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Technical Report Overview

Report: Elk Valley Selenium Speciation Monitoring Program, 2022 Annual Report

Overview: This report summarizes the findings of the 2021 Selenium Speciation Monitoring Program (SeSMP). This monitoring program was designed to identify areas with atypical selenium speciation and increase understanding of the potential mechanisms driving generation of organic and reduced forms of selenium.

This report was prepared for Teck by ADEPT Environmental Sciences Ltd, Windward Environmental LLC, and Minnow Environmental Inc.

For More Information

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Future studies will be made available at **teck.com/elkvalley.**

Elk Valley Selenium Speciation Monitoring Program

2022 Annual Report

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GLOSSARY

µg/L	micrograms/Liter
AFDM	Ash Free Dry Mass
BI [Se]	Benthic Invertebrate Tissue Selenium Concentration
CABIN	Canadian Aquatic Biomonitoring Network
CALA	Canadian Association for Laboratory Accreditation
CMm	Coal Mountain Mine
DMDSe	Dimethyldiselenide
DMSe	Dimethylselenide
DMSeO	Dimethylselenoxide
DO	Dissolved Oxygen
DOC	Dissolved Organic Carbon
DS	Downstream
EMC	Environmental Monitoring Committee
EVO	Elkview Operations
EVO SRF	Elkview Saturated Rock Fill
FRO	Fording River Operations
GHO	Greenhills Operations
GPS	Global Positioning System
GLM	General Linear Model
ICP-MS	Inductively Coupled Plasma Mass Spectrometry
km	kilometer
LAEMP	Local Aquatic Effects Monitoring Program
LCO	Line Creek Operations
MeSe(IV)	Methylseleninic acid
MeSe(VI)	Methaneselenonic acid
mg/kg dw	milligrams/kilogram dry weight
mL	milliliter
m/s	meters/second
ORP	Oxidation Reduction Potential
PCA	Principal Component Analysis
RAEMP	Regional Aquatic Effects Monitoring Program
SeCN	Selenocyanate
SeMet	Selenomethionine
SeSMP	Elk Valley Selenium Speciation Monitoring Program
Se(VI)	Selenate
Se(IV)	Selenite
$SeSO_3$	Selenosulphate
TDS	Total Dissolved Solids
TOC	Total Organic Carbon
TSS	Total Suspended Solids
US	Upstream
WLC AWTF	West Line Creek Active Water Treatment Facility

1.0 INTRODUCTION

ADEPT Environmental Sciences Ltd. (ADEPT), Windward Environmental LLC (Windward), and Minnow Environmental Inc. (Minnow) are pleased to provide Teck Coal Limited (Teck) with the 2022 Annual Report on the Elk Valley Selenium Speciation Monitoring Program (SeSMP). Study designs for the 2021-2023 cycle of the SeSMP (Golder 2021b, ADEPT 2022a) were developed with advice and input from the Elk Valley Environmental Monitoring Committee (EMC). The study designs, as well as the approach to preliminary data analysis and interpretation presented herein, also received input from Dr. Jen Ings (Minnow), Dr. Kevin Brix (EcoTox LLC), Dr. Sam Luoma (Samuel N Luoma PhD LLC), and Dr. Peter Campbell (Institut National de la Recherche Scientifique). All field data presented in this report were collected by Minnow and Teck.

1.1 Scope of this Report

This annual report addresses requirements for selenium speciation monitoring in Sections 8.6 and 9.11 of *Environmental Management Act* Permit 107517 (18 May 2023). Specifically, this report documents the activities and results of monitoring undertaken for each element of the SeSMP in 2022, including data reporting and a preliminary interpretation of study questions based on the current year's data.

As in the 2021 annual report (ADEPT 2022b), the focus of the analysis herein is on developing a reliable interpretation of data to support Teck in managing selenium speciation and bioaccumulation in the Elk Valley. To that end, analyses in this report generally follow those provided in the 2021 annual report (ADEPT 2022b), with adjustments and updates reflecting learnings from 2021 and the preliminary interpretation presented herein. Specifically, analyses herein align closely with the 2021 annual report approach to characterizing regional patterns of speciation (Study Question 1) and bioaccumulation (Study Question 4). Analyses herein expand on the 2021 annual report by evaluating full seasonal cycles of speciation and benthic invertebrate selenium concentrations at four study sedimentation ponds (Study Question 2) and by providing the first evaluation of long-term trends in speciation at compliance and Order stations (Study Question 2). For the evaluation of local-scale longitudinal patterns of speciation (Study Question 1) and mechanisms of organoselenium production (Study Question 3), the 2021 annual report (ADEPT 2022b) was unable to support a conclusive interpretation using data from a single year of study. The preliminary evaluation of 2022 data discussed herein also indicates that these study questions are complex and require analysis of a combined dataset from multiple years of study to support robust conclusions. Therefore, this report focuses on summarizing the 2022 dataset related to these two study questions, with the intent that a detailed statistical analysis will be conducted in a three-year interpretive report following the 2021-2023 cycle. The three-year interpretive report will draw on a compiled dataset from the 2021-2023 SeSMP cycle, combined with other available information from speciation studies and monitoring conducted by Teck, to provide more robust answers to all four study questions than could be supported by analysis of a more limited dataset.

1.2 Advice and Input from the Environmental Monitoring Committee

Technical advice and input on the 2022-2023 SeSMP were provided by the EMC at a meeting on 12 April 2023 and via written advice received 31 April 2023. Advice and input were incorporated as follows:

- Additional information on sedimentation pond characteristics was incorporated into this report. Information on fish use of sedimentation ponds and the presence and condition of fish barriers was included on pond summary sheets (Attachment D). For the present report, information on hydraulic residence time was included in the table of predictor variables (Attachment B); this information will be added to pond summary sheets in future reports. Where available, a summary of upstream activities that might affect pond water quantity and/or quality will also be incorporated into summary sheets in future reports.

- A recommendation has been made that alternative sediment sample methods be developed to sample sediment from Corbin Sedimentation Pond and other lined ponds (Section 6). Current sampling methods preclude sampling on lined ponds. Collection of sediment from more study ponds will allow a more robust evaluation of the role of sediment characteristics in mechanisms of organoselenium production.
- Potential additional measures related to biological productivity in study ponds (e.g., inputs of pollen, the influence of emergent and submergent vegetation, vegetation taxonomy) are being reviewed ahead of the 2023 field season (Section 6). An in-depth analysis of pond productivity will be provided in the three-year interpretive report in 2024.

As relevant, elements of the report that respond to previous EMC advice are also noted.

2.0 BACKGROUND

2.1 SeSMP Scope, Objectives, and Study Questions

The scope of the SeSMP was specified in Section 8.6 of Amended Permit 107517, which states:

> *The permittee must develop and implement a Selenium Speciation Monitoring Program. The Selenium Speciation Monitoring Program is intended to:*
>
> - *Identify sites in the Designated Area, affected or potentially influenced by the permittee's current operations, where organic and reduced forms of selenium are occurring or are likely to occur;*
> - *Investigate the physical and/or biogeochemical mechanisms driving selenium speciation and the generation of organic and reduced forms of selenium species; and*
> - *Assess the site-specific bioaccumulation of selenium in biological resources.*
>
> *The Selenium Speciation Monitoring Program must include the following elements:*
>
> *i. Assessment of water quality and selenium tissue concentrations in benthic invertebrates; and*
>
> *ii. Characterization of factors that lead to enhanced selenium bioaccumulation in the receiving environment, as applicable.*

In developing a study design for the first three-year cycle of the SeSMP (Golder 2021a), an overarching goal was established that links the specific requirements in Section 8.6 to the broader environmental management objectives outlined for Teck in Permit 107517. Objectives in support of the goal were adopted directly from the intended outcomes of the SeSMP, as summarized above. Study questions were then developed to address each of the objectives. These same study questions were retained in the study design update for the 2022 SeSMP (ADEPT 2022a) that is reported herein.

A detailed rationale for the scope of the study questions, and how these questions address the objectives, is provided in Golder (2021a). In brief, the study design was informed by analyses in the *Elk Valley Selenium Speciation Program State of the Science Report* (Golder 2021b) that highlighted the greater importance of organoselenium species over the inorganic species selenate and selenite, both in terms of enhanced organoselenium concentrations in some mine sedimentation ponds (making organoselenium an appropriate focus for studying mechanisms of change and spatial and temporal patterns of speciation) and in terms of having a larger influence on bioaccumulation (making organoselenium an appropriate focus for studying effects on bioaccumulation). Accordingly, the SeSMP study questions laid out in the study design focus on characterizing spatial and temporal patterns of organoselenium, investigating mechanisms of organoselenium production, and testing the existing bioaccumulation tool that predicts how selenium species (including organoselenium) affect bioaccumulation. The goal, objectives, and study questions for the SeSMP are provided in Box 1.

Box 1. Goal, objectives, and study questions for the SeSMP

Goal	To better understand areas with atypical selenium speciation conditions and how these conditions affect site-specific selenium bioaccumulation. This understanding will support Teck's adaptive management planning to attain area-based environmental management objectives of protection of aquatic ecosystem health and management of bioaccumulation of selenium in the receiving environment.
Objectives	Identify sites in the Designated Area, affected or potentially influenced by Teck's current operations, where organic and reduced forms of selenium are occurring or are likely to occur. Investigate the physical and/or biogeochemical mechanisms driving selenium speciation and the generation of organic and reduced forms of selenium species. Assess the site-specific bioaccumulation of selenium in biological resources.
Study Questions	Study Question 1: What is the spatial extent of detectable organoselenium? Study Question 2: Are there temporal trends in organoselenium concentrations? Study Question 3: What are the mechanisms of organoselenium production? Study Question 4: Do new data support refinement of the speciation bioaccumulation tool?

An additional requirement for the SeSMP was established during approval[1] of the Golder (2021a) study design for the 2021 SeSMP:

> *Teck must include Goddard Marsh and the Aqueduct Wetland in the Elk Valley Selenium Speciation Program as areas for detailed study during 2022 and 2023. Teck must ensure that any adjustments to the study design for these sites are discussed with the EMC and the EMC's advice incorporated into the implemented program.*

The annual reporting requirement for the SeSMP is specified in Section 9.11 of Permit 107517 (amended by letter[2] on 8 February 2023):

> *The permittee must prepare an annual report documenting the activities and results of monitoring undertaken for each element of the Selenium Speciation Monitoring Program, as per Section 8.6. The report must be submitted to the director and the EMC by May 31st of each year.*

Per these requirements, the remainder of this report documents the approach (Sections 2.2 and 2.3), specific methods (Section 3), and results (Section 4) of the 2022 SeSMP. A preliminary interpretation of the current year's results to answer the study questions is provided in Section 5. Recommendations for the following year's SeSMP are provided in Section 6.

2.2 Overview of the 2021-2023 SeSMP Study Design

The overall approach to answering the SeSMP study questions is discussed in detail in ADEPT (2022a) and outlined in Table 1. This approach has two parts:

The first part (Section 4 of the ADEPT 2022a study design) is an extensive (studying many locations) and intensive (measuring many things) investigation, to be conducted in the first three-year cycle of the SeSMP,

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[1] Letter from ENV to Teck dated 21 October 2021.

[2] Letter from ENV to Teck dated 8 February 2023, stating "Pursuant to Section 16 of the *Environmental Management Act*, Permit 107517 is hereby amended replacing the April 15th date for annual submission of the Selenium Speciation Monitoring Program annual report with May 31st". This change appears in the 18 May 2023 amendment of Permit 107517.

intended to characterize spatial patterns and seasonal trends in organoselenium, provide insight into the conditions that facilitate organoselenium production, and test the ability of the speciation bioaccumulation tool to predict the effect of measured organoselenium concentrations on selenium concentrations in biota. It is anticipated that the investigation component of the SeSMP and associated objectives and study questions will be refined with each three-year cycle to build on the findings of previous cycles and refocus on key residual uncertainties.

Per the approval condition for the 2021 SeSMP outlined in Section 2.1, sampling was also conducted to measure aqueous selenium speciation, routine water chemistry, and benthic invertebrate tissue selenium concentrations (where suitable habitat was present) at locations upstream and downstream of Goddard Marsh and Aqueduct Wetland. Differences in selenium speciation between locations upstream and downstream of these two lentic areas are discussed in comparison to the studied sedimentation ponds in Sections 4.1 (regional patterns) and 4.4 (mechanisms). Information on characteristics of these lentic areas will be obtained from other ongoing programs and summarized in the SeSMP three-year interpretive report in 2024.

The second part (Section 5 of the ADEPT 2022a study design) is an ongoing monitoring program aimed specifically at the interannual element of Study Question 2: *Are there temporal trends in organoselenium concentrations?* It is anticipated that the study design for ongoing monitoring will be re-evaluated and updated upon completion of the investigation studies to confirm that monitoring locations, timing, and parameters are appropriate to the objectives of ongoing monitoring.

Table 1. Outline of how 2022 SeSMP study components address the study questions

Study Question	Study Component	Overview of Study Design
Study Question 1 (Spatial Extent)	Regional survey	Regional sampling of speciation, water quality, and tissue selenium concentrations. Includes sampling at compliance and Order stations on the Elk River, Fording River, Line Creek, and Michel Creek, at the outflow of all sedimentation ponds with a permitted discharge, and upstream and downstream of a set of sedimentation ponds selected to help answer Study Questions 2, 3, and 4. Reporting on this component herein includes data tables, heat maps, and an interpretation of regional spatial patterns of speciation, focusing on peak organoselenium concentrations at each location.
	Longitudinal patterns	Local sampling of speciation, water quality, and tissue selenium concentrations along a longitudinal spatial gradient downstream of selected sedimentation ponds. Reporting on this component herein includes data tables, plots, and a preliminary interpretation of local spatial gradients of speciation at four sedimentation ponds.
Study Question 2 (Temporal Trends)	Seasonality	Monthly sampling of speciation, water quality, and tissue selenium concentrations upstream and downstream of selected sedimentation ponds. Reporting on this component herein includes data tables, plots, and a preliminary interpretation of seasonal patterns of speciation at four study sedimentation ponds.
	Long-term trends	Ongoing monitoring of speciation at compliance and Order stations (quarterly) and permitted sedimentation pond discharges (annually) in each management unit. Weekly to monthly local monitoring at sites with identified uncertainty in projected speciation, to be reviewed as uncertainty is reduced. Reporting on this component herein includes tables of speciation data collected at compliance and Order stations, plots, and a preliminary interpretation of trends.
Study Question 3	Mechanisms	Correlation- and ordination-type analyses to relate differences in speciation among ponds (regional survey) and over time within ponds (seasonality) to pond characteristics and conditions. Reporting on this component herein includes data tables of speciation, plots, and a summary of data collected in 2022 on factors that might contribute to changes in speciation at the study sedimentation ponds.
Study Question 4	Bioaccumulation	Use of paired speciation and tissue selenium data collected for Study Questions 1 and 2 to test and, if warranted, update the speciation bioaccumulation tool. Reporting on this component herein includes data tables, plots, and a preliminary interpretation of how well data collected in 2022 conform to patterns of bioaccumulation described by the de Bruyn and Luoma (2021) model.

2.3 Conceptual Model for Selenium Speciation

Selenium speciation can vary greatly across different kinds of aquatic environments, affecting its fate (Milne 1998; Maher et al. 2010), bioaccumulative potential (Reidel et al. 1996; Simmons and Wallschläger 2005; Stewart et al. 2010), and resulting toxicity (Besser et al. 1993; Janz et al. 2010). Selenium can occur in natural waters as the oxyanions selenate (SeO_4^{2-}, oxidation state VI) and selenite (SeO_3^{2-}, oxidation state IV), as organic or inorganic selenides (oxidation state -II), and as elemental selenium (oxidation state 0).

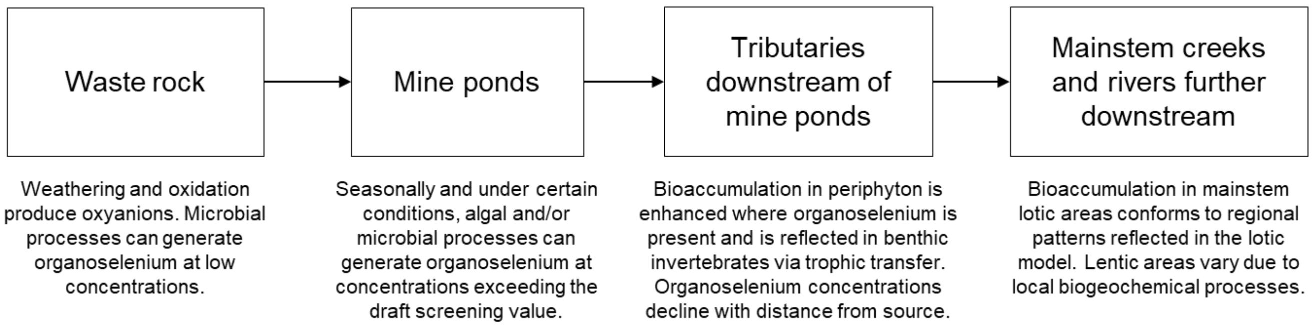
Selenate and selenite are thermodynamically stable and highly soluble in natural waters (Milne 1998), although selenite is more reactive and has a relatively strong tendency to adsorb to organic and mineral solid phases (Faust 1981; Maher et al. 2010). In contrast, elemental selenium is insoluble and generally occurs where microbial activity has resulted in the deposition of selenium in the solid phase in sedimentations (Faust 1981; Dungan and Frankenberger 1999; Maher et al. 2010). Selenides have variable properties: some are soluble (e.g., seleninic acids), some are insoluble (e.g., metal selenides), and some are volatile (e.g., dimethylselenide). The amino acids selenomethionine and selenocysteine are organoselenides that are ubiquitous in living systems but rarely detected in surface waters (LeBlanc and Wallschläger 2016). Many organoselenides are highly labile and are not expected to persist in natural waters (LeBlanc and Wallschläger 2016; Jain 2017).

The biotic and abiotic processes that transform selenium from one species to another are extremely complex. Detailed overviews of these processes are available elsewhere (e.g., Maher et al. 2010; Eswayah et al. 2016; Ponton et al. 2020). Selenium speciation data collected by Teck in focused investigations and in local and regional monitoring were summarized and analyzed in Golder (2021b), with the following key findings:

- Selenium species that are most often detected in the Elk Valley are selenate, selenite, dimethylselenoxide (DMSeO), and methylseleninic acid (MeSe(IV)). Methaneselenonic acid (MeSe(VI)), selenosulphate ($SeSO_3$), and selenocyanate (SeCN) have also been reported in some analyses but are localized and/or infrequently detected (<0.01 µg/L). Selenate is ubiquitous and predominates in Elk Valley waters. Selenite is detected in both reference and mine-affected waters but is generally present in higher concentrations at locations closer to mining. DMSeO and MeSe(IV) occur primarily in some mine sedimentation ponds and effluent retention ponds and in portions of tributaries immediately downstream of these ponds. Some pit waters contain relatively high concentrations of selenite but rarely have detectable organoselenium. Seeps rarely contain any detectable organoselenium and have consistently low concentrations of selenite. Organoselenium has been detected only rarely in Michel Creek or the Elk River but is occasionally detected in the Fording River.
- The most important species affecting selenium bioaccumulation in the Elk Valley are selenate, selenite, DMSeO, and MeSe(IV). An analysis of speciation and bioaccumulation data from the Elk Valley (de Bruyn and Luoma 2021) did not detect a contribution to bioaccumulation from any other species, although most other species were not detected in that dataset with sufficient frequency to provide a rigorous evaluation. Selenate and selenite alone can account for selenium bioaccumulation in most lotic areas in the Elk Valley, resulting in a consistent "typical" pattern of bioaccumulation relative to aqueous total selenium as described by the updated lotic bioaccumulation models (Golder 2020). Higher bioaccumulation in some areas is associated with DMSeO and MeSe(IV). The analysis of de Bruyn and Luoma (2021) indicates that the bioaccumulative potential of DMSeO and MeSe(IV) is on the order of 10× higher than selenate or selenite.
- Patterns of bioaccumulation support a draft screening value of 0.025 µg/L (expressed as the sum of DMSeO and MeSe(IV)) to indicate conditions that might cause an incremental increase in bioaccumulation relative to the normal range of variation in monitoring data. Organoselenium concentrations greater than 0.05 µg/L were more consistently associated with measured and modelled benthic invertebrate selenium concentrations outside the normal range of variability.
- The processes by which DMSeO and MeSe(IV) are generated have been linked to algal productivity and/or microbial activity in sedimentation ponds, consistent with published literature on biological reduction of selenium (e.g., Eswayah et al. 2016; Ponton et al. 2020). The inferred mechanism is assimilatory reduction of inorganic selenium to organoselenides, followed by enzymatic degradation and oxidation to form methylated selenium metabolites. The specific characteristics of sedimentation ponds that promote these processes appear to include nutrient availability and likely other factors that are not yet well understood (Lorax 2020).
- Concentrations of DMSeO and MeSe(IV) decline with distance downstream of where they are generated, and these rates of loss are faster than can be accounted for by dilution. This loss of organoselenium species from the aqueous phase is hypothesized to reflect some combination of volatilization, chemical decomposition (LeBlanc and Wallschläger 2016; Jain 2017), and uptake by periphyton (de Bruyn and Luoma 2021).

The general and site-specific information summarized in Golder (2021b) was used to develop the conceptual model for organoselenium sources and fate at Teck's operations in the Elk Valley depicted in Figure 1. This conceptual model highlights the production of organoselenium in sedimentation and effluent retention ponds as the primary mechanism by which mine-related changes to speciation affect patterns of bioaccumulation in the Elk Valley.

Figure 1. Conceptual model for changes to selenium speciation at Teck's Elk Valley operations



3.0 METHODS

The following subsections describe the specific field and laboratory methods used to implement the study components outlined in Table 1. Each component followed the design outlined in ADEPT (2022a) with modifications as noted herein to adapt to field conditions and characteristics of the data collected.

All field sampling followed approved methods of the Elk Valley Regional Aquatic Effects Monitoring Program (RAEMP; Minnow 2021). Unless otherwise specified, all aqueous selenium speciation sampling, sample handling, and chemical analysis was conducted following standard methods provided by the analytical laboratory and adopted for Teck's regional water quality monitoring program. Speciation samples were submitted to Brooks Applied Labs (Brooks, Bothell, Washington) for analysis of selenate, selenite, DMSeO, MeSe(IV), MeSe(VI), SeCN, $SeSO_3$, and SeMet.[3] Where noted, additional samples were collected and submitted for analysis of the volatile selenium species dimethylselenide (DMSe) and dimethyldiselenide (DMDSe).

3.1 Regional Survey

This study component focused on regional spatial patterns of selenium speciation in mainstem rivers and in relation to known or suspected sources of organoselenium, with a focus on sedimentation ponds per the conceptual model outlined in Section 2.3 (see analysis in Golder 2021a for further discussion). Speciation monitoring was conducted in 2022 at compliance and Order stations on the Elk River, Fording River, Line Creek, and Michel Creek, at most permitted sedimentation pond discharges, and in several local and regional monitoring programs in all major mine-affected drainages of the Elk Valley. All available data from these monitoring programs were retrieved from Teck's water quality database and compiled to support the preliminary analyses below.

To supplement data from ongoing and existing monitoring, a set of sedimentation ponds was selected for more intensive sampling in 2022 as described below. This intensive sampling program was intended to expand the spatial dataset to previously unsampled sedimentation ponds and supplement existing data for previously sampled ponds. The focus of this intensive sampling was on sedimentation ponds with a surface discharge to

[3] Brooks also reports"unknown selenium species", which is the sum of all chromatographic peaks that cannot be assigned to one of these.

downstream aquatic habitat, so that sampling could be paired with benthic invertebrate tissue selenium concentrations. As discussed in Section 2.2, sampling was also undertaken in 2022 at locations upstream and downstream of Goddard Marsh and Aqueduct Wetland.

Sampling and Analysis – Local and Regional Monitoring

Monitoring of selenium speciation at compliance and Order stations (Table 2)[4] and permitted sedimentation pond discharges (Table 3) was conducted by Teck staff at Fording River Operations (FRO), Greenhills Operations (GHO), Line Creek Operations (LCO), Elkview Operations (EVO), and Coal Mountain Mine (CMm). Sedimentation ponds shown in bold font in Table 3 were also included in the 2022 sedimentation pond study, discussed further below. Speciation monitoring under other local and regional programs (Table 4) was conducted by staff from Teck and Minnow. Monitoring locations sampled under the programs summarized in Tables 2 – 4 are shown on regional maps for each mine operation in Attachment A.

For all programs summarized below, water samples were taken in accordance with the procedures described in the most recent edition of the *British Columbia Field Sampling Manual for Continuous Monitoring Plus the Collection of Air, Air-Emission, Water, Wastewater, Soil, Sedimentation, and Biological Samples* (BC MOE 2003) or by suitable alternative procedures as authorized by the Director. Speciation samples were submitted to Brooks for analysis.

Table 2. Compliance and Order stations monitored for selenium speciation

Watercourse	Monitoring Location	EMS
Compliance Points specified in Section 2 of Permit 107517		
Fording River	FR_FRABCH	E223753
Fording River	GH_FR1	0200378
Elk River	GH_ERC	0300090
Line Creek	LC_LCDSSLCC	E297110
Harmer Creek	EV_HC1	E102682
Michel Creek	EV_MC2	E300091
Michel Creek	CM_MC2	E258937
Order Stations specified in Section 3 of Permit 107517		
Fording River	FR4/GH_FR1	0200378
Fording River	FR5/LC_LC5	0200028
Elk River	ER1/GH_ER1	0206661
Elk River	ER2/EV_ER4	0200027
Elk River	ER3/EV_ER1	0200393
Elk River	ER4/RG_ELKORES	E294312
Koocanusa Reservoir	LK2/RG_DSELK	E300230

Notes: EMS = Environmental Monitoring System

[4] Water quality monitoring at the compliance and Order stations summarized in Table 2 is conducted in accordance with requirements in Sections 2 and 3 of Permit 107517. These monitoring points are intended to capture the combined effects of all upstream mining at representative locations along the major mine-affected watercourses in the Elk Valley. Accordingly, these locations are also being used by Teck to monitor regional patterns of selenium speciation in relation to mining.

Table 3. Summary of speciation monitoring in 2022 at permitted sedimentation ponds discharges

Sedimentation Pond	**EMS**	**Monitoring Location**	**Notes**
FRO Discharge Monitoring Program (Table 13 in Permit 107517)			
North Loop Pond	E102476	FR_NL1H	(a,b)
Maintenance and Services Sed. Pond	E102478	FR_MS1	(a)
Eagle Pond Decant	E102480	FR_EC1	(a)
Clode Pond	E102481	FR_CC1	●
South Kilmarnock Sed. Pond – Phase I	E208394	FR_SKP1	(a)
South Kilmarnock Sed. Pond – Phase II	E208395	FR_SKP2	(a,c)
Smith Ponds	E261897	FR_SP1	●
Swift-Cataract Sed. Pond to Fording River	E320694	FR_SCCAT	●
Liverpool Sed. Ponds to Fording River	E304835	FR_LP1	
Post Sed. Ponds to Fording River	E304750	FR_PP1	○
Lake Mountain Sed. Ponds to Lake Mountain Creek	E306924	FR_LMP1	
Floodplain Widening Sed. Pond Decant	E325311	FR_FWP1	
GHO Discharge Monitoring Program (Table 15 In Permit 107517)			
Greenhills Creek Sed. Pond Decant	E102709	GH_GH1	●
Thompson Creek Upper Sed. Pond			(e)
Thompson Creek Lower Sed. Pond Decant	E207436	GH_TC1	●
Porter Creek Sed. Pond Decant	0200385	GH_PC1	●
Wolfram Creek Sed. Pond Decant	E257795	GH_WC1	○
Leask Creek Sed. Pond Decant	E257796	GH_LC1	○(c)
Rail Loop Sed. Pond Decant	E207437	GH_RLP	○(c)
Mickelson Creek at LRP Road	0200388	GH_MC2	(c)
Wade Creek at LRP Road	E287433	GH_WADE	○(a)
Wolf Creek Sed. Pond Decant	E305855	GH_WOLF_SP1	(c)
Willow Creek Sed. Pond Decant	E305854	GH_WILLOW_SP1	(a)
LCO Phase I Discharge Monitoring Program (Table 17 In Permit 107517)			
No Name Creek Pond Effluent to Line Creek	E221268	LC_LC9	(b)
MSA North Ponds Effluent to Line Creek	E216144	LC_LC7	●
Contingency Treatment System Effluent To Line Creek	E219411	LC_LC8P1	●(a)
LCO Phase II Discharge Monitoring Program (Table 18 In Permit 107517)			
LCO Dry Creek Head Pond			
LCO Dry Creek Sed. Ponds Effluent to Dry Creek via Return Channel	E295211	LC_SPDC	○(e)
Diversion Structure Spillway (When In Use)	E295313	LC_DSSW	(d)
LCO Dry Creek Sed. Pond 1 (When In Use)	E295314	LC_SP1D	(a)
LCO Dry Creek Sed. Pond 2 (When In Use)	E295315	LC_SP2D	(a)
EVO Discharge Monitoring Program (Tables 21 And 22 In Permit 107517)			
South Pit Creek Sed. Pond Discharge to Michel Creek	E296311	EV_SP1	●
Milligan Creek Sed. Pond Discharge to Michel Creek	E208057	EV_MG1	●
Gate Creek Sed. Pond Discharge to Michel Creek	E206231	EV_GT1	●
Bodie Creek Sed. Pond Discharge to Michel Creek	E102685	EV_BC1	●
Aqueduct Creek Control Structure to Aqueduct Creek	E302170	EV_AQ6	●
Otto Creek at Mouth Discharge to Elk River	E102679	EV_OC1	

Sedimentation Pond	EMS	Monitoring Location	Notes
Goddard Creek Sed. Pond Discharge via Goddard Marsh to Elk River	E208043	EV_GC2	
Lindsay Creek Infiltration Basin Discharge to Ground	E258135	EV_LC1	●(c)
Dry Creek Sed. Pond Decant to Harmer Creek	E298590	EV_DC1	●
6 Mile Creek Sed. Pond Decant Discharge to Elk River	E102681	EV_SM1	
CMO Discharge Monitoring Program (Table 24 In Permit 107517)			
Decant Discharge from Main Interceptor Sed. Ponds	E102488	CM_SPD	●
Decant Discharge from Corbin Sed. Pond	E206438	CM_CCOFF	●(f)
Other Permitted Discharges			
Harmer Creek Sed. Pond	E102682	EV_HC1	●
West Line Creek AWTF Buffer Pond	E291569	WL_BFWB_OUT_SP21	●

Notes: EMS = Environmental Monitoring System (note that sampling may not always occur at the indicated EMS and monitoring location codes because riffle habitat sampled for benthic invertebrate tissue may not be within a reasonable distance from the permitted site locations; in such cases, new codes were developed); Sed. = Sedimentation; ponds in **bold** were included in the 2022 SeSMP study (sampled upstream, downstream, and in-pond where possible); ○ = sampled for speciation in 2021; ● = included in the 2021 SeSMP study
(a) = rarely discharges and/or was not discharging at time of sampling in 2022; (b) = flows to mine works; (c) = discharges to ground; (d) = not in use in 2022; (e) = included as additional longitudinal and seasonal study location; (f) = previous sampling location CM_CCPD is no longer safe to access and has been replaced by CM_CCOFF

Table 4. Summary of local and regional monitoring programs that measured selenium speciation in 2022

Monitoring Program	Speciation Monitoring Locations Planned for 2022-2023
Corbin Sedimentation Pond	CM_CCOFF, CM_SPD
LCO Dry Creek Water Management System / LCO Dry Creek LAEMP	LC_DC3, LC_DCEF, LC_SPDC, LC_DCDS, LC_DC1, LC_DC4, LC_FRUS, LC_FRB, LC_GRCK
LCO LAEMP	RG_SLINE/LC_SLC, RG_LI24/LC_LC1, RG_LCUT/LC_WLC, RG_LILC3/LC_LC3, RG_LISP24 /WL_DCP_SP24, RG_LIDSL/LC_LCDSSLCC, RG_LIDCOM/LC_LCC, RG_LI8/LC_LC4, RG_FRUL/LC_LC6, RG_FO23
Greenhills Creek LAEMP	RG_GHUT, RG_GHNF, RG_GHBP, RG_GHFF / RG_GHFFA, RG_GAUT, RG_GANF, RG_GHP/GHPS
Fording River LAEMP	RG_UFR1/FR_UFR1, RG_HENUP/FR_HC3, RG_FRSCH2, RG_FRGHSC, RG_FOUCL/FR_FOUCL, RG_FOUNGD, RG_FODHE/FR_FR1, RG_FOUSH, RG_FRCP1SW, RG_MP1/FR_MULTIPLATE, RG_FOUKI/FR_FR2, RG_FOBKS/FR_FR3, RG_SCOUTDS/FR_SCOUTDS, RG_FOBSC/FR_FR4, RG_FRUPO/FR_FRRD, RG_FOBCP/FR_FRCP1, RG_FODPO/GH_PC2, RG_FOUEW/FR_FR5, RG_FO22/FR_FRABCH
West Line Creek AWTF	WL_BFWB_OUT_SP21, WL_LCI_SP02, WL_WLCI_SP01
EVO LAEMP	RG_ALUSM/EV_AC2, RG_MI25/CM_MC1, RG_ERCKUT, RG_ERCKDT/EV_ECOUT, RG_ERCK/EV_EC1, RG_GATE, RG_GATEDP, RG_BOCK, RG_MI3, RG_MIDER, RG_MIDBO, RG_MICOMP/EV_MC2
EVO SRF	F2_NWPI, F2_BPO, EV_MC2, EV_MC2a, EV_MC3, EV_EC1, EV_ECOUT, EV_BRD_LOT3, EV_BC1, EV_GT1, EV_ER1
EVO Dry Creek Water Treatment Project / Harmer Dam Removal Project	EV_HC1, EV_HC1a, EV_HCDSDAM, EV_DC2a, EV_DCOUT
RAEMP (not including LAEMP sites)	RG_CLODE, RG_KICKRG_GHCKD, RG_FODGH, RG_ALUSM, RG_HACKDS, RG_GRDS, RG_BACK, RG_ELELKO, RG_ELH93

Notes: FRO = Fording River Operations; LCO = Line Creek Operations; EVO = Elkview Operations; LAEMP = Local Aquatic Effects Monitoring Program; AWTF = Active Water Treatment Facility; SRF = Saturated Rock Fill; RAEMP = Regional Aquatic Effects Monitoring Program; sampling under the indicated programs is described in detail in program-specific study designs and/or permit requirements.

Sampling and Analysis – 2022 Sedimentation Pond Study

A set of sedimentation ponds was selected for intensive sampling as described in ADEPT (2022a). Candidate ponds were required to have both safe access and a surface discharge to downstream aquatic habitat, to focus effort on sites with the greatest relevance to potential environmental effects, and so that benthic invertebrate tissue could be collected for selenium analysis. Ponds were prioritized for sampling if they had no existing aqueous speciation and/or benthic invertebrate tissue selenium data, or if existing data indicated that the pond would help establish a range of low to high organoselenium concentrations.[5]

At each sampled pond, locations were selected upstream of the pond inflow and downstream of the pond outflow. Locations were selected to be as close to the pond inflow and outflow as safely accessible and, where possible, suitable for collection of periphyton and benthic invertebrates. Sampling location maps for the 2022 regional survey of sedimentation ponds are provided in Attachment A.

Water quality samples and in situ water quality measurements (temperature, dissolved oxygen, pH, conductivity, specific conductance, and oxidation-reduction potential were collected from all upstream and downstream locations.[6] Sampling was conducted as follows:

- Water samples were collected by wading into a mid-channel area (unless it was not practical or safe to do so), moving from downstream to upstream, so as not to collect water downstream of disturbed substrates. Samples were collected from mid-depth by inverting sample bottles below the surface of the water. Samples were taken to shore prior to adding applicable preservatives. Water samples being analyzed for dissolved parameters were filtered in the field using a clean syringe affixed with a 0.45-µm membrane. Once filtered, the sample was preserved immediately in the manner specified by the analytical laboratory. Global Positioning System (GPS) coordinates and sample date, time, and identifier were recorded on field sheets. Samples were kept cold until analysis. Samples were shipped to the analytical laboratory daily or every other day to achieve compliance with recommended analytical hold times.
- Water quality samples were analyzed by Canadian Association for Laboratory Accreditation Inc. (CALA)-certified laboratories. Water samples were analyzed by ALS Environmental for the same suite of parameters as monthly samples collected by Teck, including total and dissolved metals, nutrients, major ions, and other conventional parameters such as total suspended and dissolved solids (TSS and TDS) and total and dissolved organic carbon (TOC and DOC). Speciation samples were analyzed by Brooks.
- Benthic invertebrate tissue chemistry samples were collected in triplicate at the nearest downstream or upstream riffle to the pond. Benthic invertebrate tissue chemistry samples were collected according to RAEMP methods (Minnow 2021).[7] During sampling, the technician moved across the stream channel from bank to bank in an upstream direction. The net was held immediately downstream of the technician's feet, so the detritus and invertebrates disturbed from the substrate were passively collected into the kick-net by the stream current. Upon collection of the sample using the kick and sweep sampling method, organisms in the sample were carefully removed from sample debris using tweezers until a minimum of approximately 0.5 g of wet tissue was obtained. Invertebrate tissue samples were then photographed to document taxa composition,

[5] Including decision criteria for adding sites to the SeSMP was noted in EMC advice and input received in March 2021.

[6] In-situ chlorophyll-a and phycocyanin were measured in 2021 but could not be included in the 2022 program due to sensor availability.

[7] The RAEMP uses Canadian Aquatic Biomonitoring Network (CABIN) protocols (Environment Canada 2012), using a net with a triangular aperture 36 cm per side and 400-µm mesh. For tissue sample collection, the protocol is modified by removing the time constraint.

placed into labelled, sterile, 20 mL scintillation vials, stored in a cooler with ice packs, and transferred to a freezer later in the day.

- Frozen samples were shipped by courier in coolers with ice packs to TrichAnalytics Inc. (Saanichton, BC). Samples were dehydrated upon receipt and were analyzed using Laser Ablation Inductively Coupled Plasma Mass Spectrometry (ICP-MS). Results were reported on a dry weight basis.

- Triplicate composite samples of periphyton were collected for measurement of ash free dry mass (AFDM) and chlorophyll-*a*.[8] Chlorophyll-*a* data provide an indication of the abundance of chlorophyll-producing algae within the periphyton community. AFDM data provide an indication of the total dried biomass of organisms comprising the periphyton community (e.g., algae, fungi, bacteria, protozoa). Composite samples were collected a minimum of 5 m apart.

- Periphyton samples were collected from riffle habitat with water depth of at least 5 cm and uniform substrate characteristics, including relatively flat rocks with a diameter of at least 12 cm. Five rocks were selected, excluding those that are too small, highly angular, or uncharacteristic in surface texture, and taken to shore. A thin rubber or acetate template with a 4 cm^2 opening in the middle was then placed firmly on each rock so that the periphyton could be scraped from the opening using a scalpel. Scrapings from each of the five rocks were placed on a wetted Whatman GF/F glass fiber filter (90 mm diameter, 0.7 µm pore size) to provide a single composite sample per station for chlorophyll-*a* analysis. The filter paper containing the composite sample was folded in half twice and then tightly wrapped with aluminum foil. The foil-wrapped sample was placed in a labelled Whirl-Pak® bag and stored in a cooler with freezer packs in the field until transfer later in the day to a freezer for storage. Samples can be stored frozen for up to 30 days if they are not exposed to light (APHA et al. 1998). The same five rocks sampled for chlorophyll-*a* were used to collect separate scrapings for analysis of AFDM. The material on the scalpel from each scraping was rinsed into a small prelabelled plastic jar with additional water added as necessary to cover the tissue. Each composite sample for AFDM analysis was then placed in a cooler until transfer to a freezer later in the day.

The following characteristics were recorded for each sedimentation pond:

- Aquatic vegetation was recorded as categories of percent cover of the pond area for each of four vegetation types: 1) submergent macrophytes; 2) emergent macrophytes; 3) free-floating algae; and 4) attached filamentous algae.

- A description was recorded of features shading the pond.

Where possible, the following samples were collected within each sedimentation pond:

- Sediment samples were collected for grain size and TOC analysis from unlined ponds with safely accessible sediment. Sediment samples could not be collected from ponds that were lined, could not be safely accessed, or had dense vegetation that precluded safe access to sediment.

- In situ measurements of water temperature, turbidity, DO, DO%, pH, conductivity and specific conductance, and ORP were collected from 3 locations at each pond. Depth profiles were collected at those locations if depth was >3 m.[9]

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[8] Inclusion of productivity measures was noted in EMC advice and input received in March 2021.

[9] Sampling multiple locations and depths within ponds was noted in EMC advice and input received in March 2021.

Preliminary Data Analysis

Speciation data from regional and local monitoring and the 2022 sedimentation pond study were compiled and summarized to provide a regional overview and visualization of patterns of selenium speciation across the Elk Valley. Concentration data were presented in tables and used to generate heat maps to visually depict the spatial distribution of organoselenium concentrations across the major mine-affected drainages of the Elk Valley.

Heat maps were generated to show the maximum organoselenium concentration (as the sum of DMSeO and MeSe(IV)) measured at each location in 2021. These concentrations were colour-coded as in Golder (2021b) to show maximum measured concentrations relative to draft screening values, to support an interpretation of potential effects on bioaccumulation. Concentration ranges discussed in Golder (2021b) and the associated interpretation are:

- In lotic monitoring areas in the Elk Valley with no detectable organoselenium or detectable organoselenium <0.025 µg/L (shown as white symbols on the heat maps), selenium bioaccumulation is strongly inhibited by sulphate and organoselenium does not have a discernible effect on bioaccumulation.
- 0.025 to 0.05 µg/L organoselenium (shown as blue symbols) is sometimes associated with a discernible increment in bioaccumulation.
- 0.05 to 0.1 µg/L organoselenium (shown as yellow symbols) is often associated with a discernible increment in bioaccumulation.
- >0.1 µg/L organoselenium (shown as orange symbols) is consistently associated with a discernible increment in bioaccumulation.

3.2 Longitudinal Patterns

This study component was designed to repeat the longitudinal analysis in Golder (2021a) in four study reaches to test the consistency of selenium species loss rates across a range of creek conditions. Study reaches for longitudinal sampling were selected to meet the following criteria: 1) the source must have high enough concentrations and low enough dilution following discharge that organoselenium species should remain detectable at multiple downstream stations if they behave conservatively; 2) a downstream reach must be present with suitable habitat for benthic macroinvertebrates over several kilometres; and 3) the source and all downstream sites must be safely accessible for sampling anticipated peak organoselenium concentrations in late summer. Selected study reaches were lower Greenhills Creek downstream of Greenhills Main Sedimentation Pond, lower Harmer Creek downstream of Harmer Creek Sedimentation Pond, upper Harmer Creek between EVO Dry Creek Sedimentation Pond and Harmer Creek Sedimentation Pond, and upper Thompson Creek between Upper and Lower Thompson Creek sedimentation ponds.

Sampling and Analysis

Multiple stations were sampled in each of the four study reaches to characterize longitudinal gradients in selenium species concentrations (Attachment A). Sample locations within each study reach were selected at the time of sampling based on considerations of safe access and available habitat, targeting locations near the source, 500 m to 1.5 km downstream of the source, 2 to 3 km downstream of the source, and 4 to 6 km downstream of the source. Speciation samples were also taken on Grave Creek upstream of Harmer Creek and on the Fording River upstream of Greenhills Creek. Four locations were sampled downstream of EVO Dry Creek and Upper Thompson sedimentation ponds. The planned location ~2.5 km downstream of Harmer Creek Sedimentation Pond could not be accessed due to a decommissioned road. The planned location furthest downstream of Greenhills Creek Sedimentation Pond was not sampled because the Fording River flows through a steep canyon in this area and could not be safely accessed.

Field sampling methods were as described in Section 4.1. Water samples were taken for routine water chemistry and selenium speciation. In situ water quality parameters were recorded, triplicate composite benthic invertebrate tissue samples were collected for selenium analysis, and a periphyton sample was collected for measurement of AFDM and chlorophyll-a. Flow velocity was measured with a MF Pro velocity sensor at mid-depth at five points distributed across the channel.

Preliminary Data Analysis

Travel time was calculated for each location downstream of the source sedimentation ponds by dividing distance between sampling locations (m) by flow velocity (m/s). For the present report, longitudinal patterns were visualized by plotting concentrations of each species as a function of travel time. Statistical analysis of longitudinal patterns will be conducted in the three-year interpretive report, including adjustment of concentrations for mixing with other sources of water,[10] calculation of rate constants of loss as described in ADEPT (2022b), and comparison of rates among study reaches.

3.3 Seasonality

This study component was designed to repeat the seasonal analysis in Golder (2021a) at four additional sedimentation ponds to test the consistency of seasonal patterns across a range of pond conditions. Locations for seasonal sampling were selected to meet the following criteria: 1) the site must have high enough concentrations that organoselenium species will be detectable in multiple months; 2) water quality at the site must not be confounded by variable inputs such as pit dewatering; and 3) the site must be safely accessible for sampling of both influent and effluent in all months. Selected sites were the same ponds identified in Section 3.2 for longitudinal sampling: Greenhills Main Sedimentation Pond, Harmer Creek Sedimentation Pond, EVO Dry Creek Sedimentation Pond, and Upper Thompson Creek Sedimentation Pond (Attachment A).

Sampling was conducted monthly through 2022, with biweekly sampling during the peak growing season (July through September).

Sampling and Analysis

Field sampling methods were as described in Section 4.1. On each sampling date, water samples were taken upstream and downstream of each pond for routine water chemistry and selenium speciation. Field measurements were taken of pond conditions. Water samples were collected at the pond outflow for measurement of AFDM and chlorophyll-a. Composite benthic invertebrate and periphyton tissue samples were collected in triplicate upstream and downstream of each pond for selenium analysis. Documentation of periphyton (visual assessment of dominant taxa, coverage, CABIN scores) and benthic invertebrates (taxa present and proportional contribution, presence of annelids[11]) was conducted per RAEMP methods.

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[10] Mixing calculations will need to evaluate alternative tracers of source water at some locations. Notably, the study reach on upper Thompson Creek exhibited a three-fold increase in concentrations of selenate and sulphate between the second and third sampling points due to the influence of North Thompson Creek, making these constituents less useful as tracers of mixing.

[11] Annelids can introduce variability in selenium chemistry results if included in composite tissue chemistry samples (Luoma 2021). The sampling protocol used in the RAEMP (and herein) addresses this effect as follows: if annelids are present in a sample, the field crew records on field sheets the number of annelids in the sample and the proportion of total biomass represented by annelids. If annelids represent ≤5% of total invertebrate biomass in the sample, annelids are excluded from the composite sample. If annelids represent >5%, annelids are included in the composite sample at roughly the same percentage of biomass as they are present in the kick sample and a separate annelid-only tissue sample is collected for analysis.

Preliminary Data Analysis

For the present report, aqueous speciation and benthic invertebrate tissue selenium concentrations were tabulated and plotted to illustrate seasonal cycles and support a preliminary evaluation of how these compare between study ponds. More detailed comparisons among ponds and among years will be conducted for the three-year interpretive report, drawing on the results of multiple years of study at the four ponds evaluated herein and other ponds for which Teck has collected sufficient information to describe seasonal cycles of speciation.

3.4 Long-Term Trends

This study component focused on evaluating interannual trends in selenium speciation, relying on the quarterly monitoring conducted by Teck since 2017 at compliance and Order stations on the Elk River, Fording River, Line Creek, and Michel Creek (Table 2).

For the present report, all available data from compliance and Order stations were retrieved from Teck's water quality database and plotted to support a visual evaluation of changes over time. Concentrations of individual species were plotted separately for each quarter to avoid conflating seasonal changes (per Section 3.3) with interannual trends.

