TERMS)



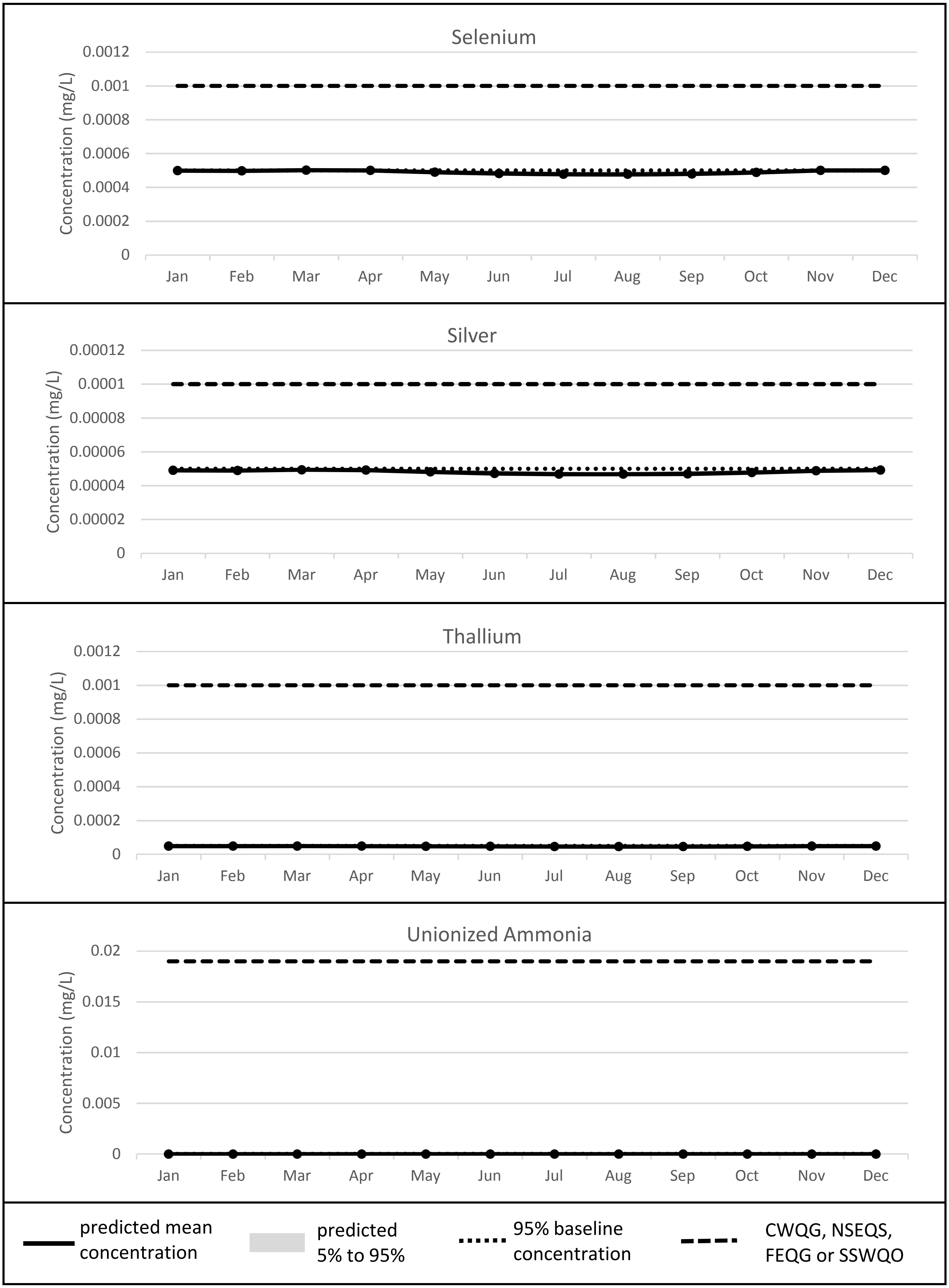
PREDICTED CONCENTRATIONS AT WATERCOURSE 12 (USING BASE CASE SOURCE TERMS)

