DRAFT 2025 ELK VALLEY WATER QUALITY PLAN

This plan does not amend the approved
Elk Valley Area Based Management Plan (2014)
unless this plan is approved by the minister
under the Environmental Management Act.

Prepared by
Ministry of Environment and Parks
Environmental Protection Division
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May 2025

BRITISH COLUMBIA

Preface

Note: This Preface may be changed and revised as this document is finalized and/or after a decision is made by the minister.

This 2025 Elk Valley Water Quality Plan (2025 EVWQP) has been prepared for submission to the minister for approval as phase 1 of amendments to the Elk Valley Area Based Management Plan (ABMP) in response to Ministerial Order No. M232-2024 (Order M232) issued on July 9, 2024. The 2025 EVWQP fulfills the requirements set out in the Terms of Reference provided in Schedule B attached to Order M232. Upon its approval, this 2025 EVWQP will amend and replace the 2014 Elk Valley Water Quality Plan which was approved by the Minister of Environment on November 18, 2014 as the ABMP.

The 2025 EVWQP was developed from July 2024 to April 2025. The Ministry of Environment and Parks led its development. The ministry engaged with ʔaq̓am First Nation, ʔakisq̓nuk First Nation, yaqan nuʔkiy First Nation, and Yaq̓it ʔa·knuqɬi'it First Nation to prepare the 2025 EVWQP, as per an agreed upon process designed to advance British Columbia's commitments to reconciliation with Ktunaxa First Nations and implementing UNDRIP. Development of the 2025 EVWQP was also informed by input from an Advisory Committee that included representatives from provincial and federal governments, Ktunaxa First Nations, and industry.

The 2025 EVWQP outlines the ministry's commitments to manage the environment and reduce water quality impacts from effluent discharges while mining continues in the Elk Valley, and after mine closure. The 2025 EVWQP is organized into nine sections:

- Sections 1 and 2 provide introductory and background information.
- Section 3 includes a vision statement and the ABMP purpose.
- Section 4 describes the ABMP's goals, including outcomes, objectives and targets.
- Sections 5 and 6 provide an implementation strategy and describe area based management tools to support progress towards the goals.
- Section 7 describes how the ABMP is reviewed and kept relevant and effective.
- Section 8 includes a closing, and Section 9 provides a glossary of terms.

Nothing in this 2025 EVWQP should be construed as waiving compliance with any applicable statutory or other legal requirement. The 2025 EVWQP does not intend to make any determinations related to Aboriginal rights and interests. While the approved ABMP must be considered by Environmental Management Act directors and delegates of directors in making decisions related to effluent discharges in the Elk Valley, it is not intended to interfere with statutory decision maker obligations to fully assess the circumstances and implications of any proposed decisions. Authorization holders and

applicants are advised they must comply with all applicable federal, provincial and municipal enactments pertaining to their projects.

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Placeholder

Executive Summary

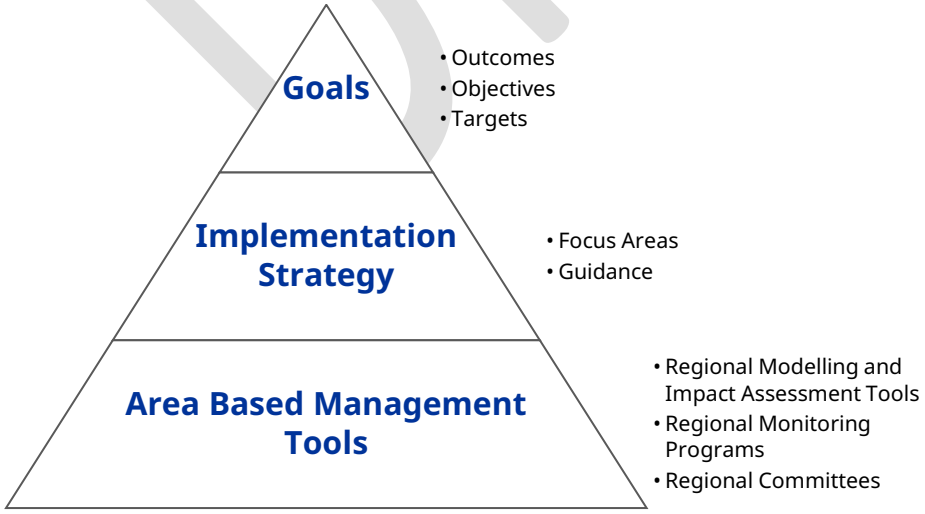
The Elk Valley is highly valued for providing significant economic, social and ecological benefits to those who live, work and spend time in the region. The 2014 Elk Valley Water Quality Plan (2014 EVWQP) was approved in 2014 under the Environmental Management Act (EMA) as the area based management plan for an area designated by a 2013 ministerial order. The 2014 EVWQP was intended to address deteriorating water quality conditions resulting from mining-related impacts in the watershed, including from historical mining activities.

The ABMP is a Ministry of Environment and Parks (ENV) policy that sets the current guidance for water quality management in the Elk Valley. It informs decision-making by directors and their delegates under the EMA. The ABMP guides water quality improvements in the Elk Valley while mining and its economic benefits continue and into the future after mining.

The vision for the Elk Valley Designated Area is for water quality that is safe for ʔa·kxaṁis ḳapi qapsin (All Living Things), supports healthy communities and ecosystems, and is protective of Ktunaxa rights and the uses and values of all who live in the watershed and have relationships with the water.

The ABMP is a regional plan that guides water quality improvements at a watershed scale towards the vision while mining continues and after mine closure. It focuses on protecting the overall health of aquatic ecosystems in the Elk River watershed. Specifically, the ABMP addresses water quality concentrations of selenium, nitrate, sulphate and cadmium, and the management of calcite accumulation.

As shown in the following figure, the ABMP establishes goals which are supported by an implementation strategy and area based management tools.

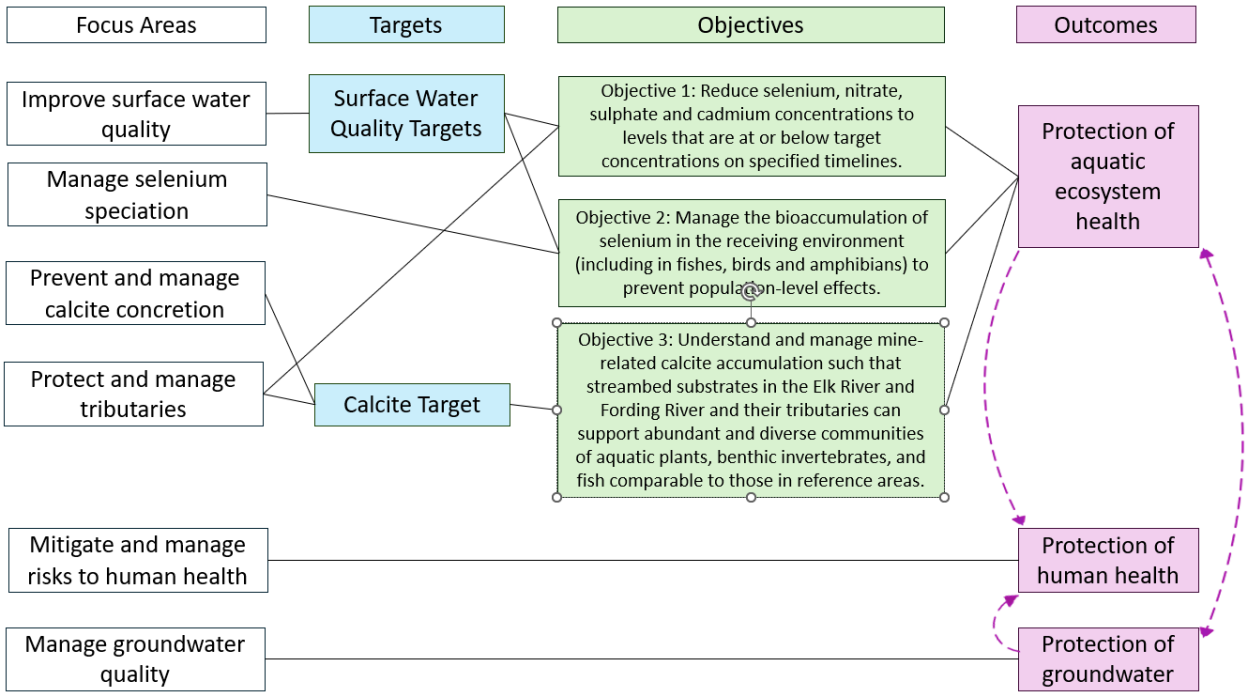


Goals include outcomes and objectives, as well as targets for selenium, nitrate, sulphate, cadmium, and calcite. The goals describe what the plan is to achieve in the longer term and in the nearer term. The goals inform statutory decision-making under the EMA and guide the regulation of effluent discharges into the Designated Area from current and future dischargers.

The plan's goals guide an implementation strategy which is designed around six focus areas:

- improve surface water quality
- manage selenium speciation
- prevent and manage calcite concretion
- protect and manage tributaries
- mitigate and manage risks to human health
- manage groundwater quality

The following figure shows linkages from the focus areas to the ABMP's goals.



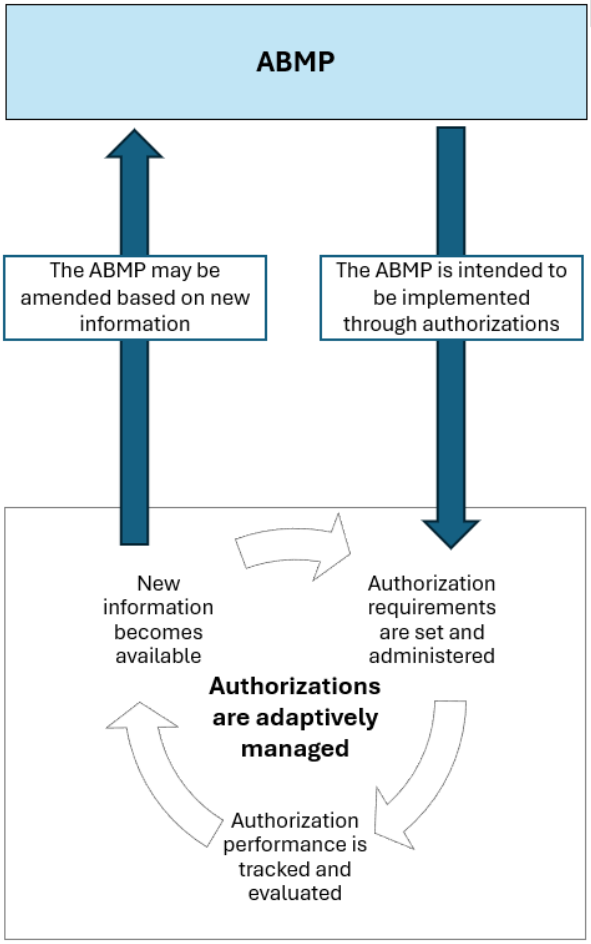
The ABMP provides guidance to ministry statutory decision makers. In the Elk Valley, the ABMP applies in addition to the ministry's usual province-wide regulatory and policy framework for the management of effluent discharges. The ABMP is a major policy considered by statutory decision makers, in addition to other laws and policies, when exercising discretionary authority under the EMA.

While the implementation strategy provides guidance to statutory-decision makers, it also recognizes that addressing water quality is a shared responsibility. Successful

implementation of the ABMP requires the participation of many parties working to make progress in each of the focus areas. The ABMP informs efforts by governments, dischargers, Ktunaxa First Nations and others to respond to water quality issues.

The ABMP also depends on there being a shared understanding of regional tools used for area based management. The ABMP's regional tools include models and impact assessment tools, programs, and committees. These tools help manage the environment consistently and adaptively on a regional basis with coherence among many discharges aligned with the goals of the ABMP.

The ABMP is intended to adapt and respond to new information, including information from authorizations as shown in the figure below. This plan is expected to be modified in the future as required to incorporate new information to ensure it remains relevant and effective.



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1. Introduction

The Elk Valley is located in the Rocky Mountains of southeastern British Columbia, 60 kilometres west of Alberta and north of the United States (Figure 1). The Elk Valley is situated within the homelands of the Ktunaxa peoples. Figure 1 shows the Ktunaxa communities of ʔaq̓am, ʔakisq̓nuk First Nation, yaqan nuʔkiy First Nation, and Yaq̓it ʔa·knuqƛ̓i'it First Nation.

To the Ktunaxa peoples, the Elk Valley is also known as **Qukin ʔamakʔis**, meaning Raven's Land. The Ktunaxa peoples have lived in Qukin ʔamakʔis for more than 10,000 years and have been stewards of ʔamak (land), wuʔu (water), and ʔa·kxaḿis q̓api qapsin (All Living Things).

The Elk Valley watershed is drained by the Elk River. The Elk River flows from north to south into the Kootenay River at Koocanusa Reservoir which straddles the United States border. The Elk River supplies drinking water, supports recreation and industry, and provides important habitat for fish, plant and wildlife species unique to the region.

Words highlighted in bold when they first appear are defined in the glossary in Section 9.2.

The Elk Valley has a diverse economy primarily based on tourism, mining and forestry. Coal mining is the primary economic driver in the region and contributes significantly to the provincial and Canadian economies. In 2022[1], Elk Valley coal mining made up roughly 59% of British Columbia's mining sector gross domestic product, and produced approximately 85% of Canada's steelmaking coal. Approximately one in five jobs in the East Kootenay region and 80% of southeast B.C.'s regional gross domestic product depend on these coal mines[1].

Coal mines have operated in the Elk Valley since 1898. Mining operations prior to 1970 were small and mostly underground. In the 1970s, mining transitioned to larger scale open pit (surface) mining. Waste rock generation has increased significantly since the 1970s, with the creation of valley-fill waste rock areas. Waste rock is the biggest source of selenium, nitrate and sulphate in water in the Elk Valley.

[1] Data source: Deloitte LLP report to the BC Chamber of Commerce, Economic Contribution Analysis of Mining Operations in the Elk Valley, January 2022

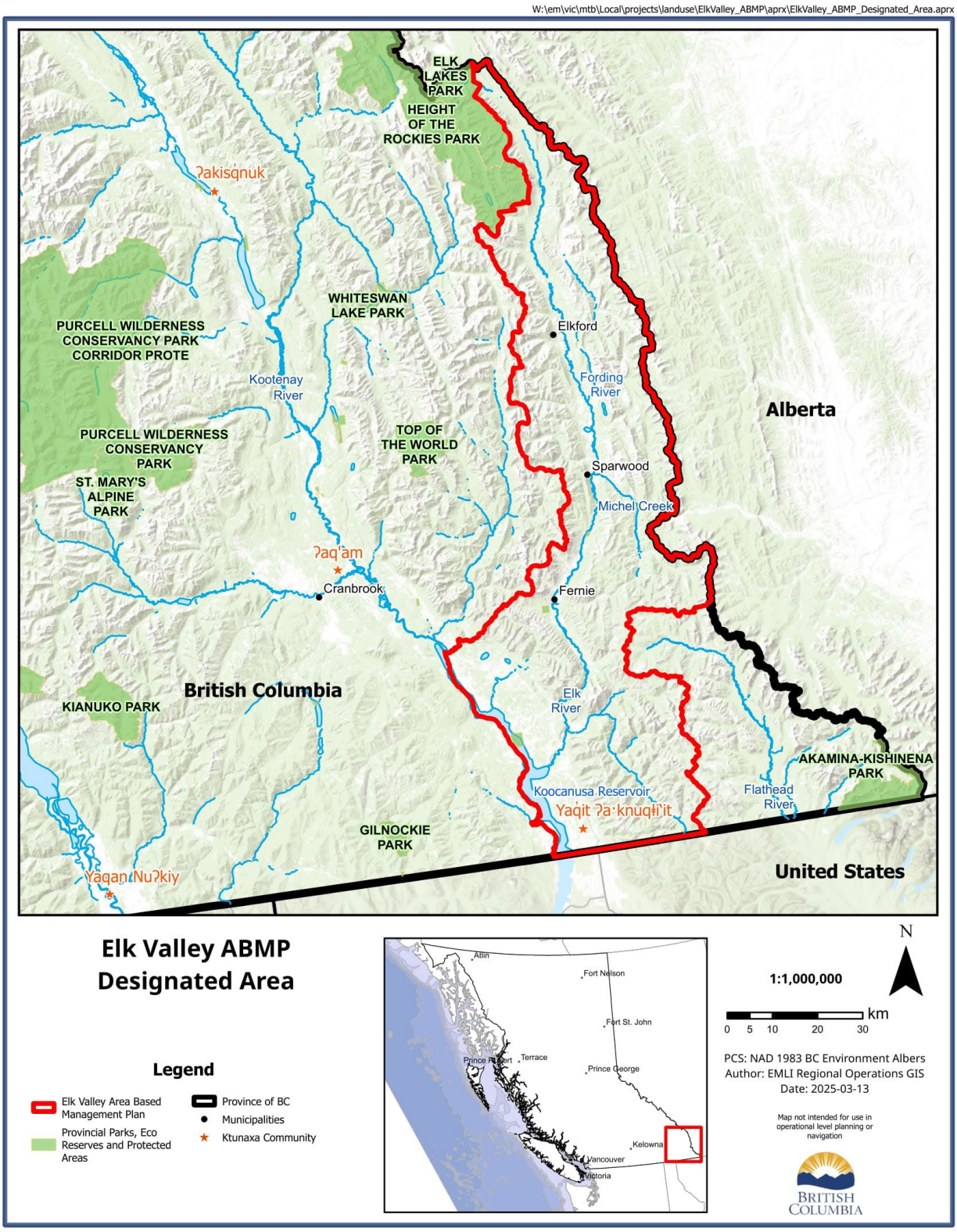


Figure 1: Area Based Management Plan Designated Area

In the 1990s, increasing levels of selenium, nitrate and sulphate were found in water downstream of the mines. The increases were found to be resulting from extensive disturbance to land and water associated with mining, and large volumes of waste rock being generated at the mines. Calcite formation was also discovered in some streams close to the mines.

In 2013, in response to increasing concentrations of contaminants above provincial water quality guidelines, and evidence of calcite formation in some watercourses, the Minister of Environment required development of an area based management plan for an area that included the Elk Valley. An **area based approach** was deemed necessary for setting in-stream water quality **targets**, in addition to usual end-of-pipe discharge **limits**, given the extent of mine development and the number of point and non-point sources of mine-related effluent discharges to mainstem rivers.

The Elk Valley **Area Based Management Plan (ABMP)** has been in place under the **Environmental Management Act (EMA)** since 2014. Since then, the Province of British Columbia has set expectations stemming from the ABMP for mining companies to take actions and make investments to improve water quality in parallel with their ongoing mining. Many of these improvements have been overseen by the Ministry of Environment and Parks, including through decision-making under the EMA, and with support from other provincial agencies.

The ABMP has guided and supported efforts by industry, government, Ktunaxa and others to respond to water quality issues. The ABMP has been used by the ministry to manage where there have been uncertainties and to take actions towards improving water quality. It has driven and continues to drive investments in new and improved technologies and practices by **dischargers**. Studies and monitoring have improved the understanding of aquatic ecosystem health, and comprehensive research and development programs are advancing new technologies and approaches to further improve water quality.

The ministry is committed to continued progress towards the long-term vision for the Elk Valley (see Section 3). The ABMP guides actions and decisions that align with its goals. As existing mines move through their life cycles towards closure and reclamation, and as new mines and expansions are contemplated, the ABMP will be essential to inform decision-making about economically important activities while **protection** of human health and the environment remains a priority consideration under the EMA.

2. Background

The Elk Valley has a unique history and regulatory framework. The Elk Valley is the only area in British Columbia with an area based management plan. The **2014 Elk Valley Water Quality Plan (2014 EVWQP)** was approved in 2014 as the area based management plan for the Elk Valley. The 2014 EVWQP intended to address deteriorating water quality conditions resulting from discrete and cumulative effects of numerous point and non-point sources of mine-influenced discharges from extensive and historical mine development in the watershed.

In 2024, the minister required an amendment to the Elk Valley ABMP, leading to development of this **2025 Elk Valley Water Quality Plan (2025 EVWQP)**.