3.5 Mechanisms

The investigation of mechanisms is designed to identify factors related to sedimentation ponds that tend to be associated with relatively high (or low) concentrations of organoselenium. The overall goal of these analyses is to develop a basis for understanding what characteristics of sedimentation ponds, and under what conditions, cause relatively large changes to speciation. The intent is that the results of this analysis will help develop a mechanistic understanding of the processes underlying these changes. Such an understanding could inform Teck's Adaptive Management Plan by helping to identify opportunities to mitigate the changes and thereby reduce selenium bioaccumulation risk.

Rationale for the factors investigated in this analysis is provided in the study design (ADEPT 2022a). In brief, Golder (2021a) concluded that the mechanism of production of organoselenium is related to algal productivity and/or microbial activity. A primary inferred mechanism is assimilatory reduction of inorganic selenium to organoselenides, followed by enzymatic degradation and oxidation to form methylated selenium metabolites. Therefore, characteristics and conditions in sedimentation ponds that promote organoselenium production are expected to be those that promote biological activity in general, such as warm temperatures, long residence times, and ample nutrients and light. The 2022 SeSMP field program attempted to characterize these factors by measuring a range of site-specific characteristics of the sedimentation ponds (e.g., depth, aspect, vegetation, sediment, hydraulic residence time) and biogeochemical conditions in the sedimentation ponds (e.g., temperature, chlorophyll-*a*, nutrient concentrations, turbidity).[12] Compiled data will provide a set of dependent (*response*) variables that reflect changes to aqueous selenium speciation and a paired set of independent (*predictor*) variables that represent potential drivers of these speciation changes.

The present report provides a summary of data collected in 2022 to support the investigation of mechanisms. Observed changes in speciation associated with sedimentation ponds were visualized as upstream-downstream biplots. For comparison to sedimentation ponds, the study lentic areas Goddard Marsh and Aqueduct Wetland

[12] Collection of information on potential drivers of speciation changes was noted in EMC advice and input received in March 2021.

were included on these biplots. A summary is also provided of data collected in 2022 on factors that may contribute to speciation changes at the study sedimentation ponds.

As discussed in ADEPT (2022b), analysis of data from a single year was not able to definitively identify drivers of speciation changes. It is expected that greater confidence in interpretation of mechanisms can be obtained by analyzing a larger dataset compiled from multiple years of study. Therefore, statistical analysis of combined data from the first SeSMP cycle will be conducted for the three-year interpretive report, including regression-type analysis to try to explain the variation in dependent variables using combinations of predictor variables and exploratory ordination-type analyses of how predictor variables vary and covary among ponds.

3.6 Bioaccumulation

This study component tests our current understanding of the bioaccumulative potential of organoselenium. The analysis evaluates how well the speciation bioaccumulation tool was able to predict benthic invertebrate tissue selenium concentrations from aqueous speciation using data collected in the regional survey, seasonal study, and longitudinal study.

For the present report, the degree of similarity between predicted and observed benthic invertebrate selenium concentrations in the 2022 dataset was compared to the fit of the bioaccumulation tool to the dataset used to derive it. This comparison was performed as in de Bruyn and Luoma (2021) and ADEPT (2022b): 1) by comparing modelled vs. measured benthic invertebrate selenium concentrations; 2) by evaluating patterns of residuals as a function of concentrations of each selenium species; and 3) by evaluating patterns of benthic invertebrate tissue selenium concentrations relative to organoselenium concentrations in the 2022 SeSMP dataset and the de Bruyn and Luoma (2021) dataset.

4.0 RESULTS

4.1 Regional Survey

Field Data – Local and Regional Monitoring

Selenium speciation data are presented below from monitoring at regional compliance (Table 5) and Order stations (Table 6), permitted sedimentation pond discharges (Table 7), and locations included in the 2022 sedimentation pond study (Table 7, indicated by asterisks). Where benthic invertebrate selenium concentrations were collected under other programs in the same quarter, these data are also presented. Data from the other local and regional monitoring programs summarized in Table 4 are provided in Attachment C.

Table 5. Selenium speciation in 2022 at Compliance Points specified in Section 2 of Permit 107517

Station	Q	n	Maximum Selenium Species Concentrations per Quarter (µg/L)					BI [Se] (mg/kg dw)
			DMSeO	MeSe(IV)	MeSe(VI)	Se(IV)	Se(VI)	
FR_FRABCH - Fording River above Chauncey Creek (RG_FO22)	Q1	6	<0.010	<0.010	<0.010	0.163	102	7.44
	Q2	1	<0.010	<0.010	<0.010	0.079	29.8	-
	Q3	3	<0.010	0.014	<0.010	0.175	75.0	10.8
	Q4	5	<0.010	<0.010	<0.010	0.127	83.9	5.40
GH_FR1 - Fording River below Greenhills Creek (RG_FODGH)	Q1	1	0.011	<0.010	<0.010	0.284	60.7	-
	Q2	1	<0.010	0.017	<0.010	0.320	57.2	-
	Q3	2	<0.010	0.013	<0.010	0.132	23.8	10.6
	Q4	1	<0.010	0.012	<0.010	0.295	43.8	-
GH_ERC - Elk River below Thompson Creek (RG_EL20)	Q1	1	<0.010	<0.010	<0.010	0.018	3.31	-
	Q2	0	-	-	-	-	-	-
	Q3	1	<0.010	<0.010	<0.010	0.026	1.12	8.64
	Q4	1	<0.010	<0.010	<0.010	<0.020	2.17	-
LC_LCDSSLCC - Line Creek below South Line Creek (RG_LIDSL)	Q1	13	0.018	0.023	0.060	0.415	43.5	-
	Q2	12	0.016	0.020	0.029	0.269	47.4	4.72
	Q3	15	<0.010	0.012	<0.010	0.097	33.5	7.18
	Q4	15	<0.010	0.018	0.039	0.249	31.4	7.43
EV_HC1 - Harmer Creek below spillway of Harmer Dam (RG_HACKDS)	Q1	4	<0.010	<0.010	<0.010	0.150	36.2	-
	Q2	7	<0.010	<0.010	<0.010	0.194	40.7	-
	Q3	6	0.015	0.027	<0.010	0.312	27.2	14.1
	Q4	4	0.017	0.014	<0.010	0.247	28.2	-
EV_MC2 - Michel Creek below Bodie Creek (RG_MICOMP)	Q1	8	<0.010	<0.010	<0.010	0.076	12.3	-
	Q2	12	<0.010	<0.010	<0.010	0.049	7.80	7.03
	Q3	12	<0.010	<0.010	<0.010	0.141	18.6	6.51
	Q4	11	<0.010	<0.010	<0.010	0.140	11.5	7.84
CM_MC2 - Michel Creek below Corbin Creek (RG_MIDCO)	Q1	7	<0.010	<0.010	<0.010	0.198	9.39	-
	Q2	6	<0.010	<0.010	<0.010	0.110	6.01	-
	Q3	7	<0.010	0.011	<0.010	0.182	7.74	3.48
	Q4	5	<0.010	<0.010	<0.010	0.141	6.97	-

Notes: DMSeO = dimethylselenoxide; MeSe(IV) = methylseleninic acid; MeSe(VI) = methaneselenonic acid; Se(IV) = selenite; Se(VI) = selenate; BI [Se] = benthic invertebrate tissue selenium concentration (mean of replicates); non-detect results shown in grey; these data are also shown in Attachment E as organoselenium = DMSeO + MeSe(IV); "-" = no datum available

Table 6. Selenium speciation in 2022 at Order Stations specified in Section 3 of Permit 107517

Station	Q	n	Maximum Selenium Species Concentrations per Quarter (µg/L)					BI [Se] (mg/kg dw)
			DMSeO	MeSe(IV)	MeSe(VI)	Se(IV)	Se(VI)	
GH_FR1 - Fording River below Greenhills Creek (RG_FODGH)	Q1	1	0.011	<0.010	<0.010	0.284	60.7	-
	Q2	1	<0.010	0.017	<0.010	0.320	57.2	-
	Q3	2	<0.010	0.013	<0.010	0.132	23.8	10.6
	Q4	1	<0.010	0.012	<0.010	0.295	43.8	-
LC_LC5 - Fording River below Line Creek (RG_FO23)	Q1	1	<0.010	<0.010	<0.010	0.138	40.3	-
	Q2	4	0.011	0.013	<0.010	0.213	48.6	6.83
	Q3	7	<0.010	0.015	<0.010	0.229	35.1	7.99
	Q4	3	<0.010	<0.010	<0.010	0.203	39.2	-
GH_ER1 - Elk River above Fording River (RG_ELUEL)	Q1	1	<0.010	<0.010	<0.010	0.022	2.83	-
	Q2	0	-	-	-	-	-	-
	Q3	1	<0.010	<0.010	<0.010	0.023	0.95	9.40
	Q4	1	<0.010	<0.010	<0.010	<0.020	1.94	-
EV_ER4 - Elk River below Fording River (RG_EL19)	Q1	1	<0.010	<0.010	<0.010	0.076	16.7	-
	Q2	1	<0.010	<0.010	<0.010	0.054	8.23	-
	Q3	1	<0.010	<0.010	<0.010	0.049	10.3	8.62
	Q4	1	<0.010	<0.010	<0.010	0.049	14.7	-
EV_ER1 - Elk River below Michel Creek (RG_EL1)	Q1	1	<0.010	<0.010	<0.010	0.059	11.6	-
	Q2	1	<0.010	<0.010	<0.010	0.037	4.20	-
	Q3	1	<0.010	<0.010	<0.010	0.079	9.58	9.48
	Q4	1	<0.010	<0.010	<0.010	0.060	11.4	-
RG_ELKORES - Elk River above Elko Reservoir (RG_ELELKO)	Q1	1	<0.010	<0.010	<0.010	0.062	8.58	-
	Q2	1	<0.010	<0.010	<0.010	0.115	8.07	-
	Q3	3	<0.010	0.019	<0.010	0.173	8.03	8.65
	Q4	1	<0.010	<0.010	<0.010	0.112	9.27	-
RG_DSELK - Koocanusa Reservoir below Elk River	Q1	0	-	-	-	-	-	-
	Q2	1	<0.010	<0.010	<0.010	0.061	2.53	-
	Q3	4	<0.010	<0.010	<0.010	0.023	0.705	-
	Q4	4	<0.010	<0.010	<0.010	0.047	1.56	-

Notes: DMSeO = dimethylselenoxide; MeSe(IV) = methylseleninic acid; MeSe(VI) = methaneselenonic acid; Se(IV) = selenite; Se(VI) = selenate; BI [Se] = benthic invertebrate tissue selenium concentration (mean of 5 replicates); non-detect results shown in grey; these data are also shown in Attachment E as organoselenium = DMSeO + MeSe(IV); "-" = no datum available

Table 7. Selenium speciation data from sedimentation pond monitoring in 2022

Sedimentation Pond (Monitoring Location)	Date of Max. OrgSe	Maximum Selenium Species Concentrations in 2022 (µg/L)				
		DMSeO	MeSe(IV)	MeSe(VI)	Se(IV)	Se(VI)
Corbin Reservoir (CM_CCOFF)	06-Sep	<0.010	0.016	<0.010	0.123	26.3
SPD Pond (CM_SPD)*	16-Aug	<0.010	0.025	<0.010	0.771	2.38
Aqueduct Control (EV_AQ6)	10-Aug	0.016	0.049	<0.010	0.323	3.70
Bodie North (EV_BC1)	30-Aug	0.215	0.119	<0.010	2.70	70.1
EVO Dry Creek (EV_DCSP_DS1)	02-Aug	0.016	0.193	<0.010	1.64	115
Goddard (EV_GC2)	05-May	<0.010	0.018	<0.010	0.154	46.1
Gate (EV_GT1)	02-Aug	0.055	0.096	<0.010	0.758	140
Harmer Reservoir (EV_HC1)	06-Sep	0.015	0.027	<0.010	0.312	27.2
Lindsay 2 (EV_LC1)	02-Aug	0.017	0.035	<0.010	0.187	1.22
Milligan (EV_MG1)	23-Aug	0.117	0.823	<0.010	6.93	31.3
Otto Ponds (EV_OCFB)	03-May	<0.010	0.039	<0.010	0.181	1.31
Six Mile Lower (EV_SM1)*	15-Aug	<0.010	0.024	<0.010	0.223	1.92
South Pit (EV_SP1)	03-Aug	0.023	0.114	<0.010	0.409	127
Clode Main (FR_CC1)	22-Sep	<0.010	0.019	<0.010	0.233	130
Lake Mountain Sediment (FR_LMP1)*	22-Aug	0.015	0.043	<0.010	1.07	214
Liverpool Sed Pond (FR_LP1)	11-Nov	0.134	0.048	<0.010	2.73	78.7
Maintenance & Services Sed Pond (FR_MS1)	19-Aug	0.023	0.172	<0.010	4.12	1.13
North Loop Sed Pond (FR_NL1H)	19-Aug	<0.010	0.022	<0.010	0.523	14.7
Post Sed Ponds (FR_PP1)	11-Aug	0.050	0.195	<0.010	3.24	340
Swift Secondary Pond (FR_SCCAT)*	19-Aug	0.072	0.138	<0.010	1.17	502
Kilmarnock Secondary (FR_SKP2)*	19-Aug	0.012	0.044	<0.010	0.174	101
Smith Ponds (FR_SP1SP_DS)*	22-Aug	0.012	0.060	<0.010	0.528	41.8
Greenhills Main (GH_GH1)	27-Aug	0.112	0.087	<0.010	2.32	127
Porter Creek Secondary (GH_PC1)*	17-Aug	0.017	0.027	<0.010	0.259	65.2
Rail Loop (GH_RLP)	14-Aug	<0.010	<0.010	<0.010	1.67	7.41
Thompson Lower (GH_TC2)*	22-Aug	0.434	0.539	<0.010	4.33	152
Thompson Upper (GH_UTSP_DS1)	23-Aug	0.056	0.303	<0.010	5.15	48.0
Wade Pond Lower (GH_WASP_DS)*	22-Aug	<0.010	0.017	<0.010	0.175	0.593
Wolfram Creek (GH_WC1)	13-Aug	0.049	0.093	<0.010	1.74	318
LCO Dry Head Pond (LC_DCDS)	25-Jul	0.050	0.047	<0.010	1.08	59.7
MSAN 1 (LC_LC7)	30-Aug	<0.01	<0.010	<0.010	0.0790	6.90
LCO Dry Creek Sed Pond 1 (LC_SP1D)[a]	25-Oct	0.780	0.133	<0.010	11.1	27.6
LCO Dry Creek Sed Pond 2 (LC_SP2D)[a]	27-Oct	0.232	0.088	<0.010	1.39	0.041

Notes: DMSeO = dimethylselenoxide; MeSe(IV) = methylseleninic acid; MeSe(VI) = methaneselenonic acid; Se(IV) = selenite; Se(VI) = selenate; non-detect results shown in grey; * = sample from regional survey of sedimentation ponds (same value reported in Table 8) ; these data are also shown in Attachment E as organoselenium = DMSeO + MeSe(IV); [a] = not discharging at this time (sample is from within pond)

Field Data – 2022 Sedimentation Pond Study

Selenium speciation data and benthic invertebrate selenium concentrations upstream and downstream of the sedimentation ponds sampled in the 2022 regional survey are presented in Table 8. Sedimentation pond characteristics and conditions are summarized in Pond Summary Sheets (Attachment D) and provided in detail in tables (Attachment B).

Table 8. Selenium speciation and benthic invertebrate tissue selenium data from the 2022 regional survey of sedimentation ponds and lentic areas

Sedimentation Pond		Selenium Species Concentrations (µg/L)						BI [Se] (mg/kg dw)
		DMDSe	DMSe	DMSeO	MeSe(IV)	Se(IV)	Se(VI)	
Corbin Reservoir	US	<0.022	<0.047	<0.010	<0.010	0.102	29.5	1.59
	DS	<0.022	<0.047	<0.010	0.014	0.128	28.9	2.22
SPD Pond	US	<0.022	<0.047	<0.010	0.012	0.673	2.80	10.4
	DS	<0.022	<0.047	<0.010	0.025	0.771	2.38	7.47
Aqueduct Control	US	<0.022	<0.047	<0.010	0.019	0.373	4.10	(a)
	DS	<0.022	<0.047	<0.010	0.039	0.405	3.80	12.0
Bodie North	US	<0.022	<0.047	0.047	0.051	1.46	99.8	(a)
	DS	<0.022	<0.047	0.084	0.124	2.55	123	26.0
EVO Dry Creek	US	<0.022	<0.047	<0.010	0.038	1.61	144	19.0
	DS	<0.022	0.140	<0.010	0.142	2.00	135	55.0
Harmer Creek	US	<0.022	<0.047	<0.010	0.017	0.326	28.1	13.3
	DS	<0.022	<0.047	<0.010	0.023	0.338	25.3	12.3
Gate Creek	US	<0.022	<0.047	<0.010	0.032	0.636	73.3	15.0
	DS	<0.022	<0.047	<0.010	0.046	0.702	76.0	15.8
Lindsay 2	US	<0.022	<0.047	<0.010	<0.010	0.122	2.79	(a)
	DS	(b)		<0.010	0.026	0.185	1.18	(a)
Milligan Creek	US	<0.022	<0.047	<0.010	0.048	1.31	74.4	24.0
	DS	0.144	0.446	0.117	0.676	6.28	31.3	116
South Pit Creek	US	<0.022	<0.047	<0.010	<0.010	0.174	128	(a)
	DS	<0.022	<0.047	0.015	0.100	0.427	118	28.7
Swift Creek Secondary	US	<0.022	<0.047	0.092	0.078	1.17	400	(a)
	DS	<0.022	<0.047	0.072	0.138	1.17	502	9.8
Clode Main	US	<0.022	<0.047	<0.010	<0.010	0.168	83.1	(a)
	DS	<0.022	<0.047	<0.010	0.015	0.265	127	18.7
Porter Creek Secondary	US	<0.022	<0.047	<0.010	<0.010	0.178	65.8	6.87
	DS	<0.022	<0.047	0.017	0.027	0.259	65.2	12.7
Smith Ponds	US	<0.022	<0.047	<0.010	<0.010	0.035	30.3	(a)
	DS	<0.022	<0.047	0.012	0.060	0.528	41.8	31.7
Greenhills Main	US	<0.022	<0.047	<0.010	0.034	1.25	165	12.5
	DS	<0.022	<0.047	0.035	0.087	2.10	119	13.6
Thompson Lower	US	<0.022	<0.047	0.012	0.063	2.69	149	22.0
	DS	<0.022	0.210	0.434	0.539	4.33	152	51.0
Thompson Upper	US	<0.022	<0.047	<0.010	0.030	0.666	74.8	14.3
	DS	<0.022	0.188	0.075	0.248	4.58	55.6	38.5
Wade Pond Lower	US	<0.022	<0.047	<0.010	<0.010	0.171	0.707	9.03
	DS	<0.022	<0.047	<0.010	0.017	0.175	0.593	(a)
MSAN 1	US	<0.022	<0.047	<0.010	<0.010	<0.020	1.94	8.87
	DS	<0.022	<0.047	<0.010	<0.010	0.073	6.27	13.0
WLC AWTF	US	(a)						
	DS	<0.022	<0.047	0.014	0.031	1.24	14.8	(a)
Goddard	US	<0.022	<0.047	<0.010	<0.010	0.245	92.1	13.2
	DS	<0.022	<0.047	<0.010	0.011	0.351	88.2	(a)

Kilmarnock Secondary	US	<0.022	<0.047	<0.010	0.028	0.096	78.2	8.80
	DS	<0.022	<0.047	0.012	0.044	0.174	101	(a)
Lake Mountain Sediment	US	<0.022	<0.047	0.011	0.039	1.03	240	9.60
	DS	<0.022	<0.047	0.015	0.043	1.07	214	19.7
LCO Dry Head Pond	US	<0.022	<0.047	0.024	0.023	0.98	72.9	8.27
	DS	<0.022	<0.047	0.029	0.037	1.00	73.4	11.9
Otto Ponds	US	<0.022	<0.047	<0.010	0.031	0.086	0.120	(a)
	DS	<0.022	<0.047	<0.010	0.025	0.112	0.199	(a)
Six Mile Lower	US	<0.022	<0.047	<0.010	0.011	0.174	1.97	5.43
	DS	<0.022	<0.047	<0.010	0.024	0.223	1.92	8.33
Eagle Creek Pond	US	<0.022	<0.047	<0.010	<0.010	0.250	252	25.3
	DS	(a)						
Goddard Marsh	US	<0.022	<0.047	<0.010	0.011	0.351	88.2	(a)
	DS	<0.022	<0.047	0.017	0.099	2.86	79.8	44.0
Aqueduct Wetland	US	<0.022	<0.047	<0.010	0.016	0.224	2.89	(a)
	DS	<0.022	<0.047	<0.010	0.019	0.387	3.26	25.7

Notes: US = upstream; DS = downstream; DMDSe = dimethyldiselenide; DMSe = dimethylselenide; DMSeO = dimethylselenoxide; MeSe(IV) = methylseleninic acid; Se(IV) = selenite; Se(VI) = selenate; BI [Se] = benthic invertebrate tissue selenium concentration (mean of 3 replicates); "-" = no datum available; non-detect results lkshown in grey; (a) = sample not collected because no suitable habitat present (e.g., because water enters or leaves the sedimentation pond through a pipe) or because inflow location could not be located; (b) = sample lost in transit; these data are also shown in Attachment E as organoselenium = DMSeO + MeSe(IV)

Preliminary Data Analysis

Selenium speciation data collected in regional and local monitoring (Tables 5 and 6; Attachment C), sedimentation ponds (Tables 7 and 8), the longitudinal study (Table 10), and sampling of Goddard Marsh and Aqueduct Wetland (Figure 6) were plotted on regional heat maps for each mine operation to provide a visual overview of patterns of speciation across the Elk Valley (Attachment E). As described in Section 3.1, the maps in Attachment E show the maximum measured organoselenium concentration at each location in 2022 relative to draft screening values, and the associated tables (Tables 5 and 6; Attachment C) show individual species concentrations associated with the sampling event that had that maximum measured organoselenium concentration. High-level regional patterns of maximum organoselenium concentrations apparent on the heat maps and local patterns apparent in Attachment C are discussed below.

At a regional scale, the patterns of organoselenium concentrations are consistent with those described in 2021 (ADEPT 2022b). The highest organoselenium concentrations occur immediately downstream of sedimentation ponds,[13] with maximum reported concentrations ranging from <0.01 µg/L to >0.9 µg/L (Table 7).[14] These concentrations decline with distance due to dilution and loss processes. Declines in concentrations are gradual along larger tributaries (e.g., Harmer Creek downstream of EVO Dry Creek, Line Creek downstream of the WLC AWTF) and are more discontinuous where smaller mine-affected tributaries enter larger mainstem creeks and

[13] The two studied lentic areas were at the lower end of this range, with maximum organoselenium concentrations of 0.019 µg/L downstream of Aqueduct Wetland and 0.116 µg/L at the outflow of Goddard Marsh.

[14] The highest organoselenium concentrations measured in 2022 occurred immediately downstream of Milligan Creek Sedimentation Pond (maximum 0.94 µg/L) and Lower Thompson Creek Sedimentation Pond (maximum 0.97 µg/L). The potential for these concentrations to affect bioaccumulation further downstream was discussed at an EMC meeting on 12 April 2023. In brief, Milligan Creek constitutes <0.1% of the flow of Michel Creek and accordingly has no material effect on organoselenium concentrations and bioaccumulation in Michel Creek. Thompson Creek constitutes <1% of the flow of the Elk River and accordingly has no material effect on organoselenium concentrations and bioaccumulation in the Elk River. Although Thompson Creek constitutes ~5% of flow the Elk River Side Channel prior to mixing with the mainstem Elk River, the side channel downstream of Thompson Creek is seasonally dry, which limits potential effects on bioaccumulation. Further evaluation of this area is recommended in 2023 (Section 6).

rivers that provide high dilution (e.g., Clode Creek entering the Fording River, Goddard Creek entering the Elk River). As a result, concentrations in Harmer Creek and Line Creek tend to be <0.025 µg/L or 0.025 – 0.05 µg/L, whereas concentrations in the Elk River and Michel Creek are usually below detection and almost always <0.025 µg/L. A reach of the Fording River immediately downstream of Greenhills Creek (GH_FR1 in Table 6) is an exception to this general pattern, with maximum organoselenium concentrations 0.025 – 0.05 µg/L, reflecting proximity to Greenhills Main Sedimentation Pond and the relatively high flow from Greenhills Creek compared to most other mine-affected tributaries.[15] The upper Fording River also has a segment with maximum organoselenium concentrations that reflect inputs from the FRO-South AWTF effluent retention pond.[16] Most other portions of the mainstem Fording River are below detection or <0.025 µg/L.

Local monitoring programs provide more spatial resolution on the broad patterns described above in areas that have been identified with elevated uncertainty about potential changes to speciation. Detailed analyses of patterns of speciation and related factors are provided in program-specific reporting. In brief, general patterns apparent in these local monitoring programs are:

- Review of speciation data from monitoring at CMm indicated few detectable organoselenium concentrations in mine works or receiving environment locations, consistent with 2021. Organoselenium was detected in 2022 at CM_CCOFF and CM_SPD, but neither exceeded the draft screening value of 0.025 µg/L.
- LCO Dry Creek LAEMP monitoring is described in Minnow (2023a). Speciation in 2022 was generally similar to 2021 but with lower peak concentrations of selenite and organoselenium species. Detectable organoselenium was present upstream of the LCO Dry Creek Water Management System (DCWMS), indicating that organoselenium generation is occurring either in upstream waste rock or in the reach of LCO Dry Creek between the spoils and the DCWMS. Maximum organoselenium concentrations at the outflow of the DCWMS were higher than upstream of the DCWMS. After discharge to LCO Dry Creek, organoselenium concentrations declined progressively with distance. There was no discernible effect of LCO Dry Creek on organoselenium concentrations in the Fording River.
- LCO LAEMP monitoring is described in Minnow (2023b). Speciation in 2022 was generally similar to 2021. Organoselenium was not detected in Line Creek upstream of the WLC AWTF nor in West Line Creek. The maximum organoselenium concentrations in Line Creek downstream of the outflow of the AWTF effluent retention pond was 0.065 µg/L on 28 March 2022. Organoselenium concentrations in Line Creek declined progressively with distance from the AWTF and were near or below detection near the mouth of Line Creek. There was no discernible effect of Line Creek on organoselenium concentrations in the Fording River.
- Greenhills Creek LAEMP monitoring is described in Minnow and Lotic (2023a). Monitoring in 2022 found detectable organoselenium in upper Greenhills Creek, indicating that organoselenium generation is occurring either in upstream waste rock or in the reach of Greenhills Creek between the spoils and the sedimentation ponds. Maximum organoselenium concentrations downstream of Greenhills Main Sedimentation Pond were ~10× higher than upstream. Organoselenium was not detected in Gardine Creek. As discussed in the regional overview above, there was a discernible effect of Greenhills Creek on organoselenium concentrations in a downstream reach of the Fording River.

[15] Detectable organoselenium was present at GH_FR1, ~200 m downstream of Greenhills Creek. The maximum organoselenium concentration at GH_FR1 in 2022 was lower than previous years (Figure 5) and BI [Se] (Table 5) was less than the lowest level 1 benchmark (11 mg/kg dw).

[16] Detectable organoselenium was present at RG_SCOUTDS (~200 m downstream of the outfall) and RG_FOBSC (~500 m downstream of the outfall). Minnow and Lotic (2023) concluded that there was no change in BI [Se] relative to immediately upstream of the outfall. Mean BI [Se] was less than the lowest level 1 benchmark (11 mg/kg dw) on all sample dates in 2022 at both locations.

- Fording River LAEMP monitoring is described in Minnow and Lotic (2023b). Monitoring in 2022 found an increase relative to 2021 in the frequency of detection of MeSe(IV) and DMSeO at some locations downstream of the FRO-South AWTF. Maximum organoselenium concentrations in 2022 were >0.025 µg/L at RG_SCOUTDS and RG_FOBSC (~500 m downstream of RG_SCOUTDS) and either below detection or ≤0.025 µg/L at all other mainstem monitoring locations in the FRO LAEMP.
- A draft report on EVO LAEMP monitoring was not available at the time of preparation of this report, but preliminary results were presented to the EMC on 1 May 2023. Monitoring in 2022 found maximum organoselenium concentrations in Erickson Creek ranging from below detection in upstream reaches to 0.025 – 0.05 µg/L near the mouth. Higher organoselenium concentrations occurred downstream of sedimentation ponds on Gate Creek (~0.3 µg/L) and Bodie Creek (~0.6 µg/L). Organoselenium concentrations in Michel Creek were mostly below detection and always <0.025 µg/L.
- EVO SRF monitoring is described in Teck (2023). Monitoring in 2022 found maximum organoselenium concentrations in the range 0.025 – 0.05 µg/L at the SRF Effluent Retention Pond Outflow and <0.025 µg/L in upstream reaches of Erickson Creek, with higher concentrations (0.025 – 0.05 µg/L) near the mouth. Organoselenium concentrations in Michel Creek and the Elk River were mostly below detection and always <0.025 µg/L.
- Review of speciation data from monitoring related to the EVO Dry Creek Water Treatment Project and Harmer Dam Removal Project indicated that maximum organoselenium concentrations in 2022 were relatively high at the outflow of EVO Dry Creek Sedimentation Pond (>0.1 µg/L at EV_DCOUT) and lower further downstream (~0.05 µg/L at EV_DC2A). Maximum organoselenium concentrations at the outflow of Harmer Creek Sedimentation Pond (EV_HC1, EV_HCDSDAM) were in the range 0.025 – 0.05 µg/L, declining to <0.025 µg/L at EV_HC1A. These patterns are consistent with results of the longitudinal study (Section 4.2)

4.2 Longitudinal Patterns

Field Data

Distances of sampling locations from the study sedimentation ponds, flow velocities at each location, and calculated travel times downstream of the ponds are summarized in Table 9.

Table 9. Details of sampling locations for the longitudinal study

Site Distance (km)	Watercourse	Measured flow velocity (m/s)	Cumulative travel time (h)
EVO Dry Creek Sedimentation Pond			
0.01	EVO Dry Creek	0.262 ± 0.177	0.0147
0.50	Harmer Creek	0.776 ± 0.199	0.190
3.16	Harmer Creek	0.675 ± 0.386	1.28
6.05	Harmer Creek	0.590 ± 0.610	2.64
Harmer Creek Sedimentation Pond			
0.13	Harmer Creek	0.546 ± 0.287	0.0662
0.61	Harmer Creek	0.493 ± 0.560	0.334
4.76	Grave Creek	0.886 ± 0.435	1.64
Greenhills Main Sedimentation Pond			
0.05	Greenhills Creek	0.433 ± 0.278	0.0326
0.62	Fording River	0.175 ± 0.042	0.934
2.02	Fording River	-	1.95
Upper Thompson Sedimentation Pond			
0.06	Thompson Creek	0.245 ± 0.024	0.0731
0.62	Thompson Creek	0.355 ± 0.166	0.505
2.74	Thompson Creek	0.334 ± 0.168	2.27
3.39	Thompson Creek	0.222 ± 0.064	3.09

Notes: Distance is from sedimentation pond outflow; flow velocity is mean ± standard deviation of 5 measurements; "-" = not measured; measured flow velocity was applied to the reach between that location and the next upstream location

Selenium speciation and benthic invertebrate tissue selenium concentrations from the longitudinal study are summarized in Table 10. Note that data in Table 10 for the first location downstream of each sedimentation pond are the same data reported as "DS" for these four sedimentation ponds in Table 8.

Table 10. Selenium speciation and benthic invertebrate tissue selenium data from the longitudinal study

Site	Selenium Species Concentrations (µg/L)						Dissolved [Se] (µg/L)	Total [Se] (µg/L)	BI [Se] (mg/kg dw)
Distance (km)	DMDSe	DMSe	DMSeO	MeSe(IV)	Se(IV)	Se(VI)			
EVO Dry Creek Sedimentation Pond									
0.01	<0.022	0.140	<0.010	0.142	2.00	135	176	147	55.0
0.50	<0.022	<0.047	<0.010	0.019	0.444	37.7	32.1	38.4	10.3
3.16	<0.022	<0.047	<0.010	0.017	0.385	32.0	30.0	32.0	12.3
6.05	<0.022	<0.047	<0.010	0.017	0.326	28.1	26.9	28.3	13.3
Harmer Creek Sedimentation Pond									
0.13	<0.022	<0.047	<0.010	0.023	0.338	25.3	25.0	23.8	12.3
0.61	-						25.7	24.4	14.7
4.76	<0.022	<0.047	<0.010	0.013	0.213	14.8	17.2	17.8	11.5
Greenhills Main Sedimentation Pond									
0.05	<0.022	<0.047	0.035	0.087	2.10	119	157	142	12.3
0.62	<0.022	<0.047	0.026	0.064	2.33	130	129	96.1	17.7
2.02	<0.022	<0.047	<0.010	0.012	0.296	43.3	37.2	37.3	13.0
Upper Thompson Sedimentation Pond									
0.06	0.026	0.111	0.056	0.303	5.15	48.0	69.9	55.6	34.3
0.62	0.048	<0.047	0.043	0.154	4.62	40.6	42.0	45.2	25.7
2.74	<0.022	<0.047	<0.010	0.065	2.65	172	147	142	15.0
3.39	<0.022	<0.047	0.012	0.063	2.69	149	154	140	22.0

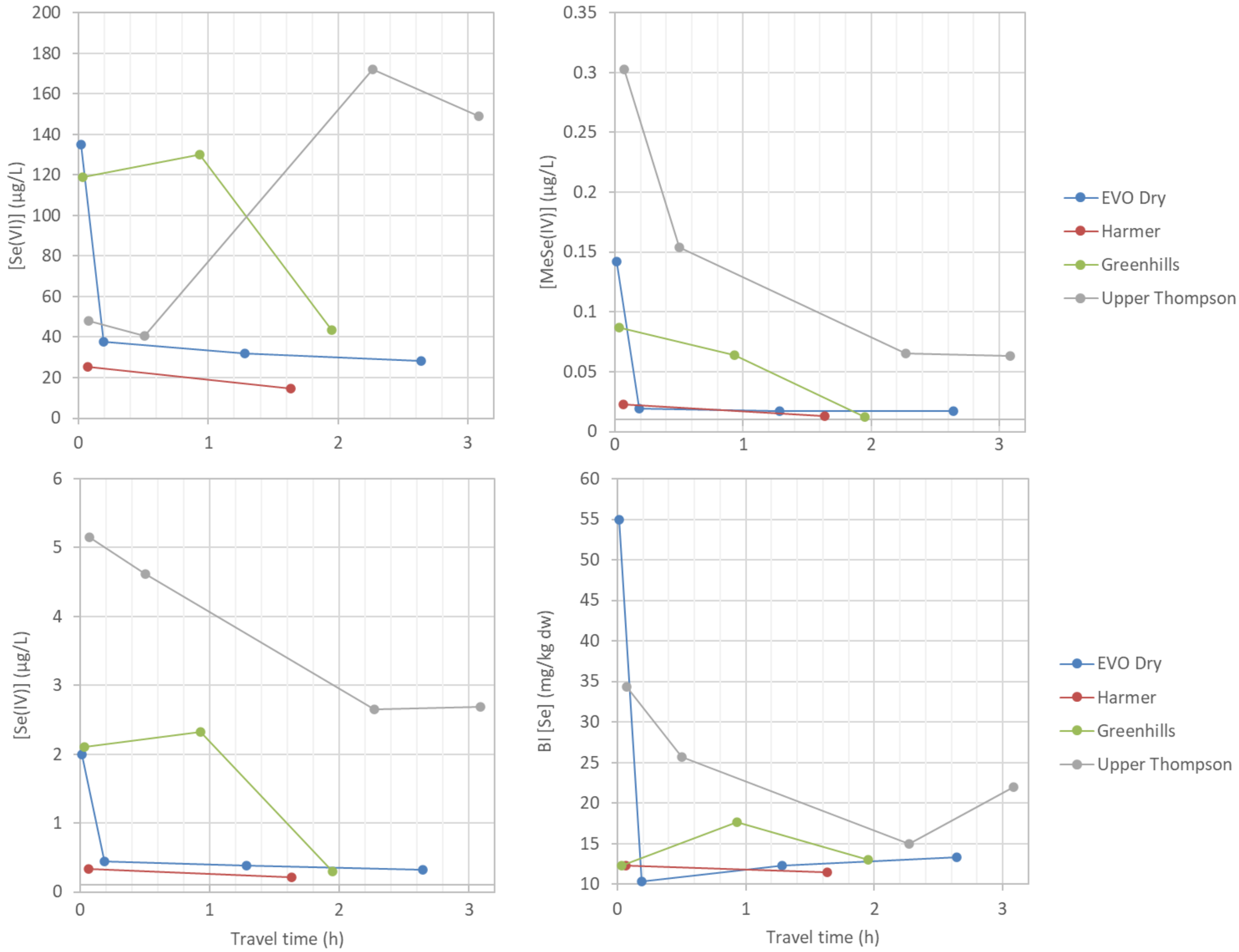
Notes: Distance = distance from sedimentation pond outflow; DMDSe = dimethyldiselenide; DMSe = dimethylselenide; DMSeO = dimethylselenoxide; MeSe(IV) = methylseleninic acid; Se(IV) = selenite; Se(VI) = selenate; BI [Se] = benthic invertebrate selenium concentration (mean of 3 replicates); "-" = no datum available; non-detect results shown in grey; these data are also shown in Attachment E as organoselenium = DMSeO + MeSe(IV)

Preliminary Data Analysis

Longitudinal concentration gradients for selenate, selenite, MeSe(IV), and benthic invertebrate tissue selenium are plotted in Figure 2. DMSeO, DMSe, and DMDSe were detected at too few sites to compare longitudinal patterns (Table 10).

Longitudinal concentration gradients on Figure 2 are visually similar to what was observed in 2021 (ADEPT 2022b). Changes in selenate concentrations reflect mixing with other sources of water, which in upper Thompson Creek resulted in a 3-fold increase in aqueous selenium concentrations downstream of the confluence of North Thompson Creek. Selenite and MeSe(IV) exhibited proportionately greater losses over time compared to selenate, indicating one or more loss terms in addition to mixing. As noted in Section 3.3, estimation of loss rate coefficients in the Greenhills Creek and upper Thompson Creek study reaches will require evaluation of alternative tracers to account for mixing with high-sulphate and high-selenate waters. This analysis will be conducted on the combined dataset from the 2021 – 2023 SeSMP cycle and will be reported in the three-year interpretive report.

Figure 2. Longitudinal gradients of speciation and invertebrate tissue selenium concentrations



Notes: Se(VI) = selenate; Se(IV) = selenite; MeSe(IV) = methylseleninic acid; BI [Se] = benthic invertebrate tissue selenium

4.3 Seasonality

Field Data

Selenium speciation and benthic invertebrate tissue selenium concentrations from the seasonal study are summarized in Table 11. Note that data in Table 11 for late August 2022 are the same data reported for these four sedimentation ponds in Table 8.

Table 11. Selenium speciation and benthic invertebrate tissue selenium data from the 2022 seasonal study

Site	Sample Date	Selenium Species Concentrations (µg/L)							Dissolved [Se] (µg/L)	Total [Se] (µg/L)	BI [Se] (mg/kg dw)
		DMDSe	DMSe	DMSeO	MeSe(IV)	OrganoSe	Se(IV)	Se(VI)			
EVO Dry Creek Sedimentation Pond											
US	07-Feb	<0.022	<0.047	<0.01	0.019	0.019	0.413	157	144	148	19.0
US	07-Mar	<0.022	<0.047	<0.01	0.021	0.021	0.410	141	153	148	12.6
US	13-Apr	<0.022	<0.047	<0.01	0.034	0.034	0.499	143	121	121	34.3
US	18-May	<0.022	<0.047	<0.01	0.024	0.024	0.460	82.2	84.9	82.5	26.8
US	22-Jun	<0.022	<0.047	<0.01	0.026	0.026	0.526	69.2	76.7	74.4	13.2
US	13-Jul	<0.022	<0.047	<0.01	0.048	0.048	0.789	95.2	121	118	10.4
US	27-Jul	<0.022	<0.047	0.015	0.054	0.069	1.09	128	121	124	17.3
US	08-Aug	<0.022	<0.047	<0.01	0.040	0.040	1.38	138	127	139	19.3
US	24-Aug	<0.022	<0.047	<0.01	0.038	0.038	1.61	144	147	134	19.0
US	09-Sep	<0.022	<0.047	0.013	0.035	0.048	1.16	134	147	152	16.5
US	21-Sep	<0.022	<0.047	<0.01	0.031	0.031	1.00	139	120	122	13.9
US	19-Oct	<0.022	<0.047	<0.01	0.020	0.020	0.699	139	146	144	13.6
US	16-Nov	<0.022	0.074	<0.01	0.025	0.025	0.510	152	150	146	16.4
US	14-Dec	<0.022	<0.047	<0.01	0.019	0.019	0.400	131	150	144	15.9
DS	07-Feb	<0.022	<0.047	<0.01	0.015	0.015	0.442	157	144	155	55.1
DS	07-Mar	<0.022	<0.047	<0.01	0.020	0.020	0.515	140	149	149	59.5
DS	13-Apr	<0.022	<0.047	<0.01	0.039	0.039	0.542	144	124	121	60.6
DS	18-May	<0.022	<0.047	<0.01	0.030	0.030	0.458	84.8	87.1	82.7	49.5
DS	22-Jun	<0.022	<0.047	0.012	0.025	0.037	0.543	69.8	75.5	76.2	15.9
DS	13-Jul	<0.022	0.054	<0.01	0.113	0.113	1.07	108	121	117	33.2
DS	27-Jul	<0.022	0.055	<0.01	0.120	0.120	1.51	131	133	132	42.8
DS	08-Aug	<0.022	0.095	<0.01	0.112	0.112	1.79	138	126	124	35.2
DS	24-Aug	<0.022	0.140	<0.01	0.142	0.142	2.00	135	137	142	54.6
DS	09-Sep	<0.022	0.132	<0.01	0.035	0.035	1.21	132	147	138	57.6
DS	21-Sep	<0.022	0.076	<0.01	0.059	0.059	1.24	140	128	123	39.1
DS	19-Oct	<0.022	0.083	<0.01	0.025	0.025	0.855	141	145	147	54.3
DS	16-Nov	<0.022	<0.047	<0.01	0.031	0.031	0.734	150	150	143	50.9
DS	14-Dec	<0.022	0.058	<0.01	0.021	0.021	0.594	129	139	136	60.2

Site	Sample Date	Selenium Species Concentrations (µg/L)							Dissolved [Se] (µg/L)	Total [Se] (µg/L)	BI [Se] (mg/kg dw)
		DMDSe	DMSe	DMSeO	MeSe(IV)	OrganoSe	Se(IV)	Se(VI)			
Harmer Creek Sedimentation Pond											
US	07-Feb	<0.022	<0.047	<0.01	<0.01	<0.01	0.143	44.0	41.5	41.7	10.3
	07-Mar	<0.022	<0.047	<0.01	0.014	0.014	0.152	39.7	42.2	45.1	9.09
	13-Apr	<0.022	<0.047	<0.01	0.015	0.015	0.193	53.0	39.3	46.5	8.45
	18-May	<0.022	<0.047	<0.01	<0.01	<0.01	0.108	20.1	20.6	20.1	11.6
	22-Jun	<0.022	<0.047	<0.01	<0.01	<0.01	0.093	9.74	11.4	10.5	10.7
	13-Jul	<0.022	<0.047	<0.01	0.017	0.017	0.155	18.6	20.6	19.9	12.3
	27-Jul	<0.022	<0.047	<0.01	0.023	0.023	0.261	24.6	23.8	24.1	13.3
	08-Aug	<0.022	<0.047	<0.01	0.020	0.020	0.291	26.2	25.2	28.6	12.5
	24-Aug	<0.022	<0.047	<0.01	0.017	0.017	0.326	28.1	26.9	28.3	13.3
	09-Sep	<0.022	<0.047	<0.01	0.023	0.023	0.279	28.4	29.7	31.2	13.8
	21-Sep	<0.022	<0.047	<0.01	<0.01	<0.01	0.108	10.1	27.5	28.0	14.9
	19-Oct	<0.022	<0.047	<0.01	0.012	0.012	0.190	29.3	30.5	30.1	14.5
	17-Nov	<0.022	<0.047	<0.01	<0.01	<0.01	0.167	34.5	35.6	33.9	12.5
	14-Dec	<0.022	<0.047	<0.01	<0.01	<0.01	0.130	32.0	33.6	34.9	11.1
DS	07-Feb	<0.022	<0.047	<0.01	<0.01	<0.01	0.150	36.6	41.5	41.4	14.2
	07-Mar	<0.022	<0.047	<0.01	0.014	0.014	0.161	37.4	39.6	41.0	17.0
	13-Apr	<0.022	<0.047	<0.01	0.017	0.017	0.204	50.2	44.3	57.1	9.12
	18-May	<0.022	<0.047	<0.01	<0.01	<0.01	0.120	19.6	19.5	19.2	9.60
	22-Jun	<0.022	<0.047	<0.01	<0.01	<0.01	0.105	9.41	10.9	11.2	7.53
	14-Jul	<0.022	<0.047	<0.01	<0.01	<0.01	0.170	17.4	18.5	19.0	14.4
	27-Jul	<0.022	<0.047	<0.01	0.028	0.028	0.251	23.7	23.4	23.1	14.7
	08-Aug	<0.022	<0.047	<0.01	0.019	0.019	0.329	26.1	25.0	26.8	12.6
	25-Aug	<0.022	<0.047	<0.01	0.023	0.023	0.338	25.3	25.0	23.8	12.2
	09-Sep	<0.022	<0.047	<0.01	0.024	0.024	0.287	25.9	28.7	28.7	12.2
	21-Sep	<0.022	<0.047	<0.01	0.024	0.024	0.256	27.4	24.5	25.8	13.2
	19-Oct	<0.022	<0.047	<0.01	0.022	0.022	0.217	28.5	30.2	31.0	14.3
	17-Nov	<0.022	<0.047	<0.01	0.015	0.015	0.166	33.2	34.1	33.0	11.5
	14-Dec	<0.022	<0.047	<0.01	<0.01	<0.01	0.149	30.1	33.2	32.3	10.1

Site	Sample Date	Selenium Species Concentrations (µg/L)							Dissolved [Se] (µg/L)	Total [Se] (µg/L)	BI [Se] (mg/kg dw)
		DMDSe	DMSe	DMSeO	MeSe(IV)	OrganoSe	Se(IV)	Se(VI)			
Greenhills Main Sedimentation Pond											
US	11-Jan	<0.022	<0.047	<0.01	0.014	0.014	0.442	133	142	141	11.5
US	08-Feb	<0.022	<0.047	<0.01	<0.01	<0.01	0.418	135	130	139	8.25
US	07-Mar	<0.022	<0.047	<0.01	<0.01	<0.01	0.439	118	122	122	12.6
US	13-Apr	<0.022	<0.047	<0.01	0.012	0.012	0.406	56.2	56	55.1	12.0
US	17-May	<0.022	<0.047	<0.01	0.011	0.011	0.335	49.0	49.6	47.7	12.4
US	22-Jun	<0.022	<0.047	<0.01	0.015	0.015	0.325	31.9	34.3	33.8	6.06
US	13-Jul	<0.022	<0.047	<0.01	0.023	0.023	0.683	95.6	88.6	88.9	10.3
US	25-Jul	<0.022	<0.047	<0.01	0.029	0.029	1.16	136	129	132	10.0
US	09-Aug	<0.022	<0.047	<0.01	0.034	0.034	1.25	165	147	146	9.67
US	23-Aug	<0.022	<0.047	<0.01	0.034	0.034	1.25	165	151	171	15.1
US	08-Sep	<0.022	<0.047	0.011	0.039	0.050	1.27	154	157	163	13.0
US	20-Sep	<0.022	<0.047	<0.01	0.025	0.025	1.12	153	139	140	11.5
US	18-Oct	<0.022	<0.047	<0.01	0.021	0.021	0.903	158	153	161	11.6
US	16-Nov	<0.022	<0.047	<0.01	0.011	0.011	0.582	152	144	148	9.91
US	14-Dec	<0.022	<0.047	<0.01	<0.01	<0.01	0.535	144	139	153	9.57
DS	11-Jan	<0.022	<0.047	<0.01	0.034	0.034	0.068	125	136	141	13.9
DS	01-Feb	<0.022	<0.047	0.028	0.051	0.079	1.21	140	132	131	17.6
DS	07-Mar	<0.022	<0.047	<0.01	0.039	0.039	0.787	124	128	125	18.7
DS	13-Apr	<0.022	<0.047	0.017	0.052	0.069	0.893	60.1	58.5	59.2	21.3
DS	17-May	<0.022	<0.047	<0.01	0.025	0.025	0.560	39.5	39.2	39.8	21.3
DS	22-Jun	<0.022	<0.047	<0.01	0.017	0.017	0.387	30.8	33.9	34.1	13.6
DS	13-Jul	<0.022	<0.047	<0.01	0.019	0.019	0.644	85.7	70.5	67.2	14.0
DS	25-Jul	<0.022	<0.047	0.061	0.052	0.113	1.59	101	96.6	95.2	16.3
DS	09-Aug	<0.022	<0.047	0.035	0.087	0.122	2.10	119	106	103	14.6
DS	24-Aug	<0.022	<0.047	0.036	0.063	0.099	1.80	98.4	126	142	12.2
DS	08-Sep	<0.022	0.041	0.081	0.087	0.168	2.41	112	140	143	11.3
DS	20-Sep	<0.022	0.039	0.055	0.082	0.137	2.90	135	123	125	11.3
DS	18-Oct	<0.022	0.078	0.096	0.085	0.181	3.28	144	142	139	14.3
DS	16-Nov	<0.022	0.045	0.087	0.046	0.133	2.53	139	140	137	13.0
DS	14-Dec	<0.022	<0.047	0.039	0.022	0.061	1.23	142	145	138	14.8