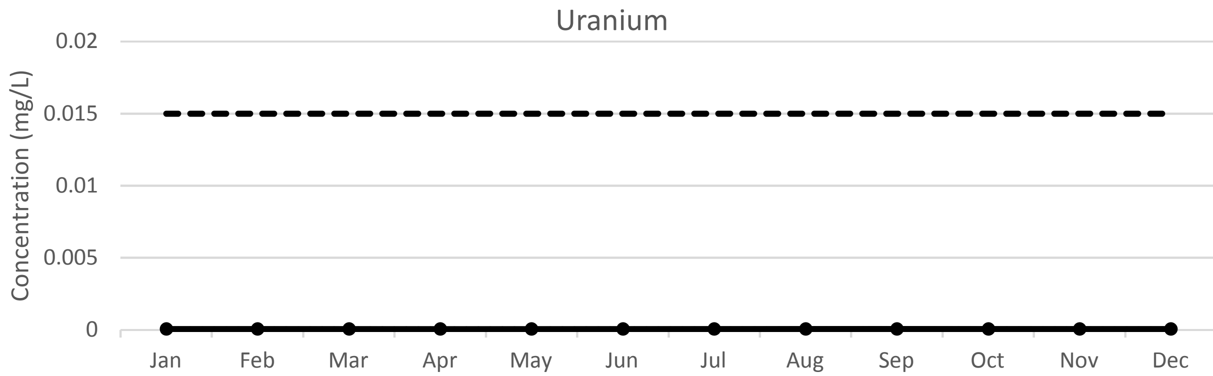


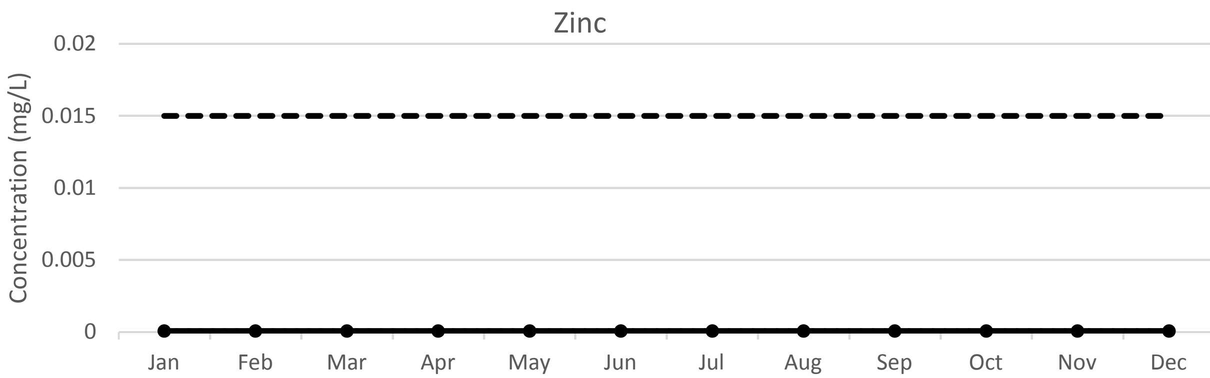
PREDICTED CONCENTRATIONS AT WATERCOURSE 12 (USING BASE CASE SOURCE TERMS)



PREDICTED CONCENTRATIONS AT WATERCOURSE 12 (USING BASE CASE SOURCE TERMS)