This section describes the development of the Elk Valley area based management plan and how the ABMP applies in the Elk Valley.

2.1. Development of the ABMP from 2013 to 2014

2.1.1. Ministerial Order No. M113-2013

Ministerial Order No. M113-2013 (**Order M113**) was issued on April 15, 2013 by the Minister of Environment. Order M113 required development of an area based management plan for a geographic area that included all of the Elk Valley watershed. This area is called the **Designated Area**. The order was issued because it had become difficult to make decisions about continued and expanded mining in the Elk Valley in the absence of a plan to manage cumulative effects from ongoing and historical mining activities (see Appendix A).

Order M113 was issued under Section 89 of the Environmental Management Act (EMA) to Teck Coal Limited (Teck Coal; now called EVR Operations Limited), owner of the active coal mines in the Elk Valley. Order M113 required Teck Coal to prepare an area based management plan that would improve water quality and guide future mine development. Order M113 established requirements to be addressed by the plan and identified outcomes and objectives to be achieved through implementation.

The Designated Area established by Order M113 is shown in Figure 1. It includes all of the Elk River watershed, including the catchments of operating, closed, and proposed coal mines in the Elk Valley. It is roughly bounded by the Canada-United States border to the south, Flathead River watershed boundary to the southeast, Alberta-B.C. provincial boundary to the northeast, Elk Lake Provincial Park and Height of the Rockies Provincial Park to the northwest, and the height of land on the west boundary of the Elk River watershed to the west. The Designated Area includes the Canadian portion of Koocanusa

Reservoir (gazetted name Lake Koocanusa), an engineered impoundment on the Kootenay/Kootenai River formed by construction of the Libby Dam in the United States in 1972, and parts of B.C. to the east of Koocanusa Reservoir that drain directly to the reservoir. The metes and bounds of the Designated Area are set out in Schedule A of Order M113.

Order M113 required the area based management plan to describe actions to immediately begin to stabilize and then reduce water quality concentrations of selenium, nitrate, sulphate, and cadmium, and to reduce the rate of calcite formation. These specific **parameters of concern** are known as the **Order parameters**:

- Selenium,
- Nitrate,
- Sulphate,
- Cadmium, and
- Calcite.

The first four Order parameters were chosen for **area based management** in the Designated Area as they were associated with numerous dispersed mining-related sources and were present, or predicted to be present, in surface water at elevated concentrations having the potential to affect aquatic ecosystems. An area based approach was necessary to manage the cumulative effects of these four parameters at a regional scale.

Calcite is an Order parameter and was included for area based management under Order M113 as it was being measured in a number of streams, was potentially impacting aquatic ecosystems, and was associated with mining-related sources. Science and understanding about calcite management was also new and developing at the time. An area based approach was necessary to manage calcite in the Designated Area.

2.1.2. 2014 EVWQP

The 2014 Elk Valley Water Quality Plan (2014 EVWQP) was prepared by Teck Coal in response to Order M113. It was developed over a twelve-month period from July 2013 to July 2014. The 2014 EVWQP was developed by Teck Coal's qualified professionals with review and input from a nine-member technical advisory committee. The committee included representatives from the Ktunaxa Nation Council, the provincial government, the federal government, the United States federal government, and the Montana state government, as well as an independent third-party qualified professional. The public was invited to provide feedback during the plan's development, both online and during 11 in-person meetings.

The 2014 EVWQP compiled and assessed science and technology, used impact assessment, risk assessment and planning tools, identified water quality targets at sites throughout the watershed (see Sidebar 1), identified a water management and treatment strategy to meet water quality targets, and identified calcite targets and a management strategy. The 2014 EVWQP also set interim achievable targets to progressively reduce water quality concentrations of selenium and nitrate within timeframes relative to the 2014 EVWQP. The 2014 EVWQP included commitments to research and develop water quality management options, monitor water quality and aquatic health, consider the latest data and science for **adaptive management**, and to report and consult with Ktunaxa First Nations, interested parties and the public.

Teck Coal submitted the 2014 EVWQP to the Minister of Environment on July 22, 2014. The minister approved the 2014 EVWQP on November 18, 2014 as the area based management plan for the Designated Area.

Appendix A includes Order M113, the 2014 EVWQP, and the 2014 approval letter. The 2014 EVWQP provides context for the development and much of the science and assessment underlying the basis of the ABMP and is thus included as an appendix.

Sidebar 1: Target Development in the 2014 EVWQP

Order M113 required targets and timelines to be developed for selenium, nitrate, sulphate and cadmium at specific locations in the Elk River, Fording River and Koocanusa Reservoir. Surface water quality targets and timelines were developed under the 2014 EVWQP following a three-step process.

- First, long-term targets were identified. Many of the long-term targets were set at the B.C. water quality guidelines (BCWQGs) for the protection of freshwater aquatic life. Others were determined using site-specific **effects benchmarks** and integrated effects calculations. Achievability also informed target development. More information about target development is provided in Sidebar 2 following Table 3 in Section 4.3.1.
- Where the long-term targets could not immediately be achieved, timelines for when long-term targets could be met were selected based on predictions of the soonest that treatment and other measures to improve water quality could be applied.
- Finally, short- and medium-term targets and timelines were established to support timely progress towards the long-term targets.

This process did not apply to the long-term selenium target for Koocanusa Reservoir, as it was established by Order M113 which adopted the BCWQG for the protection of freshwater aquatic life, the most sensitive designated use.

Sidebar 1, continued

Order M113 also required development of medium-term and long-term targets for calcite. Calcite targets were developed under the 2014 EVWQP based on site-specific studies and monitoring data. Reference areas were identified, and calcite measurement was established using a calcite index.

The calcite index was a new approach at that time for measuring and monitoring calcite accumulation and concretion, as there was no previously established methodology. Medium-term and long-term calcite targets were identified in the 2014 EVWQP. The targets were based on the new methods to measure calcite concretion and presence and to calculate a calcite index.

The 2014 EVWQP stated that the long-term calcite target would be reviewed as more data became available and referred to the long-term calcite target as an interim target. The 2014 EVWQP acknowledged that uncertainties remained and would be resolved through calcite treatment piloting and implementation, calcite monitoring, and aquatic effects studies.

Refer to Chapters 7 and 8 of the 2014 EVWQP (Appendix A) for more information about the target development process.

2.2. Development of the 2025 EVWQP

On July 9, 2024, the Minister of Environment and Climate Change Strategy issued Ministerial Order No. M232-2024 (**Order M232**) requiring the ministry to prepare amendments to the ABMP in two phases (Appendix B). This was the first time the ABMP would be amended since it was approved in 2014.

This document, the 2025 EVWQP, has been prepared by the ministry in response to Order M232. The 2025 EVWQP incorporates the first phase of amendments including requirements specified in Schedule B of Order M232. The 2025 EVWQP includes the following general changes from the 2014 EVWQP:

- structuring the ABMP with a ministry policy framework to replace the 2014 EVWQP prepared by industry,
- introducing a vision statement for water quality in the Designated Area,
- clarifying the ABMP goals,
- updating the calcite target to reflect new science,

- providing an implementation strategy to continue making progress towards the goals and vision,
- clarifying how the ABMP applies to all dischargers in the Elk Valley,
- describing the broader regulatory framework for water quality decision-making in the Elk Valley, including how the ABMP works alongside **permits**,
- providing transparency into how the goals of the ABMP guide statutory decision-making by the ministry to improve water quality, and
- describing a process to update the ABMP to stay relevant as mining continues in the Elk Valley.

The 2025 EVWQP was developed in collaboration with Ktunaxa First Nations and was informed by input from an advisory committee. Organizations represented on the advisory committee included provincial and federal governments, Ktunaxa First Nations, and industry.

The 2025 EVWQP will be submitted to the minister for approval. As of the date it is approved by the minister, the 2025 EVWQP will amend and replace the 2014 EVWQP as the ABMP for the Designated Area.

2.3. Regulatory Framework for Effluent Discharges in the Elk Valley

A stringent regulatory system governs the **discharge** of effluent into the environment in British Columbia.

The EMA regulates the introduction of waste, including effluent, into the environment in a manner that protects human health and the environment. Effluent discharges can only occur in accordance with requirements in the EMA and its associated regulations, and waste discharge **authorization(s)** may need to be in place. In addition to meeting EMA requirements, new projects with effluent discharges may also require assessments and/or authorizations under other provincial legislation, such as the Environmental Assessment Act. Federal acts and regulations also apply.

Ministry staff who are designated under the EMA as directors or delegates of directors are referred to as **statutory decision makers (SDMs)**. SDMs are empowered by the EMA to authorize effluent discharges into the environment through issuance of authorizations, such as permits. When making decisions under the EMA, SDMs consider laws and policies. Since 2014, the ABMP has been a major policy of the Ministry of Environment and Parks which SDMs must consider when making decisions related to water quality in the Designated Area. This requirement was established on November 18, 2014 when the Minister of Environment provided direction to ministry staff under Section 90(2) of the EMA (Table 1). The ABMP is also expected to inform other decision-making in the Elk Valley.

It also provides guidance for dischargers and interested parties in relation to mine planning, development, operations and closure, including environmental protection and restoration efforts in the Elk Valley.

Table 1 lists specific area based management provisions under the EMA that have been applied in the Elk Valley. EMA provisions for area based management have existed since 2004 when the EMA took effect, with the exception of the provisions listed in the bottom two rows of Table 1, which came into effect in 2016.

Table 1: Area Based Management of the Elk Valley under the EMA

EMA Provision	Reference
Section 89 The minister may require development of an area based management plan if it is advisable for the purposes of environmental management in an area.	On April 15, 2013, the minister issued Ministerial Order No. M113-2013.
Section 90(1) The minister may approve with or without amendment, an area based management plan ordered under Section 89.	On November 18, 2014, the minister approved the ABMP.
Section 90(2) The minister may require persons making decisions or classes of decisions under the EMA to consider the plan in making the decisions, for the purpose of implementing the approved plan.	On November 18, 2014, the minister ordered that any decisions or classes of decisions undertaken by an SDM take into consideration the ABMP.
Section 90.1 (came into effect May 19, 2016) If an approved area based management plan provides for the introduction of waste, then the minister may require a director under the EMA to issue a permit authorizing the introduction of waste.	This section of the EMA did not exist in 2014. On November 19, 2014, and although not required by the minister, EMA Permit 107517 was issued by the director under Section 14 of the EMA.
Section 90.2 (came into effect May 19, 2016) The minister may require amendment to an approved area based management plan if it is advisable for the purposes of environmental management in an area.	On July 9, 2024, the minister issued Ministerial Order No. M232-2024 requiring an amendment to the ABMP. The 2025 EVWQP is prepared in response to this order.

After the ABMP was approved, EMA Permit 107517 was issued to Teck Coal Limited (now called EVR Operations Limited) under the EMA. As Section 90.1 did not exist in 2014, the permit was issued by the director under Section 14 of the EMA.

EMA Permit 107517 authorized discharges of Order parameters of selenium, nitrate, sulphate and cadmium from all five operating coal mines at the time within the Elk Valley and turned many commitments Teck Coal Limited made in the 2014 EVWQP into legally

binding requirements. For example, the permit incorporated requirements for water quality limits, water quality planning, water quality modelling, monitoring, adaptive management, reporting, and research and development. EMA Permit 107517 also included requirements for calcite management.

EMA Permit 107517 exists in addition to other site-specific EMA authorizations issued to individual mine sites in the Elk Valley to authorize discharges of other wastes, including effluent, air discharges and refuse. So overall, authorizations in the Elk Valley include site-specific permits as well as the valley wide EMA Permit 107517.

2.4. Effect of Area Based Management

The ABMP sets a unique approach to address the historical and regional extent of water quality issues resulting from a large number of effluent discharges from mines. It provides a framework to guide ongoing and future mine planning, development, operations and closure in relation to the Order parameters. The ABMP is a plan for managing water quality at a watershed scale, with a focus on protecting aquatic ecosystems in the Elk River watershed.

The ABMP framework also provides a basis for managing cumulative effects on regional water quality in the Designated Area. It directly supports the Elk Valley Cumulative Effects Management Framework by addressing cumulative effects from effluent discharges of the Order parameters and how they influence aquatic ecosystems. The Elk Valley Cumulative Effects Management Framework is part of the Provincial Cumulative Effects Framework and it aims to assess the historical, current and future conditions of selected valued components and to support natural resource management decisions.

The ABMP provides a layer of oversight and scrutiny in the Elk Valley, beyond the usual regulatory framework under the EMA. This additional layer is necessary to mitigate cumulative effects and ensure water quality is improved and continues to be protected while mining activities are ongoing and after closure.

With the ABMP, surface water quality for the Order parameters of selenium, nitrate, sulphate and cadmium is managed on a regional scale across the Designated Area. Regional water quality targets in the ABMP inform the setting of discharge-specific effluent discharge limits that are coordinated with each other and that collectively contribute to managing overall regional water quality. This approach is different from the usual EMA regulatory framework, where effluent discharge limits are typically set at the point of discharge into the **receiving environment** without necessarily considering additional regional management goals or coordination with other discharges.

Similarly, for calcite, the ABMP addresses management of calcite accumulation on a regional basis by setting regional management goals.

Parameters of concern not identified for area-wide management under the ABMP are addressed under the ministry's usual regulatory framework under the EMA. This means that **non-Order parameters** discharged in effluent are evaluated and managed at a local site-specific scale. The region-wide and area based management approach applicable to Order parameters under the ABMP does not directly apply to non-Order parameters.

Order M113 set expectations for the unique approach to area based management of the Order parameters and water quality in the Designated Area. While protection of human health and the environment remains a priority consideration under the EMA, the ABMP also incorporates important concepts that are fundamental to how waste discharges are regulated throughout British Columbia:

- The ABMP provides sustainable solutions by seeking to balance environmental, economic, and social needs now and into the future.
- The ABMP takes a risk-based approach.
- The ABMP manages cumulative effects on aquatic ecosystems and considers the combined impact of past, present and reasonably foreseeable future effluent discharges, recognizing that the watershed has a finite capacity.
- The ABMP promotes pollution prevention and seeks to avoid generation of waste, before treating waste.
- The ABMP advances stewardship by striving to minimize effluent discharges and protecting water quality in areas not currently impacted by mining.
- The ABMP supports restoration of values in impacted areas.
- The ABMP promotes using the best science towards achievable solutions and relies on implementation of **best achievable technologies.**
- The ABMP has a foundation in adaptive management to drive **continuous improvement** of regional water quality and manage uncertainty.
- The ABMP promotes shared responsibility and collective action to achieve its goals.

The area based management approach provided in the ABMP is extended to permits under the EMA. EMA Permit 107517 is the first of its kind in British Columbia because it applies to 5 mines. It accounts for point and non-point source discharges and sets limits in the receiving environment, rather than at every discharge location, to align with ABMP surface water quality targets. EMA Permit 107517 includes legally binding compliance limits for selenium, nitrate and sulphate for each mine site, as applicable, and also reflects the ABMP water quality targets. Calcite requirements in EMA Permit 107517 also align with the ABMP's goals for calcite.

The intention of the ABMP is that EMA Permit 107517 will be adaptively managed, as will any other authorizations issued under the EMA in consideration of the ABMP. This means that permit requirements may change over time in response to new data and information. Depending on the nature of new data and information and any changes to a permit, there could be a need to change the ABMP so that it stays relevant and effective. Together, the ABMP and related permits support adaptive management in the Elk Valley. Adaptive management is a systematic process for continually improving management and practices to meet objectives by learning from the outcomes of operational, monitoring, and research and development programs. Figure 2 shows how adaptive management of authorizations like EMA Permit 107517 inform adaptive management of the ABMP. Similarly, any changes to the ABMP could influence authorizations in the Designated Area and could require consequential authorization updates (see Section 7).

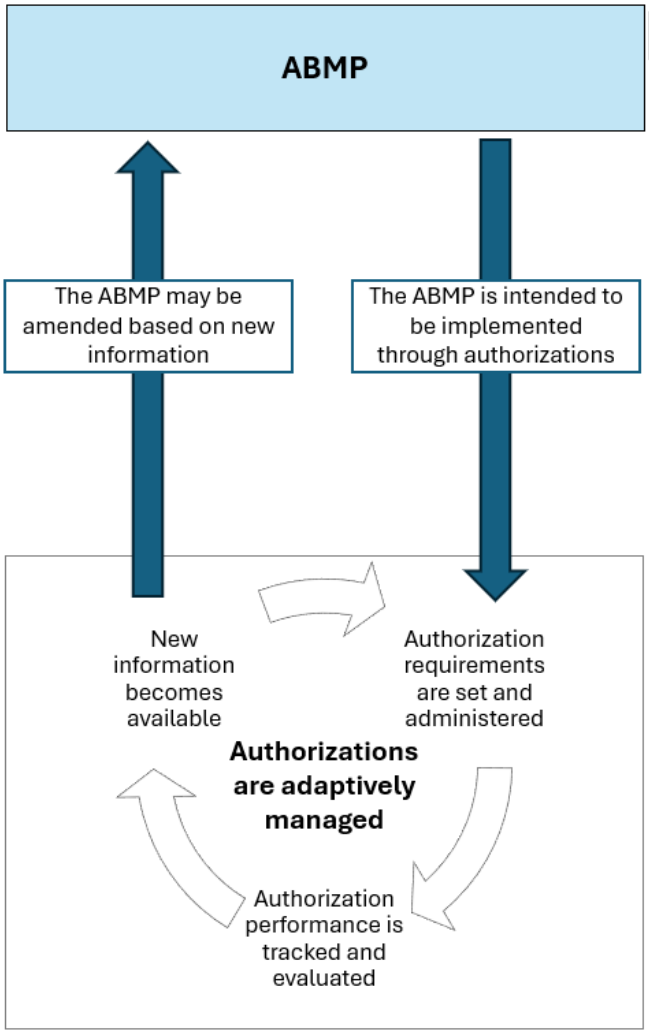


Figure 2: Adaptive Management of the ABMP and Authorizations Under the EMA

3. Vision Statement and ABMP Purpose

The vision for the Designated Area is for water quality that is safe for ʔa·kxaw̓is q̓api qapsin (All Living Things), supports healthy communities and ecosystems, and is protective of Ktunaxa rights and the uses and values of all who live in the watershed and have relationships with the water.

The vision will be advanced through the ABMP and its goals, including the B.C.-Ktunaxa shared multigenerational continuous improvement outcomes (see Section 4.1). This progress occurs while mining and other activities in the watershed are ongoing such that the social and economic benefits can be realized while advancing towards the vision.

The ABMP will make progress towards the vision through B.C. and Ktunaxa working together towards shared decision-making including the application of ʔaknumuɂtiɬɬ (Ktunaxa Natural Law).

The ABMP **purpose** given in Order M232 is for the ministry to establish environmental outcomes and objectives, including targets for selenium, nitrate, sulphate, cadmium, and calcite, in the Designated Area that will:

- remediate the effects from past activities that are impacting the Elk River watershed by improving water quality, and
- guide the regulation of effluent discharges into the Designated Area from current and future mining and other dischargers.

4. Goals

The goals of the ABMP are represented by **outcomes**, **objectives** and targets. Outcomes are the ABMP's ultimate results and describe a desired long-term future state for the Designated Area. Objectives represent progress towards the outcomes, and targets are measurable and achievable indicators related to the objectives.

The ABMP's goals contribute to the ABMP's purpose and strive to achieve the vision described in Section 3. The goals guide statutory decision-making and the implementation strategy provided in Section 5 and are supported by the area based management tools described in Section 6.

Figure 3 shows how the goals of the ABMP are supported by the implementation strategy and regional tools.