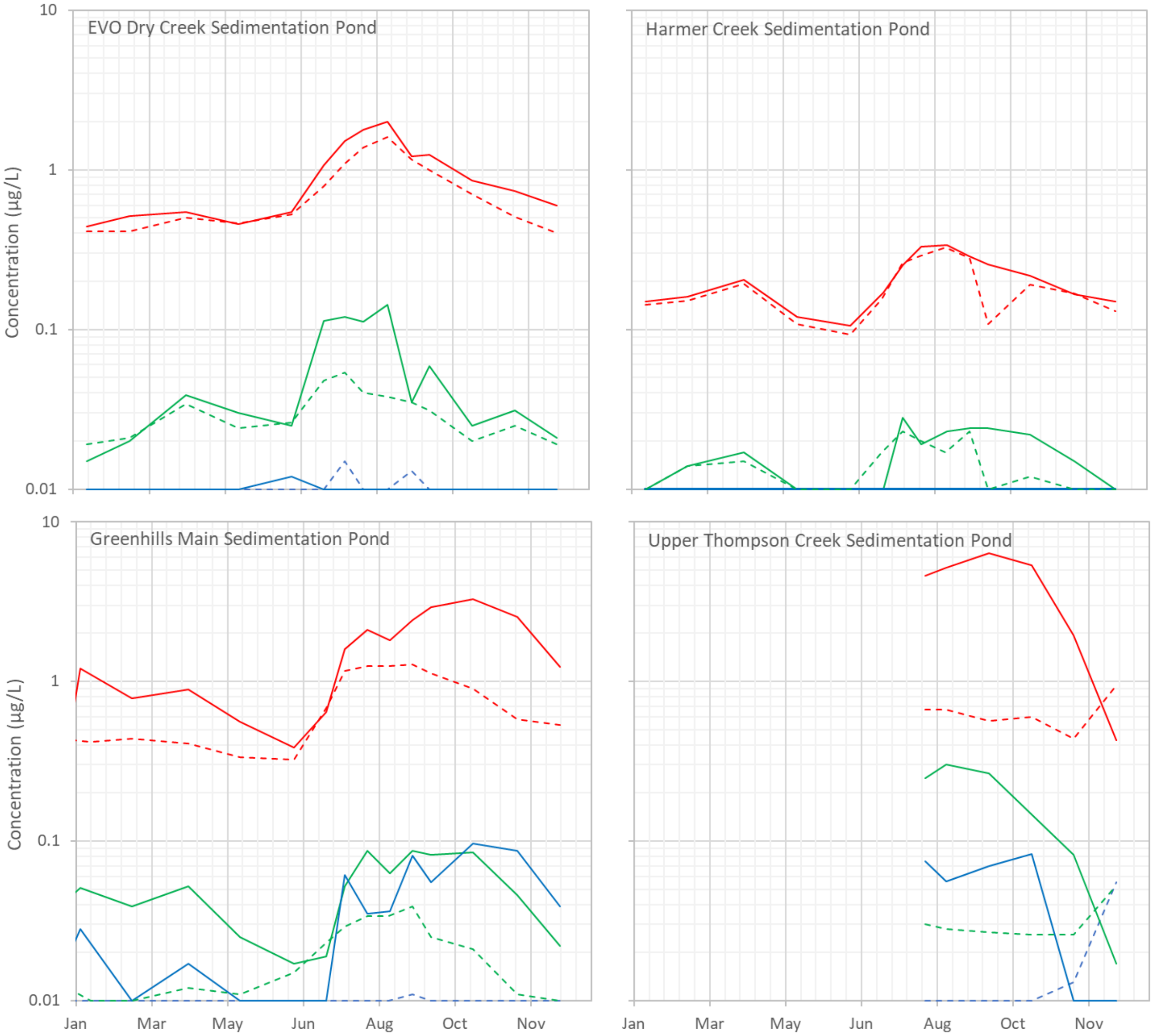
Site	Sample Date	Selenium Species Concentrations (µg/L)							Dissolved [Se] (µg/L)	Total [Se] (µg/L)	BI [Se] (mg/kg dw)
		DMDSe	DMSe	DMSeO	MeSe(IV)	OrganoSe	Se(IV)	Se(VI)			
Upper Thompson Creek Sedimentation Pond											
US	09-Aug	<0.022	<0.047	<0.01	0.030	0.030	0.666	74.8	70.7	76.6	13.9
	23-Aug	<0.022	<0.047	<0.01	0.028	0.028	0.662	69.0	64.8	71.0	14.6
	20-Sep	<0.022	<0.047	<0.01	0.027	0.027	0.563	55.3	52.6	55.2	9.68
	18-Oct	<0.022	<0.047	<0.01	0.026	0.026	0.596	57.9	54.6	54.9	9.94
	15-Nov	<0.022	0.106	0.013	0.026	0.039	0.438	52.5	53.3	54.9	15.1
	13-Dec	<0.022	<0.047	0.055	0.053	0.108	0.940	47.8	50.5	52.4	10.0
DS	09-Aug	<0.022	0.188	0.075	0.248	0.323	4.58	55.6	60.8	60.3	42.5
	23-Aug	0.026	0.111	0.056	0.303	0.359	5.15	48.0	69.9	55.6	34.0
	20-Sep	<0.022	0.069	0.070	0.265	0.335	6.33	42.8	42.5	48.3	31.5
	18-Oct	<0.022	0.118	0.083	0.147	0.230	5.32	43.7	46.9	50.0	40.9
	15-Nov	<0.022	<0.047	<0.01	0.082	0.082	1.95	45.7	53.5	47.0	35.2
	13-Dec	<0.022	0.043	<0.01	0.017	0.017	0.430	49.7	49.7	44.5	45.0

Notes: US = upstream; DS = downstream; DMDSe = dimethyldiselenide; DMSe = dimethylselenide; DMSeO = dimethylselenoxide; MeSe(IV) = methylseleninic acid; OrganoSe = sum of DMSeO and MeSe(IV); Se(IV) = selenite; Se(VI) = selenate; BI [Se] = benthic invertebrate tissue selenium concentration (mean of 3 replicates); "-" = no datum available; non-detect results shown in grey; (a) = sample broken in storage

Preliminary Data Analysis

Seasonal patterns of selenite (shown as red series), DMSeO (blue series), and MeSe(IV) (green series) at sampling locations upstream (dashed lines) and downstream (solid lines) of the four study ponds are plotted in Figure 3. For each plotted colour series, the difference between dashed and solid lines shows the incremental change in concentrations of the species with passage through the study pond. For ease of comparison, all four study ponds are plotted on the same axis ranges.

Figure 3. Seasonal cycles of selenium species concentrations in 2022 at four study sedimentation ponds



Notes: Blue lines = dimethylselenoxide; green lines = methylseleninic acid; red lines = selenite; dashed lines = inflow; solid lines = outflow; lines join values in each series for ease of interpretation and do not indicate interpolated conditions between the sampling dates

Selenite (red lines on Figure 3) exhibited seasonal variation both upstream and downstream of the study ponds. Increases in concentration between inflow and outflow were observed in some or all months at all four study ponds and both the timing and magnitude of increases varied among ponds. Peak concentrations of selenite occurred between August and October. These patterns are consistent with the seasonal patterns described for these ponds in ADEPT (2022b) and in Golder (2021a) for Bodie Creek and Gate Creek sedimentation ponds. As in 2021, Harmer Creek Sedimentation Pond exhibited lower concentrations of selenite and less difference between inflow and outflow compared to the other study ponds. Upper Thompson Creek Sedimentation Pond exhibited the largest effect on selenite, with up to a 10-fold increase in concentration between inflow and outflow.[17]

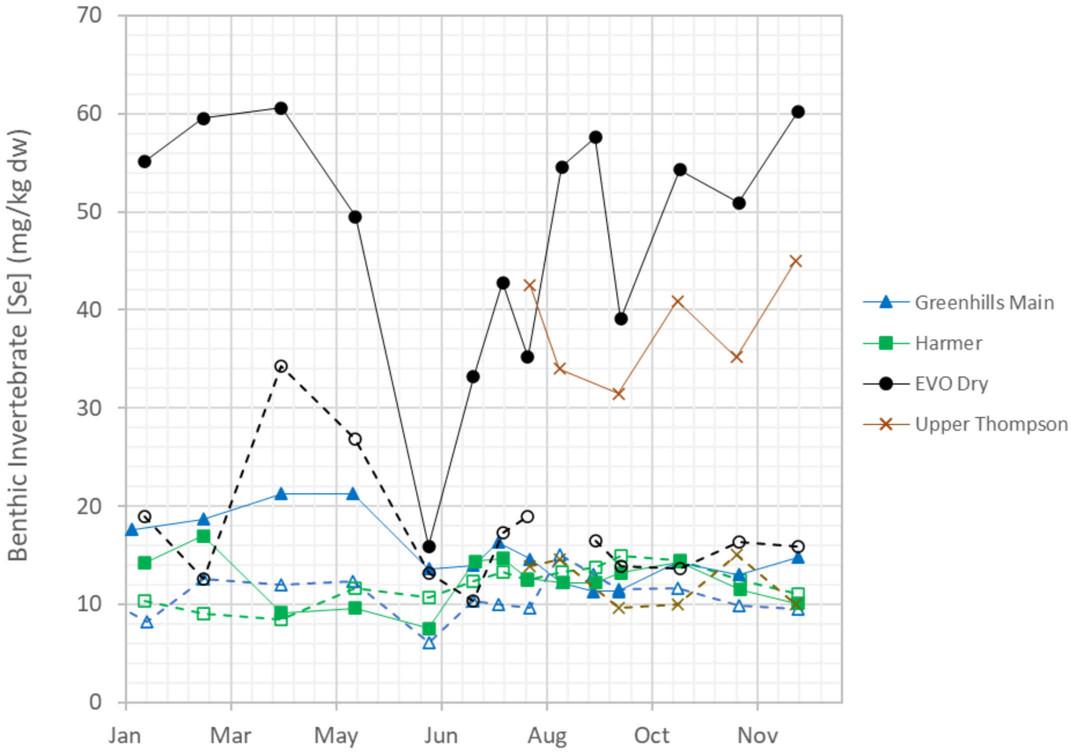
The organoselenium species DMSeO (blue lines) and MeSe(IV) (green lines) exhibited seasonal patterns similar to selenite in each pond, and similarly differed among ponds in the timing and magnitude of peak concentrations. MeSe(IV) was detected on most sample dates both upstream and downstream of all four study ponds, with peak incremental increases occurring between July and October. DMSeO exhibited similar patterns to MeSe(IV) at Greenhills Main and Upper Thompson Creek sedimentation ponds but was rarely detected at EVO Dry Creek and Harmer Creek sedimentation ponds.

The volatile organoselenium species DMSe and DMDSe were either below detection or were present at lower concentrations than other organoselenium species (Tables 10 and 11). DMDSe was detected in a single sample in the seasonal study (downstream of Upper Thompson Creek Sedimentation Pond; Table 11). DMSe was detected more often, exhibiting a seasonal peak lower in magnitude but similar in timing to MeSe(IV) downstream of EVO Dry, Greenhills Main, and Upper Thompson Creek sedimentation ponds (Table 11).

Seasonal patterns of benthic invertebrate selenium concentrations upstream and downstream of the four study ponds are plotted in Figure 4. Previous seasonal analyses (e.g., Golder 2020) have found that benthic invertebrate selenium concentrations vary across sampling events but exhibit no consistent seasonal trend. The data plotted on Figure 4 also provide no clear indication of consistent seasonal patterns. The sampling location downstream of EVO Dry Creek Sedimentation Pond, which had the highest benthic invertebrate selenium concentrations measured in this study, exhibited relatively low concentrations in June and July but consistently higher (albeit variable) concentrations and no clear seasonality in other months. Variability among ponds was highest in April and May, with concentrations higher than other months at some locations (upstream of EVO Dry Creek Sedimentation Pond, downstream of Greenhills Main Sedimentation Pond), lower than other months at some locations (upstream and downstream of Harmer Creek Sedimentation Pond), and not discernably different from other months at the remaining locations.

[17] Sampling at Upper Thompson Sedimentation Pond on 13 December 2022 indicated a decrease in concentrations of selenite and organoselenium from upstream to downstream, as indicated by the dashed lines being higher than the solid lines. It is unclear at this time if this is a real pattern (i.e., this pond is acting as a sink for reduced species) or if there may have been a sample labelling or data handling error. Sampling in 2023 will be reviewed for comparison.

Figure 4. Seasonal patterns of benthic invertebrate selenium concentrations in 2022 at study sedimentation ponds



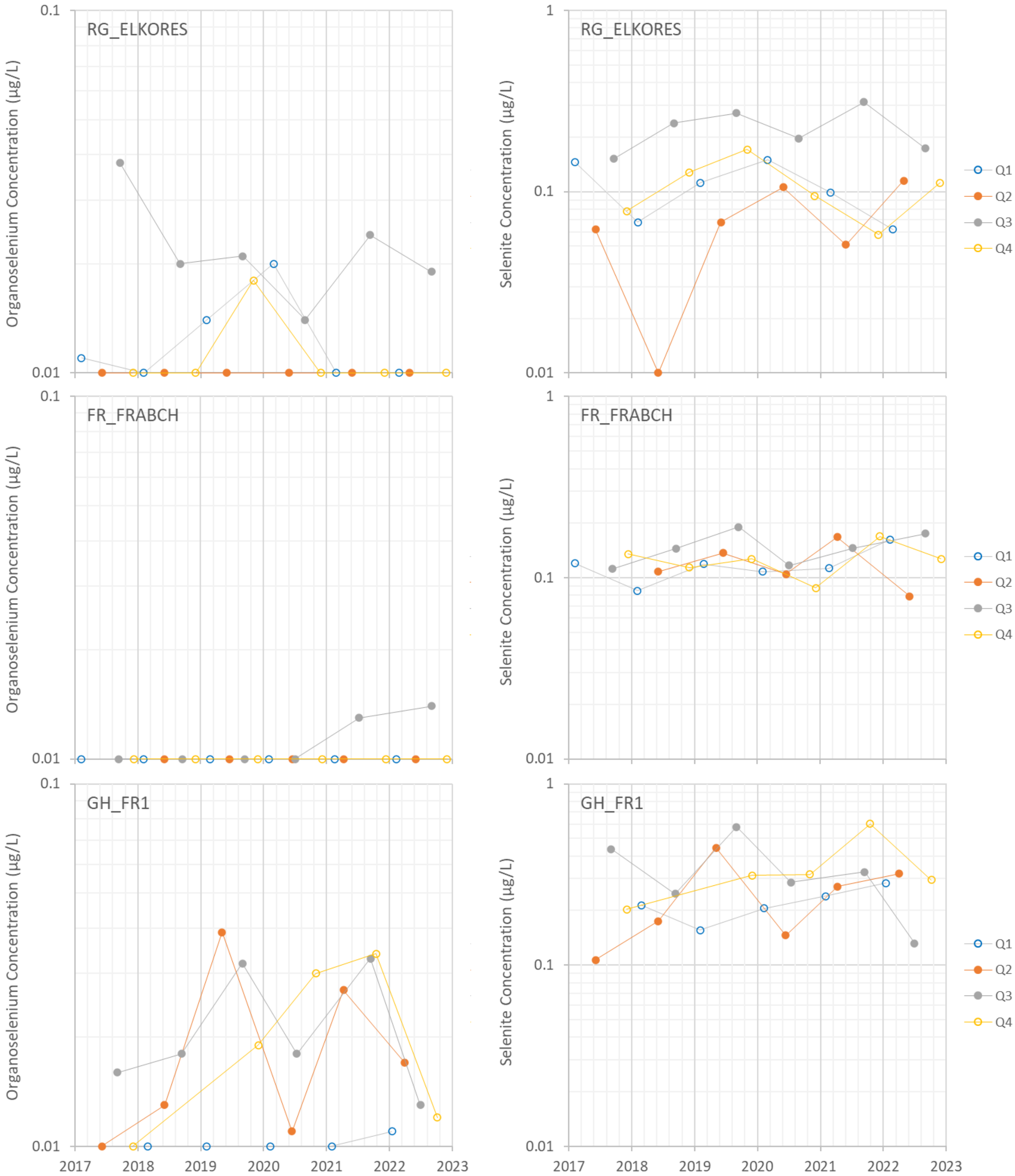
Notes: Open symbols with dashed lines are upstream and filled symbols with solid lines downstream of the indicated sedimentation pond; lines join symbols in each series for ease of interpretation and do not indicate interpolated conditions between the sampling dates

4.4 Long-Term Trends

Speciation data collected at compliance and Order stations are summarized in Tables 5 and 6 (2022) and Attachment F (2017 – 2022). Maximum selenite and organoselenium concentrations in each quarter are plotted as time series in Figure 5. Time series are not shown for stations that have never had detectable organoselenium (GH_ER1, GH_ERC) or for which organoselenium was detected on only one or two sampling events since 2017 (one detection: CM_MC2, EV_ER1, EV_ER4; two detections: EV_MC2).

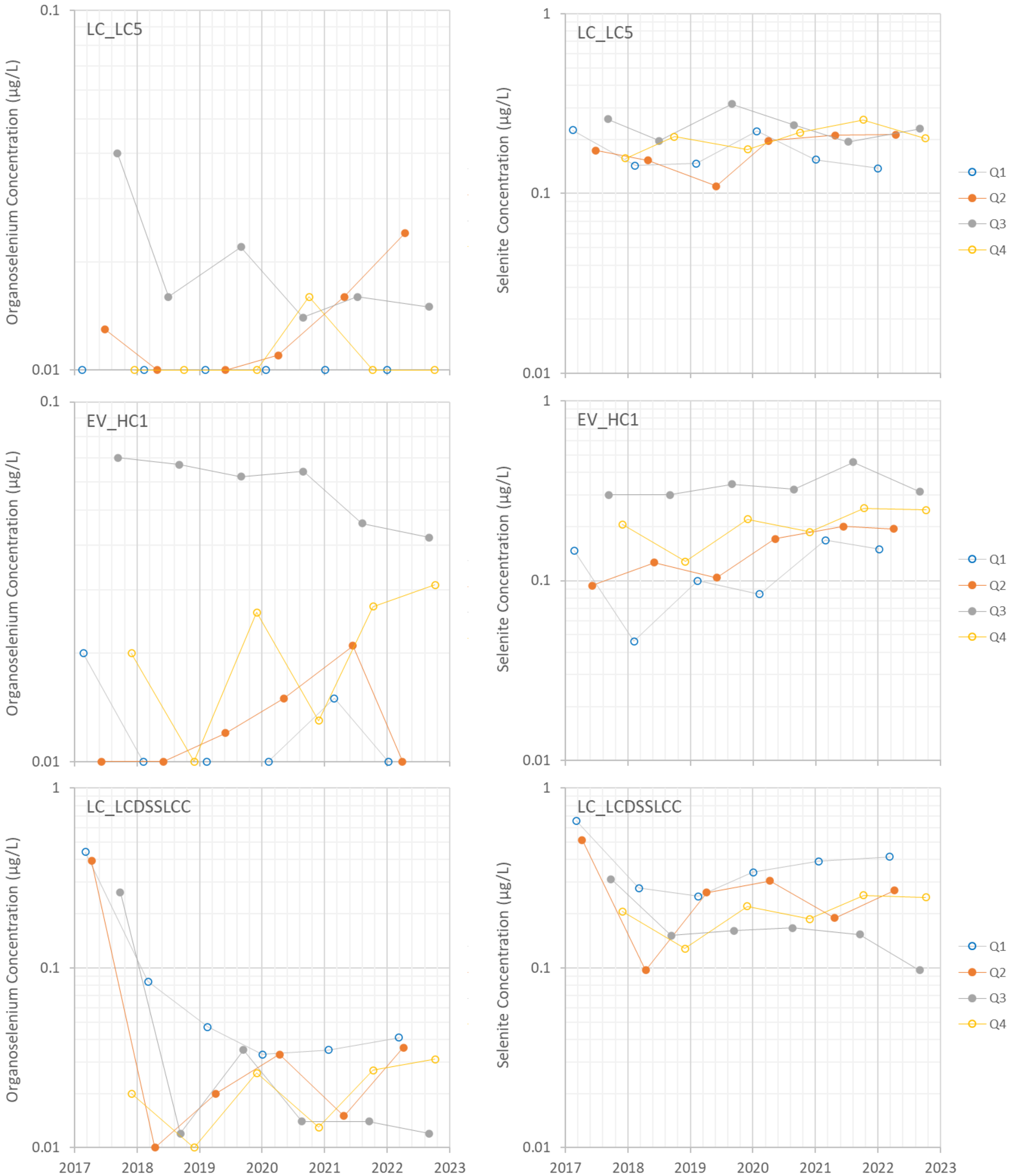
Figure 5 provides no clear indication of a long-term trend in maximum organoselenium or selenite concentrations in any quarter at any station, with the possible exception of a trend to lower peak organoselenium concentrations at EV_HC1 (Q3 at the Harmer Creek compliance point). Quarterly results suggest a possible shift in timing of peak organoselenium concentrations to occur earlier in the year at LC_LC5 (Fording River downstream of Line Creek). Considering maximum concentrations across all quarters (i.e., the highest points among the data series on each plot), these data suggest possible declines in peak organoselenium concentrations over the period of record at EV_HC1 and LC_LCDSSLCC (Line Creek compliance point).

Figure 5. Interannual trends in speciation at compliance and Order stations on the Elk and Fording Rivers



Notes: Values on X-axis (plotted as 0.01 µg/L) are non-detect results

Figure 5. Interannual trends in speciation at compliance and Order stations (cont'd)

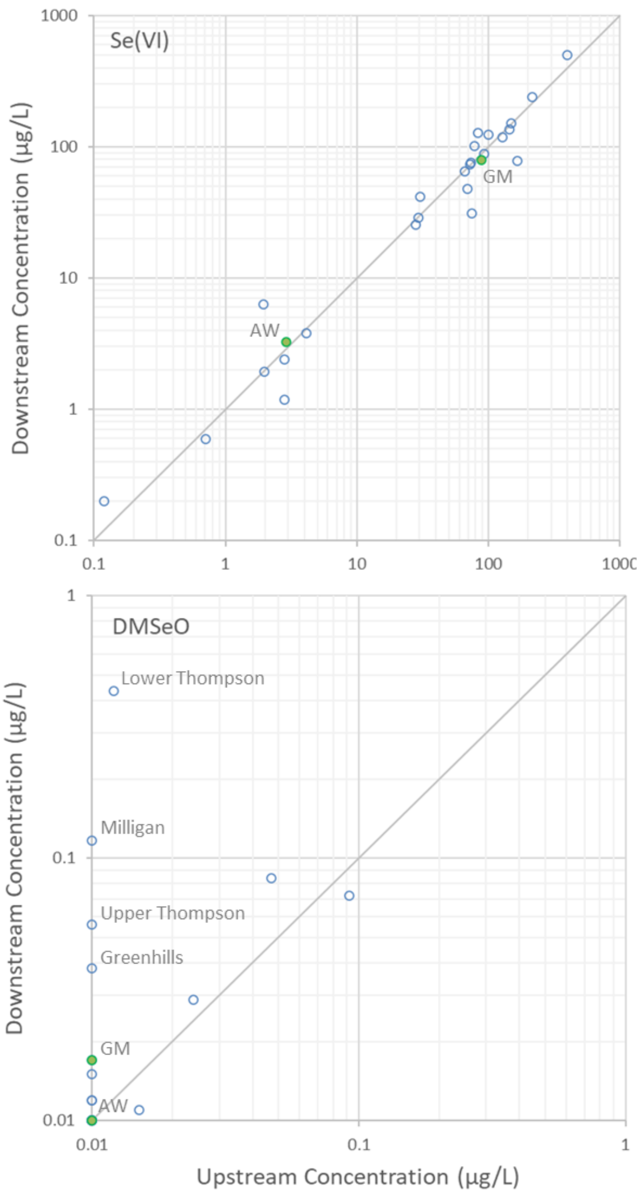


Notes: Organoselenium concentration range extends to 1 µg/L for LC_LCDSSLCC (lower left panel); values on X-axis (plotted as 0.01 µg/L) are non-detect results

4.5 Mechanisms

As was observed in 2021 (ADEPT 2022b), there was large variation among study sedimentation ponds in 2022 in how speciation changed from upstream to downstream. Upstream-downstream changes in speciation associated with sedimentation ponds are illustrated on Figure 6 as concurrent concentrations relative to a diagonal 1:1 line. These patterns of speciation change will be used as response variables for the investigation of mechanisms in the three-year interpretive report. Also plotted on Figure 6 are data collected upstream and downstream of Goddard Marsh (denoted GM) and Aqueduct Wetland (denoted AW), to support a comparison of these lentic areas (filled green symbols) with the study sedimentation ponds (open blue symbols).

Figure 6. Upstream-downstream patterns of speciation at 2022 study locations



Notes: DMSeO = dimethylselenoxide; MeSe(IV) = methylseleninic acid; Se(IV) = selenite; Se(VI) = selenate; organoselenium and Se(IV) values on axes (plotted as 0.01 µg/L) are non-detect results; diagonal line is 1:1; open blue circles = sedimentation ponds; filled green circles = Goddard Marsh (GM) and Aqueduct Wetland (AW)

Figure 6 shows that sedimentation ponds and lentic areas tend not to affect selenate concentrations (i.e., points tend to be near and evenly distributed around the 1:1 line). Selenite concentrations tend to be similar or higher downstream compared to upstream of the study areas, with the greatest proportional increases (on the order of 5-fold) observed at Smith Creek, Upper Thompson Creek, and Milligan Creek sedimentation ponds and at Goddard Marsh. The remaining study areas exhibited smaller (less than 2-fold) or no increases in selenite between upstream and downstream samples. In contrast to selenate and selenite, the organoselenium species DMSeO and MeSe(IV) exhibited increases in concentration from upstream to downstream at nearly all study locations. These increases were highly variable among locations and in some cases represented more than an order of magnitude change. Aqueduct Wetland exhibited no material change in either DMSeO or MeSe(IV), whereas Goddard Marsh exhibited a small increase in DMSeO and an almost 10-fold increase in MeSe(IV).

Attachment B reports data collected in 2022 on factors that might explain the variability in speciation depicted in Figure 6. These factors will be used as predictor variables for the investigation of mechanisms in the three-year interpretive report.

4.6 Bioaccumulation

The de Bruyn and Luoma (2021) bioaccumulation model was used to translate the speciation data in Tables 8 (regional survey) and 11 (seasonality study) into modelled benthic invertebrate selenium concentrations immediately upstream and downstream of the study sedimentation ponds. Modelled concentrations are presented in Table 14 in comparison to the benthic invertebrate selenium concentrations measured at these locations (note: these are the same data presented in the right-most columns of Tables 8 and 11). For seasonality study data, results are shown in Table 14 for July – September to align seasonally with the dataset used to derive the model.

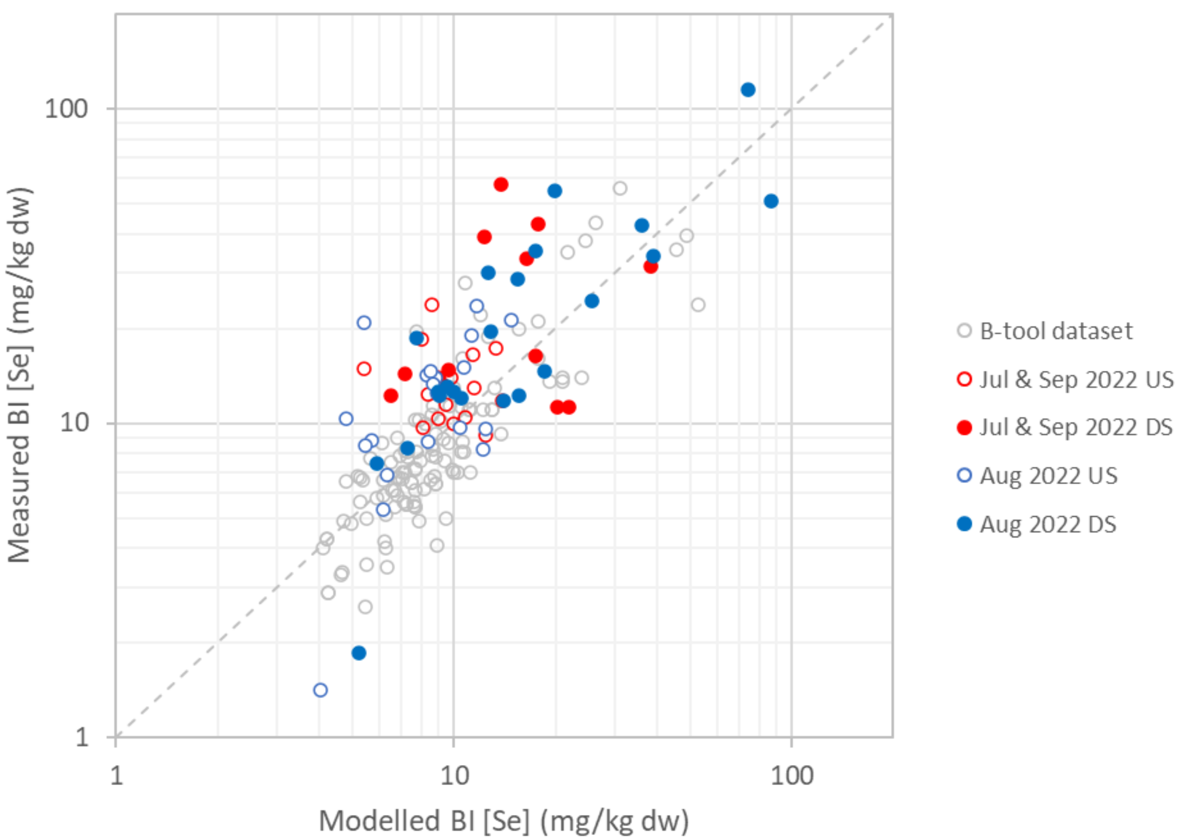
Table 12. Modelled and measured benthic invertebrate selenium data from the 2022 SeSMP

Location	Sampling Date	Upstream BI [Se] (mg/kg dw)		Downstream BI [Se] (mg/kg dw)	
		Modelled	Observed	Modelled	Observed
Aqueduct Control	11 Aug	-	-	10.5	12.0
Bodie North	11 Aug	-	-	25.6	24.5
Clode Main	19 Aug	-	-	7.75	18.6
Corbin Reservoir	16 Aug	4.02	1.42	5.23	1.87
Eagle Creek	19 Aug	5.41	20.9	-	-
EVO Dry	13 Jul	10.8	10.4	16.4	33.2
	27 Jul	13.3	17.3	17.8	42.8
	08 Aug	11.3	19.0	17.4	35.2
	24 Aug	-	-	19.9	54.6
	08 Sep	11.3	16.5	13.8	57.6
	21 Sep	9.78	13.9	12.3	39.1
Gate	25 Jul	8.61	23.9		
	11 Aug	8.32	14.2	9.55	13.1
	15 Sep	8.05	18.4		
Greenhills Main	13 Jul	8.98	10.3	8.99	14.0
	27 Jul	10.0	10.0	17.4	16.3
	09 Aug	10.4	9.67	18.6	14.6
	23 Aug	10.7	15.1	15.5	12.2
	09 Sep	11.5	13.0	22.0	11.3
	20 Sep	9.44	11.5	20.3	11.3
Harmer Reservoir	13 Jul	8.39	12.3	7.14	14.4
	27 Jul	9.25	13.3	9.62	14.7
	08 Aug	8.91	12.5	8.96	12.6
	24 Aug	8.66	13.3	9.07	12.2
	08 Sep	8.87	13.8	6.50	12.2
	21 Sep	5.43	14.9	8.87	13.2
Kilmarnock Secondary	19 Aug	8.41	8.77	-	-
Lake Mountain	22 Aug	12.4	9.55	12.9	19.6
LCO Dry Head Pond	18 Aug	12.2	8.25	14.0	11.8
LCO Dry Head Pond	13 Sep	12.4	9.12	13.9	11.8
Milligan	15 Aug	11.7	23.6	74.4	115
MSAN 1	18 Aug	5.71	8.83	-	-
Porter Creek Secondary	17 Aug	6.36	6.86	10.0	12.6
Six Mile Lower	15 Aug	6.15	5.33	7.29	8.31
Smith	22 Aug	-	-	12.7	30.1
South Pit	15 Aug	-	-	15.4	28.6
SPD	16 Aug	4.81	10.3	5.92	7.43
Thompson Lower	23 Aug	14.8	21.3	87.0	50.9
Thompson Upper	09 Aug	8.87	13.9	36.1	42.5
	23 Aug	8.52	14.6	39.1	34.0
	20 Sep	8.11	9.68	38.2	31.5
Wade Lower	22 Aug	5.46	8.51	-	-

Notes: BI [Se] = benthic invertebrate selenium concentration (mean of 3 replicates); data only shown for sampling events with both measured BI [Se] and aqueous speciation data for calculating modelled BI [Se]

The modelled and measured concentrations presented in Table 14 are plotted on Figure 7 in comparison to the dataset of measured and modelled benthic invertebrate selenium concentrations that was used to fit the parameters of the bioaccumulation tool. The dataset used to derive the bioaccumulation tool (grey symbols on Figure 7) illustrates the expected precision of modelled concentrations. As discussed in de Bruyn and Luoma (2021), the fitted model was able to calculate modelled concentrations within a factor of 2 of measured concentrations for 97% of the 113 cases used to fit model parameters. The expected range of modelled values is depicted by the residual scatter of grey points around the diagonal 1:1 line on Figure 7.

Figure 7: Evaluation of bioaccumulation tool performance on the derivation dataset (grey symbols) and data collected in the 2022 SeSMP (coloured symbols)

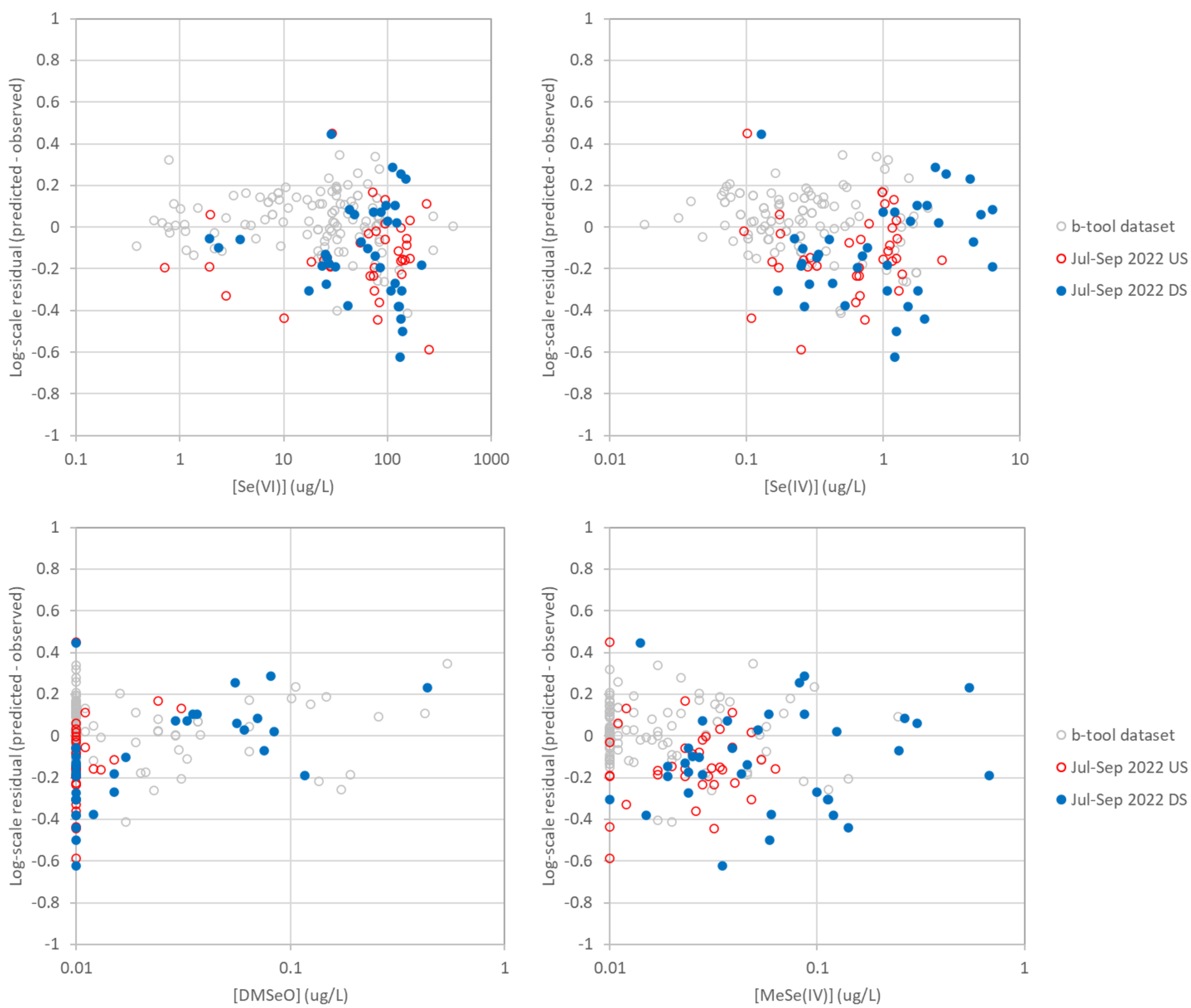


Notes: BI [Se] = benthic invertebrate selenium concentration; US = upstream; DS = downstream; reported BI [Se] is mean of 3 replicates; modelled BI [Se] was calculated from aqueous selenium speciation data collected at the time of BI sampling

Concentrations modelled from aqueous speciation measured in August 2022 were within a factor of 2 of measured concentrations for 85% of samples collected upstream (open blue symbols on Figure 7) and 82% of samples collected downstream of sedimentation ponds (filled blue symbols). Speciation measured in July and September 2022 provided slightly reduced model performance, with modelled concentrations within a factor of 2 of measured concentrations for 82% of samples collected upstream (open red symbols) and 79% of samples collected downstream of sedimentation ponds (filled red symbols). Speciation measured in other months (not plotted on Figure 7) performed less well, with modelled concentrations within a factor of 2 of measured concentrations for 79% of samples collected upstream and 55% of samples collected downstream of sedimentation ponds. These findings indicate that the b-tool performed best in months typically associated with peak organoselenium concentrations, consistent with the observation that aqueous speciation exhibits large seasonality (Figure 3), whereas benthic invertebrate selenium concentrations tend to vary less across months (Figure 4). Overall, the b-tool performed slightly less well for this dataset compared to the dataset used to derive the model, and had a higher frequency of under-predictions compared to over-predictions.

To explore whether performance of the model was related to systematic under-estimation of the bioaccumulative potential of one or more selenium species, model residuals were plotted as a function of individual species concentrations (Figure 8). Systematic under-estimation of the bioaccumulative potential of a species would be evident on a residual plot as a negative slope: if the effect of a highly bioaccumulative species was being under-estimated, residuals would become increasingly negative (predictions would increasing under-estimate observations) as the influence of that species on measured concentrations increased and the model failed to accurately reflect that influence.

Figure 8. Model residuals (log-scale differences between modelled and observed benthic invertebrate selenium concentrations) in relation to selenium species concentrations

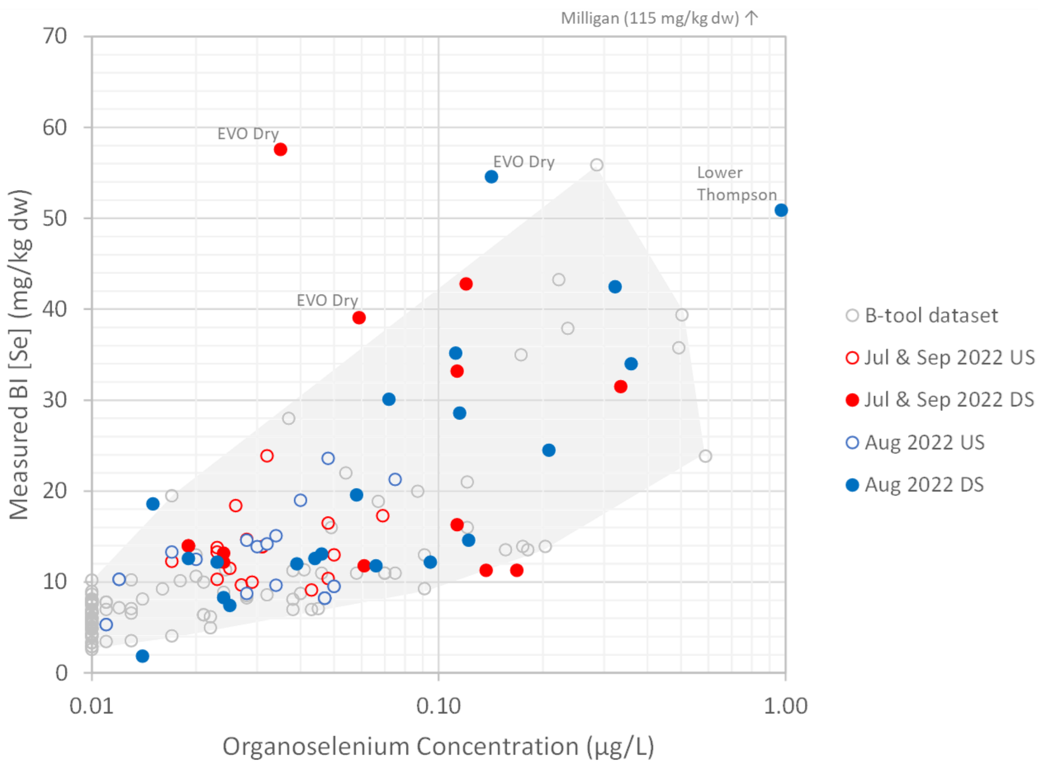


Notes: DMSeO = dimethylselenoxide; MeSe(IV) = methylseleninic acid; Se(IV) = selenite; Se(VI) = selenate

The patterns of residuals on Figure 8 do not indicate that current model systematically under-predicts the bioaccumulative potential of any species. The widest range of residuals occurred at the highest concentrations of selenate but relatively low concentrations of MeSe(IV) and the lowest concentrations (mostly below detection) of DMSeO.

Conformance of 2022 data to predictions is further explored in Figure 9. Figure 9 provides a simplified[18] illustration of the pattern of bioaccumulation described by the bioaccumulation tool: the grey symbols enclosed in a grey polygon show the range of benthic invertebrate selenium concentrations previously observed across the studied range of organoselenium concentrations (de Bruyn and Luoma 2021). Plotted for comparison are SeSMP data from August 2022 (blue symbols) and July and September 2022 (red symbols) collected upstream (open symbols) and downstream (filled symbols) of sedimentation ponds.

Figure 9. Relationship between benthic invertebrate selenium concentrations and organoselenium concentrations



Notes: BI [Se] = benthic invertebrate selenium concentration; organoselenium is the sum of DMSeO (dimethylselenoxide) and MeSe(IV) (methylseleninic acid); grey polygon encloses data used to derive the bioaccumulation tool (grey symbols); August 2022 datum from Milligan Creek Sedimentation Pond is off-scale

Most 2022 SeSMP data fell within or near the grey polygon on Figure 9, indicating general conformance to the pattern of bioaccumulation observed in the dataset used to derive the b-tool. The August 2022 samples collected downstream of Lower Thompson Creek Sedimentation Pond and Milligan Creek Sedimentation Pond (off-scale on Figure 9) extend the range of studied organoselenium concentrations to >0.9 µg/L. Within the previously studied

[18] This figure does not account for the effect of selenate or selenite, which account for some of the variability in benthic invertebrate selenium concentrations at a given organoselenium concentration.

range, three samples collected downstream of EVO Dry Creek Sedimentation Pond in August and September 2022 exhibited the greatest deviation from the grey polygon. These three samples did not have notably different speciation from other samples in the study (Table 11) and it is unclear why they exhibited relatively high bioaccumulation given the measured organoselenium concentrations.

5.0 PRELIMINARY INTERPRETATION

5.1 Study Question 1

The answer to Study Question 1: *What is the spatial extent of detectable organoselenium?* is discussed below in terms of regional patterns and local-scale (longitudinal) patterns in the 2022 dataset.

Regional patterns of organoselenium apparent on the heat maps in Attachment E are broadly consistent with those described in Golder (2021a) and ADEPT (2022b). Locations immediately downstream of sedimentation ponds exhibited a range of organoselenium concentrations in 2022, ranging from <0.01 µg/L (Eagle Creek, MSAN1) to >0.9 µg/L (Milligan Creek[19], Upper Thompson Creek[20]). Detectable organoselenium was often present immediately downstream of sedimentation ponds and in tributaries whose water quality is strongly influenced by mine-related sources of organoselenium (e.g., Line Creek, Harmer Creek). In contrast, mainstem rivers rarely had detectable organoselenium, with the exception of reaches of the Fording River immediately downstream of the FRO-South AWTF[21] and immediately downstream of Greenhills Creek.[22] These patterns are consistent with the expectation that organoselenium species are highly bioavailable (de Bruyn and Luoma 2021) and degradable (Zhang et al. 1999; Zhang and Frankenberger 2000; LeBlanc and Wallschläger 2016; Jain 2017), as well as the relatively large dilution that occurs when most mine-affected tributaries enter mainstem rivers.

The evaluation of longitudinal patterns found concentrations of DMSeO, DMSe, and DMDSe less than the detection limit (<0.01 µg/L) at most or all sites. Concentrations of Se(IV) and MeSe(IV) declined more rapidly than can be accounted for by dilution, indicating one or more loss processes for these species. These observations further support the regional pattern of localized influence from sedimentation ponds described above.

5.2 Study Question 2

The answer to Study Question 2: *Are there temporal trends in organoselenium concentrations?* is discussed below in terms of a preliminary evaluation of seasonal and long-term trends.

The seasonal data collected in 2022 supported the analysis in Golder (2021a) that found strong seasonal cycles in concentrations of selenite and organoselenium and expanded this characterization to include the volatile species DMSe at three of the study ponds. There were clear differences between ponds in the magnitude and duration of peak organoselenium concentrations. However, seasonal maxima occurred in all study ponds between July and October, supporting the August timing of the SeSMP as appropriate to capture peak or near-peak

[19] As discussed at an EMC meeting on 12 April 2023, Milligan Creek constitutes <0.1% of the flow of Michel Creek and accordingly has no material effect on organoselenium concentrations and bioaccumulation further downstream.