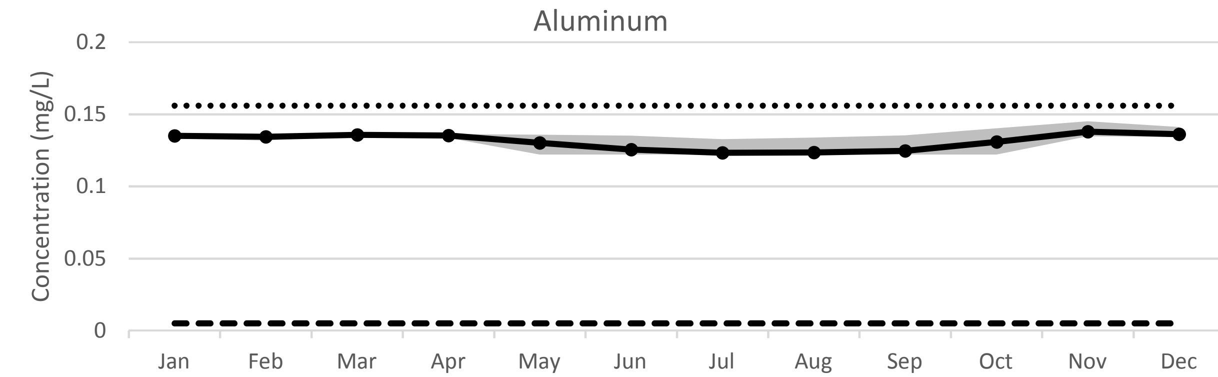


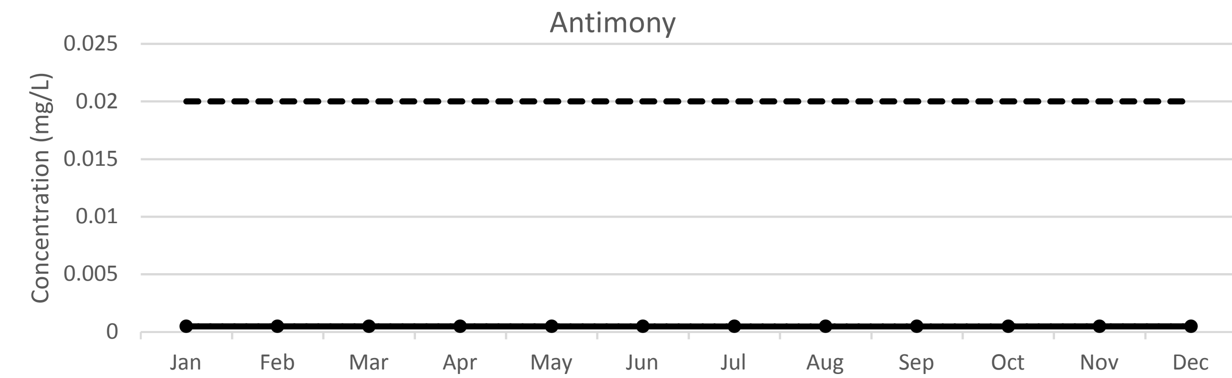


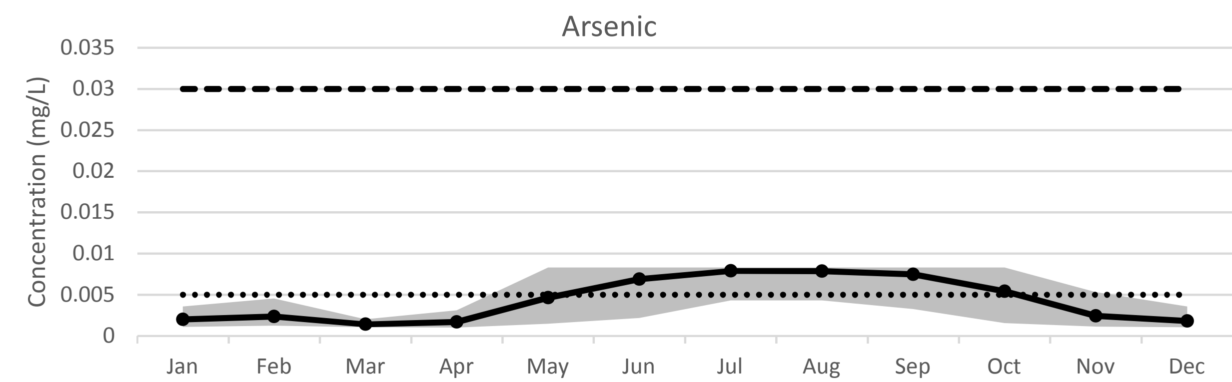


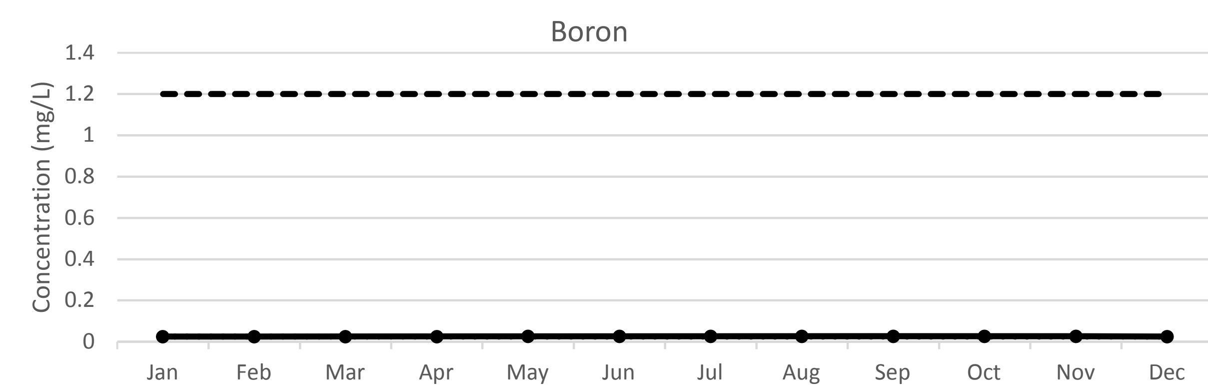
predicted mean concentration | predicted 5% to 95% | 95% baseline concentration | CWQG, NSEQS, FEQG or SSWQO

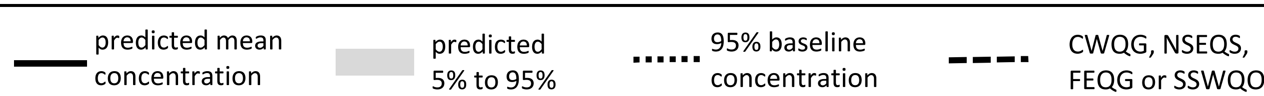
PREDICTED CONCENTRATIONS AT WATERCOURSE 12 (USING UPPER CASE SOURCE TERMS)