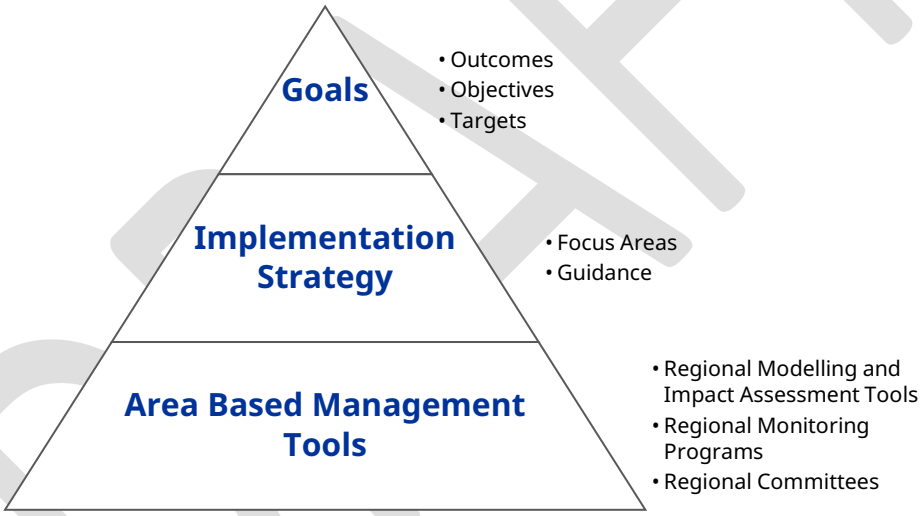


Figure 3: ABMP Framework

The ABMP outcomes and objectives were originally established in 2013 by Order M113 and in the 2014 EVWQP and are carried forward and clarified in Sections 4.1 and 4.2, as required by Order M232.

4.1. Outcomes to be Achieved

Three broad environmental management outcomes (outcomes) apply to the ABMP. The outcomes are:

- Protection of aquatic ecosystem health,
- Protection of human health, and
- Protection of groundwater.

These outcomes define the conditions that the ministry wishes to ultimately achieve and maintain over the long-term in the Elk River watershed. The outcomes seek to support the well-being of the peoples and communities that rely on the land, water, wildlife, and resources of the Designated Area.

Further detail about achievement of the ABMP outcomes is provided by the **multigenerational continuous improvement outcomes** that were developed by the ministry and Ktunaxa in 2014 at the conclusion of the 2014 EVWQP development and review process. They were called multigenerational outcomes because it was recognized that it could take several generations of time to fully achieve the outcomes at all locations. It was agreed that shared, longer term narrative statements are important to guide longer term (multigenerational) decision-making about water quality in the Designated Area.

The British Columbia – Ktunaxa shared multigenerational continuous improvement outcomes are:

- **Receiving waters** located within the Elk Valley and Koocanusa Reservoir shall be of sufficient quality to support, maintain, and, where necessary, restore the following designated uses: drinking water supplies, recreation and aesthetics, aquatic life, wildlife and agriculture.
- Receiving waters in the Elk Valley shall not be acutely or chronically toxic to fish, invertebrates, or plants.
- Exposure to bioaccumulative contaminants in receiving waters in the Elk Valley shall not result in adverse effects on the survival, growth, biomass, or reproduction of aquatic invertebrates, fish, amphibians, or birds.

Figure 4 shows how the multigenerational continuous improvement outcomes link to the ABMP outcomes. The linkages reflect that progress towards an ABMP outcome may reflect progress toward one or more multigenerational continuous improvement outcomes, and vice versa.

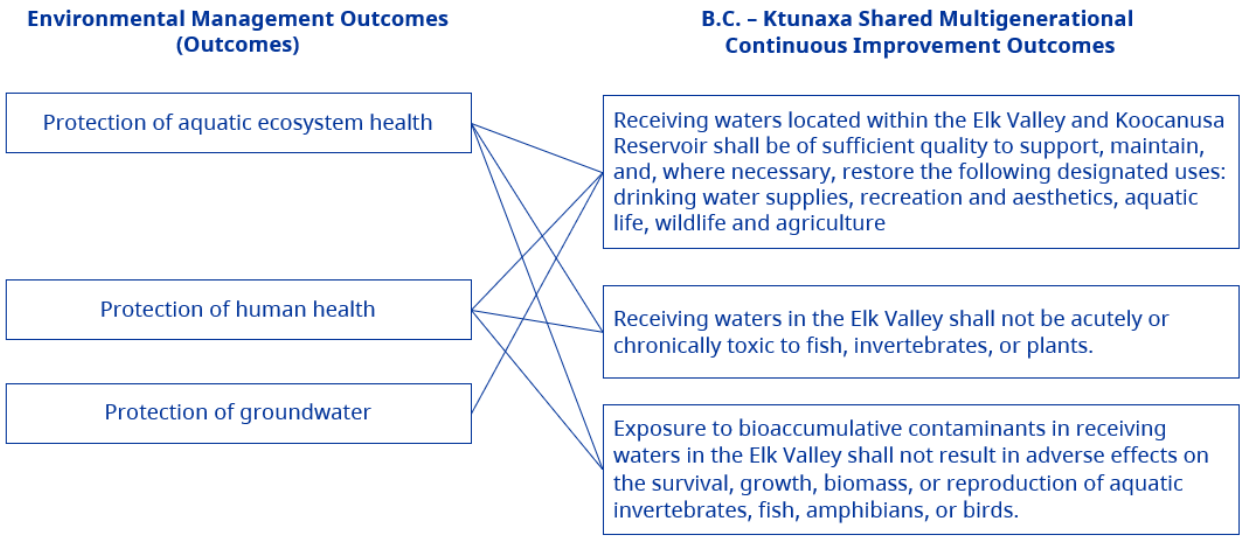


Figure 4: Linkages between ABMP Outcomes and B.C.-Ktunaxa Shared Multigenerational Continuous Improvement Outcomes

4.2. Objectives

Environmental management objectives (objectives) represent progress towards attaining the outcomes of the ABMP. While an outcome is general and longer term, an objective is more defined and nearer term and may include specific measurable targets.

The ABMP includes three objectives:

- Objective 1: Reduce selenium, nitrate, sulphate and cadmium concentrations to levels that are at or below target concentrations on specified timelines.

- Objective 2: Manage the bioaccumulation of selenium in the receiving environment (including in fishes, birds and amphibians) to prevent population-level effects.

  (This objective is evaluated by making comparisons to conservative effects benchmarks derived from lab-based studies, and applying spatial and temporal considerations to ensure that measurable effects to populations at the management unit scale are avoided).

- Objective 3: Understand and manage mine-related calcite accumulation such that streambed substrates in the Elk River and Fording River and their tributaries can support abundant and diverse communities of aquatic plants, benthic invertebrates, and fish comparable to those in reference areas.

The three objectives originated in and are derived from the 2014 EVWQP and are clarified above as required by Order M232. The three objectives relate directly to the outcome for protection of aquatic ecosystem health, which was identified as being at immediate risk at that time. Objectives specific to the protection of human health and groundwater were not developed in the 2014 EVWQP because further work was needed to understand the risks that Elk Valley water quality could pose to human health and groundwater.

The 2014 EVWQP is premised on an expectation that improving surface water quality also supports protection of human health and groundwater in the populated areas of the Elk Valley, since groundwater and surface water are linked (See Appendix A, Section 5.1.2 of the 2014 EVWQP). Improvements to surface water and reduced selenium bioaccumulation in fish reduce risks to human health. Surface water-groundwater interactions suggest that improvements to surface water also contribute to lowering potential risks to groundwater. As a result, the three environmental management objectives guide progress towards achieving all three outcomes.

4.3. Targets

A target is a specific measurable and achievable value for an Order parameter. Targets may be based on provincial water quality guidelines or developed from site-specific and science-based effects benchmarks and integrated effects analyses, or developed in other ways. The ABMP currently includes numerical targets for all Order parameters.

The targets for selenium, nitrate, sulphate and cadmium are surface water quality targets that articulate specific measurable water quality concentrations and support the ABMP's objectives to improve surface water quality and manage bioaccumulation (Objectives 1 and 2). The surface water quality targets are to be achieved at specified locations by specified timelines. Section 4.3.1 and Tables 2 and 3 provide information about these targets.

The calcite target articulates specific measurable streambed attributes to support the ABMP's objective to manage calcite accumulation (Objective 3). The calcite target applies in stream reaches in the receiving environment that are not authorized to be buried under an Environmental Assessment Certificate or Mines Act Permit. Section 4.3.2 and Table 7 provide information about the calcite target.

4.3.1. Surface Water Quality Targets

Surface water quality targets for selenium, nitrate, sulphate and cadmium apply at seven receiving environment water quality monitoring sites known as **Order stations**. The stations are located downstream of coal mining activities. Two stations are in the Fording River, four stations are in the Elk River, and one station is in Koocanusa Reservoir. The Fording River flows into the Elk River, which ultimately flows into the Kootenay River at Koocanusa Reservoir, so the Order station at Koocanusa Reservoir is the furthest downstream station.

Table 2 lists the seven Order stations and Figure 5 shows the Order station locations in relation to existing and proposed coal mines.

Table 2: Order Stations

Order Station Identifier	Ministry Site Identification Number	Monitoring Site Description	Coordinates (Latitude, Longitude)
FR4	0200378	Fording River downstream of Greenhills Creek	50.0423 N, 114.8615 W
FR5	0200028	Fording River at the mouth (downstream of Line Creek and Josephine Falls)	49.8931 N, 114.8699 W
ER1	E206661	Elk River downstream of Greenhills Operations (upstream of Boivin Creek)	50.0242 N, 114.9156 W
ER2	0200027	Elk River downstream of the Fording River (upstream of Grave Creek)	49.8665 N, 114.8687 W
ER3	0200393	Elk River downstream of Michel Creek	49.7332 N, 114.8995 W
ER4	E294312	Elk River at Elko Reservoir	49.2934 N, 115.1057 W
LK2	E300230 E327371 E327372 E237373 E327374	Koocanusa Reservoir south of the mouth of the Elk River (downstream of the Elk River). Monitoring occurs at multiple depths at 5 locations along a transect with 125 m spacing.	49.1497 N, 115.2580 W 49.1484 N, 115.2530 W 49.1487 N, 115.2546 W 49.1493 N, 115.2579 W 49.1497 N, 115.2596 W

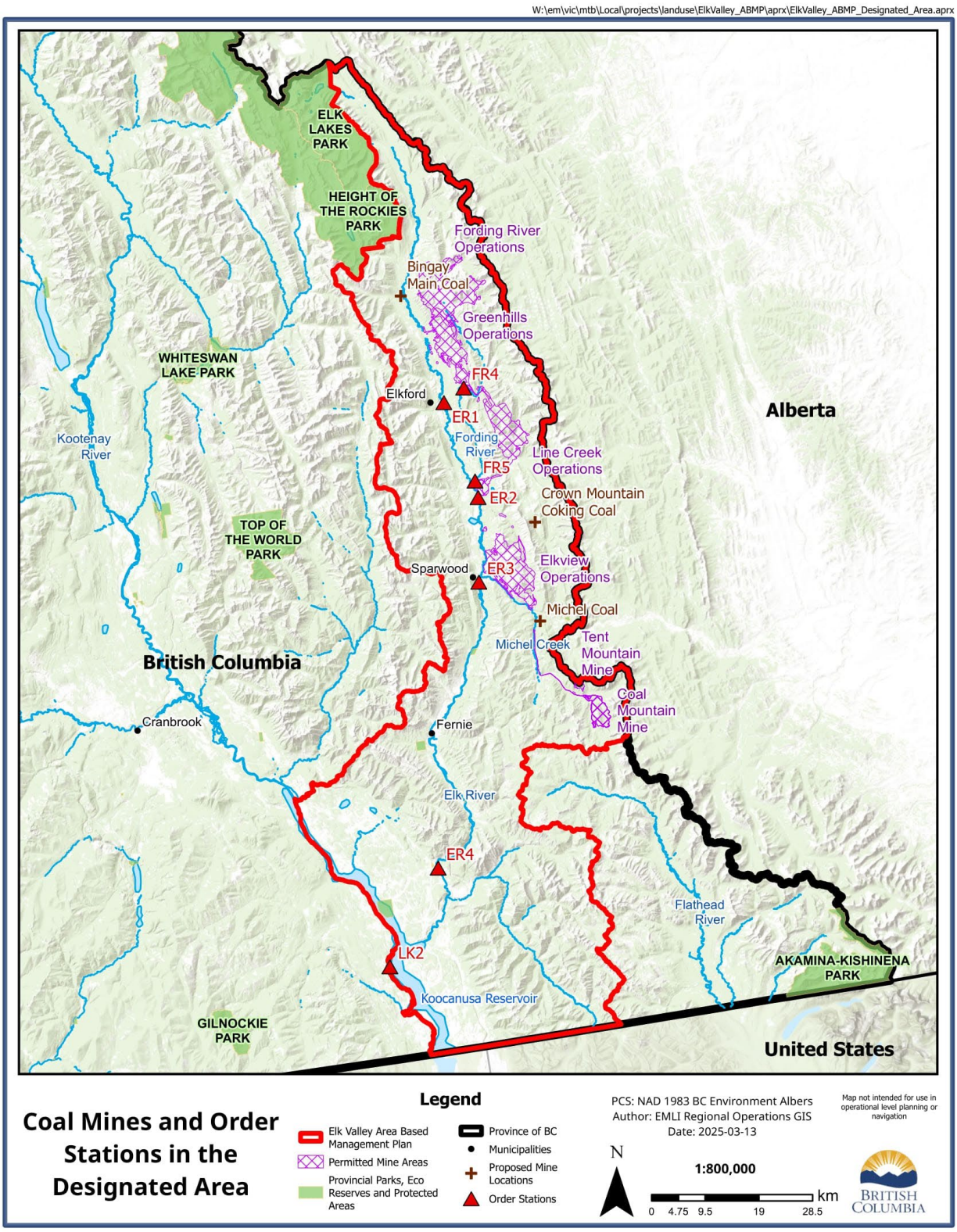


Figure 5: Coal Mines and Order Stations in the Designated Area

The surface water quality targets applicable at the Order stations are listed in Table 3. Targets are specifically established for selenium as total selenium, for nitrate as nitrate as N, for cadmium as dissolved cadmium, and for sulphate. As indicated in the notes to Table 3, where targets are hardness-dependent, they are adjusted to hardness levels as described.

Table 3 lists the targets that are now in effect, or which will be in effect at a future date as applicable only to nitrate at ER2, and these come directly from the 2014 EVWQP. The targets were designed to ensure stabilization and achievable reductions of selenium, nitrate, sulphate and cadmium concentrations throughout the watershed to meet the requirements of Order M113.

The targets apply at specific locations in mainstem rivers which means there may be some localized areas in the watershed with higher concentrations. Numerous scientific studies and analyses informed development of targets to protect aquatic life. The targets were set at levels that could be achieved and would avoid causing changes to populations of fish and other aquatic species.

The targets are maximum acceptable levels and are not considered discharge-up-to thresholds. The targets do not automatically allow conditions to worsen up to these levels when more protective levels can be achieved. More details and guidance regarding how the targets are intended to be applied in the Designated Area are provided in Section 5.

Sidebar 2 follows Table 3 and provides a summary of how the targets were developed in the 2014 EVWQP. See the 2014 EVWQP for full details of target development.

Table 3: Surface Water Quality Targets

Order Station	Order Parameter Targets (*See note 1*)				For Reference Only
	Total Selenium (µg/L)	**Nitrate as N** (mg/L)	**Sulphate** (mg/L)	**Dissolved Cadmium** (µg/L)	**Typical Monthly Average Hardness Range** (mg/L as $CaCO_3$)
FR4	57	3.0 (hardness <170) $10^{1.0003*\log10(hardness)-1.52}$ (hardness 170-500) 15.1 (hardness >500) *See note 2*	128 (hardness 0-30) 218 (hardness 31-75) 309 (hardness 76-180) 429 (hardness >180) *See note 3*	$10^{0.83*\log10(hardness)-2.53}$ (hardness ≤280) 0.32 (hardness >280) *See note 4*	250 to 650
FR5	40				225 to 550
ER1	19	3.0			125 to 215
ER2	19	4.0 (current) 3.5 (end of 2025) 3.0 (end of 2028)			165 to 350
ER3	19	3.0			125 to 325
ER4	19	3.0			130 to 300
LK2	2	3.0			75 to 200

Notes to Table 3:

1. All targets are expressed as monthly average concentrations. Hardness-dependent targets may vary with monthly average hardness concentrations (mg/L as $CaCO_3$) measured at the Order station.
2. The nitrate as N targets are hardness-dependent and are:
   a) 3.0 mg/L when hardness is less than 170 mg/L;
   b) 15.1 mg/L when hardness is greater than 500 mg/L; or,
   c) calculated, to one decimal place, using the equation when hardness is within the range of 170 to 500 mg/L.
3. The sulphate targets are hardness-dependent based on mg/L as $CaCO_3$.
4. The dissolved cadmium targets are hardness-dependent and are either:
   a) 0.32 µg/L when hardness is greater than 280 mg/L; or,
   b) calculated, to two decimal places, using the equation when hardness is 280 mg/L or less.

Sidebar 2: Surface Water Quality Target Development in 2014

The ABMP surface water quality targets are carried forward from the 2014 EVWQP. The following is a summary of how the targets and timelines were developed based on Chapter 8 of the 2014 EVWQP (Appendix A). Refer to the 2014 EVWQP including annexes for more information about the targets and target development process.

To develop the targets, the 2014 EVWQP divided the Designated Area into six management units (MUs) to evaluate baseline conditions, as shown in Figure 6 on the following page. MUs were delineated based on locations of Order stations and in consideration of geographic and hydrodynamic information.

Where feasible, long-term targets at each Order station were set by adopting the approved B.C. water quality guidelines (BCWQGs) for protection of freshwater aquatic life. If baseline water quality was not meeting BCWQGs, then site-specific effects thresholds, known as effects benchmarks, were developed. Targets were set based on projected future conditions including effluent treatment, and were compared to benchmarks to ensure that targets could be expected to be protective of the most sensitive aquatic species. Predicted effects were spatially integrated across the MU and compared to integrated assessment criteria (Appendix A, 2014 EVWQP, Annex H).

Table 4 summarizes locations where BCWQGs for freshwater aquatic life were adopted as targets, and locations where site-specific targets were developed. The 2014 EVWQP benchmark for dissolved cadmium used a hardness-equation approach comparable to the Canadian Council of Ministers of the Environment guideline for cadmium.