[20] As discussed at an EMC meeting on 12 April 2023, Thompson Creek constitutes <1% of the flow of the Elk River and accordingly has no material effect on organoselenium concentrations and bioaccumulation further downstream. Although Thompson Creek constitutes ~5% of flow the Elk River Side Channel prior to mixing with the mainstem Elk River, the side channel downstream of Thompson Creek is seasonally dry, which limits potential effects on bioaccumulation.

[21] Detectable organoselenium was present at RG_SCOUTDS (~200 m downstream of the outfall) and RG_FOBSC (~500 m downstream of the outfall). Minnow and Lotic (2023b) concluded there was no change in BI [Se] relative to immediately upstream of the outfall. Mean BI [Se] was less than the lowest level 1 benchmark (11 mg/kg dw) on all sample dates in 2022 at both locations.

[22] Detectable organoselenium was present at GH_FR1, ~200 m downstream of Greenhills Creek. The maximum organoselenium concentration at GH_FR1 in 2022 was lower than previous years (Figure 5) and BI [Se] was less than the lowest level 1 benchmark.

organoselenium concentrations. The lack of consistent seasonal patterns in benthic invertebrate tissue selenium concentrations indicates that August-September is also an appropriate sampling period to characterize bioaccumulation.

The evaluation of long-term trends provided little to no evidence of ongoing increases or decreases in organoselenium or selenite concentrations at compliance and Order stations, with the possible exception of a trend to lower peak organoselenium concentrations at the Harmer Creek and Line Creek compliance points.

5.3 Study Question 3

The answer to Study Question 3: *What are the mechanisms of organoselenium production?* will next be evaluated in detail in the three-year interpretive report. The 2022 SeSMP collected a robust set of response and predictor variables at 27 sedimentation ponds to support this evaluation. A preliminary evaluation of 2022 data shared with the EMC on 12 April 2023 supported the interpretation of 2021 data presented in ADEPT (2022b). In particular, 2022 data continue to indicate an important direct or indirect role of aquatic vegetation, but high vegetation cover alone was not consistently predictive of high organoselenium concentrations, indicating a role of some other interacting factor(s). As discussed in Section 1.1, analyses in ADEPT (2022b) and the preliminary evaluation of 2022 data indicate that this study question is complex and warrants analysis of a combined dataset from multiple years of study to support reliable conclusions. Therefore, detailed statistical analyses in the three-year interpretive report will combine the full dataset from the 2021-2023 cycle with other available information from speciation studies and monitoring conducted by Teck, to provide more robust answers to all four study questions than could be supported by analysis of a more limited dataset.

5.4 Study Question 4

The answer to Study Question 4: *Do new data support refinement of the speciation bioaccumulation tool?* is discussed below in terms of how well 2022 data conform to model predictions.

The pattern of bioaccumulation evident in the 2022 SeSMP dataset broadly overlapped with the pattern evident in previous data used to derive the b-tool, indicating that the b-tool provides a reasonable characterization of these patterns. However, the b-tool performed slightly less well overall for the 2022 dataset compared to the dataset used to derive the model. Recommendations are provided in Section 6 for a re-evaluation and possible re-calibration of the b-tool.

6.0 RECOMMENDATIONS

Recommendations for the 2023 SeSMP relate to refinements to methods and approaches in light of learnings and challenges encountered in the 2021 and 2022 programs. Recommendations are:

- Potential additional measures related to biological productivity in sedimentation ponds (e.g., inputs of pollen, the influence of emergent and submergent vegetation, vegetation taxonomy) should be reviewed ahead of the 2023 field season and implemented where feasible.
- Methods should be evaluated to obtain sediment from Corbin Main Sedimentation Pond and other ponds with liners or extensive vegetation, so that the role of sediment characteristics can be more broadly evaluated.
- The de Bruyn and Luoma (2021) b-tool should be re-evaluated relative to all available data collected since its derivation, including the SeSMP data presented herein. If warranted, the model should be recalibrated using an updated dataset. It is anticipated that this re-evaluation and potential recalibration will be presented in the 2021-2023 RAEMP report.
- Volatile selenium analysis should continue until sufficient data exist to understand the persistence and bioaccumulative potential of these species or to conclude that these species are not important drivers of bioaccumulation. Too few detected values were obtained in the 2021 and 2022 programs to provide this understanding.

Additional recommendations made in ADEPT (2022b) remain relevant and are repeated here:

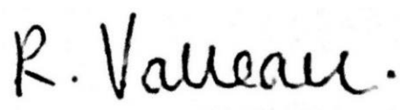
- When activities are being planned that will modify a sedimentation pond (e.g., aeration, bypass, dredging), these should be treated as an opportunity to monitor how the modifications affect conditions and selenium speciation changes in the pond. Repeated monitoring should be conducted before, during, and after the modification, including aqueous speciation upstream and downstream of the pond and relevant conditions in the pond that could be affected by the modification (considering what the modification will be, and drawing on the predictors considered in this study). If properly designed, such studies could directly test some of the hypothesized mechanisms for organoselenium generation and release.
- Any activities related to sedimentation ponds (e.g., use of flocculant, pumping of water in or out) should be recorded and stored in a way that is readily available to the SeSMP study team. Such information could be invaluable in helping to understand puzzling results, and could flag potential issues with data collection before they occur.
- All available engineering information on sedimentation pond characteristics (e.g., capacity, dimensions, baffles, liners) should also be compiled and stored in a way that is readily available to the SeSMP study team. Such information could help identify useful predictors of organoselenium concentrations.

Signature Page

Windward Environmental LLC

Claire Detering, MS
Associate / Environmental Scientist

Minnow Environmental Inc.



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Aquatic Scientist

ADEPT Environmental Sciences Ltd.

Adrian de Bruyn, PhD, RPBio
Owner, Senior Environmental Scientist

AMD/CD/RV

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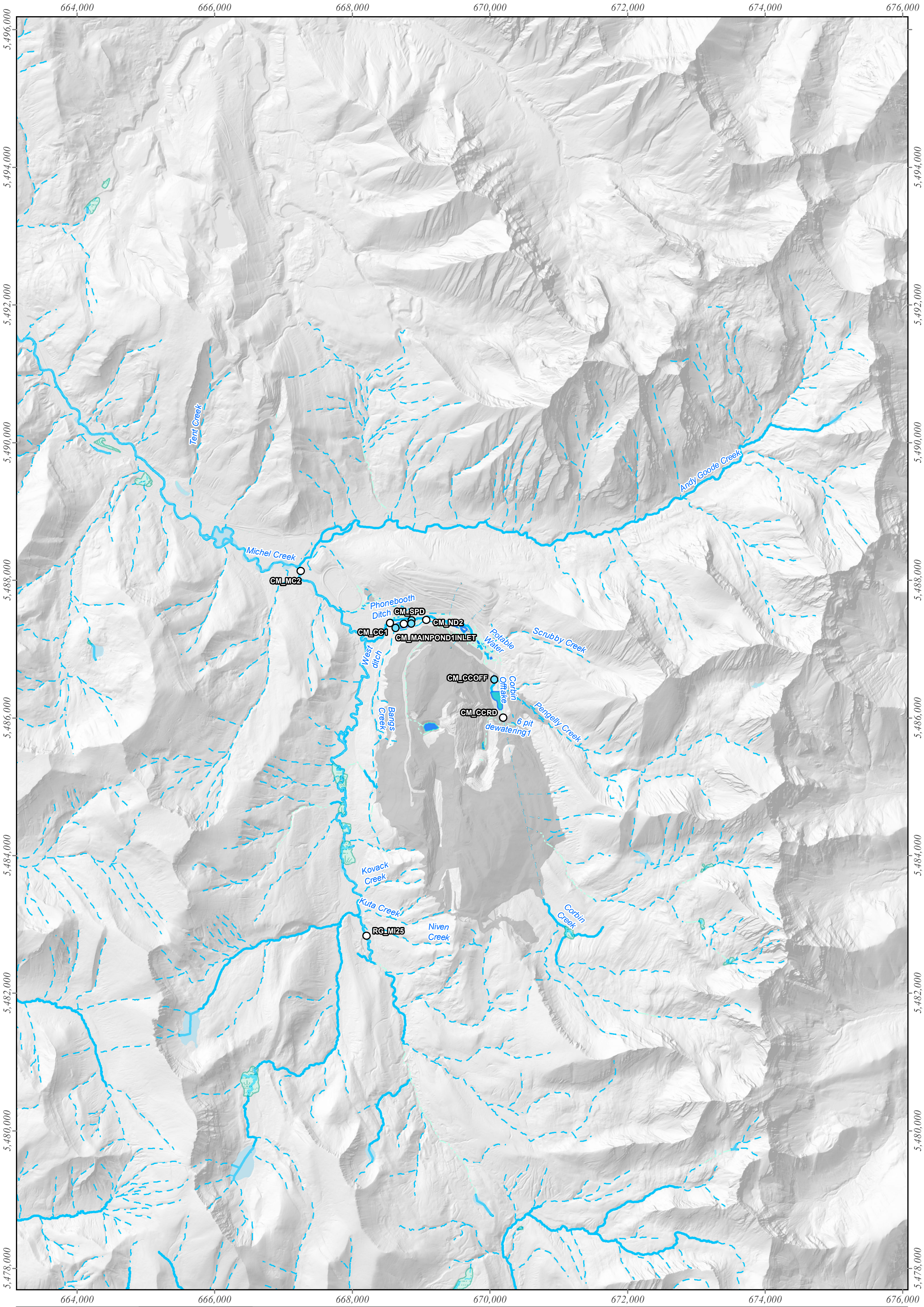
Attachment A

Speciation Sampling Locations for the 2022 Regional Survey of Sedimentation Ponds and Other Monitoring Programs



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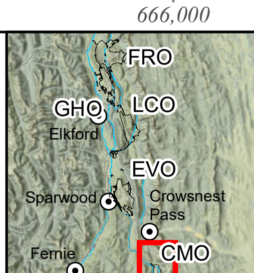

Coal Mountain SeSMP Sample Locations

Sum of Dimethyl selenoxide (DMSeO) and Methyl seleninic acid (MeSe(IV))

- <0.025 µg/L
- 0.025 µg/L - 0.0499 µg/L
- 0.05 µg/L - 0.099 µg/L
- >0.10 µg/L

- Pits + Spoils
- End Pit Lake
- Settling Pond
- Stream
- Intermittent
- Indefinite
- Subsurface

N

0 250 500 1,000 1,500 Meters

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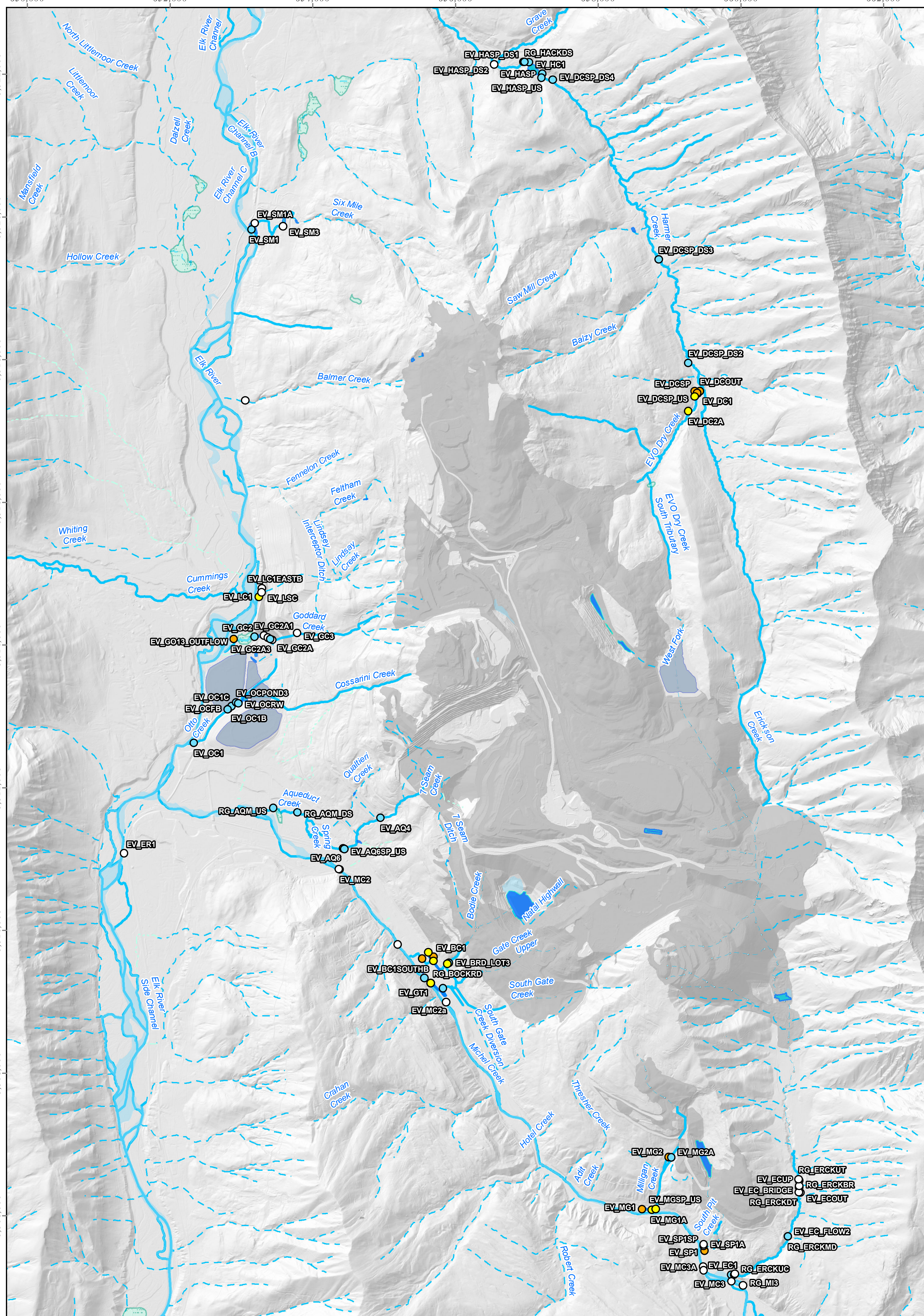

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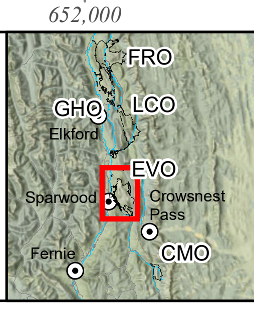

Elkview SeSMP Sample Locations

Sum of Dimethyl selenoxide (DMSeO) and Methyl seleninic acid (MeSe(IV))

- <0.025 µg/L
- 0.025 µg/L - 0.0499 µg/L
- 0.05 µg/L - 0.099 µg/L
- >0.10 µg/L

- Pits + Spoils
- End Pit Lake
- Settling Pond
- Tailings Pond

- Stream
- Intermittent
- Indefinite
- Subsurface

N

0 250 500 1,000 1,500 Meters

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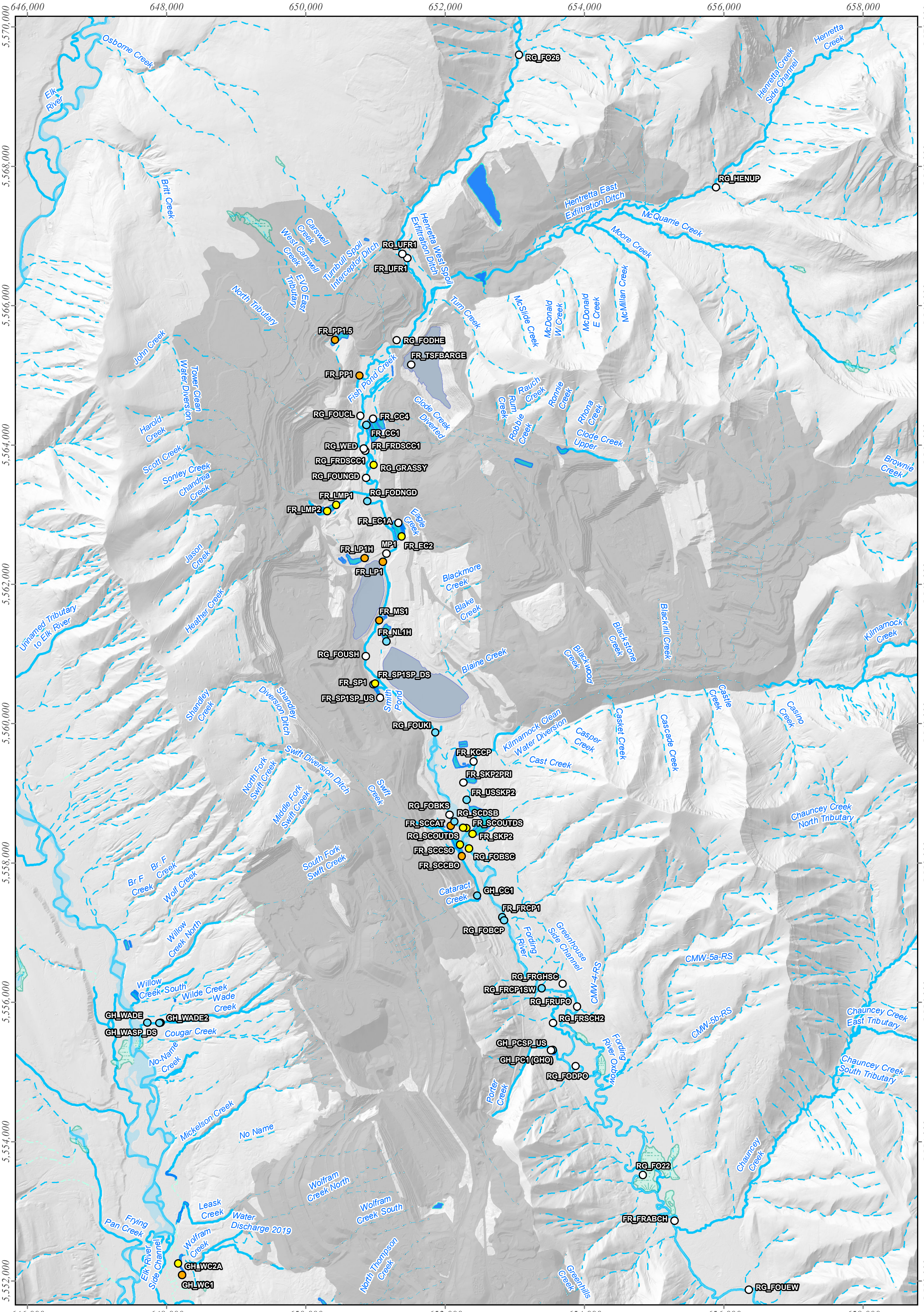

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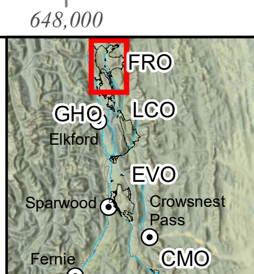

Fording River SeSMP Sample Locations

Sum of Dimethyl selenoxide (DMSeO) and Methyl seleninic acid (MeSe(IV))

- <0.025 µg/L
- 0.025 µg/L - 0.0499 µg/L
- 0.05 µg/L - 0.099 µg/L
- >0.10 µg/L
- Pits + Spoils
- End Pit Lake
- Settling Pond
- Tailings Pond
- Stream
- Intermittent
- Indefinite
- Subsurface

N

0 250 500 1,000 1,500 Meters

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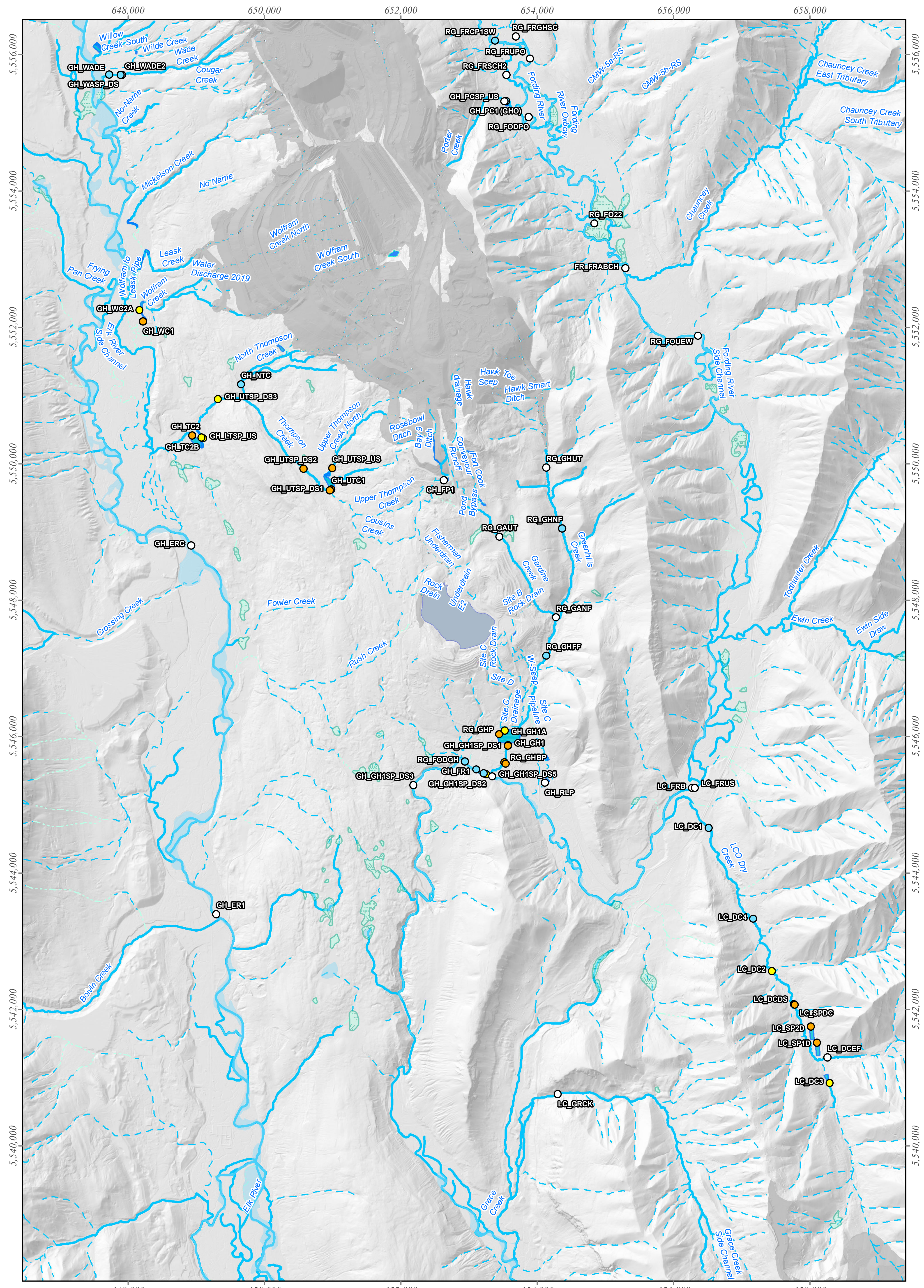

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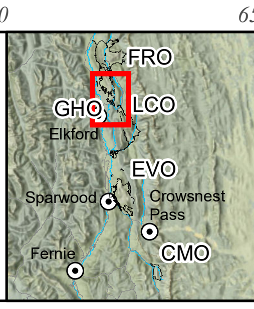

Greenhills SeSMP Sample Locations

Sum of Dimethyl selenoxide (DMSeO) and Methyl seleninic acid (MeSe(IV))

- <0.025 µg/L
- 0.025 µg/L - 0.0499 µg/L
- 0.05 µg/L - 0.099 µg/L
- >0.10 µg/L

- Pits + Spoils
- End Pit Lake
- Settling Pond
- Tailings Pond

- Stream
- Intermittent
- Indefinite
- Subsurface

N

0 250 500 1,000 1,500 Meters

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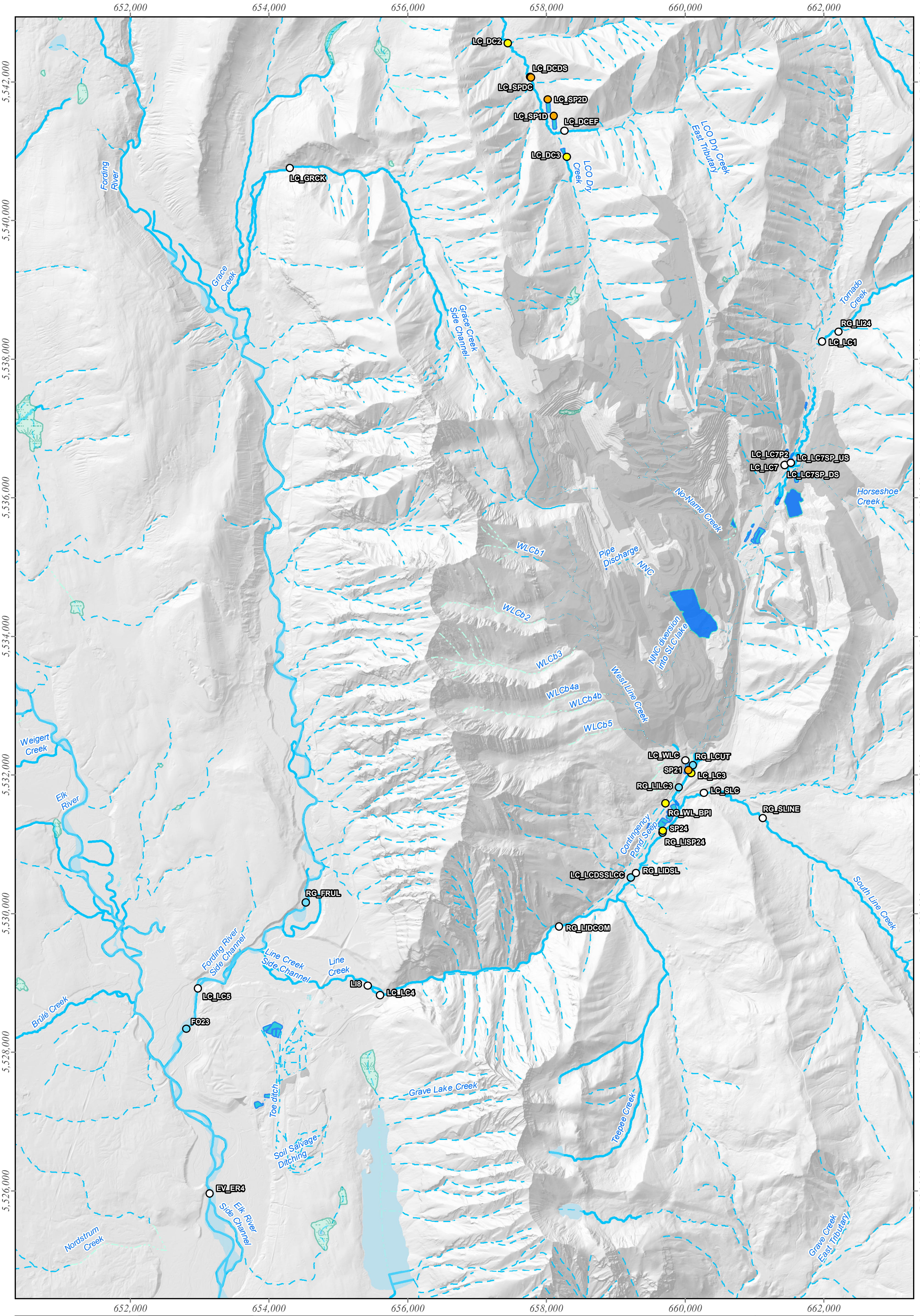

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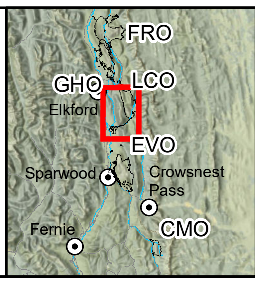

Line Creek SeSMP Sample Locations

Sum of Dimethyl selenoxide (DMSeO) and Methyl seleninic acid (MeSe(IV))

- <0.025 µg/L
- 0.025 µg/L - 0.0499 µg/L
- 0.05 µg/L - 0.099 µg/L
- >0.10 µg/L

- Pits + Spoils
- End Pit Lake
- Settling Pond
- Stream
- Intermittent
- Indefinite
- Subsurface

N

0 250 500 1,000 1,500 Meters

DATE: 5/25/2023	MINE OPERATION: Line Creek
SCALE: 1:50,000	COORDINATE SYSTEM: NAD 1983 UTM Zone 11N

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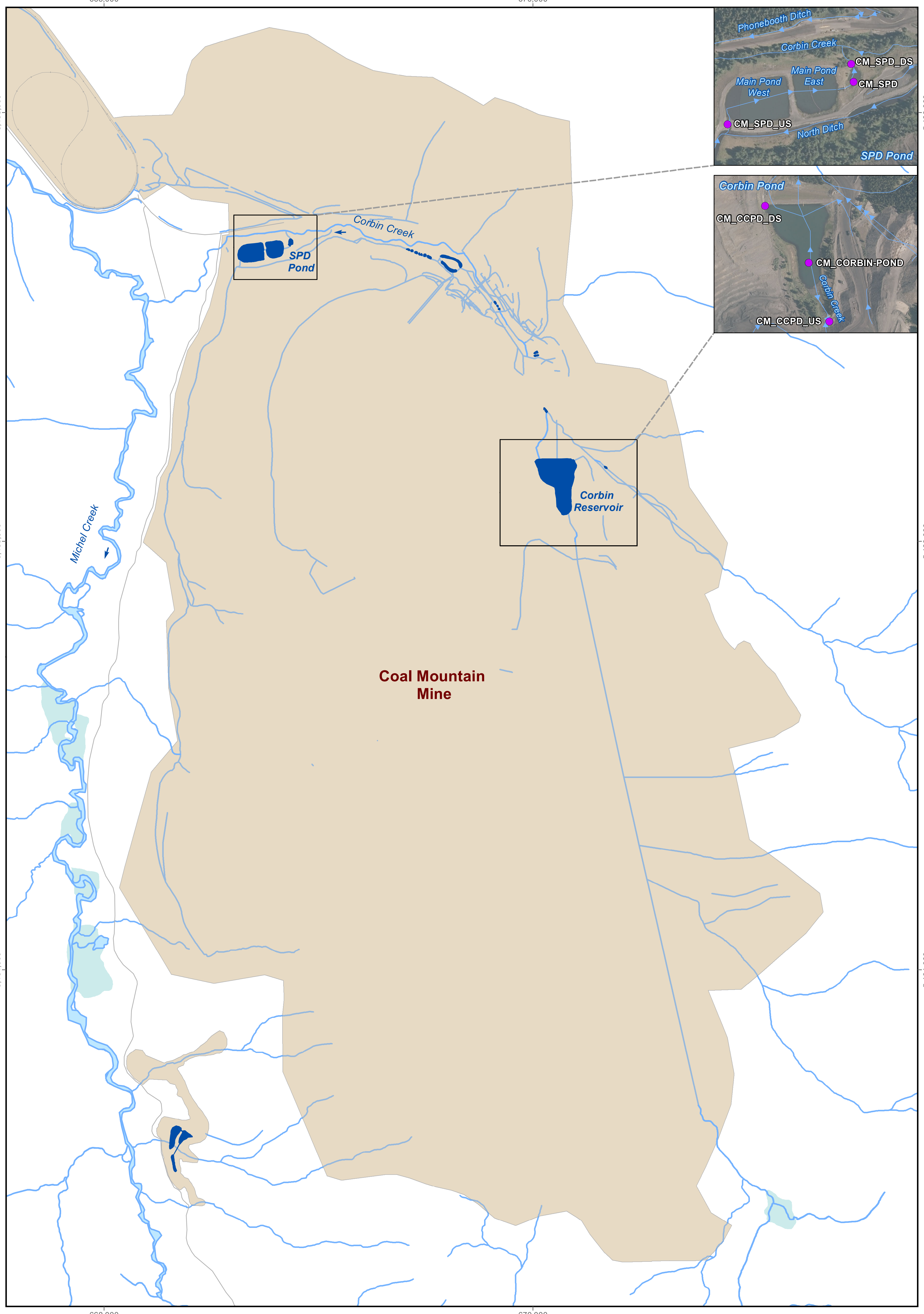


LEGEND

- Sampling Location
- Settling Pond
- Tailings Pond
- Teck Coal Mine Operation

Coal Mountain Mine - Sampling Locations for the 2022 SeSMP Regional Survey of Sedimentation Ponds

0 0.25 0.5 1
km

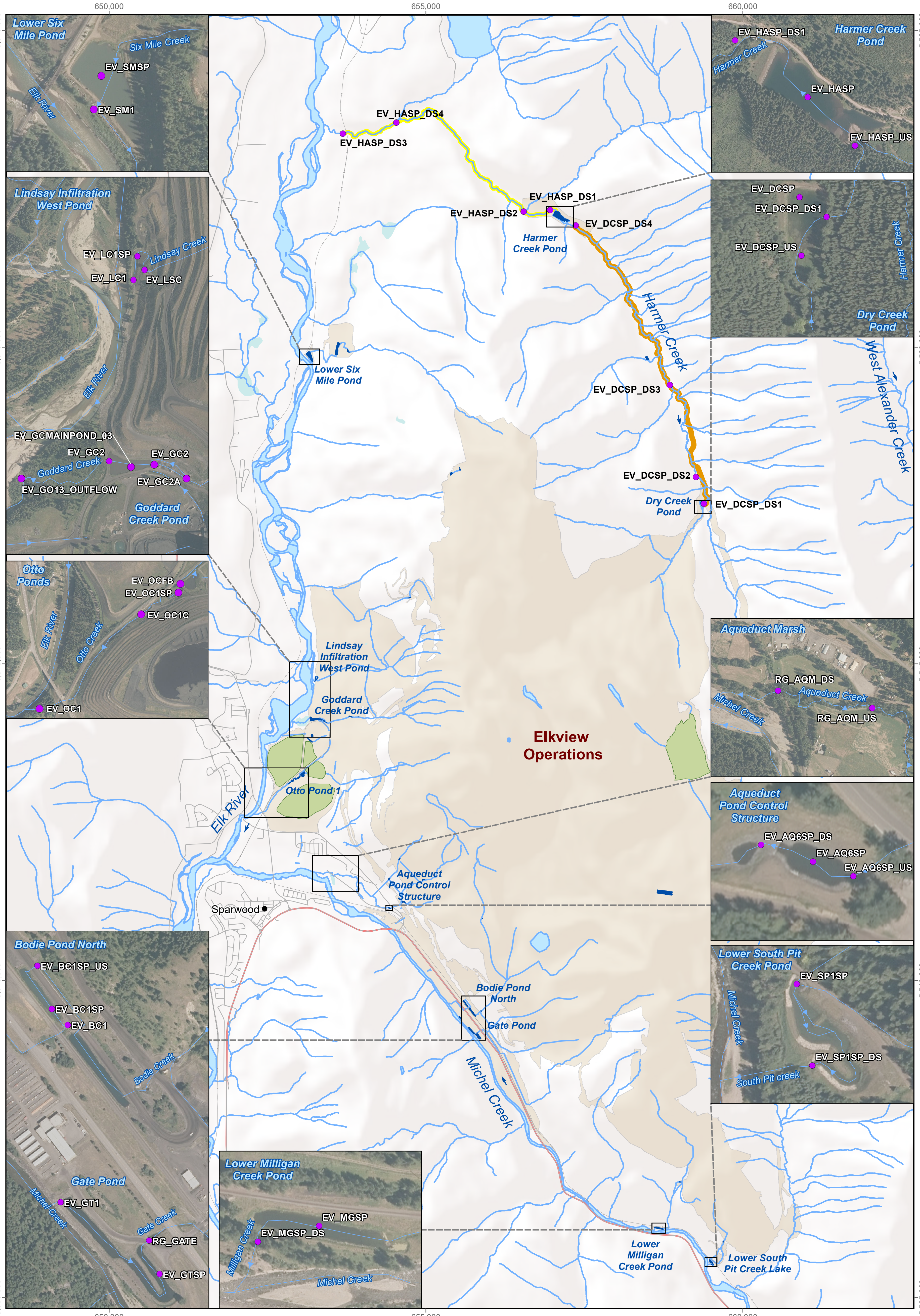
N W E S

Projection: North American Datum 1983 UTM Zone 11 U

Date: May 2023
Project 227202.0023

minnow environmental inc.

Figure 3e



LEGEND

- Sampling Location
- Longitudinal Study – Dry Creek Pond
- Longitudinal Study – Harmer Creek Pond
- Settling Pond
- Tailings Pond
- Teck Coal Mine Operation

Elkview Operation – Sampling Locations for the 2022 SeSMP Regional Survey of Sedimentation Ponds

0 0.75 1.5 3 km

N E S W

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Figure 3a

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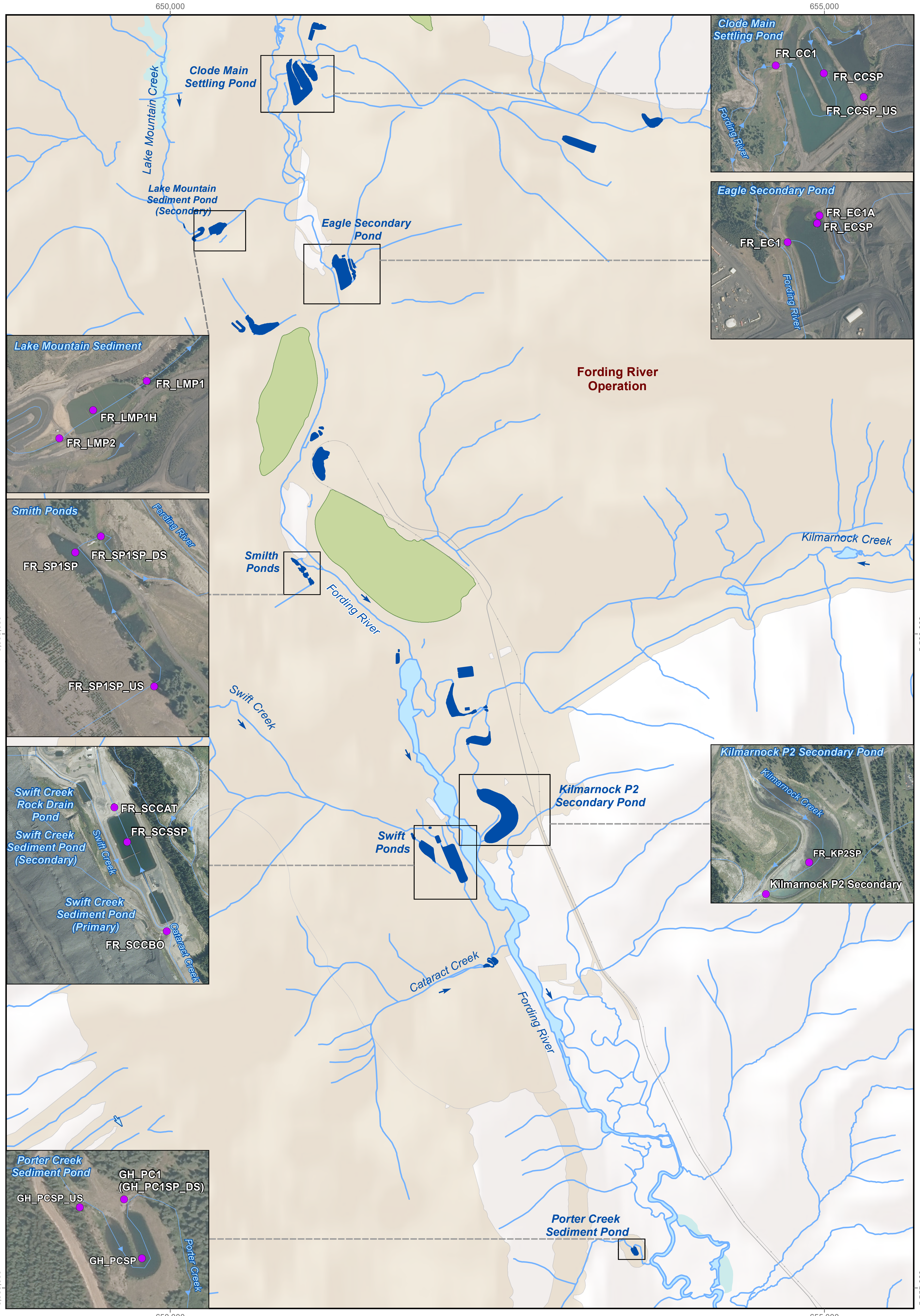

LEGEND
- Sampling Location
- Settling Pond
- Tailings Pond
- Teck Coal Mine Operation

Fording River Operation – Sampling Locations for the 2022 SeSMP Regional Survey of Sedimentation Ponds

0 0.4 0.8 1.6 km

N W E S

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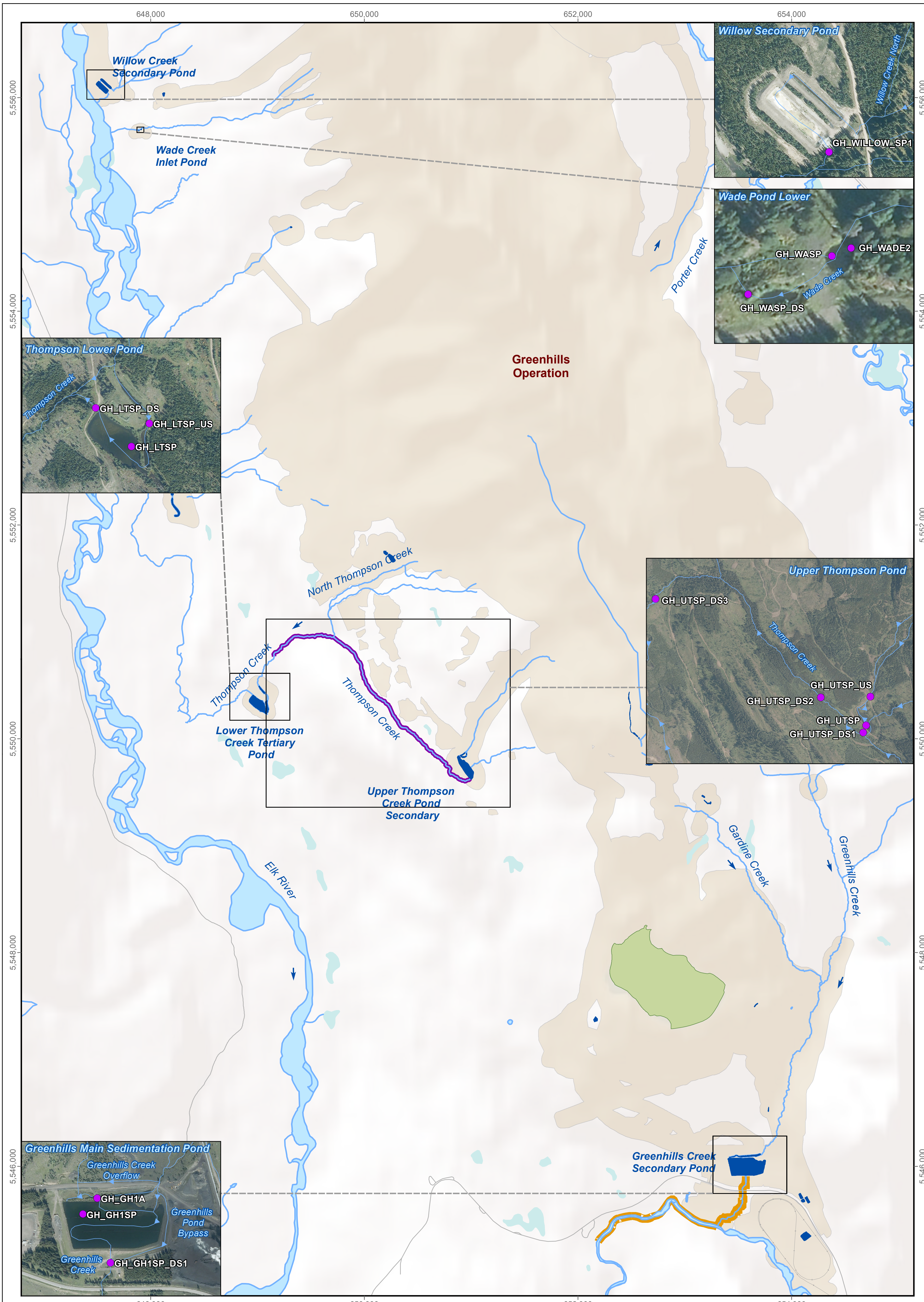
Figure 3b



LEGEND

- Sampling Location
- Longtitudinal Study - Upper Thompson Creek Pond Secondary
- Longtitudinal Study - Greenhills Main Sedimentation Pond
- Settling Pond
- Tailings Pond
- Teck Coal Mine Operation

Greenhills Operation – Sampling Locations for the 2021 SeSMP Regional Survey of Sedimentation Ponds

0 0.5 1 2
km

N
W E
S

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Date: May 2023
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Figure 3c

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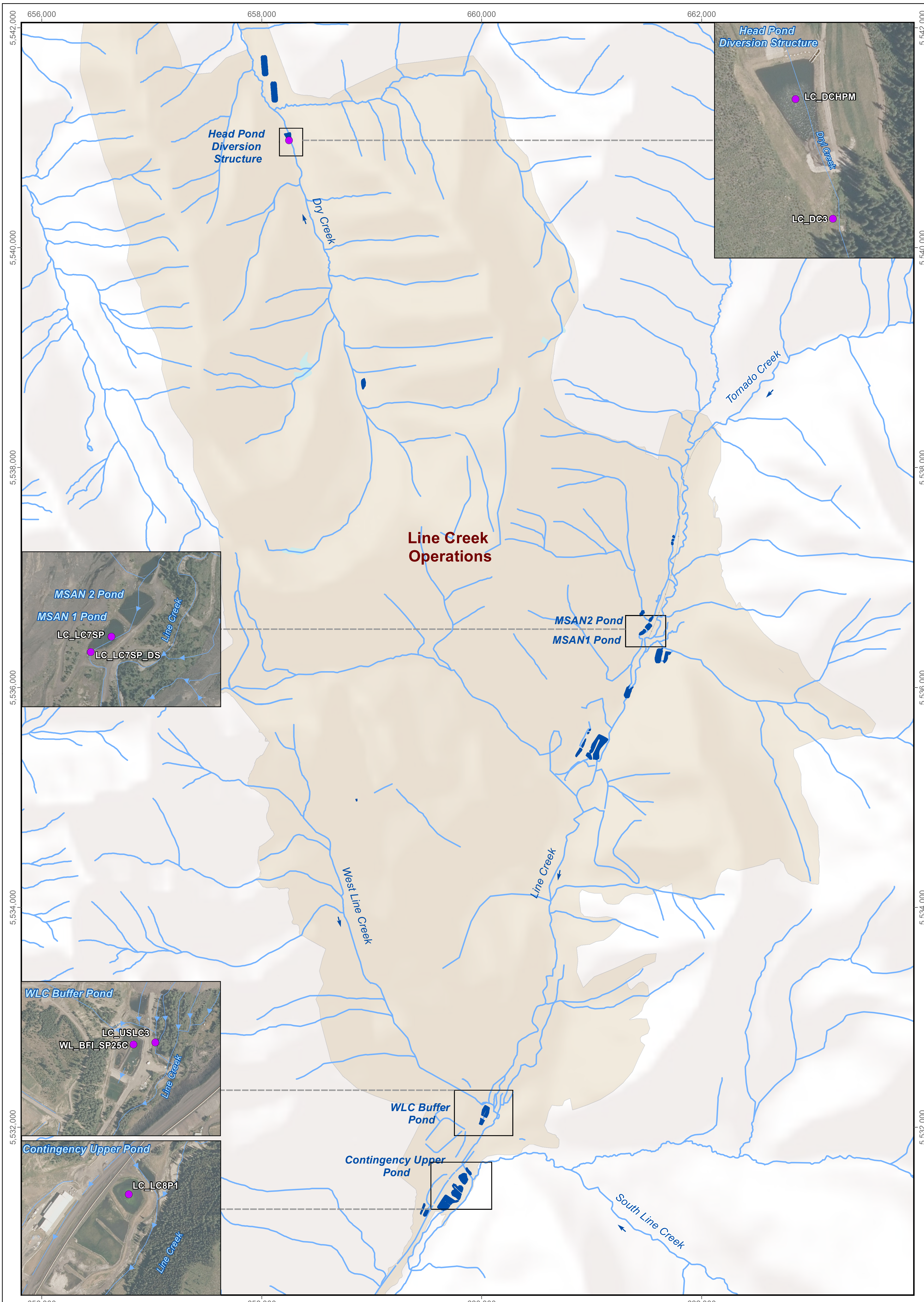