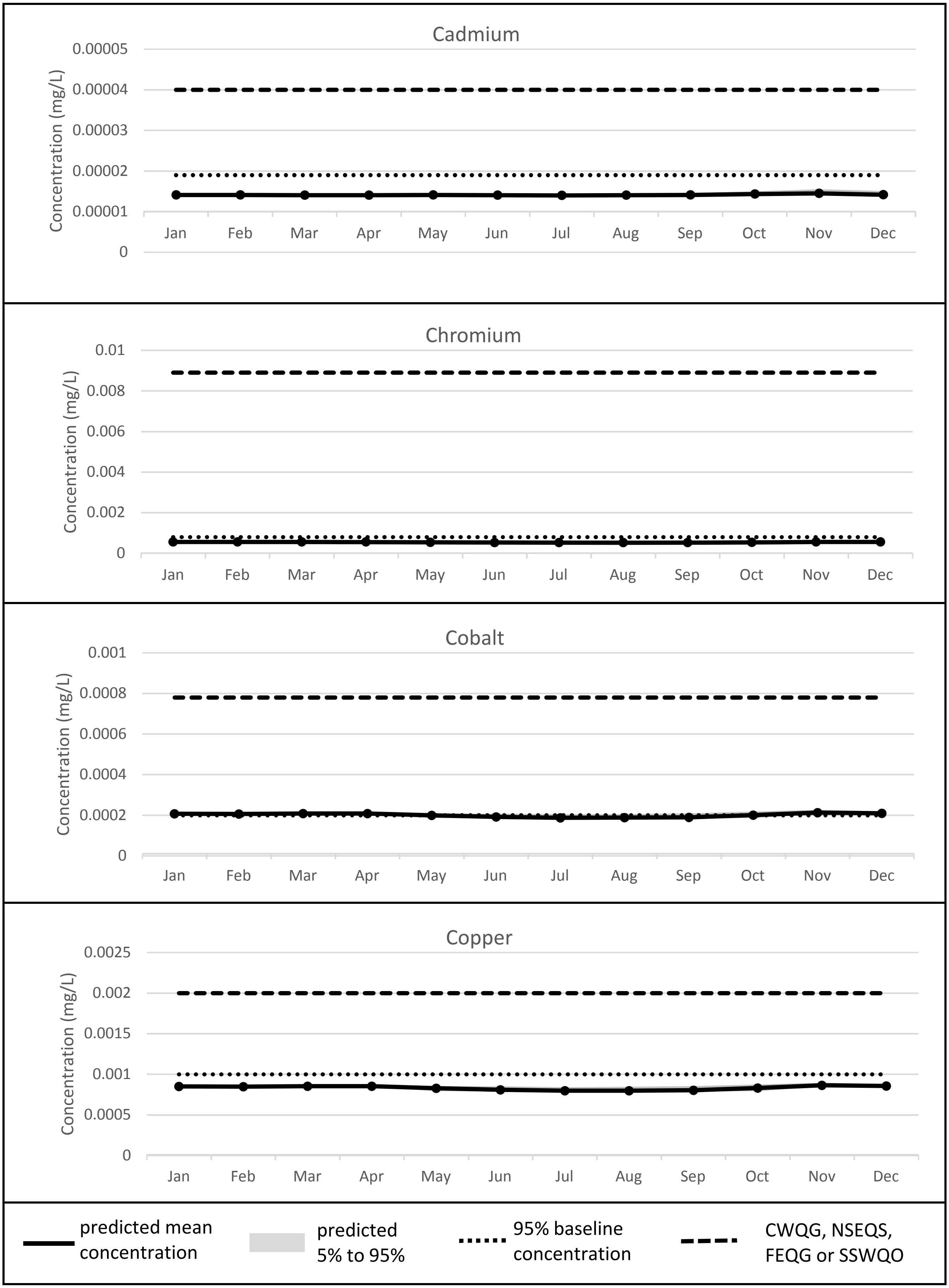




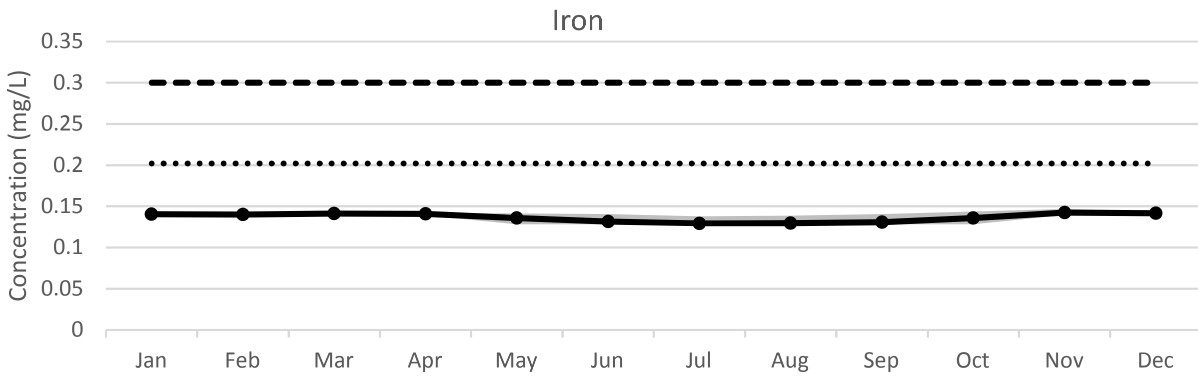


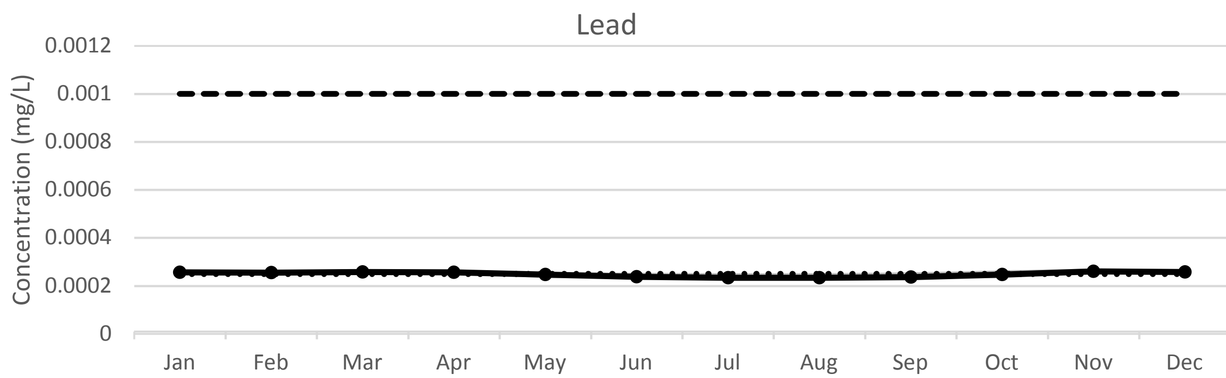


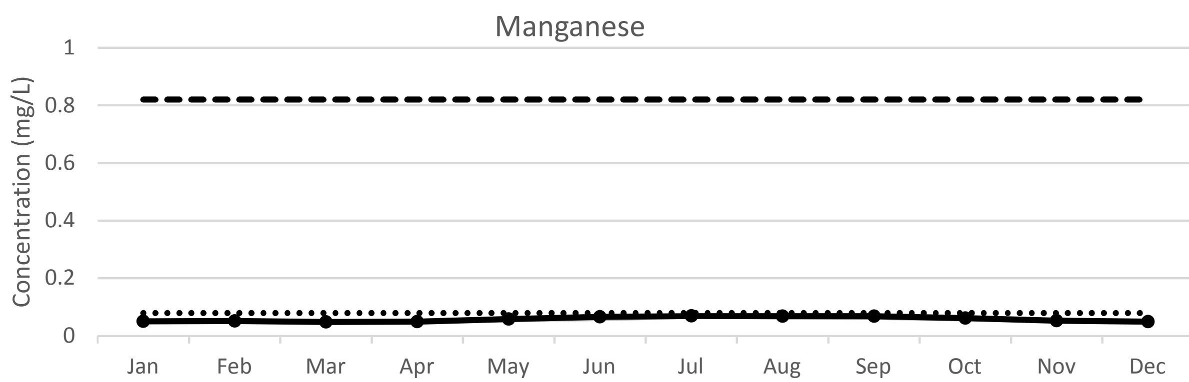
PREDICTED CONCENTRATIONS AT