Table 4: Basis of 2014 EVWQP Targets

Order Station	MU	Target Basis			
		Total Selenium	Nitrate as N	Sulphate	Dissolved Cadmium
FR4	MU-1	Site-Specific	Site-Specific	BCWQG	2014 EVWQP benchmark with comparable margin of safety to Canadian Council of Ministers of the Environment guideline (2014)
FR5	MU-2	Site-Specific	Site-Specific	BCWQG	
ER1	MU-3	Site-Specific	BCWQG	BCWQG	
ER2	MU-4	Site-Specific	BCWQG	BCWQG	
ER3	MU-5	Site-Specific	BCWQG	BCWQG	
ER4	MU-5	Site-Specific	BCWQG	BCWQG	
LK2	MU-6	BCWQG	BCWQG	BCWQG	

Note: BCWQG in this table means B.C. water quality guideline for protection of freshwater aquatic life

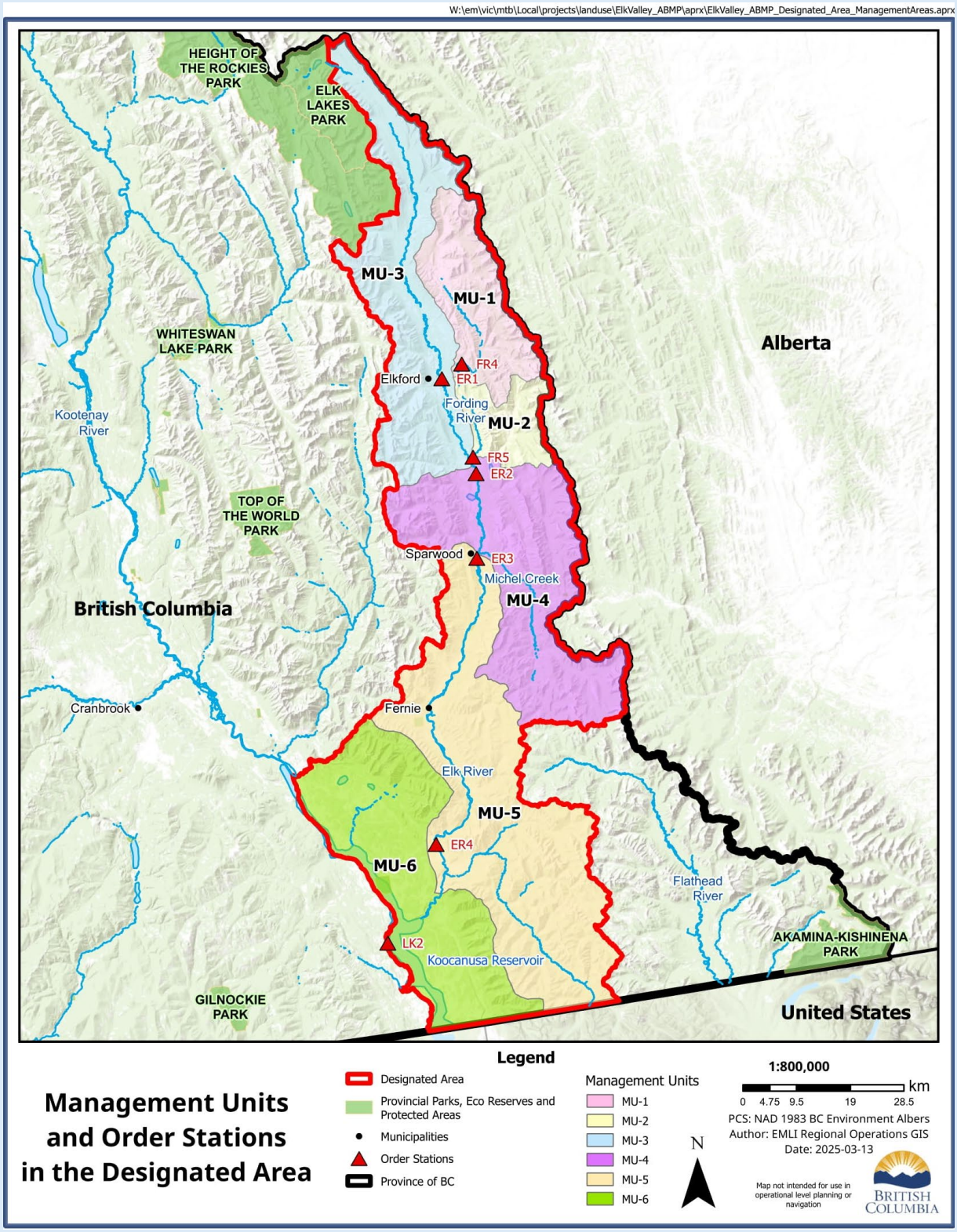


Figure 6: Management Units and Order Stations

Sidebar 2, continued

Where site-specific selenium and nitrate targets were developed, integrated assessments were completed to assess the regional (i.e., MU scale) influence of local-scale water quality conditions. A qualitative multiple-stressor analysis was completed to assess potential interactions among Order parameters and other stressors to confirm the selection of the site-specific targets (Appendix A, 2014 EVWQP, Annex H).

Integrated assessments were also completed for the other targets within MU-1, MU-2, MU-3 and MU-4 because these MUs include mine-influenced tributaries. Results of the integrated assessment are summarized in Table 6 on the next page.

Table 5 below summarizes where the long-term targets were expected to be achieved immediately in 2014 (white shading), and those where treatment in accordance with the initial implementation plan was expected to achieve them (blue shading).

The years identified in Table 5 represent when long-term targets indicated in the 2014 EVWQP are expected to be achieved.

Table 5: 2014 EVWQP Timeframe to Achieve Long-term Targets

Order Station	MU	2014 EVWQP timeframe to achieve long-term target			
		Total Selenium	Nitrate as N	Sulphate	Dissolved Cadmium
FR4	MU-1	2022	2019	2014	2014
FR5	MU-2	2023	2019	2014	2014
ER1	MU-3	2014	2014	2014	2014
ER2	MU-4	2023	2028	2014	2014
ER3	MU-5	2014	2019	2014	2014
ER4	MU-5	2014	2014	2014	2014
LK2	MU-6	2014	2014	2014	2014

Sidebar 2, continued

Table 6: Results of 2014 EVWQP Integrated Assessment

Target[1]	2014 EVWQP Level 1 Benchmark (10% effect)	Most sensitive species and endpoint	Integrated Assessment Results (see Appendix A, 2014 EVWQP Chapter 8, Table 8-11 through Table 8-15)
Total Selenium			
MU-1 57 µg/L at FR4	70 µg/L	Fish (Westslope Cutthroat Trout[2]), reproductive effects	Target would be protective and produce conditions that meet the EVWQP assessment criteria.
MU-2 40 µg/L at FR5	19 µg/L	Fish (Brown Trout), reproductive effects	Target does not meet the EVWQP assessment criteria for fish but is still expected to produce conditions that would be protective of fish and other receptors, although with a lower margin of safety than the other targets.
MU-3, MU-4, and MU-5 19 µg/L at ER1, ER2, ER3, and ER4	19 µg/L	Fish (Brown Trout), reproductive effects	Target would be protective and produce conditions that meet the EVWQP assessment criteria.
Nitrate as N			
MU-1 and MU-2 Level 1 Benchmark at FR4 and FR5	$10^{1.0003*\log10(hardness)-1.52}$ Hardness-dependent, ranges from 5.1 mg/L to 15.1 mg/L (hardness 170-500 mg/L $CaCO_3$)	Benthic invertebrates (water flea), reproductive effects	Target would be protective and produce conditions that meet the EVWQP assessment criteria.
MU-3 and MU-4 3 mg/L at ER1 and ER2	$10^{1.0003*\log10(hardness)-1.52}$ Hardness-dependent, ranges from 5.1 mg/L to 15.1 mg/L (hardness 170-500 mg/L $CaCO_3$)	Benthic invertebrates (water flea), reproductive effects	Target would be protective and produce conditions that meet the EVWQP assessment criteria.

[1] The targets shown are the long-term targets from the 2014 EVWQP

[2] Josephine Falls is a fish barrier to more sensitive species

Sidebar 2, continued

Table 6: Results of 2014 EVWQP Integrated Assessment, continued

Target[1]	2014 EVWQP Level 1 Benchmark (10% effect)	Most sensitive species and endpoint	Integrated Assessment Results (see Appendix A, 2014 EVWQP Chapter 8, Table 8-11 through Table 8-15)
Sulphate			
MU-1 through MU-4 BCWQG for protection of freshwater aquatic life at FR4, FR5, ER1, and ER2	481 mg/L 499 mg/L Hard to very hard water in the Fording and Elk rivers	Amphibians (Pacific tree frog), survival and growth Fish (Rainbow Trout), embryo-alevin development	MU-1: The target does not meet all the EVWQP assessment criteria for fish and amphibians in the Fording River mainstem, but effects integrated across the MU meet the criteria, and conditions are expected to be protective. MU-2, MU-3, and MU-4: The projected concentrations are below the target and were used in the assessment instead of the target. These conditions would be protective and produce conditions to meet the EVWQP assessment criteria.
Dissolved Cadmium			
MU-1 through MU-4 Level 1 Benchmark at FR4, FR5, ER1, and ER2	$10^{0.83*\log10(hardness)-2.53}$ Hardness-dependent, ranges from 0.03 µg/L to 0.32 µg/L (hardness 17-280 mg/L $CaCO_3$)	Benthic invertebrates (water flea), reproductive effects	The projected concentrations are below the target and were used in the assessment instead of the target. These conditions would be protective and produce conditions to meet the EVWQP assessment criteria.

[1] The targets shown are the long-term targets from the 2014 EVWQP

4.3.2. Calcite Target

Streams downstream of mines in the Elk Valley can be impacted by the formation and precipitation of calcite. To a lesser extent, calcite may also form in streams that are not influenced by mining. Calcite may form on a streambed in response to site-specific environmental conditions. For example, mining activity can increase the concentration of dissolved calcium and carbonic acid in receiving waters, which may then accumulate as a calcite precipitate on the streambed. In some reaches of certain streams, calcite precipitation may cover a portion of the streambed, making the streambed substrate (e.g., rocks and gravels) largely immovable.

Continued calcite precipitation can change the characteristics of streambeds and bind streambed substrate together, and this is referred to as calcite concretion. Accumulation of calcite can impact the availability and quality of habitat for fish and other aquatic species. Calcite can also directly impact plants and benthic invertebrates.

Once formed, calcite concretion can be difficult to reverse. Currently, the best achievable technology to rehabilitate concreted streambeds is physical excavation with streambed restoration. Physical excavation involves using heavy equipment to remove concretion and can require stream and habitat reconstruction. Physical excavation poses a risk of trade-offs with other impacts, such as causing potential damage to riparian and instream habitat. To date, authorization of physical excavation for rehabilitation has been limited due to potential risks to overall ecosystem health.

The calcite target in the 2025 EVWQP supports achievement of Objective 3. The calcite target is provided in Table 7. The target is intended to prevent concretion in stream reaches that are not currently impacted by calcite accumulation, and to inform management of calcite that may already be present. Overall, the ABMP seeks to manage calcite towards meeting the calcite target.

Table 7: Calcite Target

Calcite target	Calcite concretion less than or equal to 0.3 in receiving environment stream reaches that are not authorized to be buried under an Environmental Assessment Certificate or Mines Act Permit.
Calcite concretion	Calcite concretion equals the sum of pebble concretion scores divided by the number of pebbles counted.
Pebble concretion score	0 = no concretion 1 = concreted but movable by hand 2 = concreted and immovable by hand

The calcite target applies to stream reaches in the receiving environment in the Designated Area; however, the target does not apply to stream reaches authorized under an Environmental Assessment Certificate or Mines Act Permit to be buried. Calcite concretion describes the degree of calcite deposition in a given location and is measured in the receiving environment in the streambed. Calcite concretion above 0.3 does not necessarily mean impacts will occur, and concretion less than or equal to 0.3 is expected to be protective of aquatic life. Due to potential risks associated with physical excavation for rehabilitation, and given the need for continued research and development, the calcite target does not specify a timeframe for achievement in areas not currently meeting it. It is expected that on a case by case basis statutory decision makers will set requirements to manage calcite in these areas (see Section 5.3).

The calcite target above was developed by the ministry in 2024. Sidebar 3 and Appendix C provide additional information related to the calcite review under EMA Permit 107517 that informed the calcite target in the 2025 EVWQP.

Sidebar 3: Calcite Review

In 2024, the ministry reviewed the medium- and long-term calcite site performance objectives in EMA Permit 107517. The calcite requirements set in EMA Permit 107517 in 2014 included medium- and long-term calcite site performance objectives that came directly from the 2014 EVWQP (see Sidebar 1 in Section 2.1). The 2024 calcite review was the ministry's first reevaluation of the calcite site performance objectives under EMA Permit 107517 since 2014. The review also led to the ministry initiating an EMA Permit 107517 amendment process that commenced in 2024.

The 2024 calcite review aligned with the adaptive management approach of area based management (see Section 2.3 and Figure 2). The review incorporated new science and information learned about the effects of calcite concretion on fish, plants and benthic invertebrates from over 10 years of calcite monitoring, aquatic effects monitoring, and research and development. The review provided the following conclusions:

- Calcite has increased in the Elk Valley since 2014 when the calcite site performance objectives were originally set in EMA Permit 107517;
- Calcite index and calcite presence are not the best ecological parameters for understanding impacts to aquatic life and informing calcite management;
- The spatial extent and statistical metric for evaluating compliance with the medium- and long-term calcite site performance objectives needs to be clarified;

Sidebar 3, continued

- Although uncertainties remain in understanding the population-level effects of calcite on Westslope Cutthroat Trout and benthic invertebrates, calcite biological effect studies indicate that calcite concretion below 0.3 is likely protective of aquatic life;
- Evaluating concretion at the stream reach level, instead of stream level, would better capture calcite impacts to habitat and aquatic life; and,
- There are limited management and best achievable technology options available to rehabilitate calcite-impacted streams and as of 2024, using available technologies to achieve the medium- and long-term calcite site performance objectives in EMA Permit 107517 may pose greater risk of harm to the environment than existing concretion.

A summary of the 2024 calcite review is provided in Appendix C. The conclusions of the 2024 calcite review informed the more refined approach to calcite management provided in the 2025 EVWQP, which includes:

- Using calcite concretion to measure and understand calcite impacts;
- Evaluating calcite concretion at the stream reach level;
- Setting calcite concretion of 0.3 as the target for protection of aquatic life; and,
- Providing guidance to statutory decision makers (SDMs) for preventing calcite concretion in unimpacted stream reaches, managing calcite accumulation in impacted stream reaches, applying a risk-based approach to rehabilitating impacted streams and restoring streambeds, and supporting continuous improvement of calcite management (see Section 5.3).

The refined approach to calcite management in the 2025 EVWQP, including the calcite target in Table 7 and the guidance to SDMs provided in Section 5.3, improves the ABMP's ability to achieve Objective 3, compared to the previous calcite target in the 2014 EVWQP.

5. Implementation Strategy

The ABMP includes an implementation strategy designed around specific topics referred to as focus areas. The focus areas highlight areas where current and ongoing actions will help the ABMP progress towards its goals (outcomes, objectives and targets). The focus areas provide guidance and are not all encompassing nor the only areas that may advance the ABMP's goals.

Figure 7 shows the primary line of sight from each focus area to the ABMP's outcomes. The focus areas address all of the ABMP's goals (see Section 4). The first four focus areas primarily support the outcome for protection of aquatic ecosystem health. The remaining two focus areas primarily address protection of human health and groundwater. As shown by the dashed lines at the right side of Figure 7, actions towards one outcome may also support other outcomes (see Section 4).

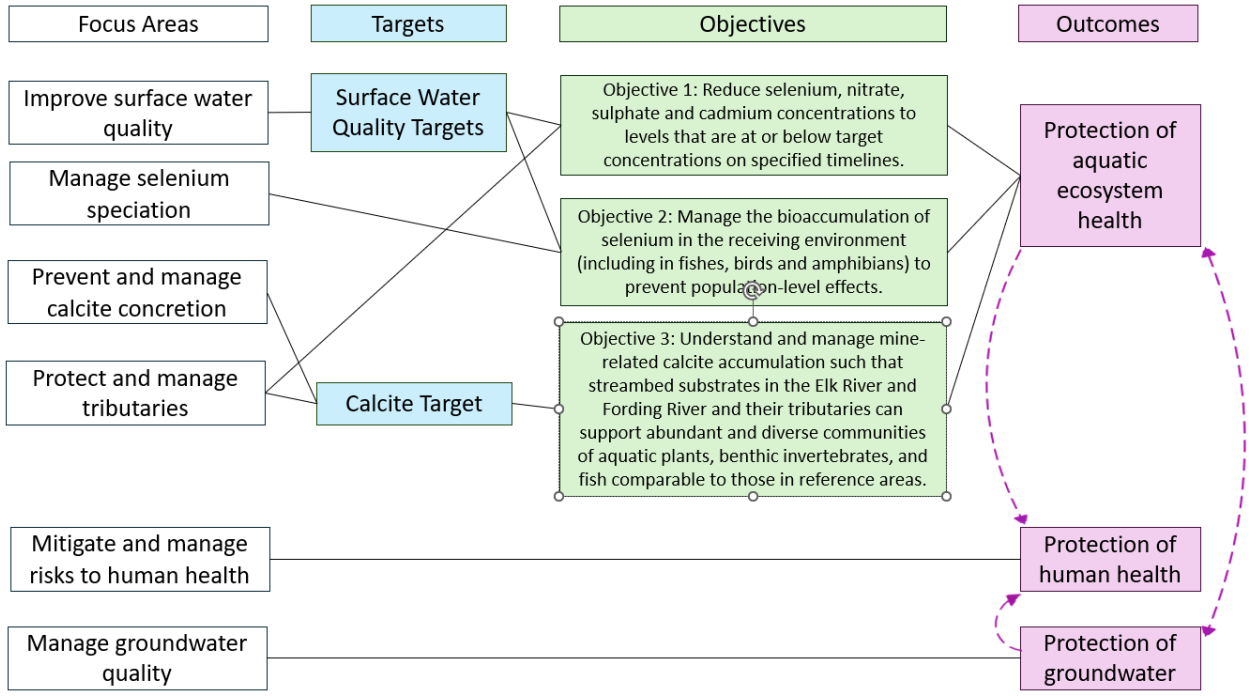


Figure 7: Focus Areas with Primary Linkages to ABMP's Goals

The implementation strategy provides guidance for decision-making. Much of the guidance provided in this implementation strategy has been available to ministry statutory decision makers (SDMs) through the 2014 EVWQP, ministry policies, and other aspects of the regulatory framework under the EMA. This 2025 EVWQP organizes and contextualizes guidance so it is easier to understand and use, and is more transparent including for external parties.

The primary audience for this implementation strategy is ministry SDMs exercising discretionary authority under the EMA to regulate waste discharges. As described in Section 2.3, SDMs are ministry staff designated under the EMA as directors or delegates of directors who are empowered by the EMA to authorize effluent discharges into the environment through issuance of EMA authorizations. Since 2014, the ABMP has been a major policy that SDMs must consider when making decisions related to water quality in the Designated Area, as per direction issued under Section 90(2) of the EMA (see Table 1).

The implementation strategy's guidance may inform SDM's reviewing applications, decision-making, assessing the effectiveness of authorizations, and when exercising discretionary authority in other ways. Implementing this guidance is expected to result in progress over time towards achieving the ABMP's goals.

The guidance is intended to inform decision-making, however SDMs are required to exercise discretion and are not constrained by or limited to the focus areas or the guidance, nor are they required to conform to the ABMP. SDMs should consider specific areas of guidance in the ABMP, as well as the ABMP in its entirety, when making decisions. Depending on the decision being made, SDMs may closely follow the implementation strategy under one or more focus areas, or may consider the goals of the ABMP or other ABMP elements more generally. Depending on circumstances, SDMs may deviate from the ABMP in exercising discretionary authority.

While SDMs consider the ABMP when making decisions under the EMA, SDMs are not bound by the guidance provided and are expected to exercise discretion. Discretionary authority provides for responsiveness and flexibility in making the best possible decisions. Discretion allows an SDM to take into account all of the facts and circumstances in a situation to decide on an appropriate outcome within the larger regulatory framework. As a policy, the ABMP is beneficial to the statutory decision-making process because it provides guidance to promote consistency in decision-making to increase the likelihood the ministry may achieve the vision for the Elk Valley and the ABMP's goals. At the same time, careful consideration is needed when applying guidance in the ABMP as each decision is unique with its own set of considerations.

The guidance should also be considered by other ministry and provincial government staff in setting priorities and making operational decisions, and it can also inform actions by other parties including industry.

This implementation strategy provides examples of how the guidance provided to SDMs may influence dischargers currently introducing or seeking to discharge effluent into the environment in the Elk Valley. Examples are provided below each guidance table (Tables 8 to 14). Current and future dischargers should refer to the guidance in the ABMP when

contemplating mine planning, development, operations, and reclamation and closure, as well as protection and restoration efforts. Some guidance specifically applies to existing discharges (e.g., parts of Tables 9 and 10). The examples provided below the guidance tables illustrate some considerations and are not comprehensive. Dischargers will need to address the specific requirements and expectations that apply to them when discharging or seeking to discharge waste under the EMA.

This implementation strategy recognizes that addressing water quality is a shared responsibility. Successful implementation of the ABMP requires the participation of many parties working to make progress in each of the focus areas. Shared responsibility and collective action can help make progress towards the ABMP's goals.

The following subsections provide guidance for each focus area. The guidance relates to the subject of the focus area and also addresses elements of adaptive management and continuous improvement. Focus areas and guidance could change in the future if the ABMP is amended in response to new information or conditions (see Section 7).

5.1. Improve Surface Water Quality

This focus area aligns directly with Objective 1 and supports Objective 2, to overall support the outcome for protection of aquatic ecosystem health (see Figure 7). This focus area also contributes to the human health and groundwater outcomes.