LEGEND

- Sampling Location
- Settling Pond
- Tailings Pond
- Teck Coal Mine Operation

Line Creek Operation – Sampling Locations for the 2022 SeSMP Regional Survey of Sedimentation Ponds

0 0.5 1 2
km

N E S W

Projection: North American Datum 1983 UTM Zone 11 U

Date: May 2023
Project 227202.0023

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Figure 3b

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Attachment B

Predictor Variables from the 2022 Regional Survey of Sedimentation Ponds

Attachment B. Predictor variables from the 2022 regional survey of sedimentation ponds

Parameter	Upstream/ Downstream	Unit	Corbin Reservoir	SPD POND	Aqueduct Control	Bodie Creek	Harmer Reservoir	EVO Dry Creek	Goddard	Lindsay 2	Milligan	Otto Ponds	Six Mile Lower	South Pit	Clode Main	Eagle Creek Pond	Lake Mountain Sediment	Swift Secondary Pond	Smith Ponds	Kilmarnock Secondary	Greenhills Main	Thompson Lower	Porter Creek Secondary	Thompson Upper	Wade Pond Lower	LCO Dry Head Pond	MSAN 1	Gate	AWTF Buffer Pond
Benthic Invertebrate Se	US	mg/kg dw	1.59	10.4	-	-	13.3	19	13.2	-	24	-	5.43	-	-	25.3	9.6	-	-	8.8	12.5	22	6.87	14.3	9.03	8.27	8.87	15	-
Benthic Invertebrate Se	DS	mg/kg dw	2.22	7.47	12	26	12.3	55	-	-	116	-	8.33	28.7	18.7	-	19.7	9.8	31.7	-	13.6	51	12.7	38.5	-	11.9	13	15.8	-
DMDSe	US	µg/L	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-
DMDSe	DS	µg/L	0	0	0	0	0	0	0	-	0.144	0	0	0	0	-	0	0	0	0	0	0	0	0	0	0	0	0	0
DMSe	US	µg/L	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-
DMSe	DS	µg/L	0	0	0	0	0	0.14	0	-	0.446	0	0	0	0	-	0	0	0	0	0	0.21	0	0.188	0	0	0	0	0
Se (IV)	US	µg/L	0.102	0.673	0.373	1.46	0.326	1.61	0.351	0.122	1.31	0.086	0.174	0.174	0.168	0.25	1.03	1.17	0.035	0.096	1.25	2.69	0.178	0.666	0.171	0.98	0	0.636	-
Se (IV)	DS	µg/L	0.128	0.771	0.405	2.55	0.338	2	2.86	0.185	6.28	0.112	0.223	0.427	0.265	-	1.07	1.17	0.528	0.174	2.1	4.33	0.259	4.58	0.175	1	0.073	0.702	1.24
Se (VI)	US	µg/L	29.5	2.8	4.1	99.8	28.1	144	88.2	2.79	74.4	0.12	1.97	128	83.1	252	240	400	30.3	78.2	165	149	65.8	74.8	0.707	72.9	1.94	73.3	-
Se (VI)	DS	µg/L	28.9	2.38	3.8	123	25.3	135	79.8	1.18	31.3	0.199	1.92	118	127	-	214	502	41.8	101	119	152	65.2	55.6	0.593	73.4	6.27	76	14.8
MeSe (IV)	US	µg/L	0	0.012	0.019	0.051	0.017	0.038	0.011	0	0.048	0.031	0.011	0	0	0	0.039	0.078	0	0.028	0.034	0.063	0	0.03	0	0.023	0	0.032	-
MeSe (IV)	DS	µg/L	0.014	0.025	0.039	0.124	0.023	0.142	0.099	0.026	0.676	0.025	0.024	0.1	0.015	-	0.043	0.138	0.06	0.044	0.087	0.539	0.027	0.248	0.017	0.037	0	0.046	0.031
SeCN	US	µg/L	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-
SeCN	DS	µg/L	0	0	0	0	0	0.012	0	0	0.014	0	0	0	0	-	0	0	0	0	0	0	0	0	0	0	0	0	0
DMSeO	US	µg/L	0	0	0	0.047	0	0	0	0	0	0	0	0	0	0	0.011	0.092	0	0	0	0.012	0	0	0	0.024	0	0	-
DMSeO	DS	µg/L	0	0	0	0.084	0	0	0.017	0	0.117	0	0	0.015	0	-	0.015	0.072	0.012	0.012	0.035	0.434	0.017	0.075	0	0.029	0	0	0.014
MeSe (VI)	US	µg/L	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-
MeSe (VI)	DS	µg/L	0	0	0	0	0	0	0	0	0.026	0	0	0	0	-	0	0	0	0	0	0	0	0	0	0	0	0	0.784
SeSO3	US	µg/L	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-
SeSO3	DS	µg/L	0	0	0	0	0	0	0	0	0	0	0	0	0	-	0	0	0	0	0	0	0	0.011	0	0	0	0	0
Total Se	US	µg/L	27	3.08	4.95	115	28.3	145	97.6	2.68	60.3	-	2.22	111	85.8	343	247	373	39.8	75.1	146	140	55.9	71	0.878	87.9	2.35	68.4	-
Total Se	DS	µg/L	27.1	3.02	4.24	95.2	23.8	147	70.9	1.46	-	1.17	2.24	109	127	-	247	469	39.6	94.7	103	135	54.5	60.3	1.04	70.6	6.78	67.9	13.9
Dissolved Se	US	µg/L	25.7	3.42	4.04	92.9	26.9	180	112	3.7	73	-	2.31	113	86	327	240	372	37.4	77.8	-	154	56.1	-	0.917	85.2	2.03	68.9	-
Dissolved Se	DS	µg/L	26.1	2.89	4.49	114	25	176	74.8	1.58	-	0.473	2.06	110	111	-	263	480	40.2	89.5	-	147	57	60.8	1.01	78	7.13	66.2	15.3
Ammonia	US	mg/L as N	0.0861	0.259	0.005	0.0211	0.005	0.005	0.005	0.005	0.005	-	0.005	0.005	0.005	0.005	0.005	0.0585	0.005	0.005	0.01	0.011	0.0056	0.005	0.005	0.005	0.005	0.164	-
Ammonia	DS	mg/L as N	0.023	0.191	0.0057	0.0117	0.0062	0.0095	0.0246	0.005	0.0311	0.0224	0.005	0.005	0.005	-	0.005	0.0459	0.0081	0.005	0.0112	0.0138	0.0067	0.0194	0.0062	0.0079	0.0084	0.116	0.0099
Chlorophyll-a	US	µg/L	0.034	0.397	0.671	4.16	0.81	0.56	1.22	0.194	0.913	0.911	2.01	0.47	0.103	0.745	2.16	15.6	0.178	4.06	0.39	1.08	3.44	1.84	3.48	1.96	0.625	-	-
Chlorophyll-a	DS	µg/L	2.2	0.63	0.663	0.637	2.94	1.04	0.907	0.353	7.06	0.694	2.96	0.414	0.745	-	6.9	22.3	0.376	18.7	1.68	2.32	1.21	3.74	3.32	2.36	1.01	0.211	0.367
Nitrate	US	mg/L as N	4.38	3.2	0.0931	11.5	0.48	2.6	2.35	0.134	0.46	-	0.0079	2.58	46.6	49.8	73	191	8.25	22.2	5.83	12.5	1.69	1.17	0.263	38.7	0.129	7.75	-
Nitrate	DS	mg/L as N	4.1	3.25	0.0719	13.1	0.468	2.24	2	0.0548	0.025	0.0232	0.005	2.38	65.3	-	75	43.5	7.44	25.9	3.82	11.3	1.66	0.368	0.0881	34.5	4.79	7.31	0.129
Nitrite	US	mg/L as N	0.0179	0.0436	0.001	0.0409	0.001	0.005	0.0094	0.005	0.005	-	0.001	0.005	0.0111	0.0093	0.028	0.15	0.005	0.0155	0.005	0.0091	0.005	0.005	0.001	0.0093	0.001	0.0102	-
Nitrite	DS	mg/L as N	0.0199	0.047	0.001	0.0361	0.001	0.0084	0.005	0.005	0.005	0.0019	0.001	0.0078	0.0565	-	0.0512	0.0895	0.0158	0.0685	0.0064	0.0277	0.005	0.005	0.001	0.0127	0.0081	0.0169	0.005
Field Oxidation-reduction Potential	US	mV	156	150	135	126	124	71	84.8	109	127	21.9	131	206	141	150	110	105	78	1320	74.8	82.1	107	113	82.7	128	143	139	-
Field Oxidation-reduction Potential	DS	mV	155	176	63.6	93.7	154	84.8	115	127	116	95.1	129	110	108	-	123	161	97.9	160	144	122	82.6	100	119	165	152	116	136
Orthophosphate	US	mg/L	0.001	0.001	0.001	0.001	0.0018	0.001	0.001	0.001	0.0192	-	0.001	0.001	0.001	0.001	0.0022	0.001	0.001	0.001	0.001	0.0016	0.001	0.0067	0.0168	0.0221	0.001	0.001	-
Orthophosphate	DS	mg/L	0.001	0.001	0.001	0.001	0.005	0.001	0.001	0.001	0.0013	0.001	0.001	0.001	0.001	-	0.0063	0.001	0.001	0.001	0.001	0.002	0.0012	0.001	0.0055	0.0154	0.001	0.001	0.001
Total Phosphorus	US	mg/L	0.002	0.002	0.0283	0.0046	0.0072	0.0059	0.0047	0.002	0.0339	-	0.0212	0.0044	0.002	0.0084	0.0091	0.0387	0.002	0.0157	0.0038	0.0086	0.0073	0.0225	0.023	0.0272	0.0026	0.0071	-
Total Phosphorus	DS	mg/L	0.0028	0.002	0.0047	0.0024	0.0169	0.0077	0.0096	0.0041	0.0215	0.0115	0.0076	0.002	0.002	-	0.0206	0.0511	0.0065	0.0279	0.0045	0.0171	0.0046	0.0095	0.0236	0.0235	0.002	0.0044	0.011
Sulphate	US	mg/L	949	814	42	961	155	742	382	68.5	485	-	71.8	743	430	1760	638	672	268	405	849	1100	375	643	32.8	278	38.4	987	-
Sulphate	DS	mg/L	904	803	43.1	929	151	731	420	78.3	461	105	70.3	713	570	-	650	1620	283	319	624	1010	376	600	31.8	246	51.9	937	766
Total Kjeldahl Nitrogen	US	mg/L as N	0.395	0.425	0.15	0.184	0.526	0.131	0.309	0.054	0.125	-	0.141	0.418	0.38	0.449	0.242	0.05	0.191	0.447	0.493	0.05	0.079	0.234	0.164	0.688	0.053	0.699	-
Total Kjeldahl Nitrogen	DS	mg/L as N	0.435	0.468	0.072	0.346	0.114	0.263	0.237	0.062	0.403	0.279	0.057	0.286	0.305	-	0.626	0.05	0.446	0.271	0.376	0.611	0.1	0.205	0.249	2.11	0.5	0.491	0.174
Total Organic Carbon	US	mg/L	0.58	0.88	0.98	0.5	0.5	0.83	0.68	0.96	2.98	-	2.05	1.06	0.7	1.06	2.06	3.19	0.63	0.92	1.07	1.89	1.3	1.04	3.91	1.83	0.5	0.66	-
Total Organic Carbon	DS	mg/L	0.66	0.58	1.06	0.96	0.68	0.9	0.89	1.26	3.68	2.55	1.61	0.8	0.67	-	2.44	2.59	1.32	1.64	2.73	2.96	0.9	1.81	4.58	1.57	0.5	0.71	0.52
Total Iron	US	mg/L	0.053	0.016	0.194	0.055	0.01	0.096	0.018	0.011	0.019	-	0.147	0.026	0.01	0.02	0.021	0.22	0.01	0.01	0.052	0.03	0.011	0.087	0.278	0.01	0.01	0.185	-
Total Iron	DS	mg/L	0.046	0.04	0.035	0.022	0.041	0.028	0.054	0.076	0.075	0.062	0.04	0.01	0.01	-	0.051	0.373	0.02	0.173	0.01	0.123	0.01	0.048	0.088	0.01	0.01	0.141	0.314
Total Manganese	US	mg/L	0.00675	0.179	0.011	0.00162	0.00133	0.00293	0.00449	0.00342	0.00246	-	0.00906	0.00197	0.00064	0.00109	0.00344	0.032	1.00E-04	0.00218	0.00365	0.00552	4.00E-04	0.00965	0.0233	0.0012	0.00085	0.00746	-
Total Manganese	DS	mg/L	0.00527	0.111	0.0108	0.00105	0.00679	0.00224	0.0184	0.00421	0.0131	0.194	0.00299	0.00089	0.00086	-	0.00605	0.0477	0.00165	0.0147	0.00179	0.0172	0.00084	0.0103	0.0259	0.00253	0.00155	0.00539	0.148
Carbonate	US	mg/L	1	1	11.9	1	4.6	1	12.2	1	11.9	-	1	1	1	1	1	1	1	1	17.4	3.8	11	14.4	7	4.6	4.2	4.1	-
Carbonate	DS	mg/L	1	1	9.4	4.8	6.8	1	14.2	1	1	1	1	1	1	-	1	1	1	1	16.2	1	11.3	9.2	8.5	4.7	3.5	7.1	1
Bicarbonate	US	mg/L	523	368	295	399	216	381	310	659	316	-	268	424	294	674	306	328	486	399	311	291	253	274	322	180	154	439	-
Bicarbonate	DS	mg/L	465	341	303	330	209	386	284	602	284	414	264	414	314	-	281	616	464	379	281	243	238	216	300	181	161	432	376
Total Alkalinity	US	mg/L as $CaCO_3$	429	302	262	327	184	313	274	540	279	-	219	347	241	553	251	269	399	327	284	245	226	249	275	156	133	367	-
Total Alkalinity	DS	mg/L as $CaCO_3$	381	280	264	278	182	317	257	493	233	340	216	340	258	-	230	505	380	310	258	199	214	192	260	156	138	366	308
Hardness	US	mg/L as $CaCO_3$	1280	999	313	1210	328	1050	620	634	695	-	246	997	823	2620	1080	1550	633	792	1080	1250	597	873	286	570	163	1320	-
Hardness	DS	mg/L as $CaCO_3$	1220	968	305	1280	306	1040	638	634	623	417	237	984	1050	-	1100	2250	633	687	836	1350	592	762	247	509	205	1330	1160
Total Dissolved Solids	US	mg/L	1660	1400	346	1620	404	1310	816	608	847	-	292	1280	1140	3070	1650	2210	823	982	1450	1660	757	1200	324	736	157	1800	-
Total Dissolved Solids	DS	mg/L	1580	1400	352	1620	399	1310	824	594	1320	514	283	1260	1420	-	1690	3000	823	881	1180	1740	748	1080	304	656	199	1700	1280
Total Suspended Solids	US	mg/L	2.3	3.3	40.6	4.6	1	4.7	7.9	1	3.2	-	23.6	2.4	1	1.9	7	250	1.4	1.3	4.1	4	1.2	9.9	6.5	1.2	1	5	-
Total Suspended Solids	DS	mg/L	42.4	1.8	8.5	1.2	2.6	3.3	4	1	1.9	103	9.2	1.4	1.1	-	46.9	11.8	3.6	14.8	2.6	5.4	1.5	3.5	8.3	1	1	4.3	2.1
Field Dissolved Oxygen	US	mg/L	8.93	11.3	9.21	9.21	10.4	9.16	8.75	5.31	9.83	8.3	8.59	9.89	9.76	10.2	8.92	6.16	6.74	10.9	9.24	8.08	10.3	9.61	9.02	10.4	9.94	9.71	-
Field Dissolved Oxygen	DS	mg/L	8.88	9.68	8.96	9.05	10.2	8.48	7.34	9.77	9.72	6.3	8.78	10.3	9.59	-	10.7	10.4	9.04	11.4	8.24	13.5	10.6	8.19	9.18	10	9.99	9.98	18.7
Field pH	US	-	7.08	8.2	8.44	7.89	8.44	8.18	8.41	6.82	8.54	7.9	8.57	7.77	7.87	7.36	8.1	7.37	7.05	8.2	8.39	8.32	8.39	8.46	8.91	8.29	8.41	8.33	-
Field pH	DS	-	8.09	7.95	8.35	7.96	8.21	8.09	8.11	7.31	8.37	7.7	8.37	7.98	8.18	-	8.17	7.17	8.01	7.76	8.34	8.24	8.35	8.33	8.64	8.26	8.23	8.31	7.27
Specific Conductivity	US	µS/cm	2180	1860	658	2140	623	1700	1030	905	1210	580	523	1700	1740	3650	2000	2850	1160	1400	1820	2070	1040	1550	532	117	963	2180	-
Specific Conductivity	DS	µS/cm	2040	1610	537	2160	622	1700	1190	917	1140	709	521	1660	1850	-	2000	3390	1170	1260	1620	2020	1050	1420	510	960	397	2190	1960
Field Temperature	US	°C	5.7	10.6	12.7	17.9	8.2	11.2	16.4	12.8	10	21.8	16.7	9.2	13.4	7.5	10.1	10.1	8.31	9.5	15.1	13.3	6.8	9.2	11.6	6.6	7.8	12	-
Field Temperature	DS	°C	13	16.9	14.9	20.3	8.4	11.8	15.7	18.3	17.3	17.3	19.6	14.1	14.2	-	12.5	12.8	12.9	7.7	17.3	20.8	9.2	18.5	14.9	6.8	8.1	11.9	12.7
Field Turbidity	US	NTU	4.48	4.86	12.7	5.68	1.77	0.87	7.9	5.22	2.99	4.59	10.6	1.96	1.06	7.01	4.01	1.43	0.95	1.42	2.81	0.79	5.12	28.8	7.65	5.77	3.56	7.12	-
Field Turbidity	DS	NTU	5.19	2.54	2.75	7.84	2.81	0.46	8.64	1.48	0.47	18	3.55	0.77	4.72	-	4.55	0.08	1	4.64	0.5	1.92	1.56	4.83	10.5	-	6.65	8.95	16.9
Pond Substrate % Gravel	SP	%	-	-	< 1	2.8	< 1	< 1	-	< 1	-	< 1	-	-	9.4	< 1	-	2.6	-	23.1	< 1	7.5	-	< 1	-	-	-	< 1	-
Pond Substrate % Very Coarse Sand	SP	%	-	-	< 1	< 1	< 1	< 1	-	< 1	-	< 1	-	-	1.1	< 1	-	1.3	-	6	< 1	1.2	-	< 1	-	-	-	< 1	-
Pond Substrate % Coarse Sand	SP	%	-	-	< 1	1.3	< 1	1.3	-	< 1	-	< 1	-	-	< 1	< 1	-	1.6	-	7.3	< 1	2.5	-	< 1	-	-	-	< 1	-
Pond Substrate % Medium Sand	SP	%	-	-	< 1	3.2	< 1	3.2	-	1.1	-	< 1	-	-	1.8	< 1	-	2.2	-	6.1	< 1	4.2	-	< 1	-	-	-	3.6	-
Pond Substrate % Fine Sand	SP	%	-	-	< 1	5.3	1.3	8.2	-	3.4	-	< 1	-	-	4.7	2	-	3.1	-	5.5	< 1	4.3	-	< 1	-	-	-	4.5	-
Pond Substrate % Very Fine Sand	SP	%	-	-	4.2	6.4	5.8	14.2	-	7.1	-	2.3	-	-	7.2	16.7	-	5.7	-	5.6	< 1	2.5	-	< 1	-	-	-	6.7	-
Pond Substrate % Silt	SP	%	-	-	19	12.4	30.3	32.8	-	13.8	-	9.8	-	-	25.6	24.2	-	16	-	12.6	16.4	19.4	-	8.8	-	-	-	14.7	-
Pond Substrate % Fine Silt	SP	%	-	-	47.6	39.1	49.7	34.3	-	37.6	-	44.8	-	-	39.2	41.1	-	37.5	-	23.7	49.5	42.5	-	54.8	-	-	-	40.6	-
Pond Substrate % Clay	SP	%	-	-	28.3	28.6	12.5	5.8	-	36.9	-	42.6	-	-	10.2	15.6	-	30	-	10.1	30.7	15.9	-	33.8	-	-	-	29.5	-
Total Organic Carbon	SP	%	-	-	10.2	8.22	13.8	9.25	-	23.7	-	41.5	-	-	34.3	7.02	-	2.13	-	9.48	20.6	6.6	-	13.6	-	-	-	12	-
Total Inorganic Carbon	SP	%	-	-	2.75	5.28	0.646	6.35	-	1.34	-	0.923	-	-	2.93	2.36	-	2.01	-	3.42	1.44	4	-	1.45	-	-	-	4.33	-
Total Carbon Combustion	SP	%	-	-	13	13.5	14.4	15.6	-	25	-	42.4	-	-	37.2	9.38	-	4.14	-	12.9	22	10.6	-	15	-	-	-	16.3	-
Algae, Filamentous	SP	%	50-90%	5-15%	5-15%	0	1-5%	5-15%	0	15-50%	>90%	1-5%	1-5%	5-15%	5-15%	1-5%	1-5%	>90%	1-5%	5-15%	0	0	0	0	-	1-5%	5-15%	5-15%	-
Algae, Floating	SP	%	0	5-15%	0	1-5%	15-50%	5-15%	0	5-15%	5-15%	>90%	1-5%	5-15%	15-50%	1-5%	1-5%	1-5%	1-5%	5-15%	0	0	0	0	-	0	0	>90%	-
Vegetation, Emergent	SP	%	1-5%	5-15%	1-5%	1-5%	5-15%	15-50%	1-5%	5-15%	5-15%	1-5%	5-15%	5-15%	1-5%	1-5%	1-5%	0	1-5%	1-5%	1-5%	5-15%	5-15%	0	-	1-5%	5-15%	1-5%	-
Vegetation, Submergent	SP	%	1-5%	5-15%	>90%	>90%	5-15%	>90%	0	>90%	50-90%	15-50%	5-15%	50-90%	15-50%	15-50%	1-5%	0	50-90%	5-15%	>90%	>90%	1-5%	>90%	-	1-5%	>90%	>90%	-
Mean Hydraulic Residence Time (Jun-Sep)	SP	day	7.83	0.0295	0.67	3.38	0.707	0.293	2.64	3.26	7.49	4.17	14	2.8	4.31	-	2.74	20.6	1.24	-	2.47	2.52	0.906	3.71	-	0.603	0.125	0.936	0.0724

Notes: US = upstream of sedimentation pond; DS = downstream of sedimentation pond; SP = in pond; values below detection are shown as zero (selenium species) or as the detection limit (all other parameters)

Attachment C

Selenium Speciation Associated with Maximum Reported Organoselenium Concentrations in 2022 in Local and Regional Monitoring Programs

Attachment C. Selenium speciation associated with the sampling event that reported the maximum organoselenium concentration in 2022 local and regional monitoring programs

Program / Location	Monitoring Location	Date of Max. OrgSe	Selenium Species Concentration (µg/L)					
			MeSe(IV)	DMSeO	OrganoSe	MeSe(VI)	Se(IV)	Se(VI)
FRO North Saturated Rock Fill								
Decant from Clode Sediment Pond	FR_CC1	22 Sep	0.019	<0.010	0.019	<0.010	0.233	130
Corbin Sediment Pond								
Corbin Creek at Rock Drain	CM_CCRD	16 Aug	<0.010	<0.010	<0.010	<0.010	0.102	29.5
Corbin Offtake Valve by CCPD	CM_CCOFF	06 Sep	0.016	<0.010	0.016	<0.010	0.123	26.3
Michel Creek ds CMm, 50 m us Andy Good Creek	CM_MC2	23 Aug	0.011	<0.010	0.011	<0.010	0.182	7.74
14 pit Dewatering Horizontal Pipe	CM_14PIT-PIPE	06 Sep	<0.010	<0.010	<0.010	<0.010	1.58	1.44
34 Pit at Pipe Discharge (14 Pit Sump)	CM_34PIPEDIS	01 Feb	<0.010	<0.010	<0.010	<0.010	1.13	1.28
Six Pit	CM_6PITDW	07 Jun	<0.010	<0.010	<0.010	<0.010	0.088	0.585
Corbin Creek ds CMm	CM_CC1	06 Sep	0.013	<0.010	0.013	<0.010	0.347	12.2
North Ditch by Floc Shack	CM_ND2	02 Feb	<0.010	<0.010	<0.010	<0.010	0.905	4.13
Main Pond Decant	CM_SPD	16 Aug	0.025	<0.010	0.025	<0.010	0.771	2.38
LCO Dry Creek Water Management System / LCO Dry Creek LAEMP								
Dry Creek us East Tributary	LC_DC3	02 Aug	0.016	0.038	0.054	<0.010	1.13	79.1
East Tributary of Dry Creek	LC_DCEF	03 May	<0.010	<0.010	<0.010	<0.010	0.022	1.55
Dry Creek Sedimentation Ponds effluent to Dry Creek	LC_SPDC	25 Jul	0.052	0.051	0.103	<0.010	1.12	63
Dry Creek ds Sedimentation Ponds	LC_DCDS	25 Jul	0.047	0.05	0.097	<0.010	1.08	59.7
Near mouth of Dry Creek	LC_DC1	18 Jul	0.015	0.013	0.028	<0.010	0.41	32.8
Downstream of marsh area where DCEF comes to surface	LC_DC4	18 Jul	0.015	0.016	0.031	<0.010	0.43	34.1
Fording River 100 m us Conveyance Outfall	LC_FRUS	10 Sep	0.013	<0.010	0.013	<0.010	0.169	42.2
Fording River Bridge ds FRDSDC	LC_FRB	10 Sep	0.012	<0.010	0.012	<0.010	0.168	34.7
Grace Creek us CP railway tracks	LC_GRCK	14 Sep	<0.010	<0.010	<0.010	<0.010	0.035	1.85
LCO LAEMP								
South Line Creek	RG_SLINE	18 Apr	<0.010	<0.010	<0.010	<0.010	0.033	1.33
South Line Creek	LC_SLC	05 Apr	<0.010	<0.010	<0.010	<0.010	0.031	1.38
Line Creek us LCO	RG_LI24	19 Apr	<0.010	<0.010	<0.010	<0.010	0.032	2.24
Line Creek us LCO	LC_LC1	05 Apr	<0.010	<0.010	<0.010	<0.010	0.05	1.83
Line Creek us WLC AWTF	RG_LCUT	26 Feb	0.029	0.016	0.045	<0.010	0.191	268
Line Creek us WLC AWTF	LC_WLC	27 Jun	<0.010	<0.010	<0.010	<0.010	0.138	137
Line Creek 200m ds WLC AWTF	RG_LILC3	26 Feb	0.051	0.024	0.075	0.135	0.568	30.1
Line Creek 200m ds WLC AWTF	LC_LC3	28 Mar	0.014	0.051	0.065	0.228	0.746	62.6
Line Creek ~50m ds Contingency Pond discharge	RG_LISP24	26 Feb	0.034	0.011	0.045	0.059	0.33	17
Line Creek ds South Line Creek	RG_LIDSL	12 Aug	0.014	<0.010	0.014	0.012	0.116	20.2
Line Creek ds South Line Creek	LC_LCDSSLCC	15 Mar	0.023	0.018	0.041	0.06	0.415	43.5
Line Creek ds compliance location	RG_LIDCOM	05 Dec	0.015	<0.010	0.015	<0.010	0.118	33.7
Line Creek above Canyon	RG_LI8	04 Dec	0.014	<0.010	0.014	<0.010	0.083	32.9
Line Creek above Canyon	LC_LC4	28 Dec	0.014	<0.010	0.014	0.015	0.22	32.8
Fording River us Line Creek	RG_FRUL	09 Sep	0.022	0.017	0.039		0.337	35.5
Fording River at Elk	RG_FO23	28 Apr	0.016	<0.010	0.016	<0.010	0.211	48
Greenhills Creek and Gardine Creek								
Greenhills Creek us proposed treatment facility	RG_GHUT	17 Sep	0.013	<0.010	0.013	<0.010	0.429	226
Greenhills Near-Field ds proposed treatment facility	RG_GHNF	09 Sep	0.017	0.013	0.03	<0.010	1.17	220
Below Greenhills Creek Sedimentation Pond	RG_GHBP	13 Sep	0.099	0.25	0.349	<0.010	4.23	132
Greenhills Far-Field ds of proposed treatment facility	RG_GHFF	09 Sep	0.029	<0.010	0.029	<0.010	1.08	167
Biological monitoring	RG_GAUT	18 Sep	<0.010	<0.010	<0.010	<0.010	0.169	0.371
Biological monitoring	RG_GANF	13 Sep	<0.010	<0.010	<0.010	<0.010	0.167	5.24
Greenhills Creek Secondary Pond	RG_GHP	23 Sep	0.098	0.213	0.311	<0.010	3.52	124
Greenhills Creek Secondary Pond	RG_GHPS	10 Sep	0.013	<0.010	0.013	<0.010	0.541	85.8
Lotic Sediment Toxicity								
Fording River us Kilmarnock Creek	RG_FOUKI	05 Sep	0.02	<0.010	0.02		0.36	36.9
Fording River near Fording River Road	RG_FRUPO	07 Sep	<0.010	<0.010	<0.010		0.177	61.9
Fording River at bridge ds Kilmarnock Creek, us Swift Creek	RG_FOBKS	13 Sep	0.011	<0.010	0.011	<0.010	0.253	62.2
Elk River us Branch Creek and GHO	RG_ELUGH	10 Sep	<0.010	<0.010	<0.010	<0.010	0.075	0.776
Fording River ds Cataract Creek, us Porter Creek	RG_FOBCP	15 Sep	0.026	<0.010	0.026	<0.010	0.267	64.8
Fording River ds Cataract Creek, us Porter Creek	FR_FRCP1	16 Dec	0.027	<0.010	0.027	<0.010	0.24	87
Michel Creek us CMm	RG_MI25	13 Sep	<0.010	<0.010	<0.010	<0.010	0.02	0.148
Fording River LAEMP								
Fording River us Henretta Creek	RG_UFR1	16 Dec	<0.010	<0.010	<0.010	<0.010	0.045	0.758
Fording River us Henretta Creek	FR_UFR1	15 Feb	<0.010	<0.010	<0.010	<0.010	<0.020	0.719
Henretta Creek us all mine operations	RG_HENUP	16 Jun	<0.010	<0.010	<0.010	<0.010	0.021	0.305
Fording River side channel 2	RG_FRSCH2	15 Sep	<0.010	<0.010	<0.010	<0.010	0.085	87.1
Greenhouse side channel, Fording River ds FRUPO	RG_FRGHSC	19 Sep	<0.010	<0.010	<0.010	<0.010	0.104	107
Fording River us Clode Creek	RG_FOUCL	16 Sep	<0.010	<0.010	<0.010	<0.010	0.124	30.7
Fording River us North Greenhills Diversion	RG_FOUNGD	17 Dec	<0.010	<0.010	<0.010	<0.010	0.177	57.2
Fording River ds Henretta Creek	RG_FODHE	17 Dec	<0.010	<0.010	<0.010	<0.010	0.096	34.2
Fording River us Shandley Creek	RG_FOUSH	17 Sep	<0.010	<0.010	<0.010	<0.010	0.375	40.7
Fording River ~1150 m ds Compliance Point	RG_FRCP1SW	22 Sep	0.023	<0.010	0.023	<0.010	0.375	90.9
Fording River plate culvert Greenhills access road	RG_MP1	09 Dec	<0.010	<0.010	<0.010	<0.010	0.291	50.5
Fording River us Kilmarnock Creek	RG_FOUKI	05 Sep	0.02	<0.010	0.02		0.36	36.9
Fording River at bridge ds Kilmarnock Creek, us Swift Creek	RG_FOBKS	13 Sep	0.011	<0.010	0.011	<0.010	0.253	62.2
Fording River ds Swift Cataract Outfall	RG_SCOUTDS	07 Nov	0.039	0.014	0.053	<0.010	0.253	67
Fording River ds Swift Cataract Outfall	FR_SCOUTDS	10 Nov	0.061	0.016	0.077	0.018	0.311	74.4
Fording River ds Swift Creek, us Cataract Creek	RG_FOBSC	07 Nov	0.041	0.015	0.056	<0.010	0.276	69.9
Fording River near Fording River Road	RG_FRUPO	07 Sep	<0.010	<0.010	<0.010		0.177	61.9
Fording River ds Cataract Creek, us Porter Creek	RG_FOBCP	15 Sep	0.026	<0.010	0.026	<0.010	0.267	64.8
Fording River ds Cataract Creek, us Porter Creek	FR_FRCP1	16 Dec	0.027	<0.010	0.027	<0.010	0.24	87
Fording River ds Porter	RG_FODPO	12 Dec	0.013	<0.010	0.013	<0.010	0.384	92.1
Fording River ds Chauncey Creek	RG_FOUEW	17 Feb	0.014	<0.010	0.014	<0.010	0.26	115
Fording River us Chauncey Creek	RG_FO22	09 Sep	0.014	<0.010	0.014	<0.010	0.175	75
Fording River us Chauncey Creek	FR_FRABCH	15 Feb	<0.010	<0.010	<0.010	<0.010	0.163	102
West Line Creek AWTF								
WLC Active Water Treatment Pond Buffer Pond weir box	WL_BFWB_OUT_SP21	02 Sep	0.318	0.102	0.42	0.304	2.33	12.6
AWTF Influent Line Creek	WL_LCI_SP02	05 Jul	<0.010	<0.010	<0.010	<0.010	0.117	41.5
AWTF Influent West Line Creek	WL_WLCI_SP01	11 Oct	0.017	0.021	0.038	<0.010	0.116	348
EVO LAEMP								
Alexander Creek upstream of Michel Creek and EVO	RG_ALUSM	12 Sep	<0.010	<0.010	<0.010	<0.010	0.015	0.562
Michel Creek us CMm	RG_MI25	13 Sep	<0.010	<0.010	<0.010	<0.010	0.02	0.148
Upstream of proposed outfall	RG_ERCKUT	25 Apr	0.023	<0.010	0.023	<0.010	0.114	178
Erickson Creek ds proposed outfall	RG_ERCKDT	24 Apr	0.041	0.011	0.052	<0.010	0.969	62.4
Erickson Creek ds proposed outfall	EV_ECOUT	28 Feb	0.012	<0.010	0.012	<0.010	1.04	52.5
Erickson Creek at Mouth	RG_ERCK	10 Sep	0.018	0.017	0.035	<0.010	0.866	145
Erickson Creek at Mouth	EV_EC1	11 Jan	0.018	0.019	0.037	<0.010	0.88	47.5
Gate Creek us sedimentation pond	RG_GATE	16 Sep	0.113	0.062	0.175	<0.010	3.06	235
Gate Creek Sedimentation Pond Decant	RG_GATEDP	16 Sep	0.051	0.034	0.085	<0.010	0.91	201
Bodie Creek Sedimentation Pond Decant	RG_BOCK	15 Sep	0.11	0.16	0.27	<0.010	3.08	61.5
Michel us Erickson and ds Alexander	RG_MI3	12 Sep	<0.010	<0.010	<0.010	<0.010	0.071	1.4
Michel Creek ds Erickson Creek	RG_MIDER	27 Feb	<0.010	<0.010	<0.010	<0.010	0.095	12.4
Michel Creek ds Bodie Creek	RG_MIDBO	13 Sep	0.013	<0.010	0.013	<0.010	0.164	16.7
Michel Creek ds Hwy #3 Bridge	RG_MICOMP	13 Sep	0.014	<0.010	0.014	<0.010	0.174	6.97
Michel Creek ds Hwy #3 Bridge	EV_MC2	26 Sep	<0.010	<0.010	<0.010	<0.010	0.141	18.6
EVO SRF								
Michel Creek ds Hwy #3 Bridge	EV_MC2	26 Sep	<0.010	<0.010	<0.010	<0.010	0.141	18.6
Michel Creek immediately us Gate Creek sedimentation pond	EV_MC2A	31 Oct	<0.010	<0.010	<0.010	<0.010	0.114	8.45
Michel Creek us Erickson Creek	EV_MC3	31 Oct	<0.010	<0.010	<0.010	<0.010	0.064	1.17
Erickson Creek at Mouth	EV_EC1	11 Jan	0.018	0.019	0.037	<0.010	0.88	47.5
Erickson Creek ds proposed outfall	EV_ECOUT	28 Feb	0.012	<0.010	0.012	<0.010	1.04	52.5
Bodie Creek outlet of rock drain us water tank system	EV_BRD_LOT3	18 Oct	0.018	0.012	0.03	<0.010	0.647	182
Bodie Creek Sedimentation Pond Decant	EV_BC1	30 Aug	0.119	0.215	0.334	<0.010	2.7	70.1
Gate Creek Sedimentation Pond Decant	EV_GT1	02 Aug	0.096	0.055	0.151	<0.010	0.758	140
Elk River ds Michel Creek at CPR Roadhouse	EV_ER1	06 Sep	<0.010	<0.010	<0.010	<0.010	0.079	9.58
Elkview Dry Creek Water Treatment Project / Elkview Harmer Dam Removal Project								
Harmer Creek Dam Spillway	EV_HC1	06 Sep	0.027	0.015	0.042	<0.010	0.312	27.2
Monitoring location	EV_HC1A	11 Jul	0.014	<0.010	0.014	<0.010	0.137	18.6
Harmer Creek ds Harmer Dam	EV_HCDSDAM	18 Aug	0.03	0.012	0.042	<0.010	0.331	25.9
Monitoring location	EV_DC2A	11 Jul	0.032	0.021	0.053	<0.010	0.8	117
Monitoring Location ds EVO Dry Creek Outfall Location	EV_DCOUT	08 Sep	0.139	0.02	0.159	<0.010	1.66	140
Fording River South AWTF								
Fording River ds Swift Cataract Outfall	FR_SCOUTDS	10 Nov	0.061	0.016	0.077	0.018	0.311	74.4
Regional Chronic Toxicity								
Fording River us Chauncey Creek	FR_FRABCH	15 Feb	<0.010	<0.010	<0.010	<0.010	0.163	102
Fording River ds Greenhills Creek	GH_FR1	04 Apr	0.017	<0.010	0.017	<0.010	0.32	57.2
Elk River ds Thompson Creek	GH_ERC	06 Jul	<0.010	<0.010	<0.010	<0.010	0.026	1.12
Line Creek ds South Line Creek	LC_LCDSSLCC	15 Mar	0.023	0.018	0.041	0.06	0.415	43.5
South Line Creek	LC_SLC	05 Apr	<0.010	<0.010	<0.010	<0.010	0.031	1.38
Line Creek 200m ds WLC AWTF	LC_LC3	28 Mar	0.014	0.051	0.065	0.228	0.746	62.6
Fording River ds Line Creek	LC_LC5	18 Apr	0.013	0.011	0.024	<0.010	0.213	48.6
RAEMP (not including LAEMP sites)								
Clode Creek near mouth	RG_CLODE	27 Jul	0.016	<0.010	0.016	<0.010	0.29	134
Kilmarnock Creek ds rock drain	RG_KICK	09 Jul	<0.010	<0.010	<0.010		0.076	64.6
Greenhills Creek ds sedimentation pond	RG_GHCKD	11 Sep	0.106	0.222	0.328	<0.010	4.13	127
Fording River ds Ewin Creek	RG_FODGH	17 Sep	0.019	0.014	0.033	<0.010	0.326	51.3
Alexander Creek upstream of Michel Creek and EVO	RG_ALUSM	12 Sep	<0.010	<0.010	<0.010	<0.010	0.015	0.562
Harmer Creek us Harmer Pond	RG_HACKDS	16 Sep	0.029	0.014	0.043	<0.010	0.291	27.6
Grave Creek near mouth at Elk River	RG_GRDS	11 Sep	0.019	<0.010	0.019	<0.010	0.282	21.6
Balmer Creek at CFI Road	RG_BACK	13 Sep	<0.010	<0.010	<0.010	<0.010	0.182	7.49
Elk River us Elko	RG_ELELKO	14 Sep	0.024	<0.010	0.024	<0.010	0.312	8.79
Elk River us Hwy 93 bridge and Elk River mouth	RG_ELH93	15 Sep	0.018	<0.010	0.018	<0.010	0.274	7.41

Notes: US = upstream of sedimentation pond; DS = downstream of sedimentation pond; OrganoSe = sum of DMSeO and MeSe(IV)

Attachment D

Pond Summary Sheets

Corbin Reservoir
Management Unit 4

Physical Characteristics

Passive Drainage Area (km^2):	-
Normal Operating Range (m3/s):	0 to 2.75
Volume (m^3):	124,450
Surface Area (m^2)	29,600
Mean/Maximum Pond Depth (m)	1.75/7
Liner:	Yes
Fish Access:	Absolute Barrier

Habitat Characteristics

Submergent Vegetation:	Scattered (1-5%)
Emergent Vegetation:	Scattered (1-5%)
Algae (Free Floating):	None
Algae (Filamentous):	Partial Coverage (50-90%)

Field Water Quality

Date(s) Collected:	16/Aug/2022
Temperature (°C):	10.90
Conductivity (µS/cm):	2,135
DO (mg/L):	11.57
pH:	7.59
ORP (mV):	177.3

Site Description

Substrate is silty and grasses are the most abundant aquatic vegetation. Shading potential is limited due to minimal riparian cover, but tree cover on the east side of the pond may provide some shade.
Evidence of fish use: Historical presence of Brook Trout. Repletely salvaged and current use is low if any

Water Flow Description

Corbin Pond receives flow from the upper Corbin Creek catchment area, infiltration through the overlying East Spoils, and runoff from the East Access Road and 6 Pit.

Teck

CM_CORBIN-POND UTM (11U) E: 670144 N: 5486199

Corbin Pond Aerial

CM_CORBIN-POND UTM (11U) E: 670144 N: 5486199

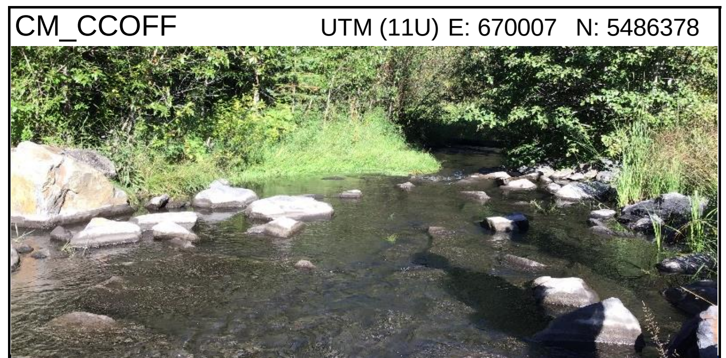
Corbin Pond

CM_CCRD UTM (11U) E: 670209 N: 5486015

No Photo Available

Upstream Corbin Pond

CM_CCOFF UTM (11U) E: 670007 N: 5486378



Downstream Corbin Pond

Corbin Creek SPD Pond

Management Unit 4

Physical Characteristics

Passive Drainage Area (km^2):	-
Normal Operating Range (m^3/s):	0 - 1.36
Volume (m^3):	-
Surface Area (m^2)	585
Mean/Maximum Pond Depth (m)	0.5/1.0
Liner:	No
Fish Access:	Partial Barrier

Habitat Characteristics

Submergent Vegetation:	Some Coverage (5-15%)
Emergent Vegetation:	Some Coverage (5-15%)
Algae (Free Floating):	Some Coverage (5-15%)
Algae (Filamentous):	Some Coverage (5-15%)

Field Water Quality

Date(s) Collected:	16/Aug/2022
Temperature (*C):	15.53
Conductivity (µS/cm):	1,709
DO (mg/L):	10.62
pH:	7.95
ORP (mV):	147.50

Site Description

Main Pond (SPD Pond) is a two-pond sediment control system in the north-west corner of CMO. The inflow is a riprap-lined spillway in the southwest corner and then though a divider dyke spillway to the east pond. The outlet is a spillway and is an engineered fish barrier blocking upstream passage of fish from Corbin Creek into the pond. The substrates are nearly all overed by macrophytes and the shading potential is minimal.

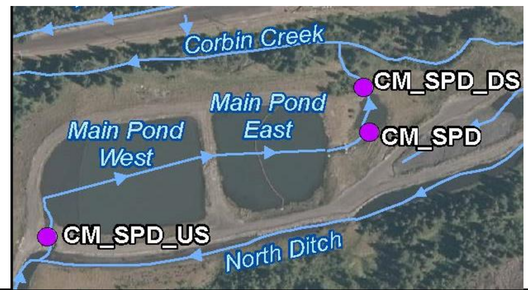
Evidence of Fish Use: Fish Barrier is passable to fish >200 mm (folk length). Longnose sucker present. Brook Trout caught in ponds since 2019.

Water Flow Description

Main (SPD) Pond collects water from the north and west areas of the CMO property. The West and North Interceptor Ditches both discharge into the Main Ponds and the discant discharges through a short-constructed channel before it converges with Corbin Creek.

Teck

CM_SPDSP UTM (11U) E: 668870 N: 5487380



SPD Pond Aerial

CM_SPDSP
UTM (11U)
E: 668870
N: 5487380

SPD Pond

CM_SPDSP_US
UTM (11U)
E: 668861
N: 5487372

Upstream SPD Pond

CM_SPD
UTM (11U)
E: 660558
N: 5531900

Downstream SPD Pond

Aqueduct Pond Control Structure
Management Unit 4

Physical Characteristics

Passive Drainage Area (km^2):	1.53
Mean Annual Discharge (m^3/s):	0.02
Volume (m^3):	430
Surface Area (m^2)	411
Mean/Maximum Pond Depth (m)	0.5/1.6
Liner:	Yes
Fish Access:	No Barrier

Habitat Characteristics

Submergent Vegetation:	Complete
Emergenet Vegetation:	Scattered (1-5%)
Algae (Free Floating):	None
Algae (Filamentous):	Some Coverage (5-15%)

Field Water Quality

Date(s) Collected:	11/Aug/2022
Temperature (°C):	14.27
Conductivity (µS/cm):	651
DO (mg/L):	8.79
pH:	8.32
ORP (mV):	49.70

Site Description

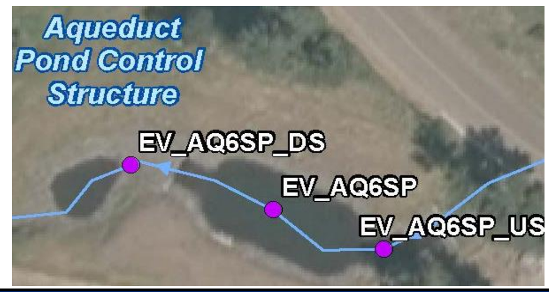
The Aqueduct Pond Control Structure was constructed in 2015 with a primary purpose of directing flow from Aqueduct Creek into a sedimentation pond and to pass excess flow downstream. However, the construction of the Aqueduct Creek Sedimentation Pond was cancelled, thus the Aqueduct Pond Control Structure does not currently serve any purpose from a water management perspective. Substrate is silty with some filamentous algae. Shading potential exists due to steep banks and riparian trees.

Evidence of fish use: Salvage data from 2021 indicates no fish use in pond.

Water Flow Description

Flow enters the pond from the northeast and decants into the lower portion of Aqueduct Creek before discharging into Michel Creek. Since the new sedimentation pond has not been completed, all flows currently exit the pond via the high-flow spillway.