WATERCOURSE 12 (USING UPPER CASE SOURCE TERMS)

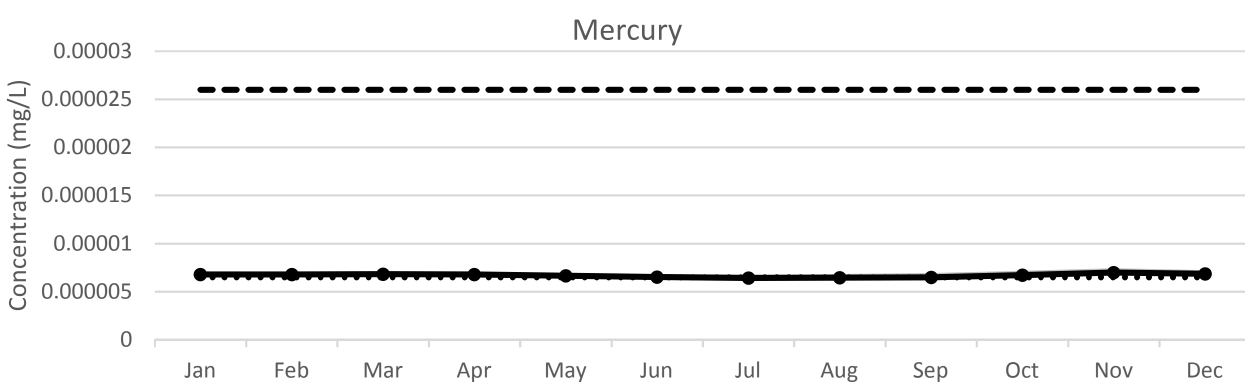


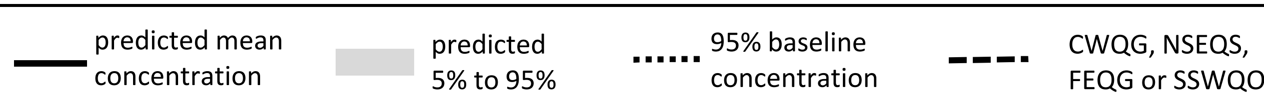
PREDICTED CONCENTRATIONS AT WATERCOURSE 12 (USING UPPER CASE SOURCE TERMS)