Specifically, this focus area supports achieving and maintaining the water quality targets in the Elk River, Fording River and at Koocanusa Reservoir. It also promotes improvements to water quality beyond the targets, including in consideration of best achievable technology assessments.

Because the surface water quality targets are based on aquatic life effects benchmarks, they are a primary driver for making progress towards the outcome of protecting aquatic ecosystem health (see Section 4.3.1).

Table 8 provides guidance for SDMs to support improvements to surface water quality through decision-making under the EMA.

Table 8: Guidance to Improve Surface Water Quality

Guidance	Specific considerations for ministry SDMs include:
Set requirements and site-specific effluent discharge limits to reduce discharges of selenium, nitrate, sulphate and cadmium to	• Set achievable site-specific discharge limits to meet or do better than the surface water quality targets. ○ Require loadings to be minimized, including in consideration of best achievable technology assessments that focus first on source control and

the maximum extent achievable. **At a minimum, ensure Order station surface water quality targets are met, recognizing that the targets are not discharge-up-to thresholds.**	avoiding waste generation, and then treating waste close to the source as it is generated. ○ Require modelling to confirm that site-specific discharge limits and downstream targets are predicted be met. • Set complementary requirements to develop and implement treatment facilities, mitigation measures and other management strategies. • Where discharges are predicted to cause or exacerbate a target exceedance, consider options such as requiring all or select upstream dischargers to assess options for reducing loadings, and adjusting requirements elsewhere such that the targets can still be met.
Include requirements to implement adaptive management and for research and development to support continuous improvement of surface water quality.	• Require surface water quality monitoring at point(s) of discharge and at Order stations. • Require aquatic effects studies to improve understanding and evaluate the effectiveness of site-specific discharge limits at achieving predicted biological endpoints/outcomes. • Require studies to evaluate and identify opportunities to improve effluent quality and lower discharge limits. • Require research and development programs to develop approaches to minimize discharges, improve management of water quality, and reduce reliance on treatment facilities that entail long-term operating and capital needs.

Based on the above guidance for SDMs, dischargers can expect to have to meet discharge-specific limits calculated such that Order station targets are predicted to be met. Mine planning should consider and address how Order station targets are met. New effluent discharges should be mitigated at the source wherever practicable. Dischargers may be required by SDMs to:

- Implement approved best achievable technologies to minimize or, where feasible, eliminate risks to the environment from effluent discharges.
- Predict discharge quality and quantity using site-specific models.
- Demonstrate how Order parameter concentrations are reduced to the maximum extent achievable.
- Develop future-looking mitigation plans to meet or do better than the targets over the full permitted life-of-mine plans and beyond.
- Mitigate new effluent discharges at source in alignment with the pollution prevention hierarchy.

- Conduct monitoring to evaluate compliance with discharge limits and attainment of targets, and to refine models.
- If targets are predicted to not be met, reassess options to reduce loadings and for mitigation strategies, including in consideration of other discharges.
- Routinely update mitigation plans to incorporate new methods for minimizing release of Order parameters and for improved water management.
- Implement studies to evaluate the effectiveness of targets at achieving anticipated biological endpoints/outcomes.
- Undertake research and development to improve source control, improve effluent quality and water management, and reduce reliance on long-term treatment.

5.2. Manage Selenium Speciation

Selenium poses unique risks to aquatic life and other species because it bioaccumulates in the food chain. Selenium is the only Order parameter known to bioaccumulate.

Chemical forms (i.e. species) of selenium bioaccumulate at different rates. The selenium effects benchmarks developed in the 2014 EVWQP used bioaccumulation models which included data from different types of habitats, including flowing (lotic) and still water (lentic) areas, and recognized habitat related differences in bioaccumulation (See Appendix A, 2014 EVWQP, Annex E). The models integrated selenium speciation by calibrating biological tissue concentrations across a range of habitats that included sites with higher and lower rates of bioaccumulation. These models were used to inform the ABMP selenium targets. The models did not integrate risks of selenium bioaccumulation from treatment facilities, since none existed when the models were developed.

Risks associated with selenium bioaccumulation are managed using an area based approach to prevent population-level effects to sensitive species. This is achieved primarily though implementing best achievable technologies to reduce total selenium so that the ABMP targets are met.

Years of comprehensive aquatic effects monitoring and advancements in analytical methods have provided new information about the generation and bioaccumulation of organic species of selenium (also called organoselenium). These advancements in science and methods have identified the potential for increased bioaccumulation associated with treatment facilities and some sedimentation ponds. Monitoring data show that selenium bioaccumulates in benthic invertebrates close to discharges from specific treatment facilities and sedimentation ponds, and that concentrations of selenium in benthic invertebrates decrease downstream. As a result, localized actions may be necessary to control and manage selenium speciation (i.e., selenite and organoselenium) at such facilities.

Adaptive management responses have identified solutions for removing or reducing the risk of selenium bioaccumulation. For example, advanced oxidation process treatment has been shown to transform highly reactive selenium species (i.e., selenite and organoselenium) to selenate, which presents a lower risk of bioaccumulation. Seasonal pond bypass is another strategy demonstrated to reduce risks of bioaccumulation related to organoselenium generation.

New information about the generation, bioaccumulation and mitigation of selenium species shows that it is important to monitor and manage chemical species of selenium, in addition to the total selenium.

This focus area supports the outcome for protection of aquatic ecosystem health as well as for human health through actions that manage selenium speciation to minimize bioaccumulation (see Figure 7). This focus area aligns directly with Objective 2 in the ABMP's goals.

Table 9 provides guidance for SDMs to improve management of selenium speciation.

Table 9: Guidance to Manage Selenium Speciation

Guidance	Specific considerations for ministry SDMs include:
Set requirements to locally manage selenium speciation to prevent population-level effects.	• Require monitoring of species of selenium in effluent discharges from ponds and biological treatment works that may locally generate highly bioavailable forms of selenium. • Require the development or use of existing selenium bioaccumulation models that account for varying rates of bioaccumulation resulting from habitat types or chemical species of selenium and use the models to identify local areas of potential risk. • Set requirements to assess identified areas of potential risk using aquatic effects monitoring programs to measure concentrations of selenium in tissue, such as benthic invertebrates and fish. • Use site-specific assessments of risk and consider best achievable technology assessments to support requirements that reduce the generation of highly bioavailable forms of selenium.
Include requirements to implement adaptive management and for research and development to support continuous	• Require periodic reviews and updates to selenium bioaccumulation models.

improvement of selenium speciation management. **This guidance applies when managing existing discharges.**	• Require research and development programs to investigate the drivers of selenium speciation and identify approaches to reduce formation of bioavailable forms of selenium. • Require review of aquatic effects monitoring results where mitigations are implemented to ensure authorizations prevent population-level effects from bioaccumulation relating to selenium speciation and make necessary adjustments.

Dischargers can expect that ministry SDMs may set requirements to prevent population-level effects resulting from selenium speciation. Dischargers may be required to:

- Conduct water quality and aquatic effects monitoring to measure selenium species concentrations (including, where relevant, organoselenium species) in water and concentrations of selenium in benthic invertebrate and fish tissue, and to compare results to effects benchmarks to estimate and interpret the potential for effects.
- Investigate mechanisms influencing selenium speciation and the generation of selenite and organoselenium to inform management actions.
- Apply adaptive management to make adjustments to prevent population-level effects. Adjustments may include water management changes, operational changes, and implementation of best achievable technologies.
- Routinely evaluate the efficacy of the adaptive management approach at preventing population-level effects.
- Predict selenium concentrations in tissue using a selenium bioaccumulation model recommended for use by the ministry.

5.3. Prevent and Manage Calcite Concretion

As discussed in Section 4.3.2, calcite accumulation in streambeds downstream of mines can impact the availability and quality of aquatic habitat for fish and other aquatic species. Calcite can also directly impact plants and benthic invertebrates. Once formed, calcite concretion can be difficult to reverse. Currently the best achievable technology to rehabilitate and restore concreted streambeds is through physical excavation with streambed restoration; however, physical excavation poses risks to overall ecosystem health that may, in some cases, outweigh potential benefits of calcite concretion removal.

This focus area supports the outcome for protection of aquatic ecosystem health by preventing and managing mine-related calcite concretion in the Elk Valley, as set out in Objective 3 of the ABMP's goals (see Figure 7). This focus area aligns with the ABMP's goal to prevent calcite accumulation before concretion occurs in order to reduce risks to fish and other species (see Section 4.3.2). This focus area guides progress towards achieving

Objective 3 in as many areas as feasible across the Designated Area, including through providing guidance in relation to the calcite target (see Section 4.3.2).

In stream reaches where calcite concretion is at or below the target, the target is intended to be maintained so that impacts are avoided. The target provides guidance to statutory decision makers (SDMs) around how to avoid calcite-related impacts and to prevent concretion in stream reaches that are currently not impacted by calcite accumulation.

In stream reaches where calcite concretion is already above the target, calcite management strategies may be implemented over time towards meeting the target. In situations where streambeds have become concreted, calcite management strategies need to consider risks to overall ecosystem health when considering options that could make progress towards the calcite target.

Table 10 provides guidance for SDMs to prevent and manage calcite concretion, including through the setting and administration of authorization requirements under the EMA.

Table 10: Guidance to Prevent and Manage Calcite Concretion

Guidance	Specific considerations for ministry SDMs include:
Set requirements to prevent calcite concretion in stream reaches currently at or below the calcite target.	• Set reach-specific calcite concretion limits to meet or do better than the calcite target. • Set accompanying requirements to limit calcite formation and avoid accumulation, including in consideration of best achievable technology assessments.

Where calcite concretion is above the calcite target, set requirements to limit further calcite accumulation in calcite-impacted stream reaches and for stream reach rehabilitation.
 	
This guidance applies when managing existing discharges.
	• Establish interim reach-specific calcite concretion limits based on local science, monitoring and achievability information to prevent further calcite accumulation.
	• Set requirements to limit further calcite formation and accumulation in stream reaches, including in consideration of best achievable technology assessments.
	• Use regulatory tools to rehabilitate impacted stream reaches and restore streambeds, including by:
	  ○ Applying a risk-based approach to rehabilitation, by focusing on stream reach habitats which have the greatest actual or potential positive influence on overall ecosystem functioning,
	  ○ Using site-specific assessments to inform development of rehabilitation plans for concreted stream reaches, and

	○ Working with other ministry partners as needed to support thoughtful design and implementation of rehabilitation projects. • Require a comprehensive calcite management plan that addresses the six bullets above.
Include requirements to implement adaptive management and for research and development to support continuous improvement of calcite management. **This guidance applies when managing existing discharges.**	• Require evaluation of the effectiveness of authorization requirements, including calcite management plans, in preventing concretion, managing calcite accumulation, and aligning with Objective 3. • Require research and development programs to develop new measures to reduce calcite formation and accumulation in the environment. • Require research and development programs to identify new and improved rehabilitation options with lower overall risks. • Require aquatic effects studies to improve the understanding of ecological conditions and risks to benthic invertebrates and fish posed by calcite formation and accumulation. • Use new information from calcite treatment piloting and implementation, aquatic effects studies and calcite monitoring to: ○ inform adjustments to planned mitigation measures by identifying current best achievable technologies, ○ inform risk based approaches to rehabilitation, ○ increase understanding of targets through additional study, and, ○ adjust monitoring programs.

Dischargers can expect to be required by SDMs to demonstrate how they will avoid calcite concretion in streams not currently impacted by calcite, and limit accumulation where it is already present. They may also be required by the ministry and/or other agencies to undertake rehabilitation with streambed restoration by using best achievable technologies and applying risk-based approaches, in order to achieve the calcite target.

In stream reaches where the calcite target is not met (i.e. calcite concretion is above 0.3), dischargers may be required to advance solutions to improve conditions. Examples of requirements could include:

- Conduct calcite monitoring and reporting.

- Develop and implement future-looking management plans and/or studies that describe the strategy to manage calcite to achieve the calcite target, including a risk-based prioritization of stream reaches based on the level of calcite concretion and the potential for improvements to aquatic habitat. The plans should be routinely updated to allow for incorporation of improved calcite management strategies developed under a research and technology development program.
- Conduct site-specific assessments and develop rehabilitation plans for concreted stream reaches.
- Conduct a research and technology development program aimed at developing mitigation strategies to improve the treatment and management of calcite.

5.4. Protect and Manage Tributaries

Tributaries are the smaller streams that flow into the Elk and Fording rivers. Maintaining healthy tributaries and tributary habitat is key to protecting overall aquatic ecosystem health in the Elk Valley. With a legacy of mining and disturbances to land and water, the overall Elk Valley watershed can benefit from undisturbed areas being preserved.

This focus area addresses tributaries not currently influenced by mining, and also seeks to ensure that mine-impacted areas continue to provide habitat and ecosystem functions that help protect overall ecosystem health in the watershed.

Although the ABMP sets surface water quality targets at Order stations in the mainstem rivers, the absence of targets for specific tributaries should not be construed as allowing for unregulated surface water quality in upstream and tributary habitats. As described in Section 2.4, the ABMP incorporates important concepts that are fundamental to how waste discharges are regulated throughout British Columbia, including the concepts of sustainability, stewardship, and minimizing effluent discharges and protecting water quality in areas not currently impacted by mining. The ABMP incorporates the Ktunaxa environmental principles regarding the importance and protection of clean water and keeping intact watersheds undisturbed, which were important views shared by the Ktunaxa Nation in 2014. Protection of tributaries follows ʔaknumuɂtiɬɬ (Ktunaxa Natural Law) and for taking only what is needed and to protect and preserve lands and resources for future generations.

Actions taken in accordance with the focus area to improve surface water quality (see Section 5.1) may contribute to improving water quality in some tributaries, in addition to the mainstems where the targets apply, thus minimizing overall risks and supporting restoration of impacted aquatic ecosystems. As indicated in Section 2.4, the ABMP supports restoration of values in impacted areas.

Rehabilitation of tributaries from stressors that are not related to waste discharges is outside of the scope of the EMA, and therefore not addressed directly in the ABMP. The ABMP addresses water quality. Other elements of protection, such as physical habitat protection, are outside of the EMA's regulatory framework. However, the ministry recognizes that protecting and rehabilitating mine-impacted tributaries and restoring streambeds can support the ABMP outcome for protection of aquatic ecosystem health. As such, the ABMP may guide how the ministry works with other provincial ministry partners on initiatives for stewardship and tributary management, including through provincial regulatory oversight.

Table 11 provides guidance for SDMs to protect and manage tributaries towards the outcome for protection of aquatic ecosystem health.

Table 11: Guidance to Protect and Manage Tributaries

Guidance	Specific considerations for ministry SDMs include:
Minimize new effluent discharges to tributaries that are not currently influenced by mining.	• Where feasible avoid authorizing new discharges to tributaries that are not influenced by mining and which are not ephemeral; and, • Further to the previous bullet, where a new project has no other option but to discharge to a tributary that has not been previously influenced, require permit applications to demonstrate how local values will be protected by applying conservative screening values, such as B.C. water quality guidelines or other protective benchmarks for the most sensitive downstream use or value, including in consideration of best achievable technology assessment.
Manage water quality in tributaries currently influenced by mining.	• When considering the guidance in Table 8 for surface water quality targets, look for opportunities to set requirements to assess and manage local water quality, in addition to improving mainstem water quality where achievable.
Consider calcite guidance in Section 5.3.	• Implement guidance to prevent and manage calcite concretion (See Table 10).

Based on the above guidance for SDMs, dischargers can expect they will need to demonstrate protection of tributaries not currently influenced by mining and which are not ephemeral. Projects should be designed to minimize effluent discharges to surface waters that are not influenced by mining, whenever feasible.

In tributaries currently influenced by mining, dischargers may be required by SDMs to assess and manage risks posed by effluent discharges of selenium, nitrate, sulphate or

cadmium. Dischargers may be required to complete best achievable technology assessments to minimize loadings as much as feasible below the ABMP's surface water quality targets at the Order stations, and also in consideration of water quality in tributaries.

The calcite target also applies to tributaries in the receiving environment. Dischargers may be required by SDMs to demonstrate how they will prevent calcite concretion in tributary stream reaches in the receiving environment that are currently at or below the calcite target. In tributaries where concretion is above the calcite target, SDMs may require dischargers to advance solutions and improve conditions as described in Section 5.3.

5.5. Mitigate and Manage Risks to Human Health

Protection of human health is central to the vision and purpose of the ABMP. It is also one of the three ABMP outcomes and a focus of the implementation strategy.

To improve understanding of the risks to human health, a multi-year Elk Valley human health risk assessment was completed in 2023 under EMA Permit 107517. This assessment examined all mine-related parameters and concluded that two Order parameters, nitrate and selenium, posed potential risks to human health.

The assessment determined that nitrate presented a risk in specific locations near mine sites if surface waters were used by infants for drinking. The assessment also found that in numerous surface water locations selenium was above the B.C. drinking water guideline, which is a screening value. These surface waters are not designated drinking water sources.

The consumption of fish was identified as the primary pathway of selenium exposure risk. The assessment determined that at average consumption rates, and at most places in the watershed, the risk is low. However, consumption of certain fish, such as Longnose Suckers from Goddard Marsh, presented an elevated risk from selenium when consumed every day. The assessment recognized that most fish data were from aquatic effects monitoring studies carried out close to the mine sites, and recommended more information be obtained for locations where harvesting typically occurs.

Mitigation measures that improve water quality by reducing concentrations of nitrate and selenium reduce risks to human health. In addition, mitigations that decrease selenium bioaccumulation in fish also reduce human health risks.

Managing risks to human health is supported through monitoring and timely reporting. For example, EMA Permit 107517 includes a requirement to communicate results of a regional drinking water monitoring program.

Table 12 provides guidance for SDMs to mitigate and manage human health risks.

Table 12: Guidance to Mitigate and Manage Risks to Human Health

Guidance	Specific considerations for ministry SDMs
Mitigate potential risks to human health by setting requirements to reduce potential human exposure to selenium and nitrate.	• Implement guidance to improve surface water quality (see Table 8). • Implement guidance to manage selenium speciation (see Table 9).
Set requirements to manage human health risks.	• Require a monitoring program for fish tissue designed to support an understanding of risks to human health. • Require timely reporting and communication of human health related monitoring results (drinking water and fish tissue). • Maintain a human health working group of subject matter experts to review human health monitoring and evaluation programs.
Use an adaptive management approach to mitigate and manage human health risks.	• Periodically review human health monitoring and evaluation programs and use advice from a human heath working group to inform adjustments to monitoring, resolve uncertainties, and evaluate the efficacy of mitigations in reducing risks to human health.

Based on the guidance for SDMs above, dischargers may be required to:

- Conduct monitoring of sources, pathways and receptors and assess risks to human health using B.C. water quality guidelines for fish consumption.
- Include Ktunaxa preferred consumption rates in all human health risk assessment scenarios.
- Participate in a human health working group (see Section 6.3).
- Evaluate the efficacy of mitigation strategies at reducing risks to human health through adaptive management.
- Provide notification to water users where drinking water sources do not meet B.C. drinking water quality guideline screening values due to mining-related influences.
- Engage in efforts as needed to resolve the issue of drinking water source contamination from mining.

5.6. Manage Groundwater Quality

Mining activities in the Elk Valley can influence groundwater through both direct and indirect pathways. Direct pathways occur where mine contact water discharges directly to ground. Indirect pathways occur where mine-influenced surface water recharges groundwater.

Direct discharge to ground, such as runoff and seepage, infiltrates into groundwater beneath or adjacent to mining-related sources. Discharge then travels through the groundwater before being forced back to surface by upward groundwater flow gradients, which are common in the Elk Valley. The extent of direct mining-related influences on groundwater are generally limited to areas relatively close to mine sites.

Approaches that can avoid, limit or reduce direct discharges to ground include using specific mine design and water management practices. These practices may include placing waste rock on low permeability material, lining contact water ponds and ditches, and intercepting mine seepage.

In addition to the direct pathway, mining activities can also influence groundwater quality indirectly via surface water. Mine-influenced surface water can move from surface watercourses into the groundwater below. This groundwater recharge generally occurs in localized areas with downward groundwater gradients, such as in areas with deeper or coarser overburden, and in riverbends. At areas further away from mine sites, surface water recharge of groundwater is the dominant pathway through which mining influences groundwater.