EV_AQ6SP UTM (11U) E: 658638 N: 5506101



Aqueduct Pond Aerial

EV_AQ6SP UTM (11U) E: 654420 N: 5511148

Aqueduct Pond

EV_AQ6SP_US UTM (11U) E: 654441 N: 5511140

Upstream Aqueduct Pond

EV_AQ6SP_DS1 UTM (11U) E: 654392 N: 5511156

Down-stream Aqueduct Pond

North Bodie Creek Sedimentation Pond
Management Unit 4

Physical Characteristics

Passive Drainage Area (km^2):	0.23
Mean Annual Discharge (m^3/s):	0.11
Volume (m^3):	3,000
Surface Area (m^2)	1,228
Mean/Maximum Pond Depth (m)	1.87
Liner:	No
Fish Access:	Temporary Fish Barrier

Habitat Characteristics

Submergent Vegetation:	Complete
Emergent Vegetation:	Scattered (1-5%)
Algae (Free Floating):	Scattered (1-5%)
Algae (Filamentous):	None

Field Water Quality

Date(s) Collected:	11/Aug/2022
Temperature (°C):	19.63
Conductivity (µS/cm):	2,172
DO (mg/L):	9.48
pH:	8.02
ORP (mV):	122.73

Site Description

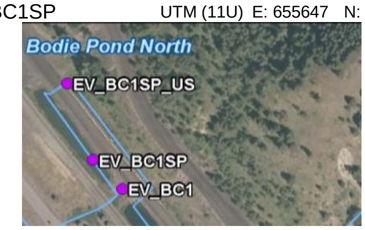
The Bodie Creek Sedimentation Pond system consists of two main sedimentation ponds (north and south) and a flocculant station located upstream. The inflow to the pond system is via a pipe (no immediate upstream habitat). The primary purpose of the pond is sedimentation control of runoff from areas with mining-related activities. The substrate is fully covered in submergent macrophyte growth (pondweed). Minimal shading potential exists. Evidence of fish use: Zero fish caught last three years (2020, 2021, 2022).

Water Flow Description

Flows enters the North Bodie Creek Sedimentation Pond from the South Bodie Creek Sedimentation Pond via a connection ditch (2x900 mm culverts). The Bodie Creek Control Pond located upstream makes it possible to divert flow away from the Bodie Creek Sedimentation Ponds to the Gate Creek Sedimentation Pond system via a buried pipeline and open channel. Flows discharging to the North Bodie Creek Sedimentation Pond decant into the lower portion of Bodie Creek and ultimately into Michel Creek.

Teck

EV_BC1SP UTM (11U) E: 655647 N: 5509613



North Bodie Creek Sedimentation Pond Aerial

EV_BC1SP
UTM (11U)
E: 655647
N: 5509613

Bodie Pond North

EV_BC1_US

Upstream Bodie Pond North

EV_BC1
UTM (11U)
E: 655675
N: 5509584

Downstream Bodie Pond North

EVO Dry Creek Pond

Management Unit 4

Physical Characteristics

Passive Drainage Area (km^2):	8.5
Mean Annual Discharge (m^3/s):	0.12
Volume (m^3):	3,000
Surface Area (m^2)	2,930
Mean/Maximum Pond Depth (m)	1/2.8
Liner:	No
Fish Access:	Partial Barrier

Habitat Characteristics

Submergent Vegetation:	Complete
Emergent Vegetation:	Partial (15 - 50%)
Algae (Free Floating):	Some Coverage (5 - 15%)
Algae (Filamentous):	Some Coverage (5 - 15%)

Field Water Quality

Date(s) Collected:	23/Aug/2022
Temperature (°C):	11.70
Conductivity (μS/cm):	1,684.0
DO (mg/L):	8.87
pH:	8.11
ORP (mV):	10.9

Site Description

Initial sampling records for Dry Creek Sedimentation Pond started in 2005, however, the pond is thought to have been constructed around 1969. The Dry Creek Sedimentation Pond serves as a sediment removal facility for the mine-influenced waters within the Dry Creek drainage, and specifically water reporting from the Dry Creek Spoils. The Dry Creek Sedimentation Pond is an active sedimentation pond but currently receives no flow from active mining areas. Substrate is silty with some aquatic vegetation. Shading potential exists due to riparian trees.

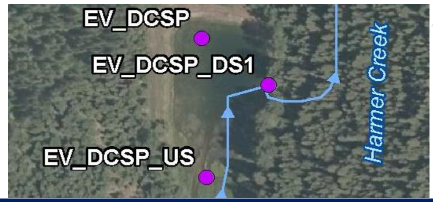
Evidence of fish use: The pond is considered to be fish barring (Westslope Cutthrout Trout likely present); however, no salvage data exists.

Water Flow Description

Flows enters the pond at the east end and decants out of the pond via a set of corrugated steel pipes in the pond’s southwest corner. The pond decants into Michel Creek.

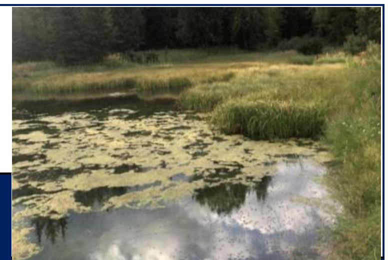
Teck

EV_DCSP UTM (11U) E: 659353 N: 5517556



Dry Creek Pond Aerial

EV_DCSP
UTM (11U)
E: 659353
N: 5517556



Dry Creek Pond

EV_DCSP_US
UTM (11U)
E: 659355
N: 5517481

Upstream Dry Creek Pond

EV_DCSP_DS1
UTM (11U)
E: 659388
N: 5517531

Downstream Dry Creek Pond

Goddard Finger Ponds
Management Unit 4

Physical Characteristics

Passive Drainage Area (km^2):	-
Mean Annual Discharge (m^3/s):	0.035
Volume (m^3):	-
Surface Area (m^2)	-
Mean/Maximum Pond Depth (m)	3
Liner:	None
Fish Access:	No barrier

Habitat Characteristics

Submergent Vegetation:	None
Emergent Vegetation:	Scattered (1 - 5%)
Algae (Free Floating):	None
Algae (Filamentous):	None

Field Water Quality

Date(s) Collected:	12/Aug/2022
Temperature (°C):	14.09
Conductivity (µS/cm):	917.9
DO (mg/L):	235.99
pH:	8.01
ORP (mV):	140.8

Site Description

The Goddard Creek system consists of four ponds in series (Middle [or Mid] Pond, Goddard Creek Finger Ponds [or Goddard Ponds 1 and 2] and the Main Sedimentation Pond) and is located immediately north of the EVO Rail Loop and west of the Process Plant. A fully automated flocculant station doses flocculant between the Finger Ponds.
Evidence of fish use: Longnose sucker and Westslope Cutthrout Trout present. Preliminary 2022 salvage data suggests a reduction in fish biomass.

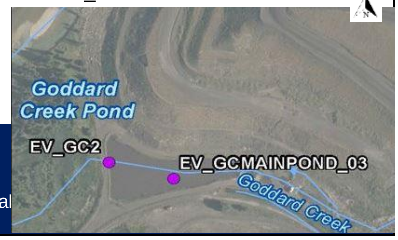
Water Flow Description

Flow exits the facility through two 600 mm CSP culverts that each discharge into concrete box weirs.Flow from the Goddard Creek catchment discharges to the Goddard Marsh. Goddard Marsh is a lentic environment (wetland area) that receives discharge from theGoddard Creek water management system. Goddard Marsh discharges into the Elk River.

Teck

EV_GCMAINPOND_03
UTM (11U)
E: 653240
N: 5514119

Goddard Finger Ponds Aerial



EV_GCMAINPOND_03
UTM (11U)
E: 653240
N: 5514119

Goddard Finger Ponds

EV_GC2
UTM (11U)
E: 653313
N: 5514126

Upstream Goddard Finger Ponds

EV_GO13_OUTFLOW
UTM (11U)
E: 652894
N: 5514082

Downstream Goddard Finger Ponds

Gate Creek Sedimentation Pond

Management Unit 4

Physical Characteristics

Passive Drainage Area (km^2):	3.45
Mean Annual Discharge (m^3/s):	0.01
Volume (m^3):	7,394
Surface Area (m^2)	5,384
Mean/Maximum Pond Depth (m)	1.3/2.7
Liner:	No
Fish Access:	Absolute Barrier

Habitat Characteristics

Submergent Vegetation:	Complete
Emergent Vegetation:	Scattered (1 - 5%)
Algae (Free Floating):	Complete
Algae (Filamentous):	Some Coverage (5 - 15%)

Field Water Quality

Date(s) Collected:	11/Aug/2022
Temperature (°C):	12.13
Conductivity (µS/cm):	2,191.3
DO (mg/L):	10.32
pH:	8.31
ORP (mV):	157.03

Site Description

The Gate Creek Sedimentation Ponds receive runoff from Gate Creek, South Gate Creek, and Bodie Creek (via the Bodie Control Pond) with the primary purpose of sediment control/settling of suspended solids. Substrate is silty but dominated by thick submerged vegetation/macrophyte growth. Limited shading potential exists due to sparse riparian trees.
Evidence of fish use: Fish salvages have been conducted in the ponds (13 longnose suckers captured in 2022) and a fish barrier has been constructed.

Water Flow Description

The primary cell is U-shaped in plan, with flow entering the system through a set of twin corrugated steel pipe culverts at the north end of its east arm. narrow channel connects the primary cell to the secondary cell. The secondary cell is rectangular in shape with inflow at its southeast corner and outflow at its northwest corner. The pond discharges directly to Michel Creek through a concrete box structure with an engineered fish barrier in the
outlet channel.

EV_GTSP
UTM (11U)
E: 655845
N: 5509125

Gate Pond Aerial

EV_GTSP
UTM (11U)
E: 655845
N: 5509125

Gate Pond

RG_GATE
UTM (11U)
E: 655826
N: 5509187

Upstream Gate Pond

EV_GT1
UTM (11U)
E: 655663
N: 5509257

Downstream Gate Pond

Harmer Creek Sedimentation Pond (EV_HASP)

Management Unit 4

Physical Characteristics

Passive Drainage Area (km^2):	21.3
Mean Annual Discharge (m^3/s):	0.681
Volume (m^3):	42,500
Surface Area (m^2):	15,490
Mean/Maximum Pond Depth (m):	2.0 / 5.7
Liner:	No
Fish Access:	Absolute downstream barrier

Habitat Characteristics

Submergent Vegetation:	Some Coverage (5 - 15%)
Emergent Vegetation:	Some Coverage (5 - 15%)
Algae (Free Floating):	Partial Coverage (15 - 50%)
Algae (Filamentous):	Scattered (1 - 5%)

Field Water Quality

Date(s) collected:	24/Aug/2022
Temperature (°C):	8.38
Conductivity (µS/cm):	630.17
DO (mg/L):	10.0
pH:	8.31
ORP (mV):	111.78

Site Description

Anthropogenic sedimentation pond formed by construction of Harmer Dam in 1971. Substrate predominantly silt, some emergent grasses at pond margins, little to no submergent vegetation. Riparian trees shade the southeast side of the pond during part of the day. Shallow near inflow, steep-sided and deep elsewhere. Generally low abundance of benthic invertebrates.

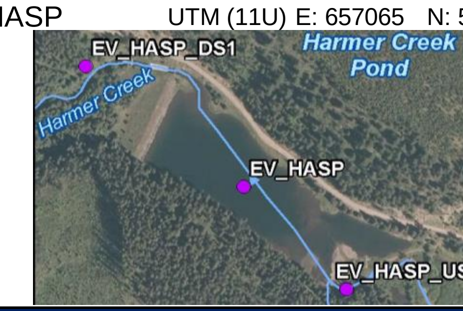
Evidence of fish use: Little to no evidence of fish use. Possible presence of Westslope Cutthroat Trout.

Hydrology

In-line with Harmer Creek. Constructed to treat mine-influenced water from Dry Creek, a tributary of upper Harmer Creek. Harmer Creek flows in from the southeast corner of the pond and flows out over a weir in the northeast corner of the pond.

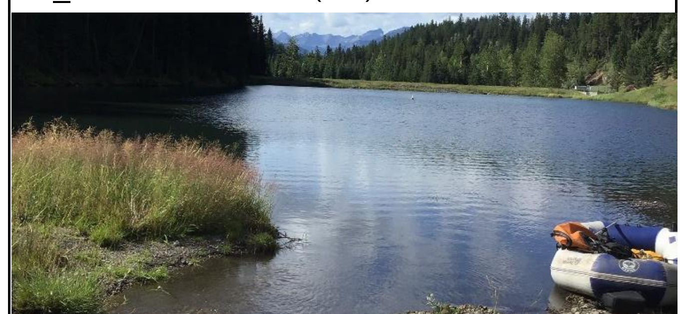
Teck

EV_HASP UTM (11U) E: 657065 N: 5522098



Harmer Creek Sedimentation Pond - Aerial

EV_HASP UTM (11U) E: 657065 N: 5522098



Pond Looking Northwest from Inflow

EV_HASP_US UTM (11U) E: 657206 N: 5521951

Upstream

EV_HASP_DS1 UTM (11U) E: 656953 N: 5522172

Downstream

Lindsay Creek Infiltration Pond
Management Unit 4

Physical Characteristics

Passive Drainage Area (km^2):	1.13
Normal Operating Range (m^3/s):	0 - 0.05
Volume (m^3):	1,900
Surface Area (m^2)	790
Mean/Maximum Pond Depth (m)	0.75/1.5
Liner:	No
Fish Access:	Absolute Barrier

Habitat Characteristics

Submergent Vegetation:	Complete
Emergent Vegetation:	Some Coverage (5-15%)
Algae (Free Floating):	Some Coverage (5-15%)
Algae (Filamentous):	Partial Coverage (15-50%)

Field Water Quality

Date(s) Collected:	12/Aug/2022
Temperature (°C):	16.82
Conductivity (µS/cm):	942
DO (mg/L):	7.91
pH:	7.01
ORP (mV):	92.42

Site Description

The primary purpose of the Lindsay Creek Sediment is to provide sediment control for the CCR spoil. Substrate is dominated by silt and clay. Minimal shading potential exists due to its location at the base of the spoil with minimal riparian cover. Most recently dredged in 2019.
Evidence of fish use: QP designated fish free (2022).

Water Flow Description

The Lindsay Creek rock drain collects infiltration through the CCR Spoil and discharges at the base of the CCR into the Lindsay Creek Infiltration Ponds . Water collected within the ponds and the discharge channel infiltrates to the ground with no direct connection to the Elk River.

Teck

EV_LC1SP UTM (11U) E: 653260 N: 5514784

Lindsay Creek Infiltration Pond Aerial

EV_LC1SP
UTM (11U)
E: 653260
N: 5514784

Lindsay Pond

EV_LSC
UTM (11U)
E: 653283
N: 5514740

Upstream Lindsay Pond

EV_LC1
UTM (11U)
E: 653247
N: 5514709

Downstream Lindsay Pond

Lower Milligan Creek Sedimentation Pond (EV_MGSP)
Management Unit 4

Physical Characteristics

Passive Drainage Area (km^2):	1.92
Mean Annual Discharge (m^3/s):	0.009
Volume (m^3):	3,093
Surface Area (m^2)	2,653
Mean/Maximum Pond Depth (m)	1.2 / 1.6
Liner:	No
Fish Access:	Absolute Barrier

Habitat Characteristics

Submergent Vegetation:	Partial Coverage (50 - 90%)
Emergent Vegetation:	Some Coverage (5 - 15%)
Algae (Free Floating):	Some Coverage (5 - 15%)
Algae (Filamentous):	Complete

Field Water Quality

Date(s) Collected:	15/Aug/2022
Temperature (°C):	17.18
Conductivity (μS/cm):	859.95
DO (mg/L):	11.56
pH:	8.41
ORP (mV):	134.03

Site Description

The Lower Milligan Creek Sedimentation Pond is located on the valley bottom, between Michel Creek and the CP Rail line. The pond was originally constructed in response to TSS non-compliances in Milligan creek, following the start of mining in the upper catchment. Substrate is silty but dominated by thick filamentous algae. Shading potential exists due to steep banks and riparian trees.
Evidence of fish use: QP designated fish free (2022).

Water Flow Description

Flows enters the pond at the east end and decants out of the pond via a set of corrugated steel pipes in the pond's southwest corner. The pond decants into Michel Creek.

Teck

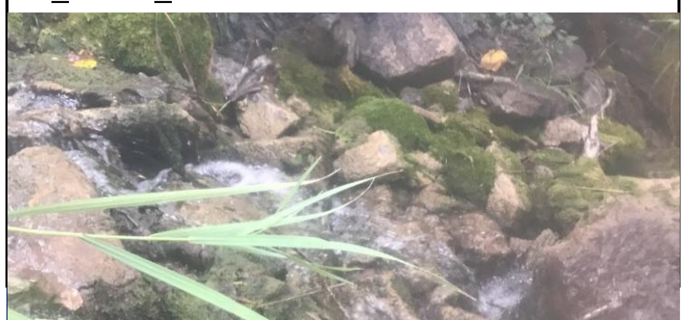
EV_MGSP UTM (11U) E: 658638 N: 5506101

Lower Milligan Pond Aerial

EV_MGSP UTM (11U) E: 658638 N: 5506101

Lower Milligan Pond

EV_MGSP_US UTM (11U) E: 658810 N: 5506095



Upstream Lower Milligan Pond

EV_MGSP_DS1 UTM (11U) E: 658607 N: 5506079

Downstream Lower Milligan Pond

Otto Ponds
Management Unit 4

Physical Characteristics

Passive Drainage Area (km^2):	-
Mean Annual Discharge (m2/s):	0.02
Volume (m^3):	8,500
Surface Area (m^2)	-
Mean/Maximum Pond Depth (m)	-
Liner:	-
Fish Access:	Absolute Barrier

Habitat Characteristics

Submergent Vegetation:	Partial Coverage (15 - 50%)
Emergent Vegetation:	Scattered (1 - 5%)
Algae (Free Floating):	Complete
Algae (Filamentous):	Scattered (1 - 5%)

Field Water Quality

Date(s) Collected:	12/Aug/2022
Temperature (°C):	18.18
Conductivity (µS/cm):	636.5
DO (mg/L):	6.55
pH:	7.67
ORP (mV):	-21.2

Site Description

Used for the settling of suspended solids. The pond has a minimum berm crest elevation of 1,130.26 m and an open-channel outlet to Otto Creek with an invert elevation of 1,128.76 m.
Evidence of fish use: Longnose Sucker and Longnose Dace present. Reduction in biomass as a result of salvage (2021 and 2022).

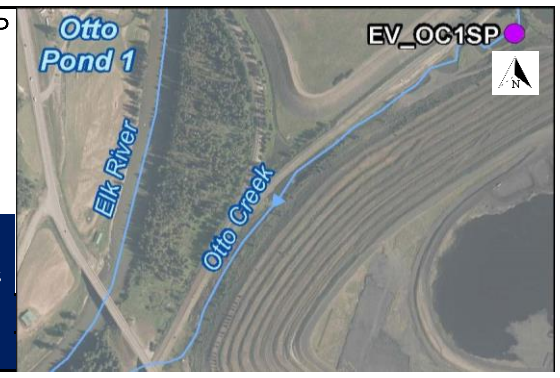
Water Flow Description

The ponds discharge via culverts, through a permanent fish barrier, to a wetland area that parallels the railway. This wetland decants into the lower portion of Otto Creek and into the Elk River. Pond 1 receives flows from Cossarini Creek only. Pond outflows combine with runoff from Otto Creek in the ditch immediately downstream of the Pond 1 outlet.

Teck

EV_OC1SP
UTM (11U)
E: 652998
N: 5513202

Otto Ponds Aerial



EV_OC1SP
UTM (11U)
E: 652998
N: 5513202

Otto Ponds

EV_OCFB
UTM (11U)
E: 653008
N: 5513245

Upstream Otto Ponds

EV_OC1
UTM (11U)
E: 652304
N: 5512622

Downstream Otto Ponds

Lower South Pit Creek Pond

Management Unit 4

Physical Characteristics

Passive Drainage Area (km^2):	0.73
Mean Annual Discharge (m^3/s):	0.01
Volume (m^3):	1,075
Surface Area (m^2)	1,940
Mean/Maximum Pond Depth (m)	0.5/1.3
Liner:	No
Fish Access:	Absolute Barrier

Habitat Characteristics

Submergent Vegetation:	Partial Coverage (50 - 90%)
Emergent Vegetation:	Some Coverage (5 - 15%)
Algae (Free Floating):	Some Coverage (5 - 15%)
Algae (Filamentous):	Some Coverage (5 - 15%)

Field Water Quality

Date(s) Collected:	15/Aug/2022
Temperature (°C):	13.44
Conductivity (µS/cm):	1,662.6
DO (mg/L):	11.04
pH:	8.02
ORP (mV):	86.3

Site Description

The Lower South Pit Creek Sedimentation Pond is located immediately adjacent to the CP Rail line and 50 m away from Michel Creek. It serves as a polishing pond for flows in the South Pit Creek drainage (receiving runoff and seepage from the South Pit spoil) before discharging to Michel Creek. Substrate is silty with some aquatic vegetation. Shading potential exists due to steep banks and riparian trees.

Evidence of fish use: A fish salvage was conducted in 2019 (trapping only). QP designated fish free (2022).

Water Flow Description

Inflow to the lower pond is through two culverts beneath the rail line at the pond's north end. The discharge pipe from the Upper South Pit Creek Sedimentation Pond passes through the lower of these two culverts, and natural flow from the original South Pit Creek drainage channel passes through the higher of the two. The pond decants into South Pit Creek before entering Michel Creek.

Teck

EV_SP1SP UTM (11U) E: 659483 N: 5505597

Lower South Pit Creek Pond Aerial

EV_SP1SP

UTM (11U)

E: 659483

N: 5505597

South Pit Pond

EV_SP1A

No Samples

No Photo Available

Upstream South Pit Pond

EV_SP1

UTM (11U)

E: 659497

N: 5505522

Downstream South Pit Pond

Clode Main Settling Pond

Management Unit 1

Physical Characteristics

Passive Drainage Area (km^2):	4.76
Mean Annual Discharge (m^3/s):	0.07
Volume (m^3):	140,000
Surface Area (m^2)	38,383
Mean/Maximum Pond Depth (m)	1.5/3.67
Liner:	No
Fish Access:	Absolute Barrier

Habitat Characteristics

Submergent Vegetation:	Partial Coverage (15 - 50%)
Emergent Vegetation:	Scattered (1 - 5%)
Algae (Free Floating):	Partial Coverage (15 - 50%)
Algae (Filamentous):	Some Coverage (5 - 15%)

Field Water Quality

Date(s) Collected:	19/Aug/2022
Temperature (°C):	14.43
Conductivity (µS/cm):	1,846
DO (mg/L):	9.93
pH:	7.93
ORP (mV):	127.8

Site Description

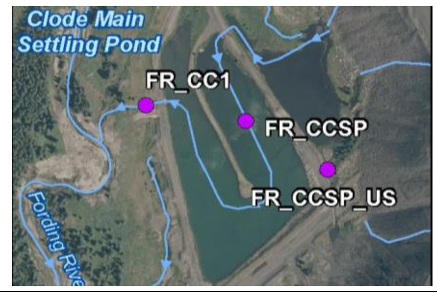
Clode Settling Ponds were constructed in 1976 and consist of a two-pond system (East and Main) separated by a separator dike. The Clode Settling Ponds are used for sediment management of pit water and mine-influenced surface water from spoils. The substrate is silty with some submerged vegetation. Minimal shading potential due to limited riparian cover. Evidence of fish use: Fish exclusion screens were installed in 2014, and fish salvages have removed fish from the ponds. One Westslope Cutthrout Trout caught in 2022.

Water Flow Description

Water enters the Clode East Settling Pond from the east via the Clode Rock Drain and multiple seeps around the primary (East) Pond, then flows to the Secondary (Main) Pond via a set of six CSP culverts. Water is discharged from the Secondary Pond to Clode Creek through a series of seven CSP culverts, which pass through the western dike of the Secondary Pond.

Teck

FR_CCSP UTM (11U) E: 651002 N: 5564262



Clode Main Settling Pond Aerial

FR_CCSP
UTM (11U)
E: 651002
N: 5564262

Clode Pond

FR_CC4
UTM (11U)
E: 651111
N: 5564197

Upstream Clode Pond

FR_CC1
UTM (11U)
E: 650869
N: 5564284

Downstream Clode Pond

Kilmarnock Secondary Pond

Management Unit 4

Physical Characteristics

Passive Drainage Area (km^2):	41.17
Mean Annual Discharge (m2/s):	0.485
Volume (m^3):	246,750
Surface Area (m^2)	-
Mean/Maximum Pond Depth (m)	-
Liner:	None
Fish Access:	Assesment required

Habitat Characteristics

Submergent Vegetation:	Some Coverage (5 - 15%)
Emergent Vegetation:	Scattered (1 - 5%)
Algae (Free Floating):	Some Coverage (5 - 15%)
Algae (Filamentous):	Some Coverage (5 - 15%)

Field Water Quality

Date(s) Collected:	19/Aug/2022
Temperature (°C):	16.80
Conductivity (µS/cm):	1,289.0
DO (mg/L):	11.90
pH:	8.19
ORP (mV):	133.8

Site Description

The South Kilmarnock Phase 2 Secondary Pond is kidney shaped. The pond is contained by the East Dam and the West Dam. Provides sediment control for runoff and seepage reporting from natural catchment and the upstream coal mining spoils in the Brownie Creek and Kilmarnock catchments.
Evidence of fish use: No salvage data.

Water Flow Description

The Secondary Pond is the largest pond in Phase 2 and receives water from the Primary Pond via an open channel with two CSP culverts which convey water beneath an access road crossing. Water runs into the Fording River.

Teck

FR_KP2SP
UTM (11U)
E: 652572
N: 5558619

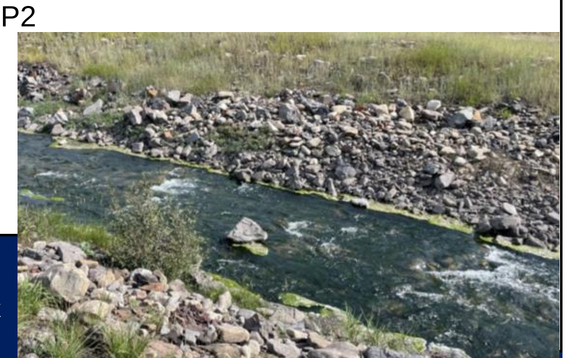
Kilmarnock Secondary Pond Aerial

FR_KP2SP
UTM (11U)
E: 652572
N: 5558619

Kilmarnock Secondary Pond

FR_USSKP2
UTM (11U)
E: 652336
N: 5558862

Upstream Kilmarnock Secondary Pond



FR_SKP2
UTM (11U)
E: 652407
N: 558433

Downstream Kilmarnock Secondary Pond

Swift Creek Sediment Pond (Secondary)

Management Unit 1

Physical Characteristics

Passive Drainage Area (km^2):	6.48
Mean Annual Discharge (m^3/s):	0.13
Volume (m^3):	36,600
Surface Area (m^2)	12,800
Mean/Maximum Pond Depth (m)	1.3/2.5
Liner:	No
Fish Access:	Absolute Barrier

Habitat Characteristics

Submergent Vegetation:	None
Emergent Vegetation:	None
Algae (Free Floating):	Scattered (1 - 5%)
Algae (Filamentous):	Complete

Field Water Quality

Date(s) Collected:	19/Aug/2022
Temperature (°C):	9.53
Conductivity (µS/cm):	3,397.0
DO (mg/L):	10.3
pH:	7.08
ORP (mV):	144.2

Site Description

Swift Creek Sediment Ponds consist of a Primary and a Secondary Pond that functions to settle water entering through the Swift and Cataract Creek Drainages. Substrate is silty but dominated by thick filamentous algae. Shading potential exists due to steep banks and riparian trees. No

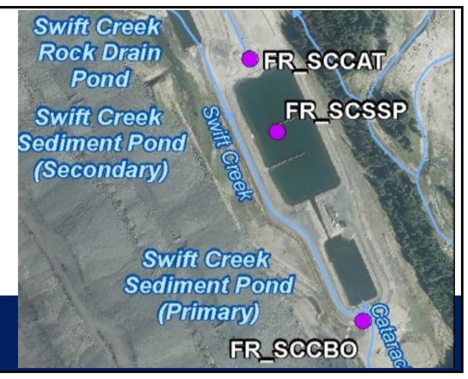
Evidence of fish use: No evidence of fish use, absolute barrier was in place at time of construction.

Water Flow Description

The mine-influenced water from the Swift/Cataract Creek catchment is conveyed to the Swift Creek Sediment Ponds via the Cataract and Swift Creek Rock Drains. The two rock drains discharge into small head ponds before being piped to the Swift Creek Sediment Ponds. In addition, the Swift Primary Pond collects drainage from Swift Creek, Cataract Creek, and collection channels along the toe of the Swift South Spoil and C Spoil. Water then supplies the FRO South Active Water Treatment Facility where it is treated before being discharged into the Fording River.

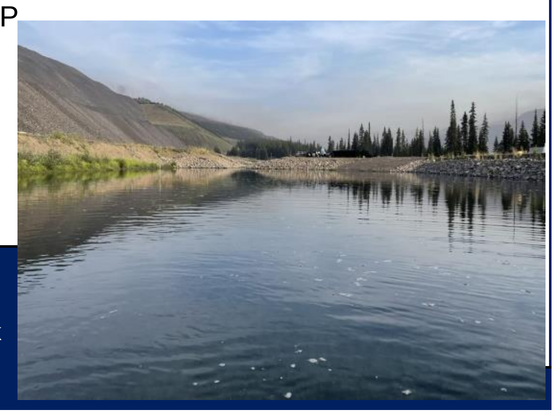
Teck

FR_SCSSP
UTM (11U)
E: 652147
N: 5558310



Swift Creek Sediment Pond (Secondary) Aerial

FR_SCSSP
UTM (11U)
E: 652147
N: 5558310



Swift Creek Pond

FR_SCCBO
UTM (11U)
E: 652241
N: 5558097

Upstream Swift Creek Pond

FR_SCCAT
UTM (11U)
E: 652080
N: 5558372

Downstream Swift Creek Pond

Smith Ponds
Management Unit 1

Physical Characteristics

Passive Drainage Area (km^2):	0.04
Normal Operating Range (m^3/s):	-
Volume (m^3):	2,300
Surface Area (m^2)	6,000
Mean/Maximum Pond Depth (m)	0.5/0.5
Liner:	No
Fish Access:	Absolute Barrier

Habitat Characteristics

Submergent Vegetation:	Partial Coverage (50 - 90%)
Emergent Vegetation:	Scattered (1 - 5%)
Algae (Free Floating):	Scattered (1 - 5%)
Algae (Filamentous):	Scattered (1 - 5%)

Field Water Quality

Date(s) Collected:	22/Aug/2022
Temperature (°C):	10.48
Conductivity (μS/cm):	1215.5
DO (mg/L):	10.00
pH:	7.30
ORP (mV):	89.9

Site Description

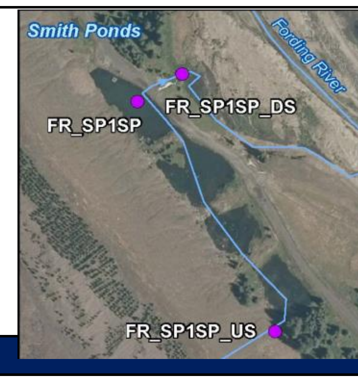
The Smith Ponds are located on the west side of the Fording River across from the South Tailings Pond. The ponds were originally constructed to collect pit water overflow from historical pits (2 Pit) that have since been backfilled with spoils. The ponds now provide a passive sediment removal function for runoff and seepage reporting from D and E Spoils. Substrate is silty. Shading potential is low due to minimal riparian cover.
Evidence of fish use: No evidence of fish use.

Water Flow Description

The Smith Ponds consist of a four-pond system operated in series and connected via open channels between them. The ponds discharge via two 600 mm CSP culverts elevated by approximately 10 m above the Fording River flood plain, which acts as a fish barrier. Following the water entering the flood plain it travels through a historical side channel of the Fording River for approximately 200 m prior to discharging to the Fording River.

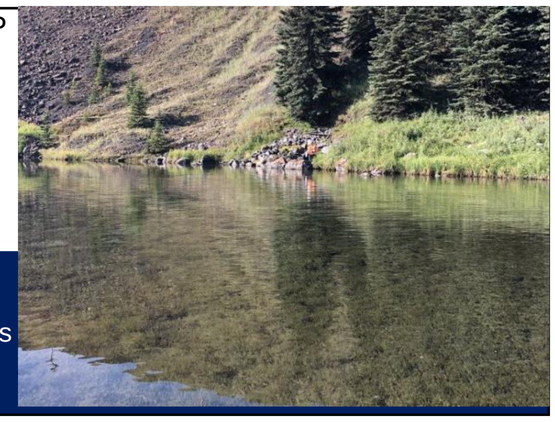
Teck

FR_SP1SP
UTM (11U)
E: 650961
N: 5560555



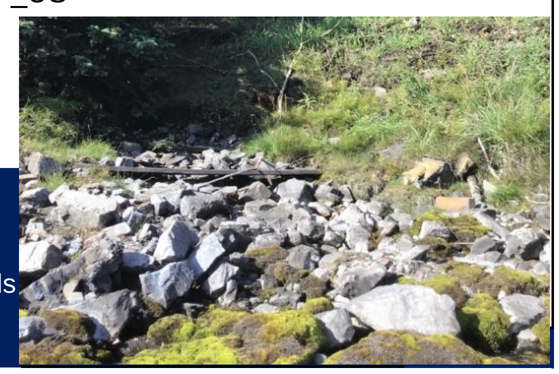
Smith Ponds Aerial

FR_SP1SP
UTM (11U)
E: 650961
N: 5560555



Smith Ponds

FR_SP1SP_US
UTM (11U)
E: 651070
N: 5560370



Upstream Smith Ponds

FR_SP1SP_DS
UTM (11U)
E: 650996
N: 5560576

Downstream Smith Ponds

Eagle Creek Pond
Management Unit 4

Physical Characteristics

Passive Drainage Area (km^2):	0.92
Mean Annual Discharge (m2/s):	0.023
Volume (m^3):	-
Surface Area (m^2)	-
Mean/Maximum Pond Depth (m)	-
Liner:	None
Fish Access:	Assesment required

Habitat Characteristics

Submergent Vegetation:	Partial Coverage (15 - 50%)
Emergent Vegetation:	Scattered (1-5%)
Algae (Free Floating):	Scattered (1-5%)
Algae (Filamentous):	Scattered (1-5%)

Field Water Quality

Date(s) Collected:	19/Aug/2022
Temperature (°C):	18.86
Conductivity (µS/cm):	3,098.2
DO (mg/L):	10.78
pH:	7.83
ORP (mV):	130.9

Site Description

The Eagle Settling Pond System is located on the Fording River floodplain, approximately 600 m north of the general offices and on the eastern bank of the Fording River. The system receives mine-influenced water from haul roads and spoil areas from the remaining portions of Clode Creek catchment downstream of the diversion. The Eagle Settling Pond System provides clarification of mine influenced water.

Evidence of fish use: No salvage data; however, fish use of the pond is unlikely.

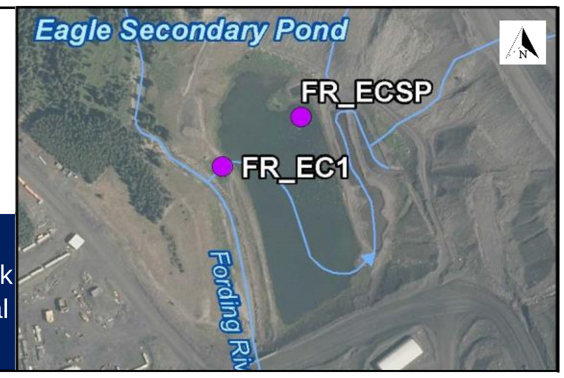
Water Flow Description

The Eagle Settling Pond System discharges from the Secondary Pond via four 0.5 m diameter CSP culverts at monitoring station FR_EC1 onto an elevated bench and then to the Fording River through coarse rock which, together with the elevated bench, creates a fish barrier.

Teck

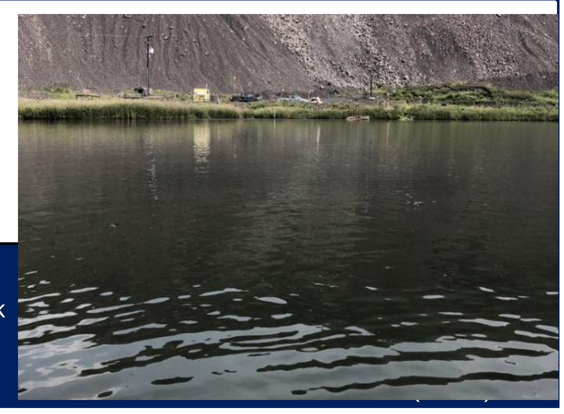
FR_ECSP
UTM (11U)
E: 651326
N: 5562859

Eagle Creek Pond Aerial



FR_ECSP
UTM (11U)
E: 651326
N: 5562859

Eagle Creek Pond



FR_EC1A
UTM (11U)
E: 651333
N: 5562882

Upstream Eagle Creek Pond

FR_EC1
UTM (11U)
E: 651326
N: 5562859

Downstream Eagle Creek Pond

Greenhills Creek Secondary Pond

Management Unit 1

Physical Characteristics

Passive Drainage Area (km^2):	0.14
Normal Operating Range (m^3/s):	-
Volume (m^3):	160,000
Surface Area (m^2)	49,458
Mean/Maximum Pond Depth (m)	3.12 / 5.9
Liner:	No
Fish Access:	Patial Barrier

Habitat Characteristics

Submergent Vegetation:	Complete
Emergent Vegetation:	Scattered (1 - 5%)
Algae (Free Floating):	None
Algae (Filamentous):	None

Field Water Quality

Date(s) Collected:	23/Aug/2022
Temperature (°C):	19.25
Conductivity (µS/cm):	1617.5
DO (mg/L):	12.1
pH:	8.35
ORP (mV):	84.3

Site Description

The Greenhills Creek Sediment Ponds provide sediment control for water transferred from upstream ponds and the Greenhills Creek catchment. Substrate is Shading potential. Sedimentation curtains were installed to increase residence time for the deposition of suspended solids. Evidence of fish use: The primary and secondary ponds are accessible to fish from upper Greenhills Creek, but the spillway presents a barrier to fish from downstream.

Water Flow Description

The Greenhills Creek Sediment Ponds are fish-bearing ponds connected to Greenhills Creek that collects inflows from the entire catchment prior to release to the Fording River. The system consists of three ponds: a primary pond (Greenhills Primary Settling Pond), an overflow/bypass sump (Greenhills Pond Overflow/Bypass Sump) and a large rectangular secondary pond (Greenhills Secondary Settling Pond). Flows enter the secondary pond via a low rock weir dyke and discharges through a 6 m wide concrete spillway into a stilling basin before entering lower Greenhills Creek.

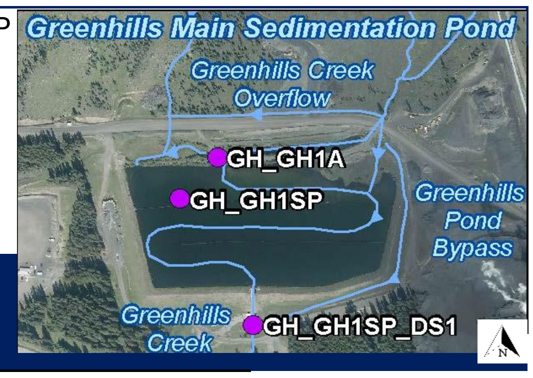
Teck

GH_GH1SP

UTM (11U)

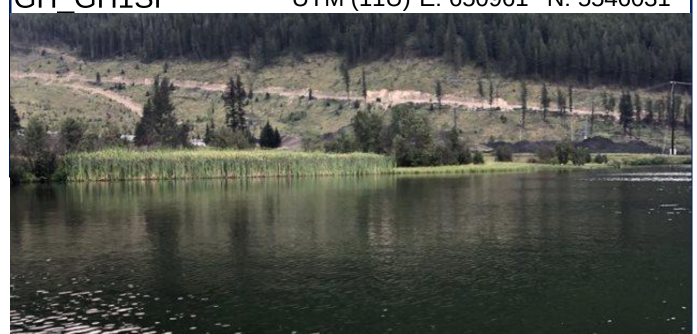
E: 650961

N: 5546031



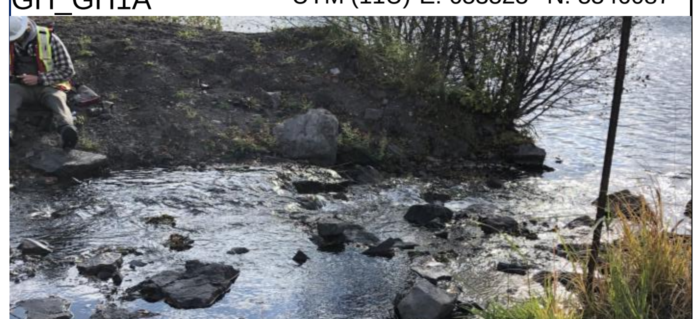
Greenhills Creek Secondary Pond Aerial

GH_GH1SP UTM (11U) E: 650961 N: 5546031



Greenhills Creek Secondary Pond

GH_GH1A UTM (11U) E: 653525 N: 5546087



Upstream Greenhills Pond

GH_GH1SP_DS1

UTM (11U)

E: 653571

N: 5545862

Down-stream Greenhills Pond

Lower Thompson Creek Tertiary Pond
Management Unit 3

Physical Characteristics

Passive Drainage Area (km^2):	4.82
Mean Annual Discharge (m^3/s):	0.009
Volume (m^3):	16,951
Surface Area (m^2)	13,382
Mean/Maximum Pond Depth (m)	1 / 1.4
Liner:	No
Fish Access:	No Barrier

Habitat Characteristics

Submergent Vegetation:	Complete
Emergent Vegetation:	5-15% emergent coverage
Algae (Free Floating):	None
Algae (Filamentous):	None

Field Water Quality

Date(s) Collected:	23/Aug/2022
Temperature (°C):	16.83
Conductivity (µS/cm):	2032.3
DO (mg/L):	9.73
pH:	8.08
ORP (mV):	82.7

Site Description

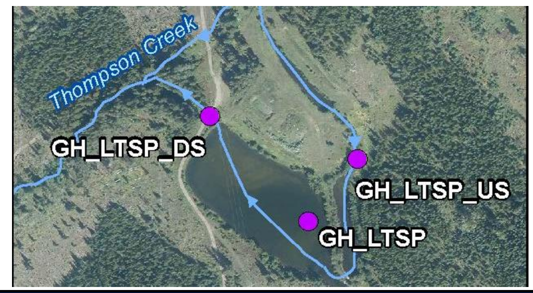
The Lower Thompson Creek Sediment Ponds system consists of three ponds, with a bypass works to allow the bypass of the entire pond system to facilitate sediment removal and during upset condition. The Tertiary Cell is a 100 m by 170 m rectangle. The Tertiary Cell is assumed to have been constructed using traditional cut and fill methods, with the West Dam being constructed of locally excavated material. The storage volume for the facility was calculated as 53,656 m^3. Substrate is macrophyte covered and shading potential is minimal Evidence of fish use: Pond system considered to be fish-bearing; Bull Trout present. 2023 Fish presence and assessment planned.

Water Flow Description

The Lower Thompson Creek Sediment Ponds catchment is downslope of the Upper Thompson Creek Sediment Ponds catchment, and it drains mine-influenced water to the Elk River

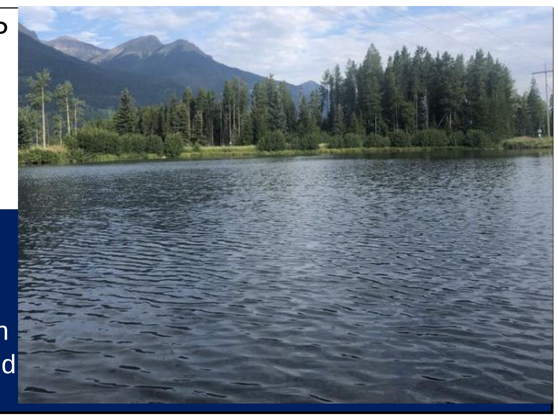
Teck

GH_LTSP UTM (11U) E: 649049 N: 5550306



Lower Thompson Creek Tertiary Pond Aerial

GH_LTSP
UTM (11U)
E: 649049
N: 5550306

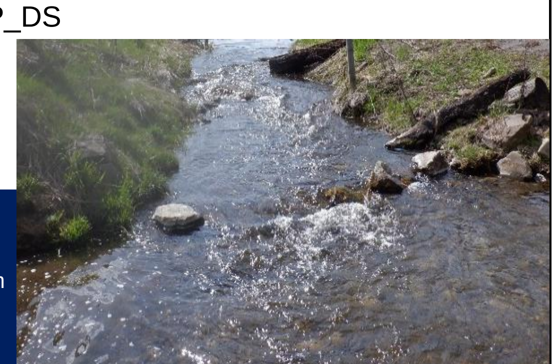


Lower Thompson Creek Pond

GH_LTSP_US
UTM (11U)
E: 649100
N: 5550371

Upstream Thompson Pond

GH_LTSP_DS
UTM (11U)
E: 648948
N: 5550415



Downstream Thompson Pond

Porter Creek Sediment Pond

Management Unit 1

Physical Characteristics

Passive Drainage Area (km^2):	1.17
Mean Annual Discharge (m^3/s):	0.009
Volume (m^3):	4,074
Surface Area (m^2)	2,348
Mean/Maximum Pond Depth (m)	- / 3.6
Liner:	No
Fish Access:	Absolute Barrier

Habitat Characteristics

Submergent Vegetation:	Scattered (1 - 5%)
Emergent Vegetation:	Some coverage (5 - 15%)
Algae (Free Floating):	None
Algae (Filamentous):	None

Field Water Quality

Date(s) Collected:	17/Aug/2022
Temperature (°C):	8.17
Conductivity (µS/cm):	1056.67
DO (mg/L):	10.75
pH:	8.42
ORP (mV):	132.97

Site Description

Porter Creek Sedimentation Pond consists of a single U-shaped cell with bypass works to bypass the pond as needed. The mining area above the pond has been relatively inactive over the past decade and therefore there has been no need to remove sediment. Substrate is typically fine material and shading potential is minimal.

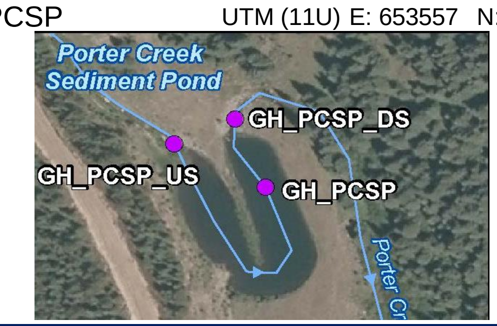
Evidence of fish use: QP disignated fish free in 2022.

Water Flow Description

The inlet culvert discharges to an approach channel, and water levels in the pond are regulated by an open-channel outlet. In a flood event the pond can be bypassed and the water discharged directly to the Fording River.