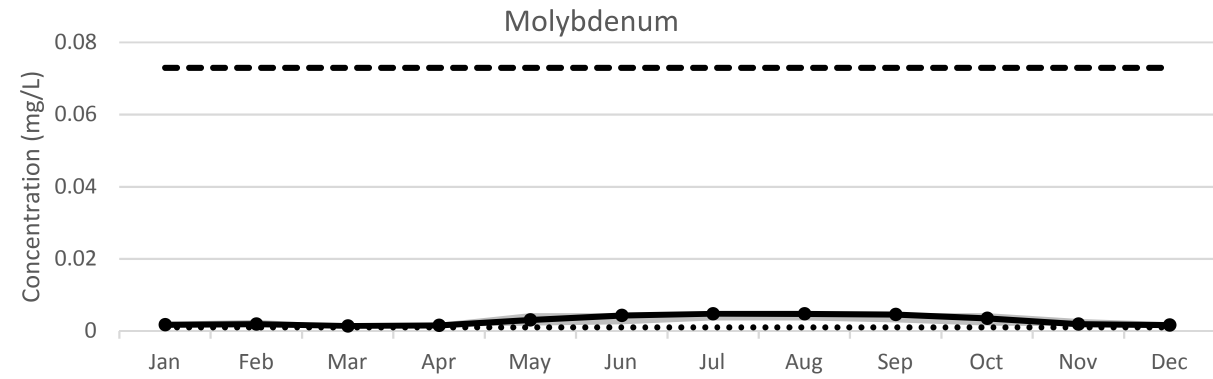


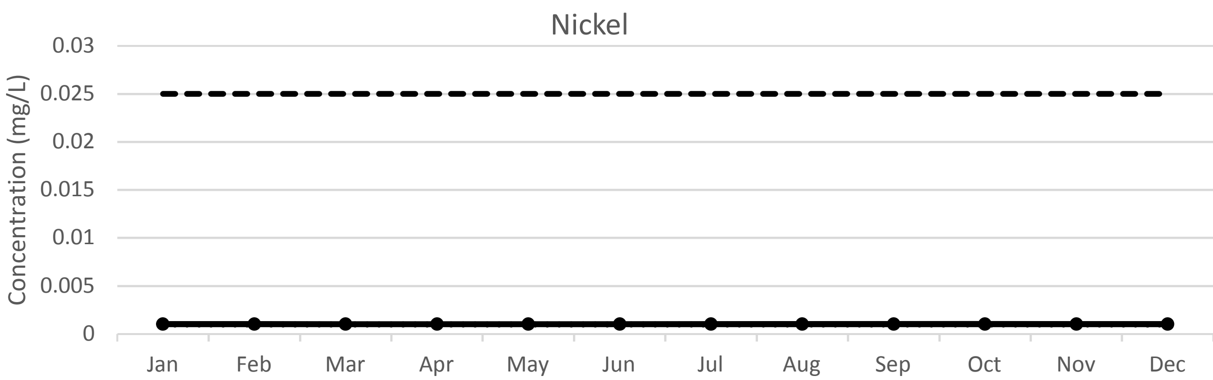


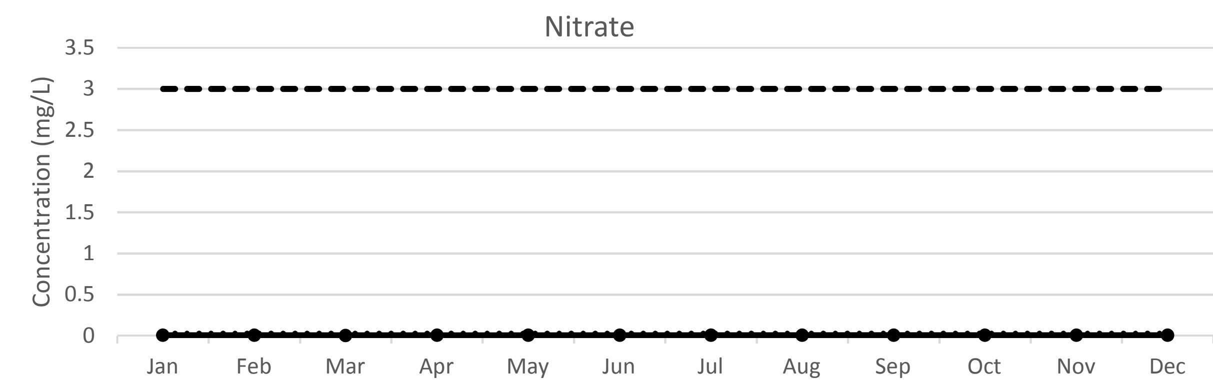


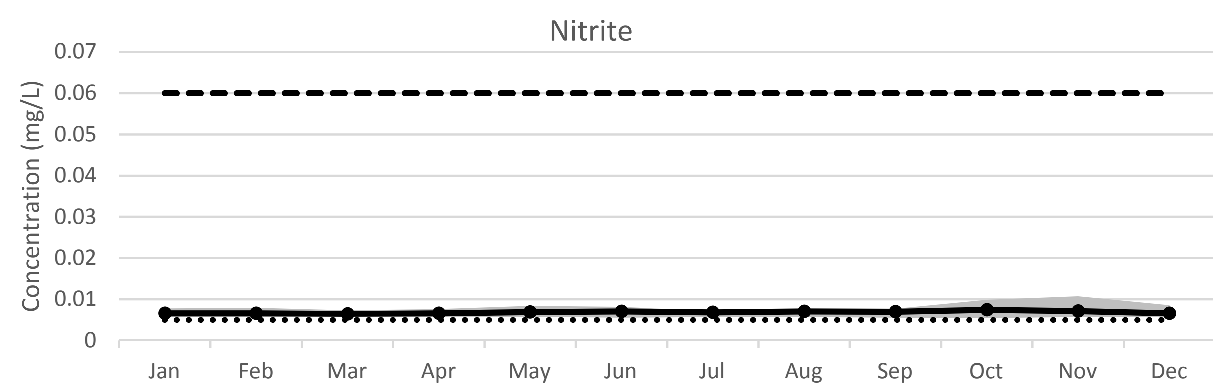


PREDICTED CONCENTRATIONS AT WATERCOURSE 12 (USING UPPER CASE SOURCE TERMS)