Groundwater quality through the indirect pathway from surface water to groundwater may be managed through managing surface water quality. The guidance provided in Table 13 and under the focus area to improve surface water quality (see Section 5.1) is expected to support management of groundwater quality and support the outcome for protection of groundwater.

Monitoring is a key component for managing groundwater quality towards the outcome of protecting groundwater. Since the 2014 EVWQP was developed, monitoring has increased the understanding of groundwater in the Elk Valley, and this knowledge continues to evolve. Improved understanding of sources, pathways and receptors can inform management of groundwater quality in specific areas.

Monitoring provides information about the location and extent of mining's influence on groundwater quality and informs the development of mitigation measures to avoid, limit or reduce mining influences on groundwater quality. Monitoring also allows the performance of mitigation measures to be assessed and improved, if needed.

Table 13 provides guidance for SDMs to manage groundwater quality in consideration of direct pathways to groundwater which are generally closer to mine sites, and indirect pathways via surface water to groundwater which are generally further from mine sites.

Table 13: Guidance to Manage Groundwater Quality

Guidance	Specific considerations for ministry SDMs
Set requirements to inform management of groundwater.	• Require hydreogeological investigations and models to identify the location, extent and magnitude of direct mine influences on groundwater quality. • Require development and implementation of mitigation measures and management strategies to limit the discharge of selenium, nitrate, sulphate and cadmium into the ground where they may impact groundwater quality. • Require regional groundwater monitoring programs to characterize the location and magnitude of indirect mine influence on groundwater quality.
Include requirements to implement adaptive management to support continuous improvement of groundwater management.	• Require programs to monitor the performance of measures to mitigate direct mine influence on groundwater. • Require programs to monitor the performance of surface water quality mitigation measures at reducing direct mining influences on groundwater. • Require adjustments to monitoring programs or mitigations, where necessary.

Dischargers can expect they may be required by SDMs to undertake monitoring and study of groundwater. Dischargers may be required to:

- Study the direct and indirect pathways through which mining-related sources can influence groundwater quality, including to improve understanding of sources and groundwater-surface water interactions, and to inform design of mitigation measures that may improve management of water quality.
- Study groundwater pathways from sources to receptors.
- Apply new or improved understandings to inform the design of mitigation strategies, including source reduction, to improve groundwater and surface water quality.
- Evaluate the efficacy of the mitigation strategies at reducing risks to groundwater.
- Participate in a groundwater working group (see Section 6.3).

6. Area Based Management Tools

Area based management tools support the ABMP in achieving its goals. The tools support both implementation of the ABMP and inform the ABMP itself. Like Section 5, this section provides guidance for SDMs on the application of area based management tools. In addition, this section provides information about each of the ABMP's tools to help inform shared understanding.

Successful area based management is complex work. It requires coherence among many discharges in line with the ABMP's goals. Success depends on there being a shared understanding of the tools used for area based management. Consistent use of tools facilitates effective environmental management in the Designated Area and adaptive management under the ABMP. In addition, consistent use of tools allows for regional insights to be drawn to inform better environmental management towards the ABMP's goals.

This section identifies tools that are accepted for regional use to support implementation of the plan and adaptive management. The ABMP's tools include:

- Regional models and impact assessment tools,
- Regional monitoring programs, and
- Regional committees.

Information about the tools is provided in the subsections that follow.

Some of these tools were created during development of the 2014 EVWQP and remain relevant for continued use today. These include a regional water quality model and selenium bioaccumulation models. These models have been maintained and updated over the years, including with incorporation of monitoring data.

Table 14 provides guidance for statutory decision makers (SDMs) for the application of regional tools. Examples of how this guidance may influence dischargers is provided below Table 14, as well as in the subsections that follow.

Table 14: Guidance for Regional Tools

Guidance	Specific considerations for ministry SDMs
Ensure accepted regional tools are used, and consistent requirements are set in authorizations. **Use regional tools to support overall continuous improvement across the region.**	• Set consistent requirements for use of regional tools to ensure coherence among dischargers and to facilitate administration, oversight and adaptive management of discharges in the Designated Area. • Establish common requirements for site-specific models and impact assessment tools, so they can be used alongside regional tools. • Require data to be collected, verified, and stored consistently, to support combining datasets and for using the data to maintain and update models and tools. • Require models to incorporate the latest climate, hydrology, hydrogeology and geochemistry science specific to the Elk Valley. • Require dischargers to use site-specific water quality models as well as a regional water quality model. • Require aquatic health risks to be predicted using accepted models and impact assessment tools. • Require participation in regional monitoring programs and/or regional committees when necessary. • Require regional monitoring data to be entered into the appropriate electronic data repositories. • For existing dischargers, require adaptive management planning to support timely responses to any unexpected conditions or findings, to identify areas of uncertainty for further analysis, and to facilitate continuous improvement. • Consider review or input into the development of regional tools from an independent third-party, if needed. • Consider applicability of tools when applying the guidance provided in Section 5.
Require information sharing to promote regional consistency and shared understanding where needed.	• Require regional water quality model outputs and reports, including clear descriptions of assumptions used and model limitations, to be publicly available to support a broad understanding of model(s), and to enable consistency in the approach used to assess the potential for impacts.

	• Require regional monitoring data to be made publicly available and establish consistent data sharing requirements. • Establish committees to facilitate information sharing and coordination, and to improve robustness and transparency in the work.
Establish new regional tools to address specific issues.	• If needed for a specific purpose, establish new regional models and impact assessment tools, programs or committees.

Based on the above guidance for SDMs, dischargers may be required to:

- Contribute to and implement modelling and impact assessment tools, share data, and participate in regional monitoring programs and committees.
- Predict effluent discharge quality and quantity in coordination with regional models.
- Predict potential risks to receptors using regional models.
- Develop and implement formal and structured adaptive management planning to support timely responses to any unexpected conditions or findings, to identify areas of uncertainty for further analysis, and to facilitate continuous improvement

6.1. Regional Models and Impact Assessment Tools

Regional models and impact assessment tools use conceptual, scientific and/or mathematical methods to describe information, processes and relationships in the environment to better understand conditions and potential scenarios that may result in the Designated Area.

The ABMP includes the following regional models and impact assessment tools:

- Conceptual Site Model: A conceptual site model describes, often in visual form, the interaction of parameters of concern from sources to pathways to receptors. It can be used to support a common understanding of how waste discharges may impact important values (receptors).

- Regional Water Quality Model: A regional water quality model is a mathematical representation of how parameters of concern released from mine sites move through the receiving environment. This type of model accounts for the physical process of dilution and often accounts for other processes when appropriate, such as surface and groundwater exchange, storage, evaporation and geochemical processes such as co-precipitation and reduction. Physical processes accounted for in the model are represented by empirical (derived by fitting a relationship to measured data) or

mechanistic (derived from known or hypothesized physical relationships) equations, or series of equations. Water quality models are used to make predictions of future conditions and play a central role in understanding the potential effects of effluent discharges and mitigation on the receiving environment.

- Impact Assessment Tools: Impact assessment tools are used to estimate the potential for impacts to sensitive species from predicted water quality data. They are used to predict potential risks from future conditions and to understand the potential causes of patterns observed in current or historical environmental data.

Regional models and impact assessment tools are described in further detail in the following subsections.

6.1.1. Conceptual Site Model

Planning and implementation of the ABMP is informed by a conceptual site model (CSM). A CSM provides a holistic representation of the interplay between point and non-point sources of parameters of concern and the environment.

The 2014 EVWQP in Appendix A includes CSMs . This 2025 EVWQP provides an additional updated CSM which describes:

- the sources of Order parameters at the mines,
- how Order parameters travel through the environment (pathways), and
- the plants, animals, and people exposed to Order parameters (receptors).

Figures 8 and 9 show two different versions of the CSM in the 2025 EVWQP. Both figures show the interaction of Order parameter sources, pathways and receptors.

The first CSM is a drawing that illustrates the CSM components as they may be found on the landscape based on present day information. The second CSM is a schematic that shows the relationships and flow pathways between Order parameter sources and receptors in the environment. The source-pathway-receptor relationships in the CSM are specific to mining and do not include other activities and land uses within the Designated Area. The CSM is not static and may be validated and refined, including with new information.

The CSM contributes to regional coherence by:

- supporting a common understanding of how effluent discharges from mining may impact values,
- checking that the correct parameters of concern, pathways and receptors are being monitored and managed, and

- informing the design and implementation of monitoring programs, management actions and regulatory requirements.

It is expected that dischargers in the Designated Area will use and adapt, as necessary, the ABMP's CSM to understand source-pathway-receptor relationships at their sites and in relation to the regional receiving environment.

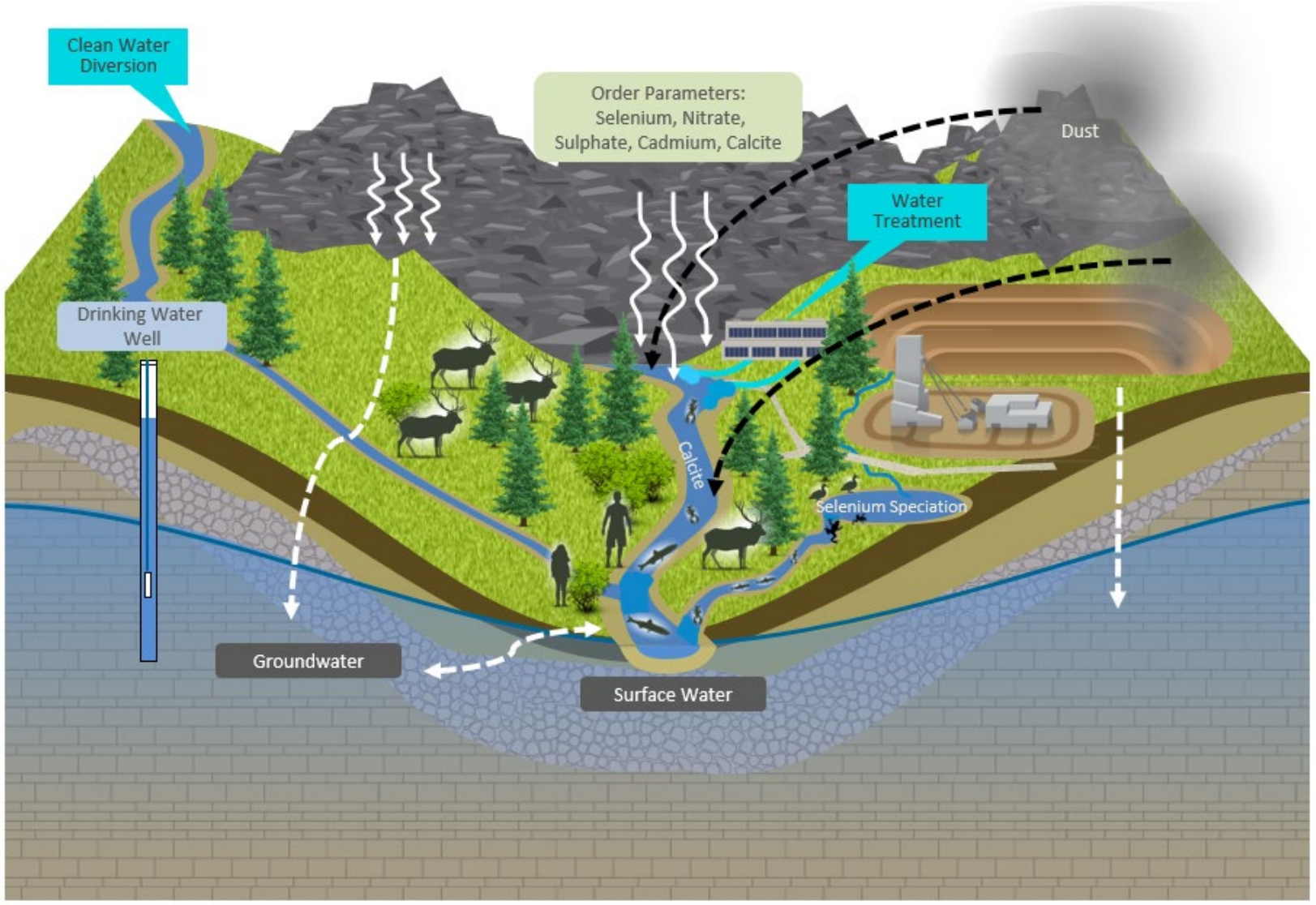


Figure 8: Conceptual Site Model – Pictorial Diagram

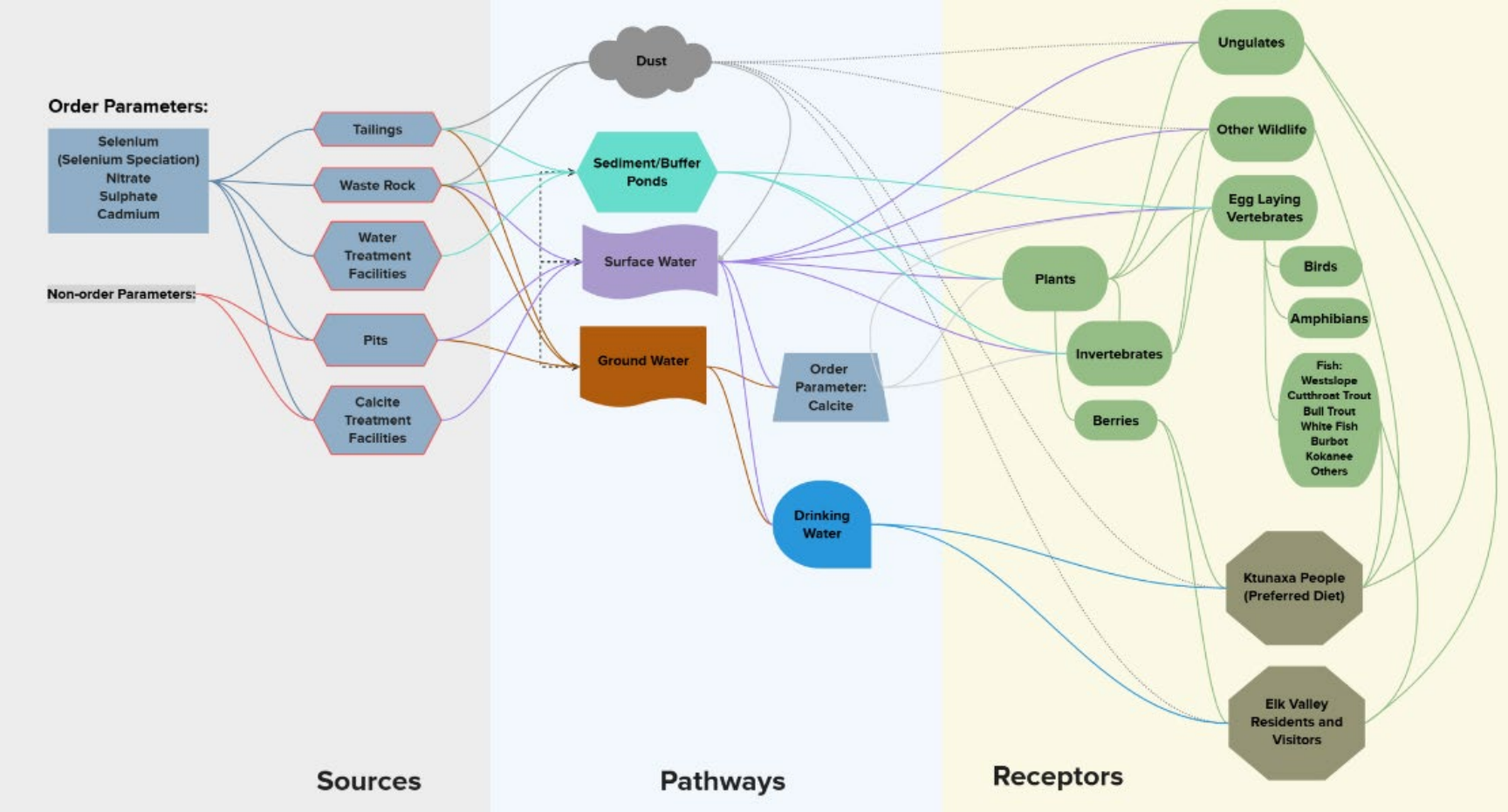


Figure 9: Conceptual Site Model – Schematic Diagram

6.1.2. Regional Water Quality Model

In 2014, a regional water quality model was constructed as a planning and assessment tool to support development of the 2014 EVWQP. The purpose of the regional water quality model was to inform water quality planning by estimating how water quality conditions in the Designated Area could change as a result of mining and associated management activities, including use of treatment facilities. The model's estimations of Order parameter concentrations at specific locations were used to develop the surface water quality targets in the 2014 EVWQP, and to identify actions that would be necessary to achieve the targets.

Since 2014, the model has been kept up to date through the ministry's administration of EMA Permit 107517. As indicated in Section 2.4, EMA Permit 107517 applies to 5 mines, accounts for point and non-point source discharges, and sets water quality limits near each mine site that align with attainment of the ABMP surface water quality targets.

EMA Permit 107517 requires the model to be regularly updated using the latest science and monitoring data. The 2014 model was updated in 2017, 2020, and most recently in 2023. Each model update has been comprehensively reviewed, including by regulators and Ktunaxa First Nations. Over the years, the model has evolved to incorporate the latest science and improvements and learnings from monitoring programs, investigations, and research and development. Each update under the permit allows the model to be adaptively managed to continuously improve its performance.

The regional water quality model is sophisticated and accounts for spatial and temporal climate and geochemical variability and associated physical processes. These modeled processes are supported by large hydrological, biological and geochemical monitoring datasets and investigations, research and development programs, and peer reviewed literature. The model describes how dispersed discharges of the surface water quality Order parameters from multiple mines in the Designated Area affect water quality, including at the Order stations. The model predicts how historical, current and future activities may affect water quality in the Elk Valley. One of the many purposes of the regional water quality model is to assess attainment of the ABMP targets.

The regional water quality model is a single integrated product made up of site-specific model components for each of the 5 mine sites and a regional model component. Each site-specific model characterizes mining activities, geochemistry, site water, and waste and water management plans for a mine site. The regional model component receives input from site-specific models and describes how Order parameters and substances mix regionally in and between surface water and groundwater and move through the aquatic

environment in the Designated Area. The site-specific models combine with the regional model component to all together form the overall regional water quality model.

The regional water quality model constructed under the 2014 EVWQP has been adaptively managed, implemented and maintained under EMA Permit 107517. Under the ABMP, the regional water quality model is the tool that informs water quality planning and assessment for the Designated Area, as well as decision-making.

6.1.2.1. Integration of Models

Dischargers introducing effluent into the environment in the Designated Area are subject to the surface water quality targets in the ABMP, and the ABMP informs the setting of discharge limits under EMA authorizations (see Section 2.4). Discharge-specific limits collectively contribute to managing overall water quality in the Designated Area to ensure that the ABMP's surface water quality targets for selenium, nitrate, sulphate and cadmium are met at the Order stations (see Section 5.1).

In British Columbia, provincial regulatory processes generally require dischargers to develop site-specific water quality models and to maintain and report on water quality associated with discharges from sources within their site boundaries. Thus, all dischargers are expected to develop site-specific models to describe the expected geochemical release of parameters of concern, including Order parameters, into the receiving environment. In the Designated Area, dischargers also need to address the ABMP. Dischargers need to predict downstream water quality changes that may result from their effluent discharges beyond their site, and to demonstrate that targets at the Order stations will be attained in the regional environment.

In the Designated Area, Order stations may be situated outside site- or model-specific boundaries and can account for influences from multiple point and non-point source discharges. Site-specific models are relied on to provide inputs into the regional model component of the regional water quality model. Site-specific model inputs into the regional model allow surface water quality to be predicted in relation to the ABMP's targets at the Order stations. Discrete site-specific model predictions from multiple discharges may then be coordinated and combined into a regional water quality model.