Teck

GH_PCSP UTM (11U) E: 653557 N: 5555294



Porter Creek Sediment Pond (Secondary) Aerial

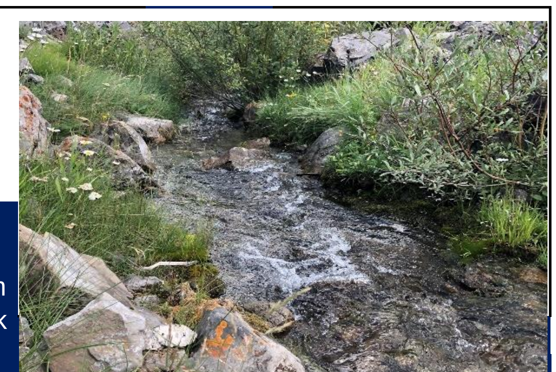
GH_PCSP
UTM (11U)
E: 653557
N: 5555294

Porter Creek Pond

GH_PCSP_US
UTM (11U)
E: 653520
N: 5555311

Upstream Porter Creek Pond

GH_PC1
UTM (11U)
E: 653545
N: 5555321



Downstream Porter Creek Pond

Upper Thompson Pond
Management Unit 4

Physical Characteristics

Passive Drainage Area (km^2):	-
Mean Annual Discharge (m2/s):	0.03
Volume (m^3):	12,604
Surface Area (m^2)	-
Mean/Maximum Pond Depth (m)	-
Liner:	None
Fish Access:	Assesment required

Habitat Characteristics

Submergent Vegetation:	Complete
Emergent Vegetation:	None
Algae (Free Floating):	None
Algae (Filamentous):	None

Field Water Quality

Date(s) Collected:	23/Aug/2022
Temperature (°C):	17.98
Conductivity (µS/cm):	1,429.0
DO (mg/L):	12.59
pH:	8.36
ORP (mV):	119.6

Site Description

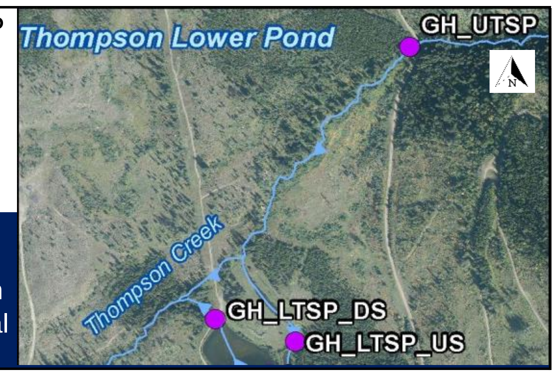
The Upper Thompson Creek Sediment Ponds are located upstream of Thompson Creek and reports to the Lower Thompson Creek Sediment Ponds. Purpose is to reduce TSS prior to Lower Thompson pond and a fish bearing water course.
Evidence of fish use: Fish presence and assessment planned for 2023.

Water Flow Description

The Upper Thompson Creek Sediment Ponds consist of a small head pond feeding one of two flow paths into a primary pond (Upper Thompson Primary) through a gated culvert. The Upper Thompson Primary cells drain to the secondary pond (Upper Thompson Secondary) via a common open channel.

Teck

GH_UTSP
UTM (11U)
E: 649321
N: 5550949

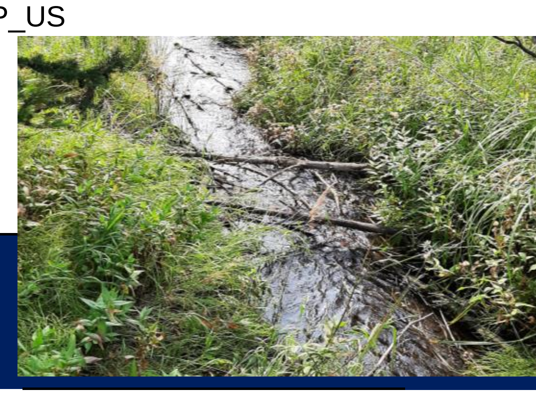


Upper Thompson Pond Aerial

GH_UTSP
UTM (11U)
E: 649321
N: 5550949

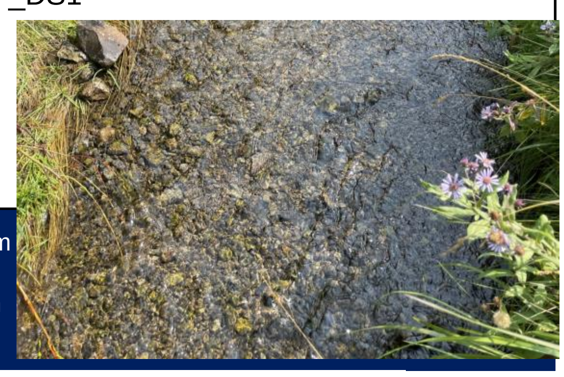
Upper Thompson Pond

GH_UTSP_US
UTM (11U)
E: 650999
N: 5549934



Upstream Upper Thompson Pond

GH_UTSP_DS1
UTM (11U)
E: 650937
N: 5549627



Downstream Upper Thompson Pond

Dry Creek Head Pond
Management Unit 4

Physical Characteristics

Passive Drainage Area (km^2):	8.8
Mean Annual Discharge (m2/s):	-
Volume (m^3):	-
Surface Area (m^2)	-
Mean/Maximum Pond Depth (m)	-
Liner:	Dual Layer Geosynthetic Liner
Fish Access:	Absolute Barrier

Habitat Characteristics

Submergent Vegetation:	Scattered (1 - 5%)
Emergent Vegetation:	Scattered (1 - 5%)
Algae (Free Floating):	None
Algae (Filamentous):	Scattered (1 - 5%)

Field Water Quality

Date(s) Collected:	18/Aug/2022
Temperature (°C):	7.57
Conductivity (µS/cm):	1,118.3
DO (mg/L):	10.84
pH:	8.19
ORP (mV):	139.0

Site Description

Manages mine-influenced water for control of suspended solids. The head pond is a diversion structure.
Evidence of fish use: No fish use, exploratory salvage in 2022 caught zero fish.

Water Flow Description

Water is discharged to Dry Creek after going through the Dry Creek Water Management System (including the head pond).

Teck

LC_DCHPM
UTM (11U)
E: 658248
N: 5540976

Dry Creek Head Pond Aerial

LC_DCHPM
UTM (11U)
E: 658248
N: 5540976

Dry Creek Head Pond

LC_DC3
UTM (11U)
E: 658346
N: 5540950

Upstream Dry Creek Head Pond

LC_DCDS
UTM (11U)
E: 657792
N: 5542051

Downstream Dry Creek Head Pond

MSAN 1 Pond
Management Unit 2

Physical Characteristics

Passive Drainage Area (km^2):	-
Mean Annual Discharge (m^3/s):	0.009
Volume (m^3):	1826
Surface Area (m^2)	1820
Mean/Maximum Pond Depth (m)	0.3/1.5
Liner:	No
Fish Access:	No Barrier

Habitat Characteristics

Submergent Vegetation:	Complete
Emergent Vegetation:	Some Coverage (5 - 15%)
Algae (Free Floating):	None
Algae (Filamentous):	Some Coverage (5 - 15%)

Field Water Quality

Date(s) Collected:	17/Aug/2022
Temperature (°C):	8.47
Conductivity (μS/cm):	403
DO (mg/L):	9
pH:	7.97
ORP (mV):	-38.53

Site Description

The Mine Services Area North (MSAN) Ponds consists of three contiguous cells and located upstream from the MSA building and below the MSAN spoils. The lower cell of MSAN Pond has a fish barrier and an outlet spillway consisting of a concrete, broad-crested weir and an adjacent staff gauge for measuring water level. The substrate was covered by think macrophyte beds with a visible blue plume suggestive of algal/microbial activity. Evidence of fish use: Westslope Cutthrout Trout and Bull Trout present.

Water Flow Description

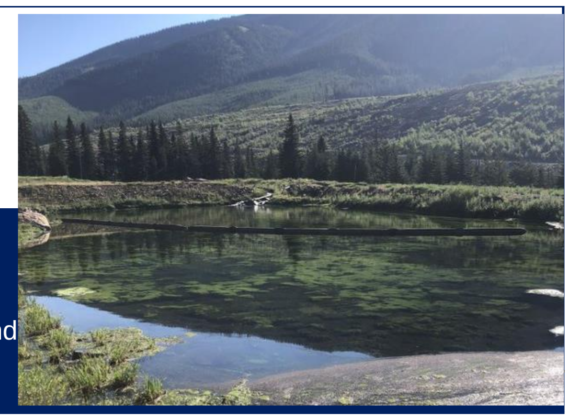
The MSAN Ponds collect surface water runoff from the MSA North Pit, providing sediment collection and clarification of water prior to release to Line Creek. Flow enters the pond system through an armoured channel with a gated culvert at the north end of the facility, flows though the three contiguous cells before being discharged to Line Creek.

Teck

LC_LC7SP UTM (11U) E: 661473 N: 5536499

MSAN 1 Pond Aerial

LC_LC7SP
UTM (11U)
E: 661473
N: 5536499



MSAN 1 Pond

Upstream area in RAZ

No Photo Available

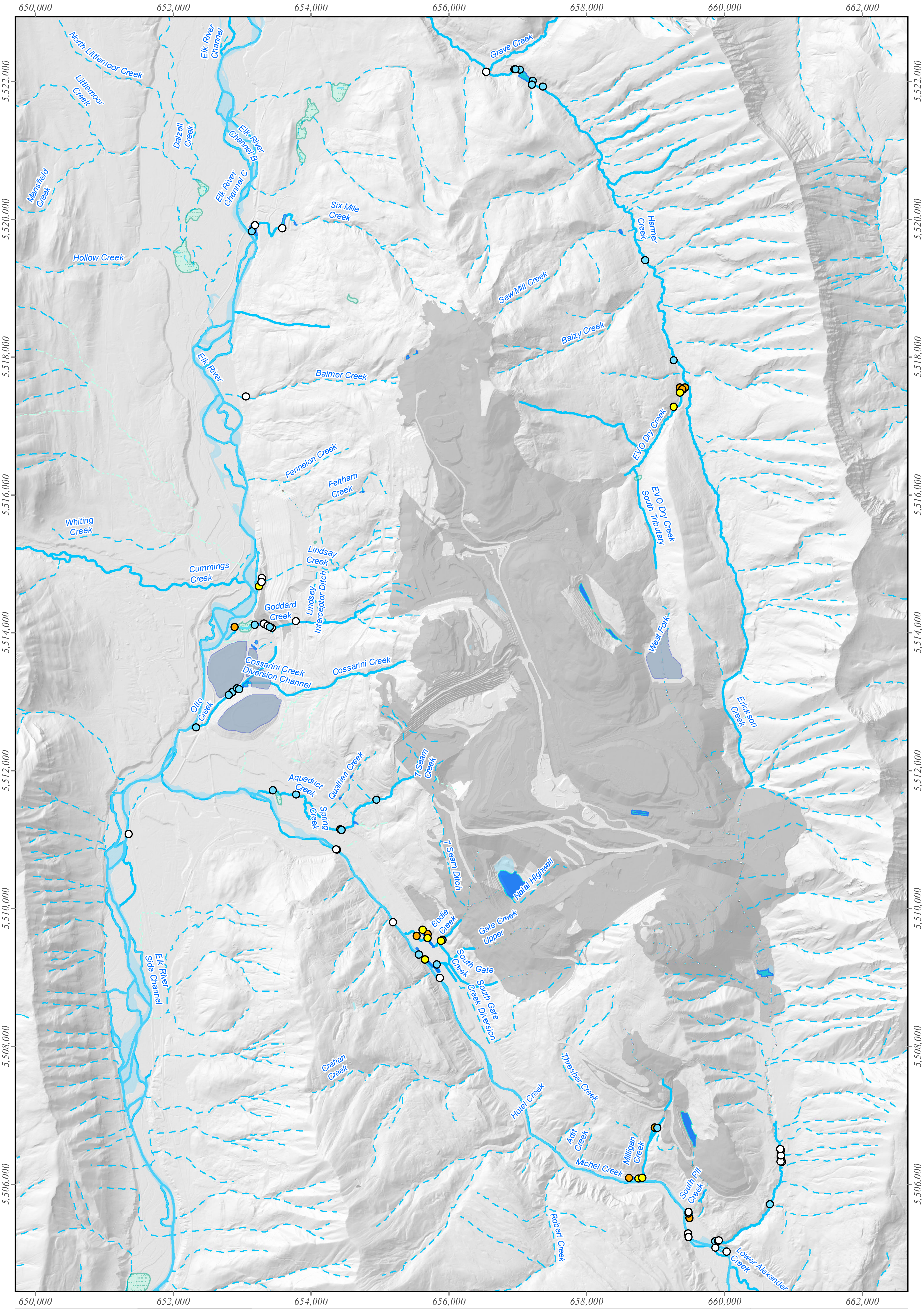
Upstream MSAN 1 Pond

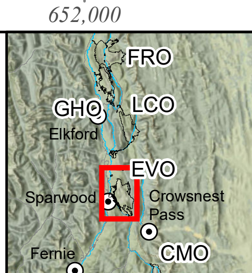
LC_LC7SP
UTM (11U)
E: 661435
N: 5536471

Downstream MSAN 1 Pond

Attachment E

Heat Maps of Maximum Organoselenium Concentrations in 2022 Regional and Local Monitoring





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Elkview Selenium Speciation Sample Locations

Sum of Dimethyl selenoxide (DMSeO) and Methyl seleninic acid (MeSe(IV))

- <0.025 µg/L
- 0.025 µg/L - 0.0499 µg/L
- 0.05 µg/L - 0.099 µg/L
- >0.10 µg/L

- Pits + Spoils
- End Pit Lake
- Settling Pond
- Tailings Pond

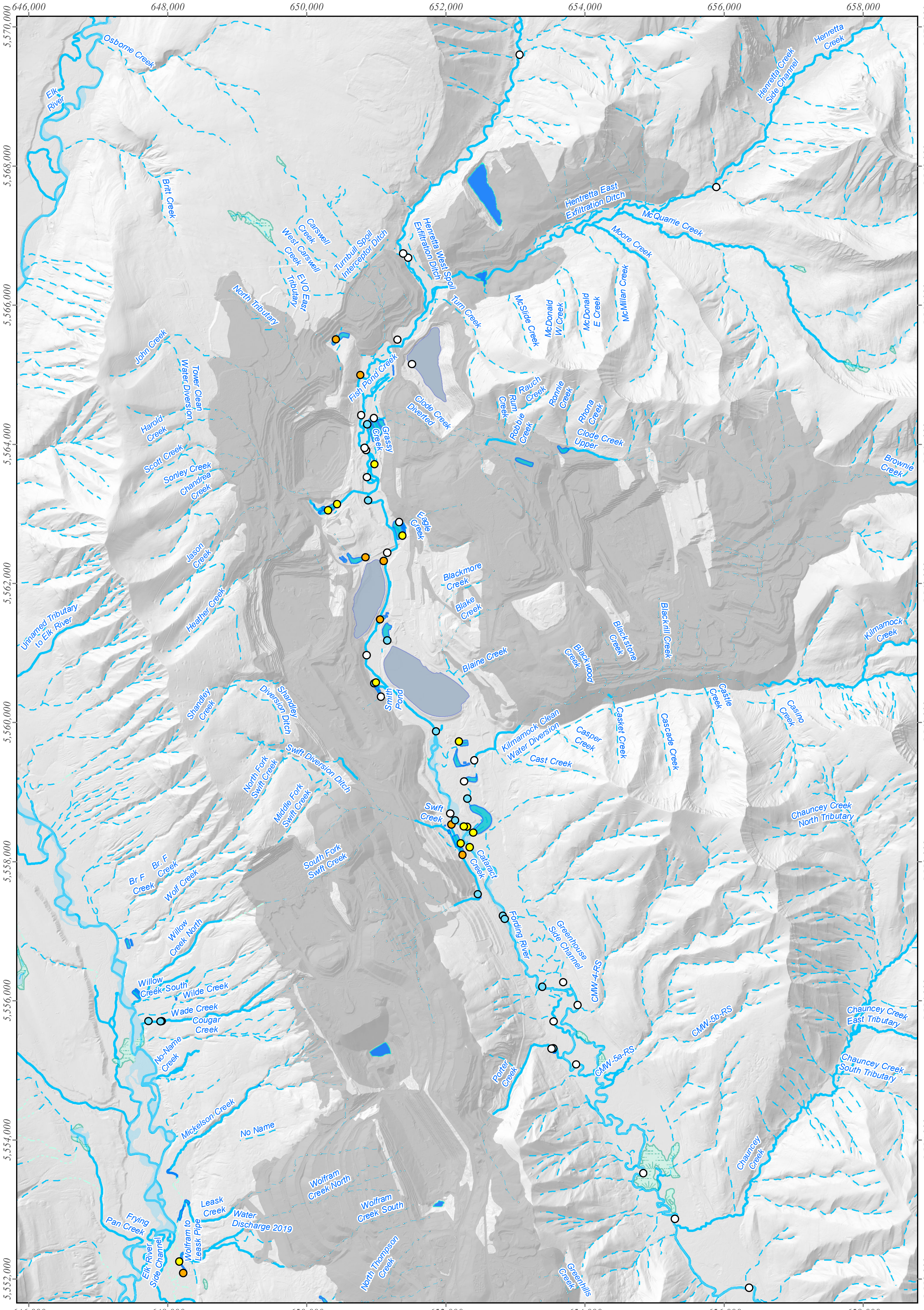
- Stream
- Intermittent
- Indefinite
- Subsurface

N

0 250 500 1,000 1,500 Meters

DATE: 3/7/2023	MINE OPERATION: Elkview
SCALE: 1:50,000	COORDINATE SYSTEM: NAD 1983 UTM Zone 11N

Document Path: G:\Data\Projects\SeSMP\HeatMaps\2022\OrganoSe.mxd



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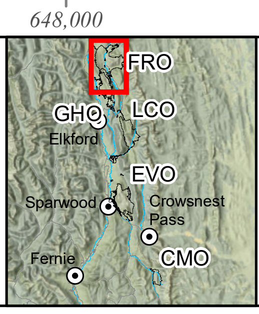


Fording River Selenium Speciation Sample Locations

Sum of Dimethyl selenoxide (DMSeO) and Methyl seleninic acid (MeSe(IV))

- <0.025 µg/L
- 0.025 µg/L - 0.0499 µg/L
- 0.05 µg/L - 0.099 µg/L
- >0.10 µg/L

- Pits + Spoils
- End Pit Lake
- Settling Pond
- Tailings Pond

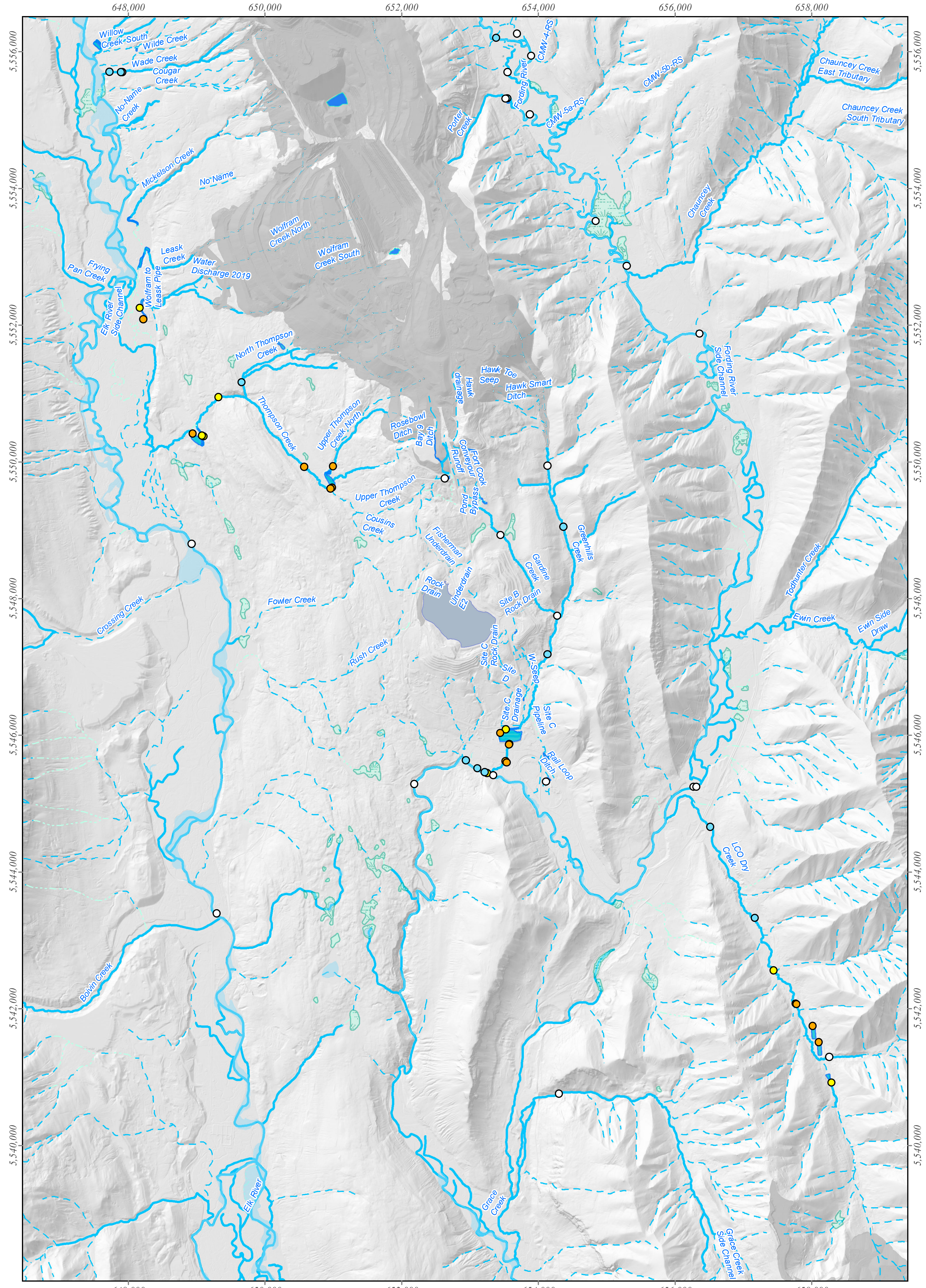
- Stream
- Intermittent
- Indefinite
- Subsurface

N

0 250 500 1,000 1,500 Meters

DATE: 3/7/2023	MINE OPERATION: Fording River
SCALE: 1:50,000	COORDINATE SYSTEM: NAD 1983 UTM Zone 11N

Document Path: G:\Data\Projects\SeSMP\HeatMaps\2022\OrganoSe.mxd



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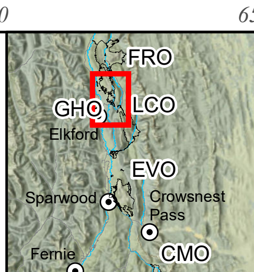


Greenhills Selenium Speciation Sample Locations

Sum of Dimethyl selenoxide (DMSeO) and Methyl seleninic acid (MeSe(IV))

- <0.025 µg/L
- 0.025 µg/L - 0.0499 µg/L
- 0.05 µg/L - 0.099 µg/L
- >0.10 µg/L

- Pits + Spoils
- End Pit Lake
- Settling Pond
- Tailings Pond

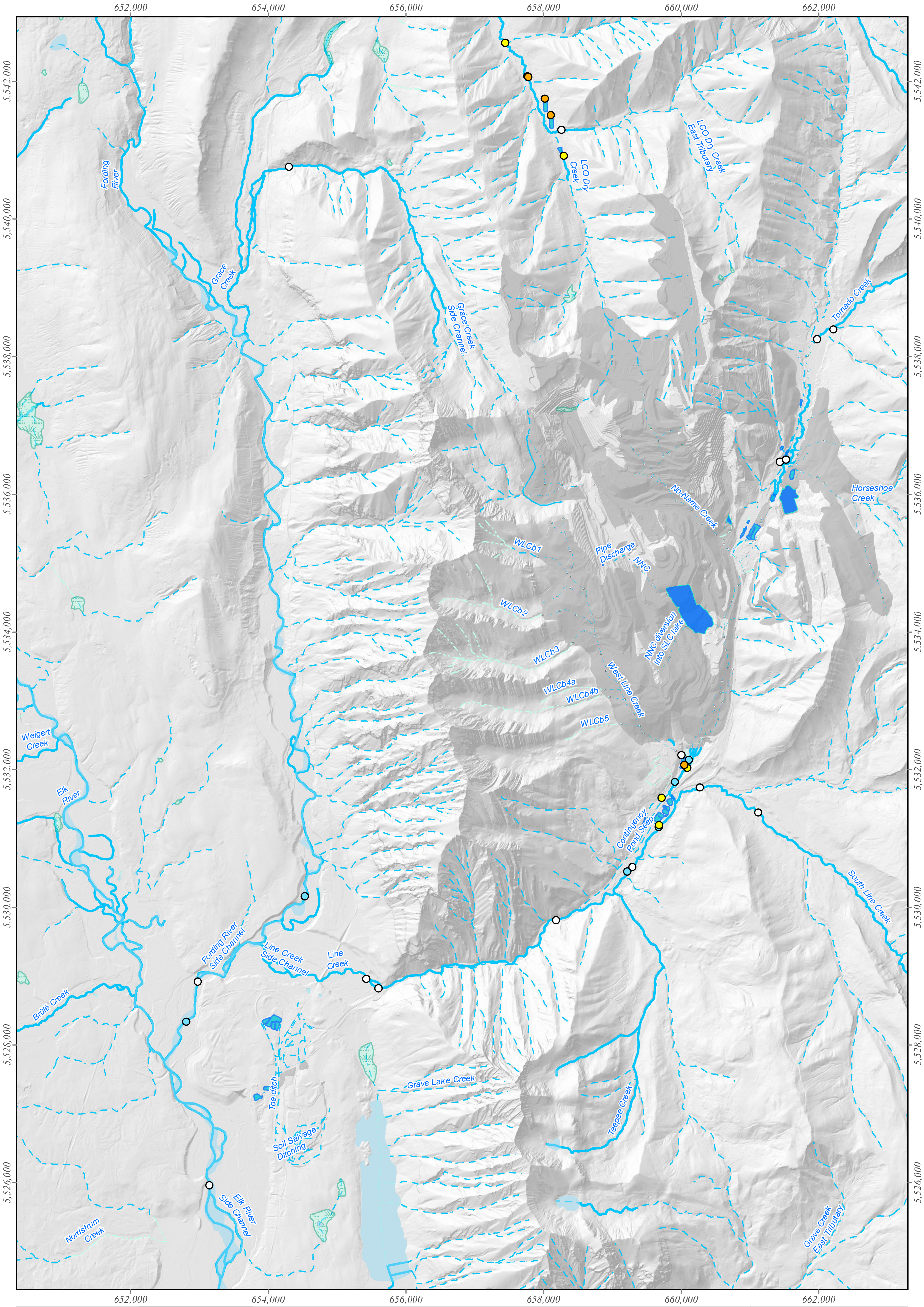
- Stream
- Intermittent
- Indefinite
- Subsurface

N

0 250 500 1,000 1,500 Meters

DATE: 3/7/2023	MINE OPERATION: Greenhills
SCALE: 1:50,000	COORDINATE SYSTEM: NAD 1983 UTM Zone 11N

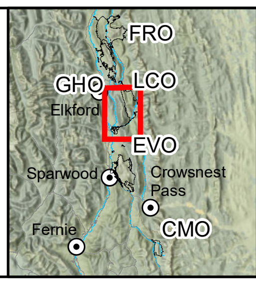
Document Path: G:\Data\Projects\SeSMP\HeatMaps\2022\OrganoSe.mxd



Line Creek Selenium Speciation Sample Locations

Sum of Dimethyl selenoxide (DMSeO) and Methyl seleninic acid (MeSe(IV))

Teck



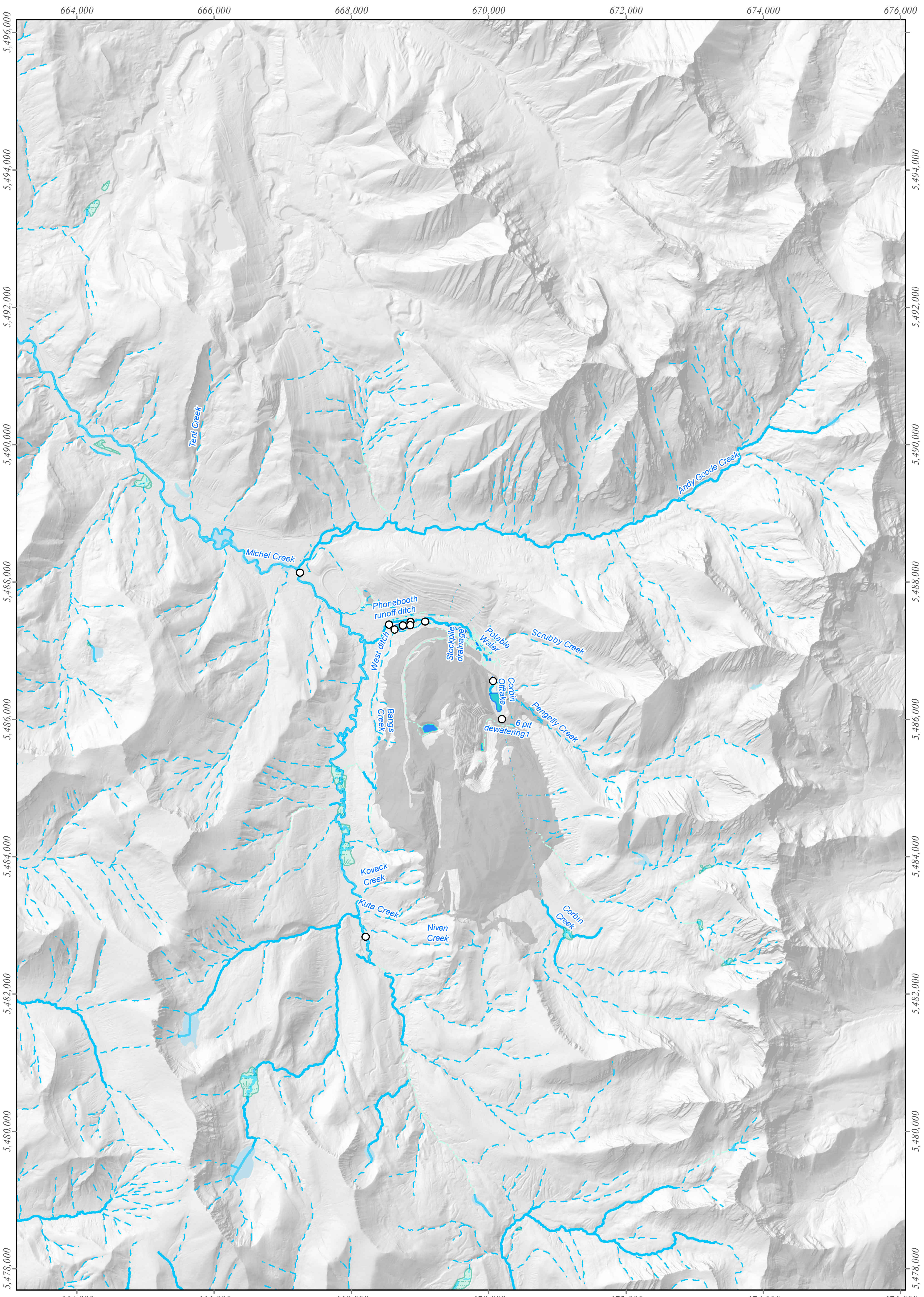
- <0.025 µg/L
- 0.025 µg/L - 0.0499 µg/L
- 0.05 µg/L - 0.099 µg/L
- >0.10 µg/L
- Pits + Spoils
- End Pit Lake
- Settling Pond
- Stream
- Intermittent
- Indefinite
- Subsurface

N

0 250 500 1,000 1,500 Meters

DATE: 3/7/2023	MINE OPERATION: Line Creek
SCALE: 1:50,000	COORDINATE SYSTEM: NAD 1983 UTM Zone 11N

Document Path: G:\Data\Projects\SeSMP\HeatMaps\2022\OrganoSe.mxd



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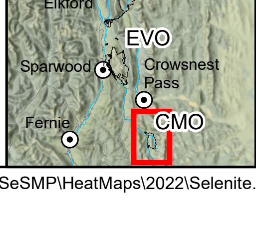


Coal Mountain Selenium Speciation Sample Locations

Selenite (Se O3(-2))

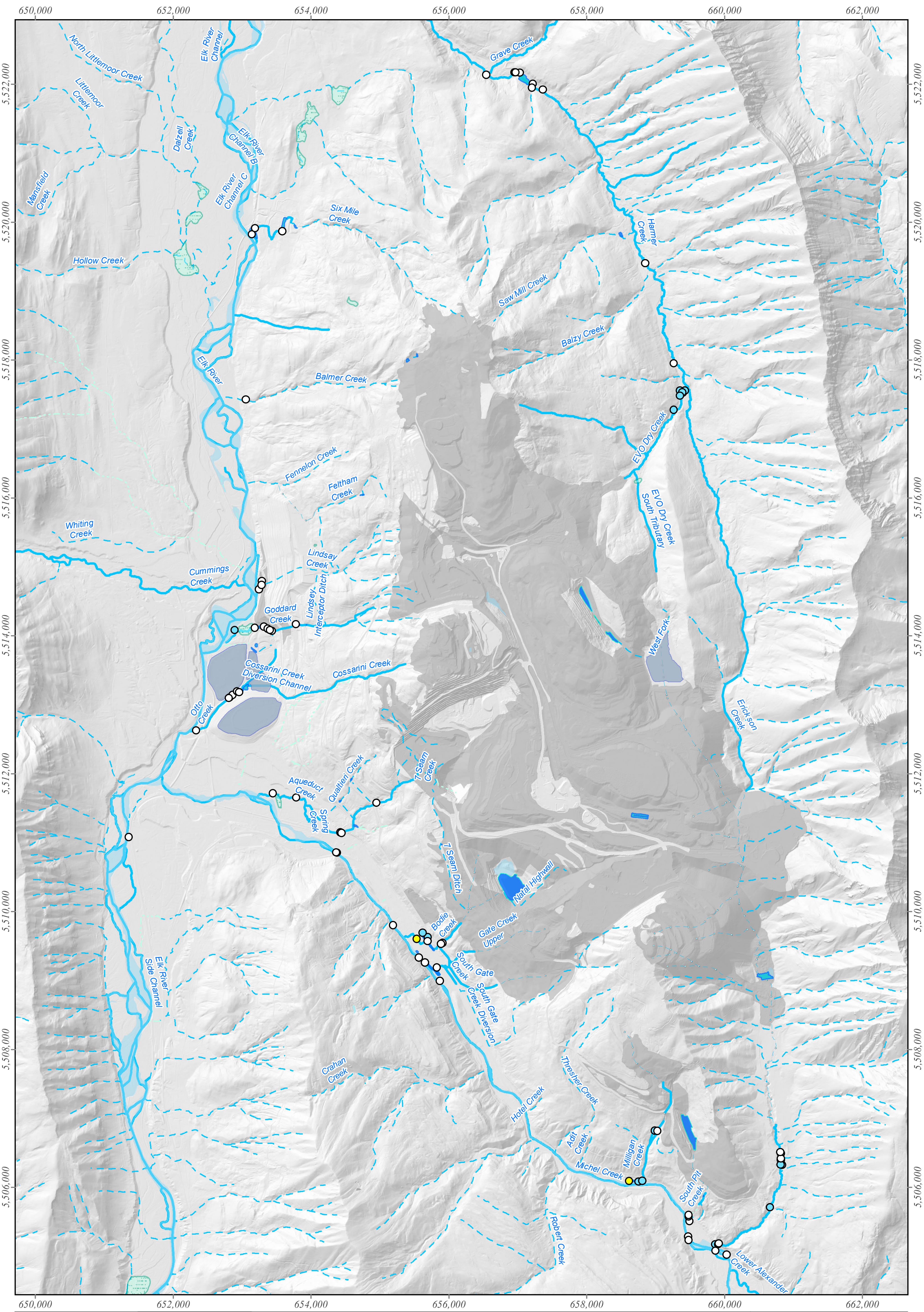
- <1 µg/L
- 1 µg/L - 2.99 µg/L
- 3 µg/L - 7.99 µg/L
- >8 µg/L
- Pits + Spoils
- End Pit Lake
- Settling Pond
- Stream
- Intermittent
- Indefinite
- Subsurface

N

0 250 500 1,000 1,500 Meters

DATE: 3/7/2023	MINE OPERATION: Coal Mountain
SCALE: 1:50,000	COORDINATE SYSTEM: NAD 1983 UTM Zone 11N

Document Path: G:\Data\Projects\SeSMP\HeatMaps\2022\Selenite.mxd



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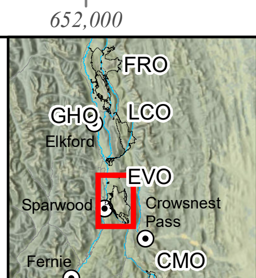


Elkview Selenium Speciation Sample Locations

Selenite (Se O3(-2))

- <1 µg/L
- 1 µg/L - 2.99 µg/L
- 3 µg/L - 7.99 µg/L
- >8 µg/L

- Pits + Spoils
- End Pit Lake
- Settling Pond
- Tailings Pond

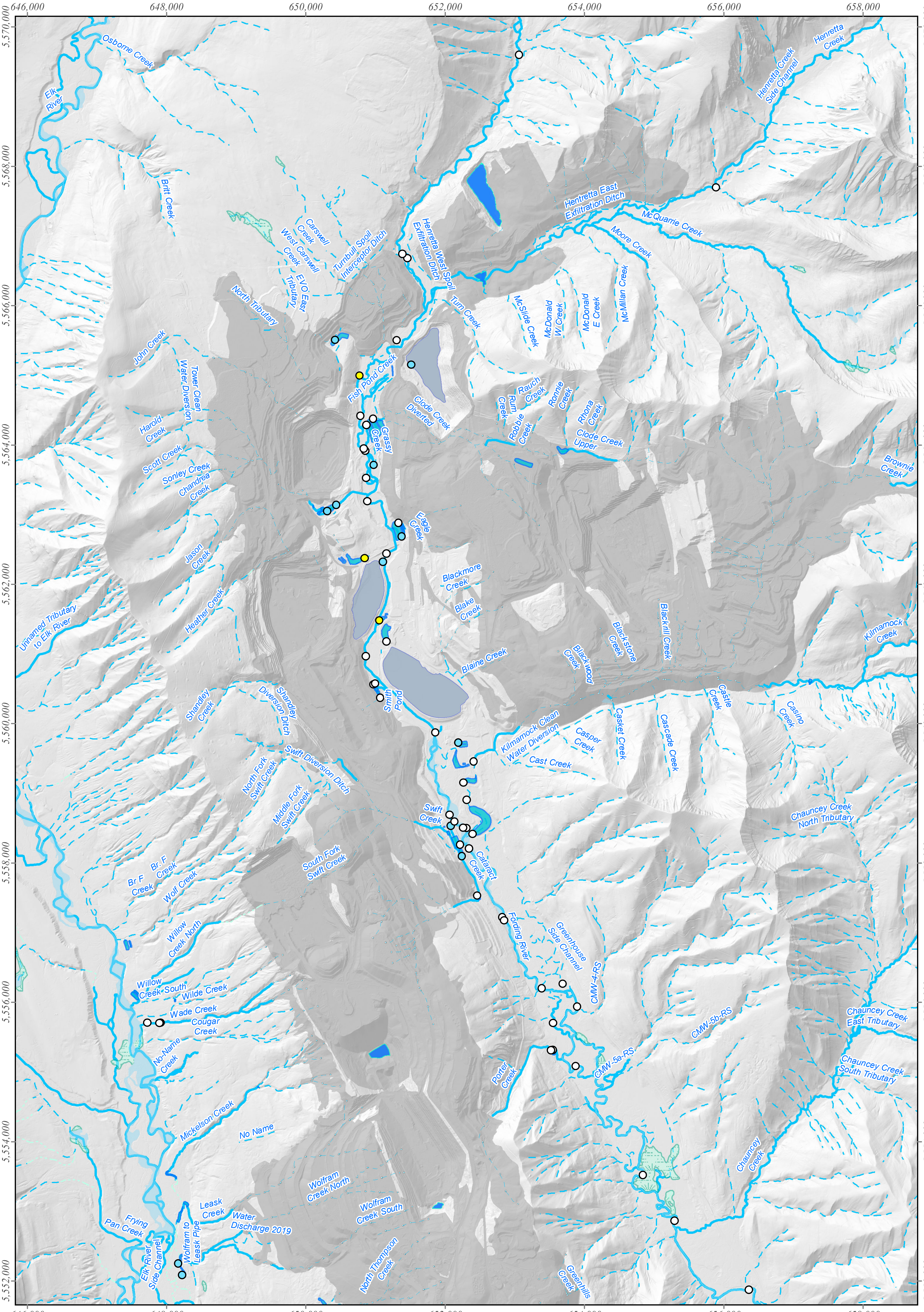
- Stream
- Intermittent
- Indefinite
- Subsurface

N

0 250 500 1,000 1,500 Meters

DATE: 3/7/2023	MINE OPERATION: Elkview
SCALE: 1:50,000	COORDINATE SYSTEM: NAD 1983 UTM Zone 11N

Document Path: G:\Data\Projects\SeSMP\HeatMaps\2022\Selenite.mxd



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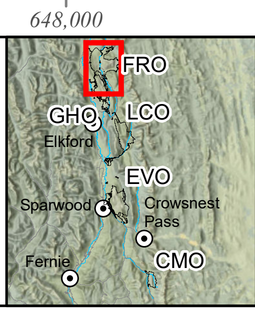


Fording River Selenium Speciation Sample Locations

Selenite (Se O3(-2))

- <1 µg/L
- 1 µg/L - 2.99 µg/L
- 3 µg/L - 7.99 µg/L
- >8 µg/L

- Pits + Spoils
- End Pit Lake
- Settling Pond
- Tailings Pond

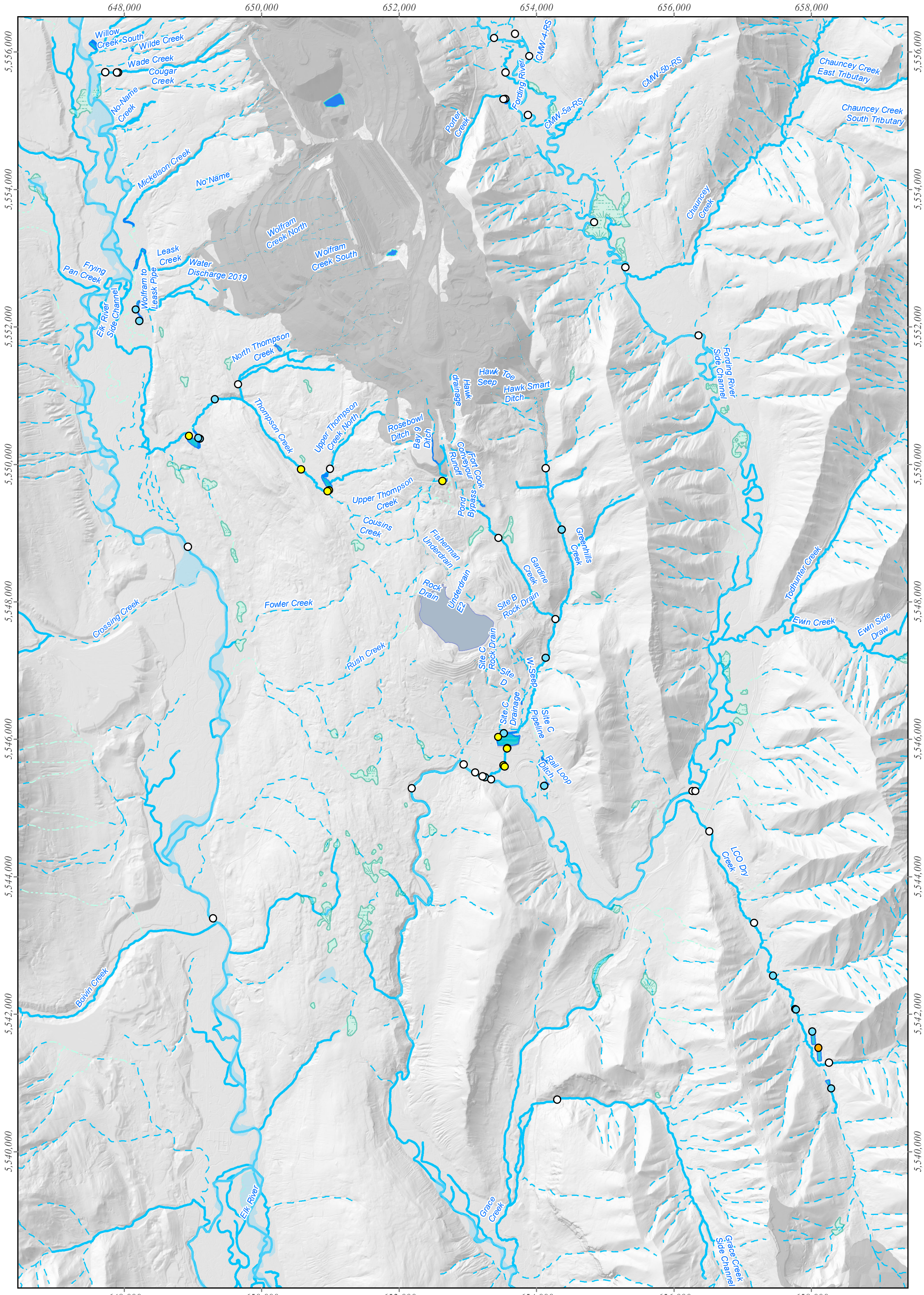
- Stream
- Intermittent
- Indefinite
- Subsurface

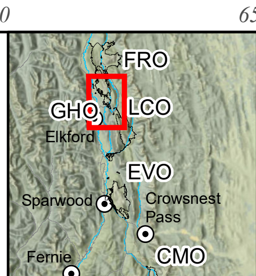
N

0 250 500 1,000 1,500 Meters

DATE: 3/7/2023	MINE OPERATION: Fording River
SCALE: 1:50,000	COORDINATE SYSTEM: NAD 1983 UTM Zone 11N

Document Path: G:\Data\Projects\SeSMP\HeatMaps\2022\Selenite.mxd





Greenhills Selenium Speciation Sample Locations

Selenite (Se O3(-2))

- <1 µg/L
- 1 µg/L - 2.99 µg/L
- 3 µg/L - 7.99 µg/L
- >8 µg/L

- Pits + Spoils
- End Pit Lake
- Settling Pond
- Tailings Pond

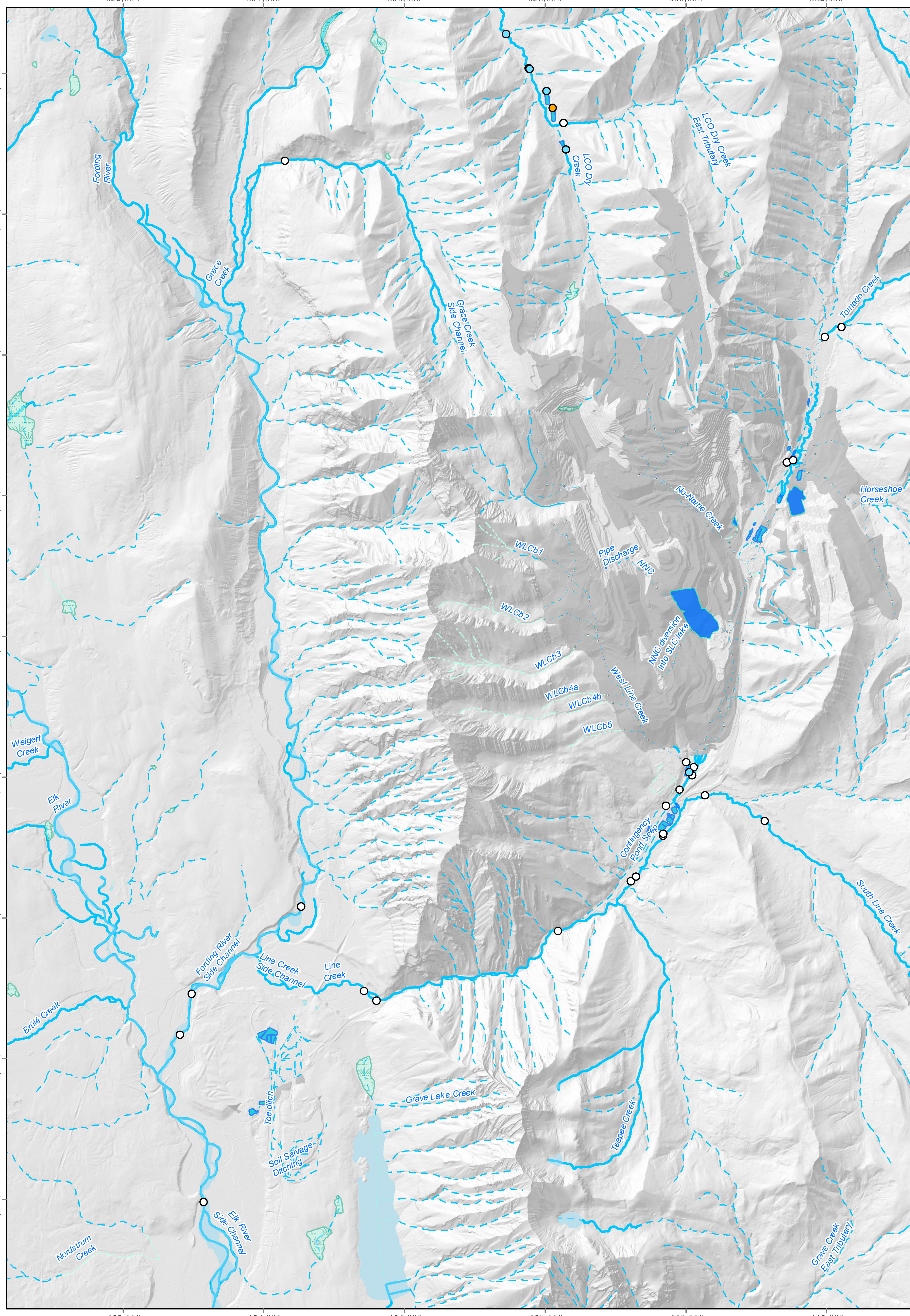
- Stream
- Intermittent
- Indefinite
- Subsurface