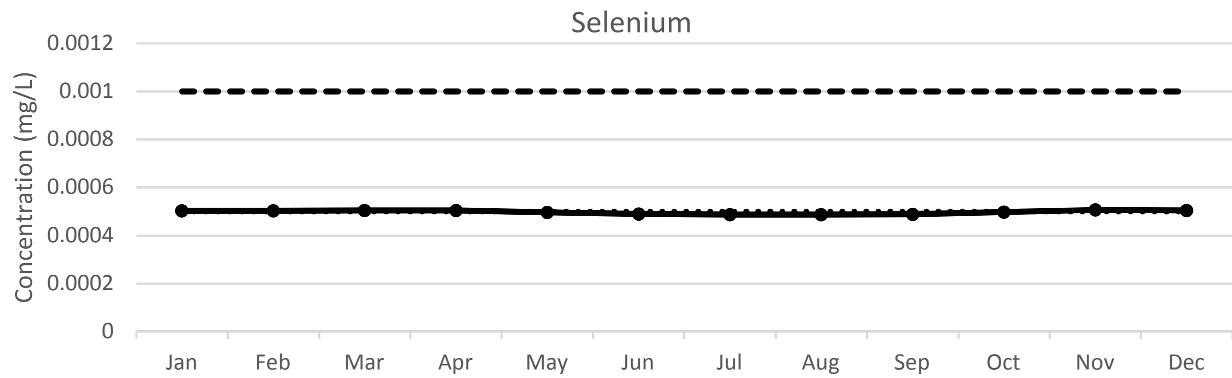
predicted mean concentration

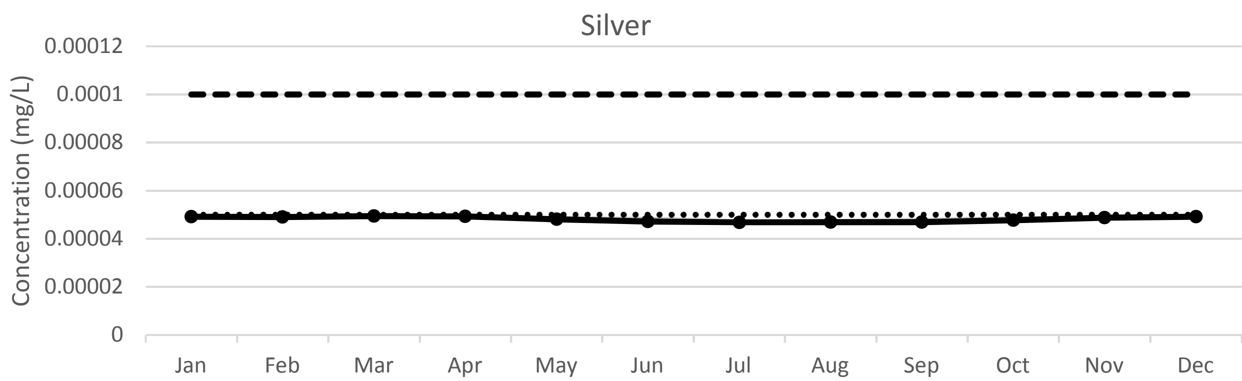
predicted 5% to 95%

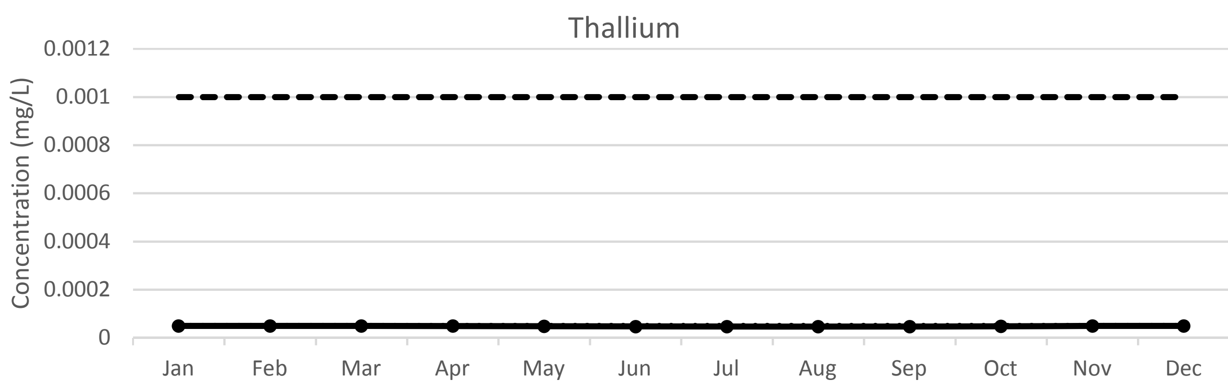
95% baseline concentration

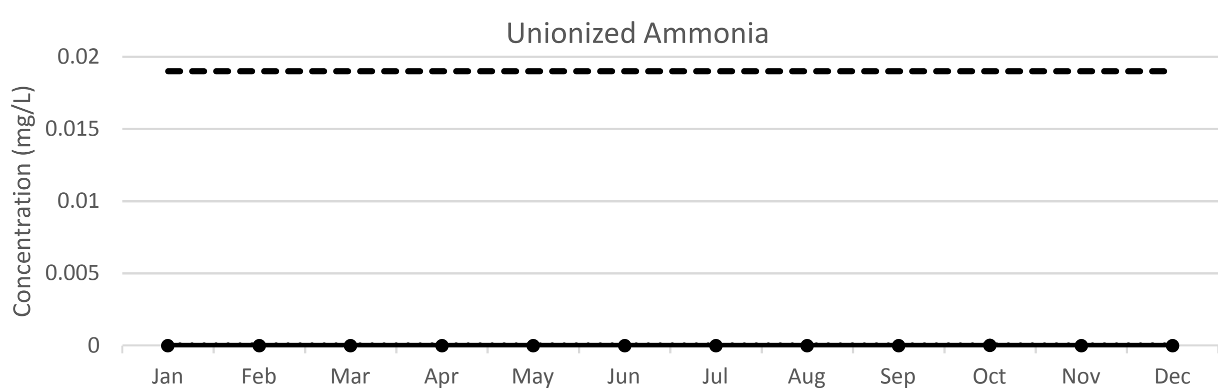
CWQG, NSEQS, FEQG or SSWQO

PREDICTED CONCENTRATIONS AT WATERCOURSE 12 (USING UPPER CASE SOURCE TERMS)