Site-specific models should be as integrated as feasible with a single regional model. To ensure accuracy and consistency in regional water quality predictions, the ministry will facilitate the coordinated use of the existing regional water quality model. This coordination will be provided for dischargers introducing effluent containing Order parameters into the environment in the Designated Area whose site-specific models are not fully integrated with the regional model. While dischargers are responsible for

developing site-specific models for their sites, development of additional regional water quality models should be avoided.

The ministry will coordinate the exchange of inputs and outputs between non-integrated site-specific models and the regional water quality model, including to ensure that water quality predictions at the Order stations and any other locations are understood. The exchange of inputs and outputs could occur as part of application and authorization processes, and during ABMP reviews (see Section 6.2.2). Dischargers will provide outputs from site-specific models for input to the regional water quality model, and the ministry will provide dischargers with associated outputs from the regional water quality model at appropriate downstream Order station locations. The regional water quality model outputs will allow dischargers from specific sites to demonstrate the influence their site-specific sources may have on surface water quality at the Order stations.

6.1.2.2. Model Use and Continuous Improvement

As indicated above, the regional water quality model is implemented and administered under EMA Permit 107517. Permit administration and new applications for authorizations under the EMA may provide information pertinent to the regional water quality model. This information could inform decision-making under the EMA (see Section 6.2.1). Information could also suggest a need for regional assessment or ABMP review, in which case the model could be used to inform regional planning and assessment in relation to the ABMP. For example, if new information received through administration of authorization processes suggests there is a need to review a surface water quality target in the ABMP, then the regional water quality model could be applied to the ABMP as part of an ABMP review or amendment process (See Section 7).

As indicated in the guidance provided in Table 11, the ABMP recognizes the value of continuous improvement of area based management tools, including the regional water quality model. The ABMP also recognizes the role that working groups can play in implementing and informing the ABMP, including its tools. Information received through permit administration and authorization processes can support overall continuous improvement.

Managing and adapting the process for consistent use of the regional water quality model is expected to be a complex work and will require information sharing and transparency, and inclusion of specialized expertise and knowledge from interested parties. As indicated in Section 6.4, the ABMP allows for establishment of new working groups. A new regional model working group could be established to include modelling experts, regulators, dischargers and Ktunaxa First Nations. The working group's role could include providing input to reviewing ABMP provisions for the regional water quality model, including when

there are new dischargers in the Designated Area. The working group could also provide advice to the ministry in the ministry's oversight of the regional water quality model, and recommendations for process adaptations.

6.1.3. Impact Assessment Tools

Impact assessment tools have been developed for the Designated Area for the Order parameters of selenium, nitrate, sulphate and cadmium. These tools allow risks to sensitive aquatic receptors in the Designated Area to be predicted and better understood. Impact assessment tools are based on site-specific data and peer-reviewed science. In addition to predicting risks of effects, these tools also provide an understanding of the potential causes of patterns observed in current or historical environmental data.

Impact assessment tools are site-specific, allowing for more accurate predictions of effects when compared to province-wide water quality guidelines which are more generic. Province-wide water quality guidelines may be based on sensitive species not present in the Elk Valley and typically do not take into account relevant site-specific environmental and toxicity modifying factors, such as those that would be present in the Elk Valley.

Impact assessment tools accepted for regional use in the Designated Area include:

- site-specific effects benchmarks for surface water quality Order parameters, and,
- selenium bioaccumulation models.

The effects benchmarks and models were developed under the 2014 EVWQP and were reviewed by the technical advisory committee at that time, and since then they have been reviewed regularly by an environmental monitoring committee under EMA Permit 107517. These tools have been developed using Elk Valley monitoring and toxicity data in addition to effects thresholds published in scientific literature.

More information about effects benchmarks and selenium bioaccumulation models is provided in Sections 6.1.3.1 and 6.1.3.2. Section 6.1.3.3 describes how impact assessment tools may be applied in the Designated Area.

6.1.3.1. Effects benchmarks

Site-specific aquatic effects benchmarks were first developed under the 2014 EVWQP for the surface water quality Order parameters. As discussed in Section 4.3.1, the effects benchmarks were used to derive some of the surface water quality targets in the 2014 EVWQP (see Table 4).

The effects benchmarks were developed by qualified professionals during preparation of the 2014 EVWQP. The benchmarks underwent comprehensive scientific peer review by the 2014 EVWQP technical advisory committee, which included consultants and experts from

the Ktunaxa Nation Council, the provincial government, the federal government, the United States federal government, and the Montana state government, as well as an independent third-party qualified professional. Sidebar 4 following Table 15 at the end of this section provides additional background information about the effects benchmarks.

Since 2014, the effects benchmarks have been administered and refined through regulatory submissions under EMA Permit 107517. These refinements have confirmed that the 2014 effects benchmarks remain relevant for continued use under the 2025 EVWQP. The benchmarks ensure site-specific science and toxicity modifying factors (such as hardness) are appropriately considered in effects assessments. They also provide consistent concentrations to assess the risk of population-level effects and are the basis of aquatic impact assessments in the Elk and Fording rivers, when B.C. water quality guidelines are predicted to be exceeded.

Ongoing monitoring and special studies may result in refinement of benchmarks. Where new science improves upon a 2014 benchmark and results in an updated effects benchmark being reviewed and accepted by the ministry, the updated effects benchmark should be used to assess effects to sensitive aquatic receptors in the Designated Area.

Effects benchmarks for use in the Elk Valley are listed in Table 15.

Table 15: Effects Benchmarks for the Designated Area

Order Parameter	Derivation Method	Effects Benchmarks
Selenium	Selenium benchmarks were derived using dose-response curves and a 2-step bioaccumulation model.	Level 1 and 2 benchmarks for growth and reproduction of fish present in the Upper Fording River and its tributaries (i.e., Westslope Cutthroat Trout). Level 1 and 2 benchmarks for sensitive fish species in the Lower Fording River. Level 1 and 2 benchmarks for invertebrates and birds in the Elk and Fording rivers and their tributaries.
Nitrate	Nitrate and sulphate benchmarks were derived using literature and site-specific toxicity data.	Level 1, 2 and 3 benchmarks for fish, invertebrates and amphibians in both the Elk and Fording rivers and their tributaries.
Sulphate		
Cadmium	Cadmium benchmarks were derived using the biotic ligand model and hardness based equations.	Level 1 benchmark for invertebrates at all Order Stations.

Sidebar 4: Elk Valley Effects Benchmarks – Additional Background

Effects benchmarks are concentrations of substances in water or in tissue (such as benthic invertebrate tissue, amphibian eggs, or fish tissue) that are linked with specific types of impacts on sensitive species in Elk Valley waters. They are expressed as:

- A percentage of effect for a specific measurement, for example 10% reduction in growth,
- For a specific life stage, for example juvenile,
- For a specific species, for example Westslope Cutthroat Trout, and
- For a group of species, for example fish, amphibians, birds, or aquatic insects.

The Elk Valley effects benchmarks were developed by qualified professionals during the 2014 area based management planning process. The benchmarks were developed by reviewing published scientific literature and carrying out controlled laboratory studies to determine the types of effects that result when the most sensitive species in each specific area are exposed to different concentrations of a substance. They were comprehensively reviewed by a technical advisory committee that included consultants and experts from governments, Ktunaxa Nation Council and an independent third-party qualified professional. Annexes E and F of the 2014 EVWQP provide detailed information about how the benchmarks were developed (Appendix A).

For selenium, nitrate, and sulphate, three levels of water quality benchmarks were defined in the 2014 EVWQP:

- Level 1 benchmarks for a 10% effect size: Substance concentrations that are expected to result in a 10% effect to a specific measurement (or endpoint) in a controlled laboratory setting. A 10% effect in the laboratory is not expected to be a measurable change in population because of naturally occurring variation.
- Level 2 benchmarks for a 20% effect size: Substance concentrations that are expected to result in a 20% effect to a specific measurement in a controlled laboratory setting. Low-level changes may be measurable in a population when substance concentrations are above Level 2 benchmarks.
- Level 3 benchmarks for a 50% effect size: Substance concentrations at which effects of up to 50% may be detected for a specific measurement in a laboratory controlled setting. The resulting impacts are expected to be measurable in monitoring programs and may cause changes in the aquatic ecosystem.

Sidebar 4, continued

For cadmium, only one level was defined since concentrations in the Elk River and Fording River were below the Level 1 benchmark (10% effect size) in 2013 and were predicted to remain so.

By developing effects benchmarks using the most sensitive species, other species in the area are expected to experience a lower level of impact, or higher level of protection, than indicated by the benchmark.

6.1.3.2. Selenium Bioaccumulation Models

Bioaccumulation models provide an understanding of how selenium concentrations in water may affect concentrations in biota, thus informing effects assessments. Two bioaccumulation modeling approaches are currently applied in the Elk Valley:

- Statistical models:
  - Lotic model to characterize patterns of selenium bioaccumulation in most aquatic habitats, and,
  - Lentic model to describe selenium bioaccumulation in lentic areas.
- Bioaccumulation Tool: a model that accounts for different forms of selenium including species of organoselenium.

In the Elk Valley, statistical selenium bioaccumulation models were used to derive the selenium effects benchmarks in the 2014 EVWQP. These models have been updated and refined by incorporating and making use of the extensive amount of selenium data collected in the Elk Valley since 2014.

Subsequent to the statistical models of the 2014 EVWQP, a bioaccumulation tool was developed for regional use and impact assessment in the Designated Area. The bioaccumulation tool is a model that incorporates understanding of how different selenium species, including organoselenium, affect rates of bioaccumulation. Selenium bioaccumulation models are reviewed on a three year cycle using recent water quality and aquatic effects data, and data from special studies.

6.1.3.3. Application of Impact Assessment Tools

To ensure ongoing consistency in assessing aquatic effects in the Designated Area, dischargers should utilize accepted impact assessment tools when available. These tools are to be used in addition to conventional methods for evaluating aquatic health, such as

chronic and acute toxicity testing, and benthic invertebrate tissue and community monitoring.

To ensure consistent use of the impact assessment tools, dischargers should consult with the ministry to determine which effects benchmarks and which bioaccumulation model(s) are appropriate for their project.

If project-specific conditions warrant deviating from using accepted effects benchmarks and/or the bioaccumulation models, dischargers may be expected to provide adequate scientific rationale to the ministry for consideration. If the ministry approves the use of alternative impact assessment tools, dischargers may be expected to provide thorough and transparent descriptions of models and tools to provide government agencies, Ktunaxa First Nations, and other interested parties with detailed understanding of how the tools work and the science supporting their development. Dischargers may need to provide sufficient information so that others can use these tools, and to avoid the need to develop duplicative tools for the same purpose.

To support critical review and to foster confidence in the impact assessments conducted in the Designated Area, the ministry will make tools accepted for use and their supporting science publicly available. This will allow multiple dischargers to access adequate information to be able to leverage the models and tools to complete science-based impact assessments without having to build new tools for the same purpose. This approach will support continuous improvement of impact assessment in the Designated Area under potential scenarios that include multiple authorizations holders.

6.2. Regional Monitoring Programs

Regional monitoring programs bring together and align efforts and information that require coherence across the Designated Area. Monitoring is necessary to confirm that the goals of the ABMP are being met. Regional monitoring programs include the following receiving environment monitoring programs and studies:

- Regional aquatic effects monitoring: monitors and interprets indicators for regional mine-related impacts to the aquatic ecosystem in the Designated Area to comprehensively evaluate aquatic ecosystem health, and to understand current conditions and track trends.
- Koocanusa Reservoir monitoring: monitors and interprets water quality and indicators of aquatic health, including fish tissue, to understand current conditions and track trends in Koocanusa Reservoir
- Surface water flow monitoring
- Regional calcite monitoring program

- Groundwater monitoring

Data from regional monitoring programs may be considered alone or together with data from other monitoring programs to assess if the ABMP is achieving its goals.

Regional monitoring programs also inform adaptive management to ensure the ABMP remains relevant and effective. Adaptive management is specifically informed by water quality monitoring at the Order stations, regional aquatic effects monitoring, groundwater monitoring, and human health risk assessment.

Consistent data collection methods and analysis may be required for those participating in regional monitoring programs. Environmental monitoring data collected under the regional monitoring programs may be reviewed by committees to evaluate whether the ABMP is making progress towards its goals (see Section 6.3).

Ministry decision makers may consider establishing new regional programs, in addition to regional monitoring programs, if needed for specific purposes related to the ABMP. New programs could be established to support regional coordination, design, planning, management and/or implementation of the ABMP. The ministry may also consider extending participation in regional monitoring programs to new dischargers.

6.3. Regional Committees

Regional committees convene resources and/or individuals to address particular topics of interest in the Designated Area and relevant to the ABMP.

At present, an environmental monitoring committee oversees aquatic effects monitoring programs in the Elk Valley administered under EMA Permit 107517. The environmental monitoring committee is a group of experts that provides advice to the ministry regarding these programs. It includes an independent scientist and representatives from Ktunaxa, dischargers and regulators.

The environmental monitoring committee also includes working groups, which provide knowledge and expertise on specific topics. These include a human health working group and a groundwater working group.

The ministry may consider extending committees to new participants. In addition, new committees or working groups may be needed to support coordination, design, planning, management, and/or implementation of the ABMP. The ministry may consider establishing new committees or working groups, if needed for a specific purpose, or to support coordination of the design, management and implementation of programs in accordance with the ABMP.

6.3.1. ABMP Implementation Committee

An ABMP implementation committee is established under the 2025 EVWQP. The committee will provide advice to the ministry in its oversight of the ABMP, including by supporting ABMP reviews (see Section 7). The group should at a minimum reflect the following perspectives:

- Ktunaxa First Nations,
- Current or historical effluent dischargers of Order parameters in the Designated Area, and,
- Provincial regulatory agencies.

The ministry may seek advice from the committee on implementation of the plan and evaluating its effectiveness, or identifying any emerging issues. The ministry may establish a terms of reference for the committee, including the purpose, structure, meeting frequency and procedures for the committee. The committee is expected to meet once per year.

It is expected that the ABMP implementation committee will review the status of implementation, using information from the ABMP's regional monitoring programs and committees, including information from the ministry's monitoring and oversight efforts, as well as information being developed under EMA authorizations associated with the ABMP. The ministry may also seek advice from the ABMP implementation committee, as needed. The ABMP implementation committee could also support updates to the ABMP (see Section 7).

7. ABMP Review and Amendment

Adaptive management is fundamental to area based management of the Designated Area. Adaptive management provides a structured yet flexible process for evaluating and, when required, adjusting the ABMP in response to new information. This allows the ABMP to adapt by incorporating new information so that the goals of the ABMP may be achieved as circumstances change. The ABMP is intended to adapt and respond to new information to ensure it remains relevant and effective towards achieving its goals and progressing towards the vision for water quality in the Designated Area.

Adaptive management may be informed by learnings and new information, including from operational, monitoring, and research and development programs. New information may be generated through administration of authorizations, such as EMA Permit 107517 (see Section 2.4). As shown in Figure 10, authorizations may provide information signaling a need to review the ABMP. For example, authorization requirements for monitoring, assessment, and/or research and development may provide new information to improve area based management under the ABMP.

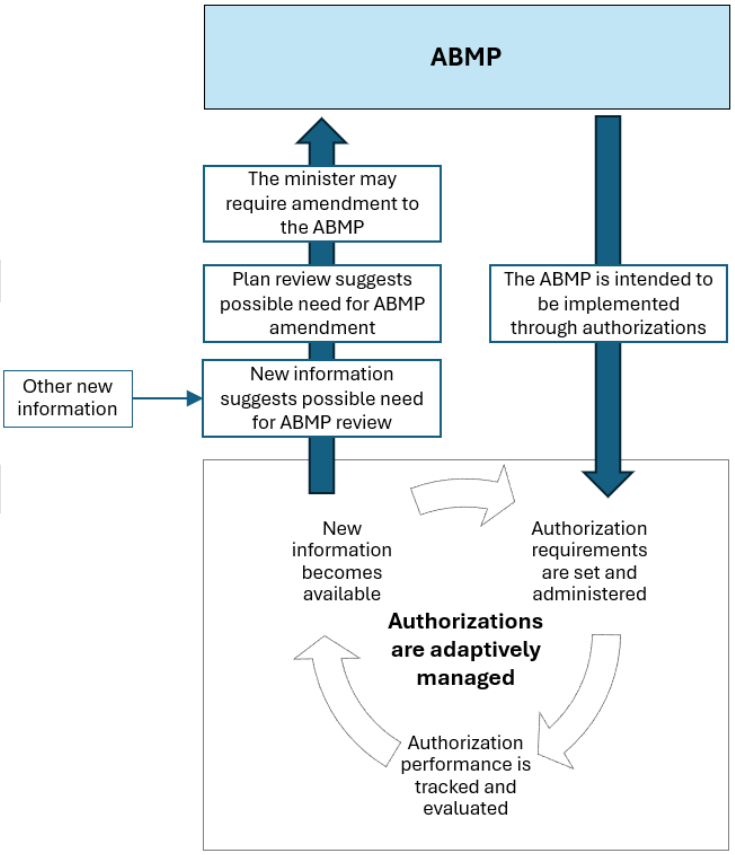


Figure 10: New Information and Adaptive Management of the ABMP

New information could also result from new developments and applications for new authorizations. For example, development of a new mine in the Elk Valley, may prompt review and evaluation of objectives or targets in the ABMP.

New information could also result from other sources or origins, such as advancements in science, technology, policy, or legislation. For example, advancements in underlying science or updated assumptions could mean the ABMP's goals, focus areas and guidance, and/or regional tools may need to be reviewed.

Area based management is informed by new information. The ministry is committed to sharing new information that becomes available, and this includes information collected under EMA authorizations in connection with the ABMP. The ministry will collate and summarize information about ABMP implementation and post this information for the public. The ministry will share the information, such as through the Elk Valley Water Quality Hub website, and will:

- Regularly provide data and information required under EMA authorizations connected to the ABMP,
- Report on ABMP reviews and/or amendments, and,
- Evaluate and report on the progress made towards the ABMP's goals and vision for the Designated Area.

7.1. ABMP Review

New information may prompt a review of the ABMP. A review is not an amendment to the ABMP. Rather, a review would assess whether an ABMP amendment should be sought.

In general, a review could assess adding, amending, removing and/or reviewing ABMP components, such as objectives, targets, Order stations, focus areas, guidance, and/or regional tools. The following is a list of some examples illustrating circumstances where an ABMP review may be needed:

- Improved understanding of species sensitivity or ecotoxicology of Order parameters (i.e., new information from administration of surface water quality benchmarks under an authorization);
- New developments in best achievable technologies or strategies for treatment and/or management of Order parameters;
- Changes to the level of exposure of humans to Order parameters;
- Opportunity to lower targets to increase protection or reduce risk;
- New legislation, or updates to existing legislation;

- New authorized points of discharge of the Order parameters of selenium, nitrate, sulphate and cadmium out of alignment with current surface water quality target locations;
- Need to add, amend or review Order station locations in response to a new discharge, or;
- New understanding of non-Order parameters which suggests that a regional management approach may be warranted (e.g. consideration as an Order parameter).

At a minimum, the ministry will undertake an ABMP review at least once every five to 10 years to assess whether any ABMP components, such as objectives, targets, Order stations, focus areas, guidance, and/or regional tools need to be added, amended, removed and/or reviewed. This review will consider new information available since the prior amendment to the ABMP, and may include, but not be limited to, consideration of the latest monitoring data and information, science and best achievable technologies.

When undertaking any review, the following general process involving the ministry and ABMP implementation committee (see Section 6.3) may be followed:

- The ministry identifies a provision of the ABMP potentially needing to be added, amended, removed and/or reviewed.
- The ministry prepares a preliminary assessment with background information, analysis, options and draft recommendations.
- The ministry notifies the ABMP implementation committee of the provision under consideration for review and seeks advice and input.
- With input from a ministry statutory decision maker, the ministry prepares a final summary and assessment of the provision(s) under consideration for review.
- The ministry notifies the ABMP implementation committee if a review will proceed, or what the next steps will be.
- The ministry establishes a terms of reference for the review. The terms of reference may include requirements for the application of area based management tools.
- The ministry completes the review in accordance with the terms of reference and with input and advice from the ABMP implementation committee and/or other parties as needed.