N

0 250 500 1,000 1,500 Meters

DATE:	MINE OPERATION:
3/7/2023	Greenhills
SCALE:	COORDINATE SYSTEM:
1:50,000	NAD 1983 UTM Zone 11N

Document Path: G:\Data\Projects\SeSMP\HeatMaps\2022\Selenite.mxd



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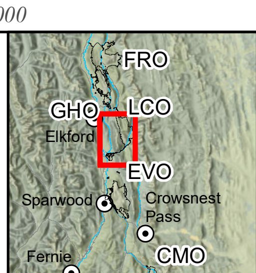


Line Creek Selenium Speciation Sample Locations

Selenite (Se O3(-2))

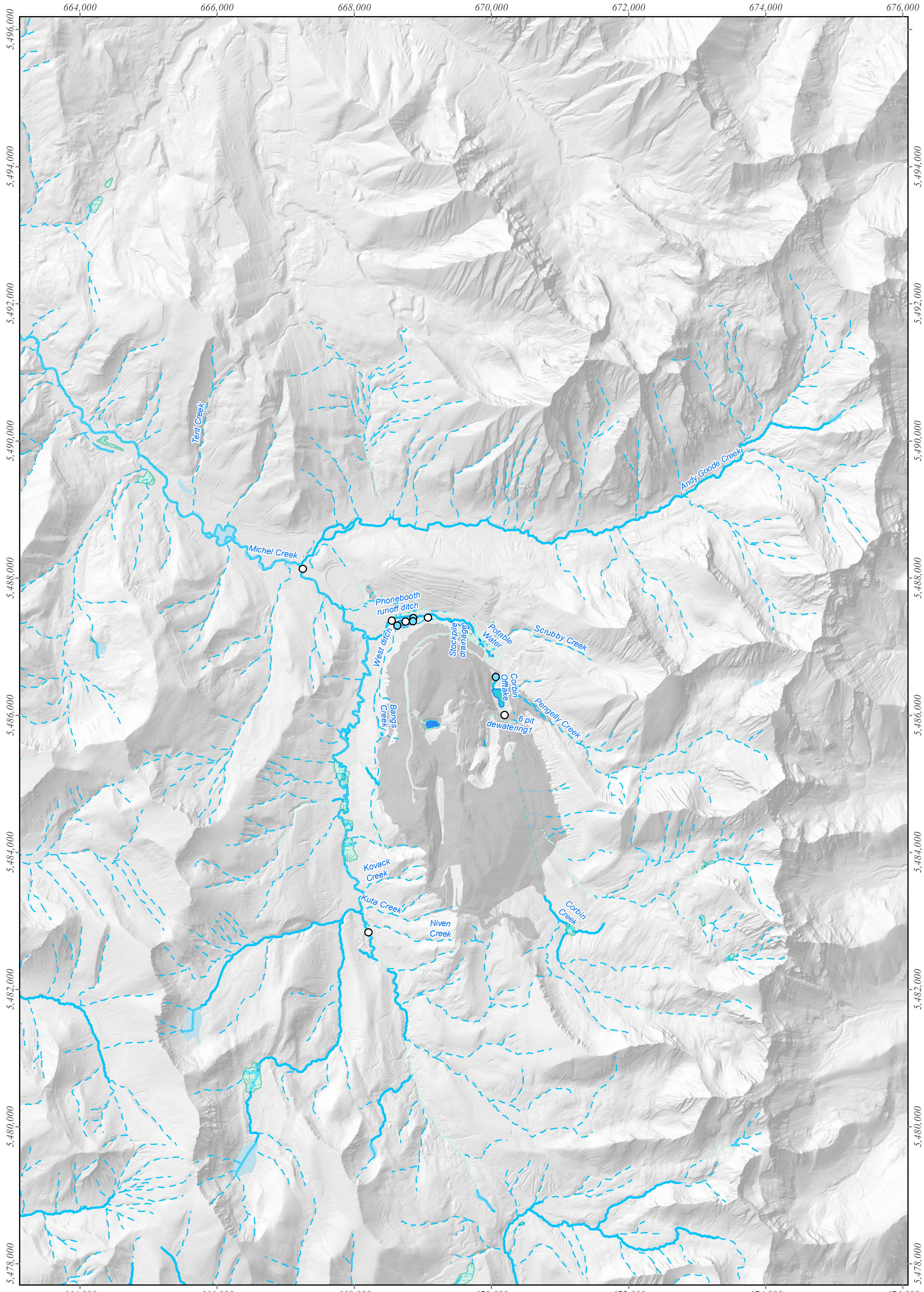
- <1 µg/L
- 1 µg/L - 2.99 µg/L
- 3 µg/L - 7.99 µg/L
- >8 µg/L
- Pits + Spoils
- End Pit Lake
- Settling Pond
- Stream
- Intermittent
- Indefinite
- Subsurface

N

0 250 500 1,000 1,500 Meters

DATE: 3/7/2023	MINE OPERATION: Line Creek
SCALE: 1:50,000	COORDINATE SYSTEM: NAD 1983 UTM Zone 11N

Document Path: G:\Data\Projects\SeSMP\HeatMaps\2022\Selenite.mxd



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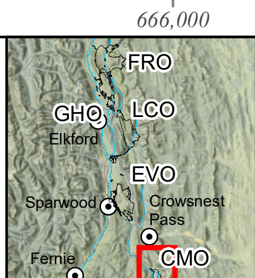

Coal Mountain Selenium Speciation Sample Locations

Sum of Dimethyl selenoxide (DMSeO) and Methyl seleninic acid (MeSe(IV))

- <0.025 µg/L
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- 0.05 µg/L - 0.099 µg/L
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- Intermittent
- Indefinite
- Subsurface

N

0 250 500 1,000 1,500 Meters

DATE: 3/7/2023	MINE OPERATION: Coal Mountain
SCALE: 1:50,000	COORDINATE SYSTEM: NAD 1983 UTM Zone 11N

Document Path: G:\Data\Projects\SeSMP\HeatMaps\2022\OrganoSe.mxd

Attachment F

Speciation Monitoring Data at Compliance and Order Stations 2017 – 2022

Attachment F. Speciation Monitoring Data at Compliance and Order Stations (2017-2022)

Station	Year	Qrtr	Date of Maximum Organo-selenium	Number of sampling events per quarter	Maximum Selenium Species Concentrations per Quarter (µg/L)							BI [Se] (mg/kg dw)
					DMSeO	MeSe(IV)	MeSe(VI)	Se(IV)	Se(VI)	SeCN	SeSO3	
GH_ERC - Elk River below Thompson Creek (RG_EL20)	2017	Q2	06-Jun-17	1	< 0.005	< 0.005	-	0.038	1.23	< 0.015	< 0.020	-
		Q3	05-Sep-17	2	< 0.005	< 0.005	-	< 0.015	1.01	< 0.015	< 0.015	5.1
		Q4	05-Dec-17	1	< 0.005	< 0.005	-	< 0.015	0.67	< 0.015	< 0.015	-
	2018	Q1	27-Feb-18	1	< 0.005	< 0.005	< 0.015	< 0.015	1.86	< 0.015	< 0.015	-
		Q2	05-Jun-18	1	< 0.010	< 0.010	-	< 0.050	1.4	< 0.040	< 0.010	-
		Q3	12-Sep-18	1	< 0.010	< 0.010	< 0.010	< 0.050	0.766	< 0.040	< 0.060	-
	2019	Q1	19-Mar-19	17	< 0.010	< 0.010	< 0.010	< 0.050	2.38	< 0.040	< 0.060	-
		Q2	14-May-19	10	< 0.010	< 0.010	< 0.010	< 0.050	2.91	< 0.040	< 0.060	-
		Q3	03-Sep-19	2	< 0.010	< 0.010	< 0.010	< 0.050	1.48	< 0.040	< 0.060	-
		Q4	03-Dec-19	1	< 0.010	< 0.010	< 0.010	< 0.050	2.9	< 0.040	< 0.060	-
	2020	Q1	11-Feb-20	1	< 0.010	< 0.010	< 0.010	< 0.050	2.87	< 0.040	< 0.060	-
		Q2	16-Jun-20	1	< 0.010	< 0.010	< 0.010	< 0.050	1.1	< 0.040	< 0.060	-
		Q3	15-Jul-20	1	< 0.010	< 0.010	< 0.010	< 0.050	0.654	< 0.040	< 0.060	-
		Q4	03-Nov-20	1	< 0.010	< 0.010	< 0.010	< 0.010	1.08	< 0.010	< 0.010	-
	2021	Q1	01-Feb-21	1	< 0.010	< 0.010	< 0.010	< 0.010	2.77	< 0.010	< 0.010	-
		Q2	18-May-21	3	< 0.010	< 0.010	< 0.010	0.022	1.3	< 0.010	< 0.010	-
		Q3	14-Jul-21	1	< 0.010	< 0.010	< 0.010	0.041	1.03	< 0.010	< 0.010	-
		Q4	05-Oct-21	2	< 0.010	< 0.010	< 0.010	0.048	2.06	< 0.010	< 0.010	-
	2022	Q1	07-Jan-22	1	< 0.010	< 0.010	< 0.010	0.018	3.31	< 0.010	< 0.010	-
		Q3	06-Jul-22	1	< 0.010	< 0.010	< 0.010	0.026	1.12	< 0.010	< 0.010	-
		Q4	05-Oct-22	1	< 0.010	< 0.010	< 0.010	< 0.020	2.17	< 0.010	< 0.010	-
FR_FRABCH - Fording River above Chauncey Creek (RG_FO22)	2017	Q1	07-Feb-17	1	-	< 0.005	-	0.12	74	< 0.025	< 0.030	-
		Q2	06-Jun-17	1	< 0.005	< 0.005	-	0.117	29.4	< 0.015	< 0.020	-
		Q3	11-Sep-17	2	< 0.005	0.008	-	0.112	52.2	< 0.015	< 0.015	5.4
		Q4	12-Dec-17	1	< 0.005	0.006	-	0.135	88.3	< 0.015	< 0.015	-
	2018	Q1	06-Feb-18	2	< 0.005	< 0.005	-	0.085	60.3	< 0.015	< 0.015	6.9
		Q2	05-Jun-18	1	< 0.010	< 0.010	-	0.108	32.3	< 0.040	< 0.060	-
		Q3	18-Sep-18	2	< 0.010	< 0.010	< 0.010	0.145	84.5	< 0.040	< 0.060	7.89
		Q4	04-Dec-18	2	< 0.010	< 0.010	< 0.010	0.114	91.4	< 0.040	< 0.060	4.2
	2019	Q1	26-Feb-19	3	< 0.010	< 0.010	< 0.010	0.119	99.5	< 0.040	< 0.060	5.35
		Q2	18-Jun-19	2	< 0.010	< 0.010	< 0.010	0.137	37.9	< 0.040	< 0.060	7.99
		Q3	17-Sep-19	3	< 0.010	< 0.010	< 0.010	0.191	64.6	< 0.040	< 0.060	7.09
		Q4	03-Dec-19	2	< 0.010	< 0.010	< 0.010	0.127	82.4	< 0.040	< 0.060	-
	2020	Q1	04-Feb-20	1	< 0.010	< 0.010	< 0.010	0.108	71.6	< 0.040	< 0.060	-
		Q2	19-Jun-20	2	< 0.010	< 0.010	< 0.010	0.105	43.5	< 0.040	< 0.060	6.71
		Q3	06-Jul-20	4	< 0.010	< 0.010	< 0.010	0.117	45.2	< 0.040	< 0.060	9.44
		Q4	09-Dec-20	2	< 0.010	< 0.010	< 0.010	0.088	70.5	< 0.010	< 0.010	0
	2021	Q1	23-Feb-21	1	< 0.010	< 0.010	< 0.010	0.113	91.9	< 0.010	< 0.010	-
		Q2	13-Apr-21	3	< 0.010	< 0.010	< 0.010	0.168	94.2	< 0.010	< 0.010	9.17
		Q3	12-Sep-21	3	< 0.010	0.012	< 0.010	0.194	87.4	< 0.010	< 0.010	8.73
		Q4	17-Dec-21	3	< 0.010	< 0.010	< 0.010	0.169	105	< 0.010	< 0.010	7.27
	2022	Q1	15-Feb-22	6	< 0.010	< 0.010	< 0.010	0.163	102	< 0.010	< 0.010	7.44
		Q2	07-Jun-22	1	< 0.010	< 0.010	< 0.010	0.079	29.8	< 0.010	< 0.010	-
		Q3	09-Sep-22	3	< 0.010	0.014	< 0.010	0.175	75	< 0.010	< 0.010	10.8
		Q4	08-Dec-22	5	< 0.010	< 0.010	< 0.010	0.127	83.9	< 0.010	< 0.010	5.4
GH_FR1 - Fording River below Greenhills Creek (RG_FODGH)	2017	Q2	06-Jun-17	1	< 0.005	< 0.005	-	0.107	17.8	< 0.015	< 0.020	-
		Q3	05-Sep-17	2	< 0.005	0.016	-	0.437	47.7	< 0.015	< 0.015	6.1
		Q4	05-Dec-17	1	< 0.005	0.008	-	0.203	48.8	< 0.015	< 0.015	-
	2018	Q1	27-Feb-18	1	< 0.005	0.009	< 0.015	0.214	55.8	< 0.015	< 0.015	-
		Q2	05-Jun-18	1	< 0.010	0.013		0.175	31.5	< 0.040	< 0.010	-
		Q3	12-Sep-18	2	< 0.010	0.018	< 0.010	0.248	26.5	< 0.040	< 0.060	10.2
	2019	Q1	05-Feb-19	1	< 0.010	< 0.010	< 0.010	0.156	25.5	< 0.040	< 0.060	-
		Q2	07-May-19	2	< 0.010	0.039	< 0.010	0.444	56.5	< 0.040	< 0.060	-
		Q3	03-Sep-19	2	< 0.010	0.032	< 0.010	0.578	53.6	< 0.040	< 0.060	8.23
		Q4	03-Dec-19	1	< 0.010	0.019	< 0.010	0.313	49.7	< 0.040	< 0.060	-
	2020	Q1	11-Feb-20	1	< 0.010	< 0.010	< 0.010	0.206	38.5	< 0.040	< 0.060	-
		Q2	16-Jun-20	1	< 0.010	0.011	< 0.010	0.146	28.2	< 0.040	< 0.060	-
		Q3	15-Jul-20	2	< 0.010	0.018	< 0.010	0.286	35.5	< 0.040	< 0.060	13.1
		Q4	03-Nov-20	1	0.014	0.016	< 0.010	0.317	63.4	< 0.010	< 0.010	-
	2021	Q1	03-Feb-21	2	< 0.010	< 0.010	< 0.010	0.24	60.6	< 0.010	< 0.010	-
		Q2	13-Apr-21	1	0.011	0.016	< 0.010	0.271	66.8	< 0.010	0.015	-
		Q3	17-Sep-21	3	0.014	0.019	< 0.010	0.326	51.3	< 0.010	< 0.010	9.99
		Q4	19-Oct-21	1	0.019	0.015	< 0.010	0.602	65	< 0.010	< 0.010	-
	2022	Q1	20-Jan-22	1	0.011	< 0.010	< 0.010	0.284	60.7	< 0.010	< 0.010	-
		Q2	04-Apr-22	1	< 0.010	0.017	< 0.010	0.32	57.2	< 0.010	< 0.010	-
		Q3	04-Jul-22	2	< 0.010	0.013	< 0.010	0.132	23.8	< 0.010	< 0.010	10.6
		Q4	11-Oct-22	1	< 0.010	0.012	< 0.010	0.295	43.8	< 0.010	< 0.010	-
	2017	Q1	21-Feb-17	1	-	0.02	-	0.147	32.4	< 0.025	< 0.030	-
		Q2	06-Jun-17	1	< 0.005	< 0.005	-	0.094	18.2	< 0.015	< 0.020	-
		Q3	11-Sep-17	2	0.037	0.033	-	0.3	29.2	< 0.015	< 0.015	11
		Q4	01-Dec-17	1	< 0.005	0.02	-	0.206	41.8	< 0.015	< 0.015	-
	2018	Q1	07-Feb-18	1	< 0.005	< 0.005	-	0.046	10.7	< 0.015	< 0.015	-
		Q2	05-Jun-18	1	< 0.010	< 0.010	-	0.126	17.5	< 0.040	< 0.060	-
		Q3	04-Sep-18	2	0.021	0.046	< 0.010	0.3	25.3	< 0.040	< 0.060	18.9
		Q4	03-Dec-18	1	< 0.010	< 0.010	< 0.010	0.128	26.5	< 0.040	< 0.060	-

EV_HC1 - Harmer Creek below spillway of Harmer Dam (RG_HACKDS)	2019	Q1	14-Feb-19	1	< 0.010	< 0.010	< 0.010	0.1	28.5	< 0.040	< 0.060	-
		Q2	04-Jun-19	1	< 0.010	0.012	< 0.010	0.104	10.9	< 0.040	< 0.060	-
		Q3	03-Sep-19	2	0.029	0.033	< 0.010	0.344	29.7	< 0.040	< 0.060	17
		Q4	03-Dec-19	1	0.013	0.013	< 0.010	0.22	40.4	< 0.040	< 0.060	-
	2020	Q1	11-Feb-20	1	< 0.010	< 0.010	< 0.010	0.084	18.1	< 0.040	< 0.060	-
		Q2	12-May-20	1	< 0.010	0.015	< 0.010	0.171	29.9	< 0.040	< 0.060	-
		Q3	01-Sep-20	3	0.034	0.03	< 0.010	0.322	30.9	< 0.040	< 0.060	16.5
		Q4	01-Dec-20	1	< 0.010	0.013	< 0.010	0.187	45.2	< 0.010	< 0.010	-
	2021	Q1	02-Mar-21	2	< 0.010	0.015	< 0.010	0.168	44.6	< 0.010	< 0.010	-
		Q2	17-Jun-21	4	< 0.010	0.021	< 0.010	0.2	22.9	< 0.010	< 0.010	-
		Q3	28-Sep-21	7	0.012	0.029	< 0.010	0.353	31.3	< 0.010	< 0.010	15
		Q4	14-Oct-21	5	0.013	0.014	< 0.010	0.253	35.7	< 0.010	< 0.010	13.7
	2022	Q1	11-Jan-22	4	< 0.010	< 0.010	< 0.010	0.15	36.2	< 0.010	< 0.010	-
		Q2	05-Apr-22	7	< 0.010	< 0.010	< 0.010	0.194	40.7	< 0.010	< 0.010	-
		Q3	06-Sep-22	6	0.015	0.027	< 0.010	0.312	27.2	< 0.010	< 0.010	14.1
		Q4	13-Oct-22	4	0.017	0.014	< 0.010	0.247	28.2	< 0.010	< 0.010	-
LC_LCDSSLCC - Line Creek below South Line Creek (RG_LIDSL)	2017	Q1	06-Mar-17	7	0.365	0.076	-	0.657	31.1	< 0.025	< 0.030	-
		Q2	10-Apr-17	14	0.348	0.045	-	0.513	39.3	< 0.015	< 0.015	10.5
		Q3	25-Sep-17	19	0.219	0.044	-	0.312	34.4	< 0.015	< 0.015	13.6
		Q4	10-Oct-17	16	0.084	0.017	-	0.333	32.1	< 0.015	< 0.015	11.6
	2018	Q1	07-Mar-18	25	0.057	0.027	-	0.278	57.9	< 0.015	< 0.015	6.43
		Q2	17-Apr-18	14	< 0.005	0.006	-	0.097	66.3	< 0.015	< 0.015	9.25
		Q3	12-Sep-18	15	< 0.010	0.012	< 0.010	0.151	62.6	< 0.040	< 0.060	7.17
		Q4	04-Dec-18	14	< 0.010	0.02	< 0.010	0.137	32.3	< 0.040	< 0.060	6.7
	2019	Q1	19-Feb-19	15	< 0.010	0.047	0.032	0.25	31.4	< 0.040	< 0.060	6.03
		Q2	08-Apr-19	17	< 0.010	0.02	0.028	0.262	35.2	< 0.040	< 0.060	6.52
		Q3	17-Sep-19	18	0.017	0.018	0.02	0.161	24.4	< 0.040	< 0.060	6.06
		Q4	07-Oct-19	12	0.016	0.025	0.018	0.209	31	< 0.040	< 0.060	-
	2020	Q1	04-Feb-20	13	0.017	0.02	0.057	0.425	39.9	< 0.040	< 0.060	-
		Q2	14-Apr-20	16	< 0.010	0.033	0.034	0.305	36	< 0.040	< 0.060	5.88
		Q3	24-Aug-20	15	< 0.010	0.014	< 0.010	0.167	30.8	< 0.040	< 0.060	7.49
		Q4	21-Dec-20	14	0.019	0.011	0.047	0.318	37.1	< 0.010	< 0.010	5.38
	2021	Q1	25-Jan-21	13	0.015	0.02	0.062	0.391	36.9	< 0.010	< 0.010	-
		Q2	27-Apr-21	14	< 0.010	0.015	0.02	0.189	36	< 0.010	< 0.010	5.15
		Q3	20-Sep-21	14	< 0.010	0.014	< 0.010	0.153	33.6	< 0.010	< 0.010	6.64
		Q4	19-Oct-21	13	< 0.010	0.014	0.034	0.27	33	< 0.010	< 0.010	5.56
	2022	Q1	15-Mar-22	13	0.018	0.023	0.06	0.415	43.5	< 0.010	< 0.010	-
		Q2	11-Apr-22	12	0.016	0.02	0.029	0.269	47.4	< 0.010	< 0.010	4.72
		Q3	06-Sep-22	15	< 0.010	0.012	< 0.010	0.097	33.5	< 0.010	< 0.010	7.18
		Q4	01-Nov-22	15	< 0.010	0.018	0.039	0.249	31.4	< 0.010	< 0.010	7.43
EV_MC2 - Michel Creek below Bodie Creek (RG_MICOMP)	2017	Q1	31-Jan-17	2	-	< 0.005	-	0.12	14	< 0.025	< 0.030	-
		Q2	06-Jun-17	1	< 0.005	< 0.005	-	0.099	3.43	< 0.015	< 0.020	-
		Q3	12-Sep-17	1	< 0.005	0.006	-	0.091	7.83	< 0.015	< 0.015	-
		Q4	06-Dec-17	1	< 0.005	< 0.005	-	0.129	13.4	< 0.015	< 0.015	-
	2018	Q1	26-Mar-18	13	< 0.005	< 0.005	-	0.382	26.3	< 0.015	< 0.015	-
		Q2	09-Apr-18	14	< 0.005	0.006	-	0.065	22.5	< 0.015	< 0.015	-
		Q3	30-Jul-18	15	< 0.010	< 0.010	-	0.211	15.7	< 0.040	< 0.060	8.68
		Q4	29-Oct-18	15	< 0.010	< 0.010	< 0.010	0.116	14	< 0.040	< 0.060	-
	2019	Q1	05-Feb-19	13	< 0.010	< 0.010	< 0.010	0.093	26.7	< 0.040	< 0.060	-
		Q2	06-May-19	14	< 0.010	< 0.010	< 0.010	0.215	5.49	< 0.040	< 0.060	-
		Q3	23-Sep-19	16	< 0.010	0.014	< 0.010	0.109	9.4	< 0.040	< 0.060	5.5
		Q4	11-Nov-19	17	< 0.010	< 0.010	< 0.010	0.11	21.5	< 0.040	< 0.060	-
	2020	Q1	19-Feb-20	16	< 0.010	< 0.010	< 0.010	0.082	21.4	< 0.040	< 0.060	-
		Q2	20-Apr-20	17	< 0.010	< 0.010	< 0.010	0.077	14.5	< 0.040	< 0.060	-
		Q3	31-Aug-20	18	< 0.010	0.012	< 0.010	0.127	14.9	< 0.040	< 0.060	9.91
		Q4	05-Oct-20	11	< 0.010	< 0.010	< 0.010	0.11	13.1	< 0.040	< 0.060	-
	2021	Q1	29-Mar-21	8	< 0.010	< 0.010	< 0.010	0.1	8.96	< 0.010	< 0.010	-
		Q2	07-Apr-21	10	< 0.010	< 0.010	< 0.010	0.073	6.42	< 0.010	< 0.010	-
		Q3	13-Sep-21	11	< 0.010	0.014	< 0.010	0.174	6.97	< 0.010	< 0.010	3.93
		Q4	11-Oct-21	7	< 0.010	< 0.010	< 0.010	0.133	8.04	< 0.010	< 0.010	-
	2022	Q1	14-Mar-22	8	< 0.010	< 0.010	< 0.010	0.076	12.3	< 0.010	< 0.010	-
		Q2	27-Apr-22	12	< 0.010	< 0.010	< 0.010	0.049	7.8	< 0.010	< 0.010	7.03
		Q3	26-Sep-22	12	< 0.010	< 0.010	< 0.010	0.141	18.6	< 0.010	< 0.010	6.51
		Q4	31-Oct-22	11	< 0.010	< 0.010	< 0.010	0.14	11.5	< 0.010	< 0.010	7.84
CM_MC2 - Michel Creek below Corbin Creek (RG_MIDCO)	2017	Q1	07-Feb-17	1	-	< 0.005	-	0.307	6.86	< 0.025	< 0.030	-
		Q2	06-Jun-17	1	< 0.005	< 0.005	-	0.059	4.15	< 0.015	< 0.015	-
		Q3	19-Sep-17	1	< 0.005	< 0.005	-	0.089	8.92	< 0.015	< 0.015	-
		Q4	06-Dec-17	1	< 0.005	< 0.005	-	0.114	10.4	< 0.015	< 0.015	-
	2018	Q1	06-Feb-18	1	< 0.005	< 0.005	-	0.064	5.3	< 0.015	< 0.015	-
		Q2	05-Jun-18	1	< 0.010	< 0.010	-	0.061	3.92	< 0.040	< 0.050	-
		Q3	04-Sep-18	1	< 0.010	< 0.010	< 0.010	0.22	5.95	< 0.040	< 0.060	-
		Q4	04-Dec-18	1	< 0.010	< 0.010	< 0.010	0.136	8.38	< 0.040	< 0.060	-
	2019	Q1	12-Feb-19	1	< 0.010	< 0.010	< 0.010	0.102	7.61	< 0.040	< 0.060	-
		Q2	04-Jun-19	1	< 0.010	< 0.010	< 0.010	< 0.050	2.46	< 0.040	< 0.060	-
		Q3	04-Sep-19	1	< 0.010	< 0.010	< 0.010	0.141	8.37	< 0.040	< 0.060	-
		Q4	03-Dec-19	1	< 0.010	< 0.010	< 0.010	0.101	9.16	< 0.040	< 0.060	-
	2020	Q1	04-Feb-20	1	< 0.010	< 0.010	< 0.010	0.085	3.53	< 0.040	< 0.060	-
		Q2	02-Jun-20	1	< 0.010	< 0.010	< 0.010	0.056	5.48	< 0.040	< 0.060	-
		Q3	01-Sep-20	2	< 0.010	< 0.010	< 0.010	0.169	9.19	< 0.040	< 0.060	0
		Q4	01-Dec-20	1	< 0.010	< 0.010	< 0.010	0.078	7.77	< 0.010	< 0.010	-
		Q1	02-Feb-21	1	< 0.010	< 0.010	< 0.010	0.072	7.92	< 0.010	< 0.010	-

	2021	Q2	01-Jun-21	1	< 0.010	< 0.010	< 0.010	0.06	4.21	< 0.010	< 0.010	-
		Q3	07-Sep-21	1	< 0.010	< 0.010	< 0.010	0.078	4.74	< 0.010	< 0.010	-
		Q4	05-Oct-21	7	< 0.010	< 0.010	< 0.010	0.097	9.41	< 0.010	< 0.010	-
	2022	Q1	01-Feb-22	7	< 0.010	< 0.010	< 0.010	0.198	9.39	< 0.010	< 0.010	-
		Q2	26-Apr-22	6	< 0.010	< 0.010	< 0.010	0.11	6.01	< 0.010	< 0.010	-
		Q3	23-Aug-22	7	< 0.010	0.011	< 0.010	0.182	7.74	< 0.010	< 0.010	-
		Q4	04-Oct-22	5	< 0.010	< 0.010	< 0.010	0.141	6.97	< 0.010	< 0.010	-
RG_ELKORES - Elk River above Elko (RG_ELELKO)	2017	Q1	08-Feb-17	1	-	0.011	-	0.145	6.36	< 0.025	< 0.030	-
		Q2	06-Jun-17	1	< 0.005	< 0.005	-	0.062	3.88	< 0.015	< 0.020	-
		Q3	19-Sep-17	2	< 0.005	0.038	-	0.152	4.33	< 0.015	< 0.015	7
		Q4	05-Dec-17	1	< 0.005	< 0.005	-	0.078	4.01	< 0.015	< 0.015	-
	2018	Q1	06-Feb-18	1	< 0.005	0.006	-	0.068	5.92	< 0.015	< 0.015	-
		Q2	05-Jun-18	1	< 0.010	< 0.010	-	< 0.050	2.61	< 0.040	< 0.060	-
		Q3	04-Sep-18	2	< 0.010	0.02	< 0.010	0.239	9.33	< 0.040	< 0.060	10.6
		Q4	04-Dec-18	1	< 0.010	< 0.010	< 0.010	0.128	9.51	< 0.040	< 0.060	-
	2019	Q1	07-Feb-19	1	< 0.010	0.014	< 0.010	0.112	9.7	< 0.040	< 0.060	-
		Q2	04-Jun-19	1	< 0.010	< 0.010	< 0.010	0.068	2.65	< 0.040	< 0.060	-
		Q3	04-Sep-19	2	< 0.010	0.021	< 0.010	0.271	7.01	< 0.040	< 0.060	8.06
		Q4	05-Nov-19	2	< 0.010	0.018	< 0.010	0.171	7.11	< 0.040	< 0.060	-
	2020	Q1	02-Mar-20	1	< 0.010	0.02	< 0.010	0.15	8.43	< 0.040	< 0.060	-
		Q2	01-Jun-20	1	< 0.010	< 0.010	< 0.010	0.106	2.89	< 0.040	< 0.060	-
		Q3	01-Sep-20	3	< 0.010	0.014	< 0.010	0.197	7.69	< 0.040	< 0.060	7.52
		Q4	01-Dec-20	1	< 0.010	< 0.010	< 0.010	0.095	6.88	< 0.010	< 0.010	-
	2021	Q1	02-Mar-21	1	< 0.010	< 0.010	< 0.010	0.099	8.52	< 0.010	< 0.010	-
		Q2	01-Jun-21	1	< 0.010	< 0.010	< 0.010	0.051	4.04	< 0.010	< 0.010	-
		Q3	14-Sep-21	3	< 0.010	0.024	< 0.010	0.312	8.79	< 0.010	< 0.010	10.5
		Q4	07-Dec-21	1	< 0.010	< 0.010	< 0.010	0.058	4.09	< 0.010	< 0.010	-
	2022	Q1	01-Mar-22	1	< 0.010	< 0.010	< 0.010	0.062	8.58	< 0.010	< 0.010	-
		Q2	03-May-22	1	< 0.010	< 0.010	< 0.010	0.115	8.07	0.011	< 0.010	-
		Q3	07-Sep-22	3	< 0.010	0.019	< 0.010	0.173	8.03	< 0.010	< 0.010	8.65
		Q4	01-Dec-22	1	< 0.010	< 0.010	< 0.010	0.112	9.27	< 0.010	< 0.010	-
GH_ER1 - Elk River above Fording River (RG_ELUEL)	2017	Q2	06-Jun-17	1	< 0.005	< 0.005	-	0.037	0.86	< 0.015	< 0.020	-
		Q3	05-Sep-17	1	< 0.005	< 0.005	-	< 0.015	0.792	< 0.015	< 0.015	-
		Q4	05-Dec-17	1	< 0.005	< 0.005	-	< 0.015	0.802	< 0.015	< 0.015	-
	2018	Q1	27-Feb-18	1	< 0.005	< 0.005	< 0.015	< 0.015	2.06	< 0.015	< 0.015	-
		Q2	05-Jun-18	1	< 0.010	< 0.010	-	< 0.050	1.04	< 0.040	< 0.010	-
		Q3	12-Sep-18	1	< 0.010	< 0.010	< 0.010	< 0.050	0.907	< 0.040	< 0.060	-
	2019	Q1	05-Feb-19	1	< 0.010	< 0.010	< 0.010	< 0.050	1.34	< 0.040	< 0.060	-
		Q2	07-May-19	2	< 0.010	< 0.010	< 0.010	< 0.050	2.71	< 0.040	< 0.060	-
		Q3	01-Sep-19	1	< 0.010	< 0.010	< 0.010	< 0.050	1.55	< 0.040	< 0.060	-
		Q4	03-Dec-19	1	< 0.010	< 0.010	< 0.010	< 0.050	2.8	< 0.040	< 0.060	-
	2020	Q1	11-Feb-20	1	< 0.010	< 0.010	< 0.010	< 0.050	2.62	< 0.040	< 0.060	-
		Q2	17-Jun-20	1	< 0.010	< 0.010	< 0.010	< 0.050	1.09	< 0.040	< 0.060	-
		Q3	15-Jul-20	1	< 0.010	< 0.010	< 0.010	< 0.050	1.12	< 0.040	< 0.060	-
		Q4	12-Nov-20	1	< 0.010	< 0.010	< 0.010	0.026	1.81	< 0.010	0.011	-
	2021	Q1	01-Feb-21	1	< 0.010	< 0.010	< 0.010	0.049	2.68	< 0.010	< 0.010	-
		Q2	05-Apr-21	1	< 0.010	< 0.010	< 0.010	0.023	3.29	< 0.010	< 0.010	-
		Q3	14-Jul-21	1	< 0.010	< 0.010	< 0.010	0.029	1.11	< 0.010	< 0.010	-
		Q4	19-Oct-21	1	< 0.010	< 0.010	< 0.010	0.036	2.12	< 0.010	< 0.010	-
	2022	Q1	07-Jan-22	1	< 0.010	< 0.010	< 0.010	0.022	2.83	< 0.010	< 0.010	-
		Q3	06-Jul-22	1	< 0.010	< 0.010	< 0.010	0.023	0.951	< 0.010	< 0.010	-
		Q4	05-Oct-22	1	< 0.010	< 0.010	< 0.010	< 0.020	1.94	< 0.010	< 0.010	-
EV_ER4 - Elk River below Fording River (RG_EL19)	2017	Q1	21-Feb-17	1	-	< 0.005	-	0.077	11.6	< 0.025	< 0.030	-
		Q2	06-Jun-17	1	< 0.005	< 0.005	-	0.052	6.84	< 0.015	< 0.020	-
		Q3	11-Sep-17	1	< 0.005	< 0.005	-	0.07	7.11	< 0.015	< 0.015	-
		Q4	07-Dec-17	1	< 0.005	< 0.005	-	0.057	12.8	< 0.015	< 0.015	-
	2018	Q1	05-Feb-18	1	0.006	0.012	-	0.123	39.7	< 0.015	< 0.015	-
		Q2	04-Jun-18	1	< 0.010	< 0.010	-	< 0.050	6.45	< 0.040	< 0.060	-
		Q3	04-Sep-18	1	< 0.010	< 0.010	< 0.010	0.077	7.87	< 0.040	< 0.060	-
		Q4	03-Dec-18	1	< 0.010	< 0.010	< 0.010	0.066	13.7	< 0.040	< 0.060	-
	2019	Q1	14-Feb-19	1	< 0.010	< 0.010	< 0.010	< 0.050	8.05	< 0.040	< 0.060	-
		Q2	03-Jun-19	1	< 0.010	< 0.010	< 0.010	0.06	6.58	< 0.040	< 0.060	-
		Q3	04-Sep-19	1	< 0.010	< 0.010	< 0.010	0.082	8.52	< 0.040	< 0.060	-
		Q4	03-Dec-19	1	< 0.010	< 0.010	< 0.010	0.075	16	< 0.040	< 0.060	-
	2020	Q1	18-Feb-20	1	< 0.010	< 0.010	< 0.010	< 0.050	7.34	< 0.040	< 0.060	-
		Q2	12-May-20	1	< 0.010	< 0.010	< 0.010	0.061	9.58	< 0.040	< 0.060	-
		Q3	01-Sep-20	1	< 0.010	< 0.010	< 0.010	0.063	9.45	< 0.040	< 0.060	-
		Q4	01-Dec-20	1	< 0.010	< 0.010	< 0.010	0.072	14.9	< 0.010	< 0.010	-
	2021	Q1	23-Feb-21	1	< 0.010	< 0.010	< 0.010	0.055	14.3	< 0.010	< 0.010	-
		Q2	06-Apr-21	1	< 0.010	< 0.010	< 0.010	0.078	13.5	< 0.010	< 0.010	-
		Q3	05-Jul-21	2	< 0.010	< 0.010	< 0.010	0.111	6.58	< 0.010	< 0.010	-
		Q4	09-Dec-21	1	< 0.010	< 0.010	< 0.010	0.055	12.1	< 0.010	< 0.010	-
	2022	Q1	15-Feb-22	1	< 0.010	< 0.010	< 0.010	0.076	16.7	< 0.010	< 0.010	-
		Q2	07-Jun-22	1	< 0.010	< 0.010	< 0.010	0.054	8.23	< 0.010	< 0.010	-
		Q3	06-Sep-22	1	< 0.010	< 0.010	< 0.010	0.049	10.3	< 0.010	< 0.010	-
		Q4	05-Dec-22	1	< 0.010	< 0.010	< 0.010	0.049	14.7	< 0.010	< 0.010	-
	2017	Q1	20-Feb-17	1	-	< 0.005	-	0.081	10.6	< 0.025	< 0.030	-
		Q2	06-Jun-17	1	< 0.005	< 0.005	-	0.055	4.18	< 0.015	< 0.020	-
		Q3	12-Sep-17	1	< 0.005	0.007	-	0.171	19	< 0.015	< 0.015	-
		Q4	06-Dec-17	1	< 0.005	< 0.005	-	0.083	10.2	< 0.015	< 0.015	-
		Q1	06-Feb-18	2	< 0.005	< 0.005	-	0.096	21.7	< 0.015	< 0.015	-

EV_ER1 - Elk River below Michel Creek (RG_EL1)	2018	Q2	05-Jun-18	1	< 0.010	< 0.010	-	< 0.050	3.32	< 0.040	< 0.060	-
		Q3	04-Sep-18	1	< 0.010	< 0.010	< 0.010	0.109	9.85	< 0.040	< 0.060	-
		Q4	04-Dec-18	1	< 0.010	< 0.010	< 0.010	0.054	9.23	< 0.040	< 0.060	-
	2019	Q1	06-Feb-19	1	< 0.010	< 0.010	< 0.010	< 0.050	10.2	< 0.040	< 0.060	-
		Q2	04-Jun-19	1	< 0.010	< 0.010	< 0.010	< 0.050	3.27	< 0.040	< 0.060	-
		Q3	03-Sep-19	1	< 0.010	< 0.010	< 0.010	0.096	8.55	< 0.040	< 0.060	-
		Q4	04-Dec-19	1	< 0.010	< 0.010	< 0.010	0.072	12.1	< 0.040	< 0.060	-
	2020	Q1	04-Feb-20	1	< 0.010	< 0.010	< 0.010	< 0.050	5.26	< 0.040	< 0.060	-
		Q2	11-May-20	1	< 0.010	< 0.010	< 0.010	< 0.050	3.83	< 0.040	< 0.060	-
		Q3	02-Sep-20	1	< 0.010	< 0.010	< 0.010	0.089	9.71	< 0.040	< 0.060	-
		Q4	07-Dec-20	1	< 0.010	< 0.010	< 0.010	0.045	7.99	< 0.010	< 0.010	-
	2021	Q1	03-Feb-21	1	< 0.010	< 0.010	< 0.010	0.057	10.3	< 0.010	< 0.010	-
		Q2	07-Apr-21	1	< 0.010	0.014	< 0.010	0.092	17.3	< 0.010	< 0.010	-
		Q3	22-Sep-21	2	< 0.010	< 0.010	< 0.010	0.091	10.8	< 0.010	< 0.010	-
		Q4	13-Dec-21	1	< 0.010	< 0.010	< 0.010	0.058	8.65	< 0.010	< 0.010	-
	2022	Q1	08-Feb-22	1	< 0.010	< 0.010	< 0.010	0.059	11.6	< 0.010	< 0.010	-
		Q2	06-Jun-22	1	< 0.010	< 0.010	< 0.010	0.037	4.2	< 0.010	< 0.010	-
		Q3	06-Sep-22	1	< 0.010	< 0.010	< 0.010	0.079	9.58	< 0.010	< 0.010	-
		Q4	07-Dec-22	1	< 0.010	< 0.010	< 0.010	0.06	11.4	< 0.010	< 0.010	-
LC_LC5 - Fording River below Line Creek (RG_FO23)	2017	Q1	14-Feb-17	1	-	0.009	-	0.225	36.2	< 0.025	< 0.030	-
		Q2	26-Jun-17	2	< 0.005	0.013	-	0.174	23.7	< 0.015	< 0.015	6.58
		Q3	08-Sep-17	11	0.024	0.016	-	0.259	30.8	< 0.015	< 0.015	8.76
		Q4	18-Dec-17	1	< 0.005	0.009	-	0.157	46.8	< 0.015	< 0.015	-
	2018	Q1	11-Mar-18	4	0.006	0.009	-	0.157	44.8	< 0.015	< 0.015	6.33
		Q2	30-Apr-18	3	< 0.010	< 0.010	-	0.153	27.6	< 0.040	< 0.060	7.88
		Q3	04-Jul-18	3	< 0.010	0.016	-	0.196	28.9	< 0.040	< 0.060	9.25
		Q4	02-Oct-18	3	< 0.010	< 0.010	< 0.010	0.207	40	< 0.040	< 0.060	9.72
	2019	Q1	07-Feb-19	4	< 0.010	< 0.010	< 0.010	0.147	44.5	< 0.040	< 0.060	6.37
		Q2	04-Jun-19	2	< 0.010	< 0.010	< 0.010	0.11	15.6	< 0.040	< 0.060	7.52
		Q3	03-Sep-19	2	< 0.010	0.022	< 0.010	0.314	34.6	< 0.040	< 0.060	8.42
		Q4	04-Dec-19	2	< 0.010	< 0.010	< 0.010	0.176	38.9	< 0.040	< 0.060	-
	2020	Q1	28-Jan-20	4	< 0.010	< 0.010	< 0.010	0.222	40.8	< 0.040	< 0.060	-
		Q2	06-Apr-20	2	< 0.010	0.011	< 0.010	0.196	39.9	< 0.040	< 0.060	7.9
		Q3	30-Aug-20	5	< 0.010	0.014	< 0.010	0.241	33.1	< 0.040	< 0.060	7.47
		Q4	05-Oct-20	2	< 0.010	0.016	< 0.010	0.218	41.7	< 0.040	< 0.060	7.19
	2021	Q1	05-Jan-21	1	< 0.010	< 0.010	< 0.010	0.154	42.8	< 0.010	< 0.010	-
		Q2	28-Apr-21	3	< 0.010	0.016	< 0.010	0.211	48	< 0.010	< 0.010	6.11
		Q3	14-Jul-21	5	< 0.010	0.016	< 0.010	0.194	30.8	< 0.010	< 0.010	8.34
		Q4	12-Oct-21	3	< 0.010	< 0.010	< 0.010	0.257	42.3	< 0.010	< 0.010	7.05
	2022	Q1	06-Jan-22	1	< 0.010	< 0.010	< 0.010	0.138	40.3	< 0.010	< 0.010	-
		Q2	18-Apr-22	4	0.011	0.013	< 0.010	0.213	48.6	< 0.010	< 0.010	6.83
		Q3	06-Sep-22	7	< 0.010	0.015	< 0.010	0.229	35.1	< 0.010	< 0.010	7.99
		Q4	11-Oct-22	3	< 0.010	< 0.010	< 0.010	0.203	39.2	< 0.010	< 0.010	-
RG_DSELK - Koocanusa below Elk	2017	Q2	06-Jun-17	4	< 0.005	< 0.005	-	0.035	1.51	< 0.015	< 0.020	-
		Q4	05-Dec-17	4	< 0.005	< 0.005	-	0.054	2.15	< 0.015	< 0.015	-
	2018	Q2	05-Jun-18	4	< 0.010	< 0.010	-	< 0.050	1.36	< 0.040	< 0.060	-
		Q3	04-Sep-18	1	< 0.010	< 0.010	< 0.010	< 0.050	0.841	< 0.040	< 0.060	-
		Q4	04-Dec-18	1	< 0.010	< 0.010	< 0.010	< 0.050	0.964	< 0.040	< 0.060	-
	2019	Q1	08-Mar-19	4	< 0.010	< 0.010	< 0.010	< 0.050	1.92	< 0.040	< 0.060	-
		Q2	18-Jun-19	4	< 0.010	< 0.010	< 0.010	< 0.050	1.49	< 0.040	< 0.060	-
		Q3	10-Sep-19	4	< 0.010	< 0.010	< 0.010	0.077	1.12	< 0.040	< 0.060	-
		Q4	03-Dec-19	1	< 0.010	< 0.010	< 0.010	< 0.050	0.716	< 0.040	< 0.060	-
	2020	Q1	25-Feb-20	3	< 0.010	< 0.010	< 0.010	0.058	2.11	< 0.040	< 0.060	-
		Q2	03-Jun-20	3	< 0.010	< 0.010	< 0.010	< 0.050	0.998	< 0.040	< 0.060	-
		Q3	01-Sep-20	3	< 0.010	< 0.010	< 0.010	< 0.050	0.955	< 0.040	< 0.060	-
		Q4	01-Dec-20	3	< 0.010	< 0.010	< 0.010	0.048	0.392	< 0.010	< 0.010	-
	2021	Q1	02-Mar-21	2	< 0.010	< 0.010	< 0.010	0.039	2.28	< 0.010	< 0.010	-
		Q2	03-Jun-21	3	< 0.010	< 0.010	< 0.010	0.014	0.293	< 0.010	< 0.010	-
		Q3	08-Sep-21	3	< 0.010	< 0.010	< 0.010	0.055	1.16	< 0.010	< 0.010	-
		Q4	07-Dec-21	3	< 0.010	< 0.010	< 0.010	0.030	1.18	< 0.010	< 0.010	-
	2022	Q2	03-May-22	1	< 0.010	< 0.010	< 0.010	0.061	2.53	< 0.010	< 0.010	-
		Q3	06-Sep-22	4	< 0.010	< 0.010	< 0.010	0.023	0.705	< 0.010	< 0.010	-
		Q4	01-Dec-22	4	< 0.010	< 0.010	< 0.010	0.047	1.56	< 0.010	< 0.010	-