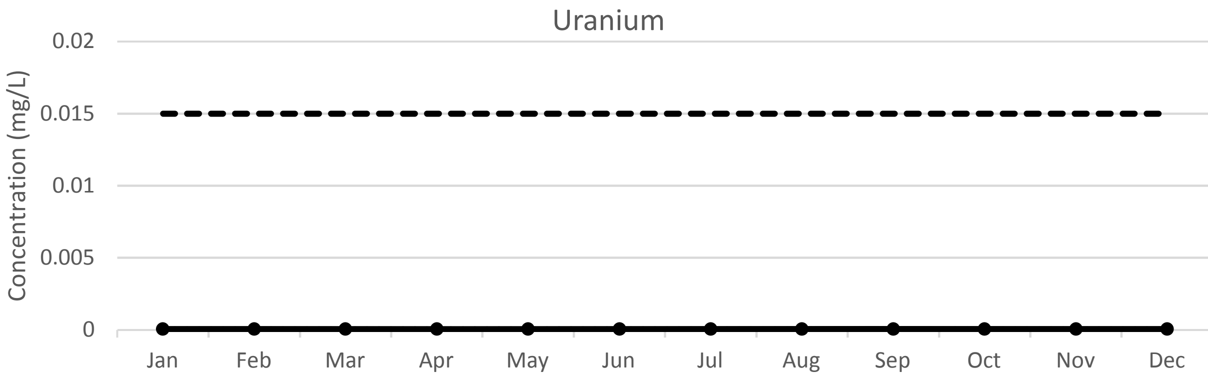


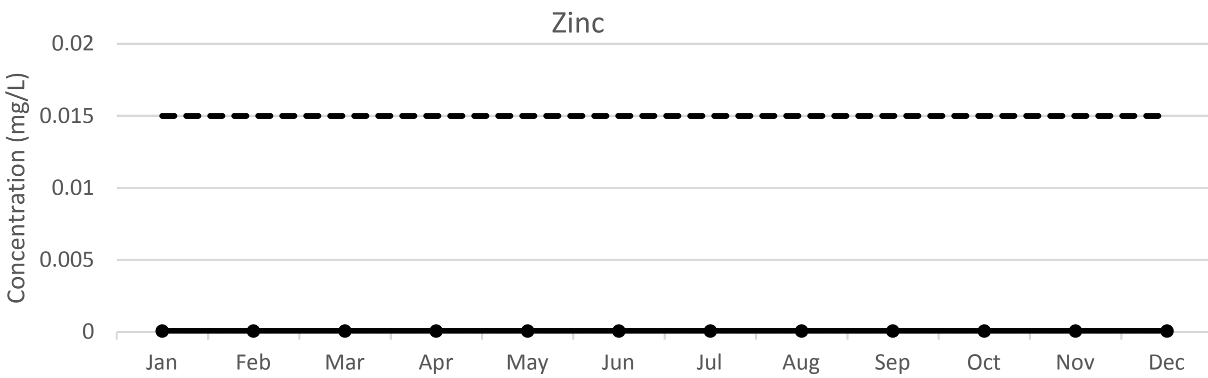






predicted mean concentration | predicted 5% to 95% | 95% baseline concentration | CWQG, NSEQS, FEQG or SSWQO





predicted mean concentration | predicted 5% to 95% | 95% baseline concentration | CWQG, NSEQS, FEQG or SSWQO