At the conclusion of the review, the ministry may wish to seek further direction from the minister, including if an amendment to the ABMP is recommended.

7.2. ABMP Amendment

An ABMP review may inform whether an ABMP amendment should be sought to adjust and adaptively manage the ABMP. If a ministry review of the plan indicates a need for an amendment then the ministry may seek direction from the minister.

The minister may require an amendment to the ABMP using authority under the EMA. An ABMP amendment would need to follow requirements under the EMA and directions provided by the minister. It is expected that a Ministerial Order under the EMA is the instrument that would lay out detailed amendment directions including a terms of reference for an amendment.

8. Closing

This 2025 EVWQP establishes a vision for water quality in the Designated Area and provides a ministry framework with goals and an implementation strategy to make progress towards this vision. The Elk Valley ABMP is the only area based management plan in the Province of British Columbia, and it exists in the Designated Area in addition to the usual regulatory framework under the EMA.

The Elk Valley has a unique history of coal mining that has impacted water quality, and this history will influence environmental management while mining continues and after mine closure.

The ABMP provides guidance to statutory decision makers under the EMA to inform decision-making, and it provides information for dischargers and interested parties to help guide progress towards the ABMP's goals.

The ABMP will need to be reviewed and amended as required to ensure it remains relevant and effective towards advancing its goals and the vision for the Designated Area, including as new information becomes available.

9. Terminology

9.1. Acronyms and Abbreviations

Acronym/Abbreviation	Description
2014 EVWQP	2014 Elk Valley Water Quality Plan
2025 EVWQP	2025 Elk Valley Water Quality Plan
ABMP	The approved Area Based Management Plan for the Designated Area
BAT	best achievable technology
BCWQG	British Columbia water quality guideline
CSM	conceptual site model
EMA	Environmental Management Act
MU	management unit
Order M113	Ministerial Order No. M113-2013
Order M232	Ministerial Order No. M232-2024
SDM	statutory decision maker

9.2. Glossary

2014 Elk Valley Water Quality Plan (2014 EVWQP): the initial Elk Valley Area Based Management Plan, developed by Teck Coal Limited in response to Order M113, and approved by the Minister of Environment on November 18, 2014.

2025 Elk Valley Water Quality Plan (2025 EVWQP): phase 1 of the Elk Valley Area Based Management Plan amendments required by Order M232, and to be submitted to the minister for approval as an amendment to the ABMP.

Area Based Management Plan (ABMP): the approved Area Based Management Plan for the Designated Area established by Order M113.

Adaptive management: a systematic process for continually improving management and practices to meet objectives by learning from outcomes of programs, including operational, monitoring and research and development programs. An adaptive management cycle typically includes five steps: assessment, design, implementation, evaluation, and adjustment.

Area based approach or area based management: coordinated management of environmental effects accounting for sources of waste that are discharged in a specific area.

Authorization: written permission to release waste into the environment under the EMA.

Best achievable technology (BAT): technology that has been evaluated for its feasibility, reliability, control-effectiveness, and cost effectiveness and is demonstrated to be best-suited to meet waste discharge standards for the protection of the environment and human health.

Continuous improvement: an ongoing effort to improve environmental management practices based on changing knowledge, technology and best practices to improve environmental performance. In the context of the Elk Valley ABMP, continuous improvement means ensuring that the ABMP continues to effectively and efficiently work towards achievement of the ABMP outcomes with progressive measurable improvements to the condition of water and all living things.

Designated Area: a portion of southeastern British Columbia that contains the Elk Valley watershed and the portion of Koocanusa Reservoir within Canada and is geographically defined by Order M113.

Discharge: to introduce effluent into water or onto land.

Discharger: a person authorized under the EMA to collect, store, treat, handle, transport, discharge, destruct or dispose of waste in relation to a prescribed industry, trade, business, activity or operation in accordance with a valid and subsisting authorization.

Effects benchmark: a concentration of an Order parameter in water or tissue that is associated with a defined level of effect and is based on conditions and species of aquatic life specific to Elk Valley waters. It is a point of reference used in assessing the potential for effects.

Environmental Management Act (EMA): legislation that regulates waste discharges to air, water and land from prescribed industries, trades, businesses, activities, and operations.

Limit: authorized quality and/or quantity of a discharge, legally enforceable if defined in a permit or other authorization.

Multigenerational continuous improvement outcome: desired long-term future state of the Designated Area. Developed by B.C. and Ktunaxa in 2014 as shared, longer term narrative statements important to guide longer term (multigenerational) decision-making about water quality in the Designated Area.

Non-Order parameter: a parameter, excluding an Order parameter, that may be present in effluent and/or the receiving environment and that should be assessed to determine whether it is a **parameter of concern** that requires management action and/or regulation.

Objective, environmental management objective: represents progress towards the outcomes of the ABMP. Referenced in Section 89(4) of the EMA.

Order M113: Ministerial Order No. M113-2013 was the directive issued by the Minister of Environment on April 15, 2013 requiring Teck Coal Limited to develop an area based management plan for the Designated Area in the Elk Valley.

Order M232: Ministerial Order No. M232-2024 was a directive issued by the Minister of Environment and Climate Change Strategy on July 9, 2024 requiring amendments to the ABMP.

Order parameter: a **parameter of concern** identified in Order M113 managed on an area-wide basis in the Designated Area; selenium, nitrate, sulphate, cadmium, and calcite.

Order station: a location specified by Order M113 to monitor water quality in the Designated Area at which surface water quality targets in the ABMP apply.

Outcome, environmental management outcome: desired long-term future state of the Designated Area. Referenced in Section 89(4) of the EMA.

Parameter of concern: any physical, chemical, or biological substance in air, soil or water at a concentration, or predicted to be at a concentration that exceeds regulatory thresholds, or may have an adverse effect on environmental or human health receptors.

Permit: see definition for **authorization.**

Purpose: the purpose of the ABMP is defined in Order M232.

Protection: the prevention of harm or injury to humans or wildlife from the discharge of effluent.

Qukin ʔamakʔis: Raven's Land. The Elk Valley.

Receiving environment: the environment into which waste is introduced. The EMA defines environment as air, land, water and all other external conditions or influences under which humans, animals and plants live or are developed.

Receiving waters: in the context of the Elk Valley ABMP, receiving waters means surface water and groundwater in the receiving environment downstream or downgradient of effluent discharges from mining activities and other dischargers.

Statutory decision maker (SDM): ministry staff appointed as a director under the EMA or delegates of directors under the EMA who have authority to make decisions under the EMA authorizing the introduction of waste into the environment subject to requirements for the protection of the environment.

Target: a measurable and achievable value for an Order parameter intended to inform area based management, including development and implementation of strategies, actions and/or requirements.

Appendix A

Ministerial Order No. M113-2013

2014 Elk Valley Water Quality Plan

Approval Letter November 18, 2014

Appendix B

Ministerial Order No. M232-2024

Appendix C

Summary of 2024 Calcite Review

Appendix C: Summary of 2024 Calcite Review

1. Purpose

The purpose of this document is to summarize the results of the scientific review conducted by the Ministry of Environment and Parks (ENV) to inform updates to the calcite targets in the 2025 Elk Valley Water Quality Plan (2025 EVWQP),[1] including recommendations for their application. Recommendations for updated calcite targets and their assessment methods are based on available science and include technical input from the following representatives: ENV; the Ministry of Mining and Critical Minerals (MCM);[2] the Ministry of Water, Land, and Resource Stewardship (WLRS); the Ktunaxa Nation Council (KNC); Yaq̓it ʔa·knuqƛ̓it (YQT); Elk Valley Resource Operations Limited (EVR);[3] the Environmental Monitoring Committee (EMC); and Fisheries and Oceans Canada (DFO).

ENV anticipates that research on, and understanding of, calcite biological effects will continue to advance under Permit 107517's (the Permit) Adaptive Management Plan (AMP) Management Objective 2 (i.e., manage calcite to meet Site Performance Objectives (SPOs) and protect the aquatic ecosystem).

2. Introduction

On August 3, 2023, ENV completed a ministry assessment of the 2022 Calcite Management Plan (CMP) submitted by EVR on July 31, 2022, in accordance with Section 5.1 of Permit 107517. The purpose of the ministry assessment was to evaluate compliance with the Section 5.1 requirements, summarize unresolved comments during the review process, and identify additional steps and potential permit amendments. The ministry assessment concluded that ENV should acknowledge the 2022 CMP submission and engage with reviewers to discuss potential permit changes regarding the medium- and long-term calcite SPOs in Section 3.4 of the Permit,[4] mitigation and remediation strategies in Section 5.1 of the Permit, and other remaining concerns.

[1] Alternative calcite targets are presented in Sections 4.3.2 and 5.3 of the 2025 EVWQP.
[2] Previously the Ministry of Energy, Mines, and Low Carbon Innovation (EMLI).
[3] Previously Teck Coal Limited.
[4] The medium- and long-term site performance objectives were based on recommendations presented in the Elk Valley Area Based Management Plan and formalized as requirements in Permit 107517 in 2014.

To advance these discussions, ENV scheduled a series of four workshops with the workshop representatives throughout 2024.[5] The focus of the workshops was to critically evaluate the calcite SPOs, established in 2014 in Section 3.4 of the Permit, for environmental protectiveness, achievability, and feasibility.

During the calcite workshops, EVR provided an overview of research on the currently understood effects of calcite concretion on aquatic life. ENV heard perspectives from workshop representatives, and ENV technical staff proposed three tiers of calcite concretion limits as part of the draft Permit amendment. The limits are intended to stabilize and/or reduce further concretion of streams at the stream reach level. Based on input from workshop participants and a review of calcite effects assessments submitted by EVR since 2014, ENV technical staff have proposed a limit of 0.1 calcite concretion (Cc) in the draft amended Permit and the supporting ministry assessment to control the accumulation of calcite concretion in stream reaches that have not shown signs of concretion related to mining activity. A limit of 0.3 Cc[6] is proposed for the protection of aquatic life in stream reaches with minimal impact from calcite concretion. ENV technical staff have further proposed reach-specific calcite concretion limits for moderately concreted reaches (i.e., greater than 0.3 Cc) as well as a requirement for EVR to initiate additional site remediation assessments for stream reaches with extensive concretion at levels that may be harmful to fish and fish habitat.

3. Overview of Recommendations

The following summarizes ENV's current understanding of calcite effects on aquatic life and considerations for measuring and reporting calcite. Additional details and citations are provided in Sections 4 and 6.

- **Calcite – Cc as an Evaluation Parameter:**
  Calcite index (CI) and calcite presence (Cp) are not recommended for the interpretation of biological effects. There is limited evidence that Cp (i.e., calcite scaling on rocks) has resulted in measurable adverse impacts to aquatic life, and the mechanism for potential adverse effects from Cp is unclear. In contrast, calcite concretion (Cc) may directly impact aquatic habitat by filling interstitial spaces (refuge

[5] Workshops were held on February 1, 2024; April 2, 2024; June 3, 2024; December 2, 2024. Representation included technical reviewers from ENV, MCM, WLRS, KNC, YQT, EVR, EMC, and DFO in all or some of the workshops.

[6] A limit of 0.25 Cc was originally proposed but was updated in January 2025 to the rounded value of 0.3 Cc to better align with the sampling precision of one significant figure. This degree of precision (tenth place) is used for assigning limits and reporting effects. The document also references precision at the hundredths place for the purpose of presenting and comparing data in statistical summaries or model estimates.

and habitat for invertebrates and fish) and impeding fish from digging redds. CI is a composite of Cp and Cc; therefore, its use for establishing ecological effects thresholds may be confounded by variations in Cp irrespective of Cc. Cc is consequently recommended for evaluating impacts and assessing compliance.

- **Calcite – Three-Year Moving Average as an Evaluation Metric:**
  Recognizing the variance in calcite concretion data associated with environmental variability and the potential for observation error, a three-year moving average of calcite concretion is recommended when presenting calcite concretion trends and evaluating compliance with calcite limits or site performance objectives.
- **Calcite – 0.1 Cc as a Limit for Reference Conditions:**
  Excluding two extreme outliers in 2015, concretion in reference reaches has not historically exceeded 0.05 Cc based on a three-year moving average (3MA). Since 2019, there have been no instances where calcite exceeds 0.02 Cc 3MA in reference streams. To better align with sampling precision, a Cc of 0.1 is proposed as a conservative limit for reference stream reaches and non-reference stream reaches with a history of no concretion.
- **Aquatic Effects – Benthic Invertebrates:**
  Benthic invertebrate community metrics deviate from reference or baseline conditions at a CI of 1.0, when concretion generally begins to occur. A CI of 1.0 is roughly equivalent to a mean Cc of 0.2. EVR reported during the first workshop session that benthic invertebrate predictive modelling indicates a threshold effect for benthic invertebrates may occur at 0.1 – 0.3 Cc.
- **Aquatic Effects – Westslope Cutthroat Trout (WCT) Spawning:**
  Modelling of calcite concretion and redd presence indicates that streams with redds have a mean concretion score of 0.08 Cc, whereas streams without redds have a mean concretion score of 0.3 Cc. Care should be taken in interpreting these findings, as the model also suggests that the highest probability of redd presence (20%) among all calcite concretion bins was observed for calcite concretion between 0.25 – 0.5. WCT population is likely to be less sensitive to calcite concretion than benthic invertebrates, and it remains unclear at what concretion value WCT population-level impacts are expected to occur in the UFR or affected tributaries.
- **Spatial Extent of Assessment – Stream Reach Level:**
  Impacts from calcite may be localized or heterogeneous, and precipitation of calcite varies due to changes in stream characteristics (e.g., temperature, turbidity, substrate type, vegetation). Reporting and interpretation at a reach-level, rather than a stream-level, is anticipated to better capture localized impacts on aquatic habitat.

Based on the available science and workshop discussions to date, ENV technical staff recommend that calcite limits in the Permit be based on calcite concretion and assessed at the reach level using a three-year moving average metric.

4. Calcite Metrics

4.1. Calcite Concretion as an Evaluation Parameter

Calcite has been monitored and reported using calcite index (CI), calcite presence (Cp), and calcite concretion (Cc) metrics, where CI = Cp + Cc. Hocking *et al.* (2022) identified a positive relationship between Cp and redd presence and redd counts, hypothesizing that Cp is correlated with conductivity and pH, two factors that may indirectly influence WCT habitat suitability by stimulating benthic productivity. The relationship between Cp and WCT redd metrics is likely confounded by these productivity measurements. Therefore, the Cp metric may not be biologically relevant for evaluating adverse impacts from calcite. Because CI is autocorrelated with Cp, CI is also not a suitable metric for understanding biological effects.

Unlike Cp and CI, there is an observable mechanism of impact for Cc; as Cc increases, interstitial spaces among stream substrate become occluded with calcite, reducing refuge and habitat availability for aquatic life. ENV therefore recommends that Cc, rather than CI or Cp, be used for interpreting biological effects of calcite and informing the establishment of permit limits for aquatic protection.

4.2. Three-Year Moving Average as an Evaluation Metric

Section 3.4 of the Permit does not specify a metric for reporting and evaluating compliance for calcite index or calcite concretion. Several options were considered for the proposed limits or targets, including point estimates (e.g., mean, mode, median, percentiles). The use of mean is consistent with point estimates used in the Permit and is an acceptable metric for summarizing calcite concretion from multiple sampling transects of 100 pebble counts completed for each reach.

ENV further recommends using a three-year moving average (3MA) calculation to assess calcite impacts and trends. Whereas water quality samples are subject to approved monitoring standards and quality assurance and quality control measures (QA/QC, e.g., field blanks, laboratory blanks, sample replicates), calcite monitoring sampling is a subjective field observation and therefore poses a greater risk of observation errors that may result in non-compliance. A resultant non-compliance may prompt a premature and potentially misguided management response rather than investigation and confirmatory sampling. A moving average approach minimizes the likelihood that a non-compliance determination is issued for what may be an isolated observer or reporting error. Conversely, for instances where an abnormally high and legitimate annual observation is reported, there is a risk that the moving average approach may delay a timely management response. To mitigate this risk, it is expected that EVR will leverage current response frameworks such as Trigger Action Response Plans and the Adaptive

Management Plan to review, address, and report abnormal results and potential signals of increasing concretion.

4.3. 0.1 Cc as a Limit for Reference Conditions

Calcite precipitation on streambeds is a naturally occurring process, with Cp observed in reference reaches within the Elk Valley. In contrast, Cc is less frequently observed than Cp in reference reaches and at a significantly lower value than in mining-exposed reaches (**Figure 1**).

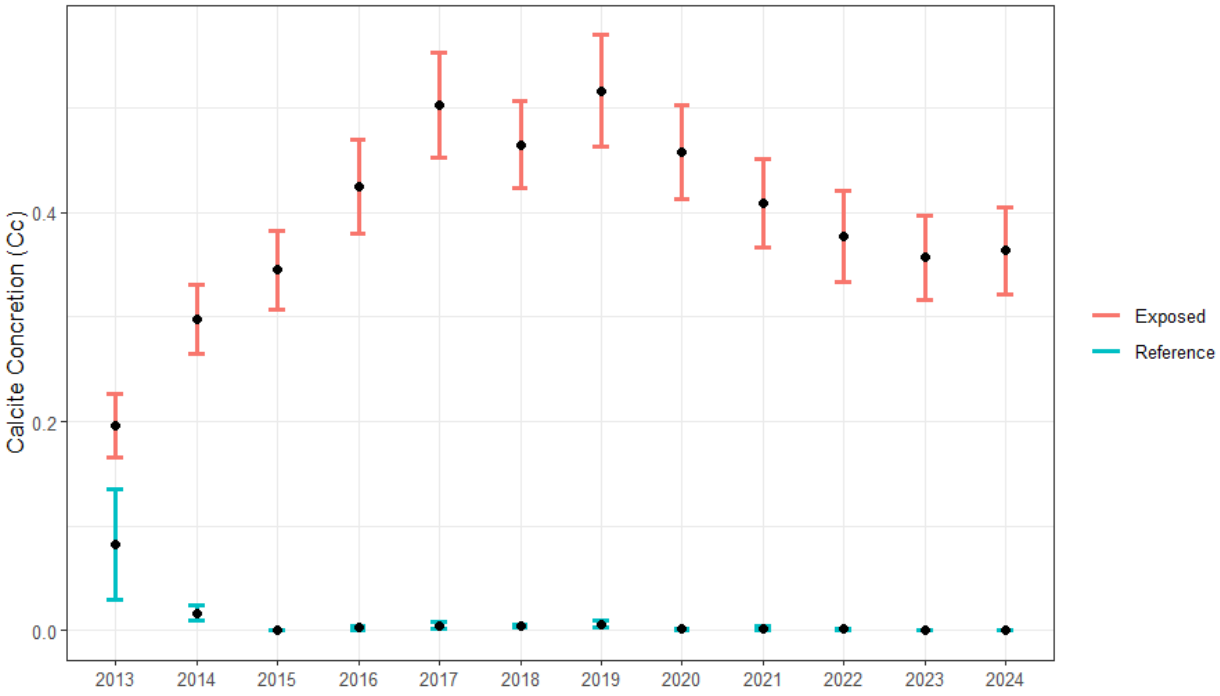


Figure 1: *Mean calcite concretion by year and exposure condition. Black points indicate the mean calcite concretion, and error bars are the standard error. "Exposed" refers to reaches that are external to or downstream of mining activity in the Elk Valley Designated Area.*

The degree to which concretion naturally occurs helps identify limits for what constitutes mine exposure. A closer visualization of historical concretion at reference reaches shows that, excluding two extreme outliers,[7] the maximum historical 3MA Cc of 0.05 was

[7] Extreme outliers defined annual averages exceeding 3 times the interquartile range and the proposed 0.1 Cc limit. These outliers were observed at the following reaches:

- CHAU1, annual Cc average of 0.67 (3 x IQR = 0.03), 2013
- SLINE2, annual Cc average of 0.57 (3 x IQR = 0.00), 2013

observed in ALEX3 (Alexander Creek) in 2015 (**Figure 2, Table 1**). Within the last five years, the 3MA has not exceeded 0.02 Cc in reference reaches.

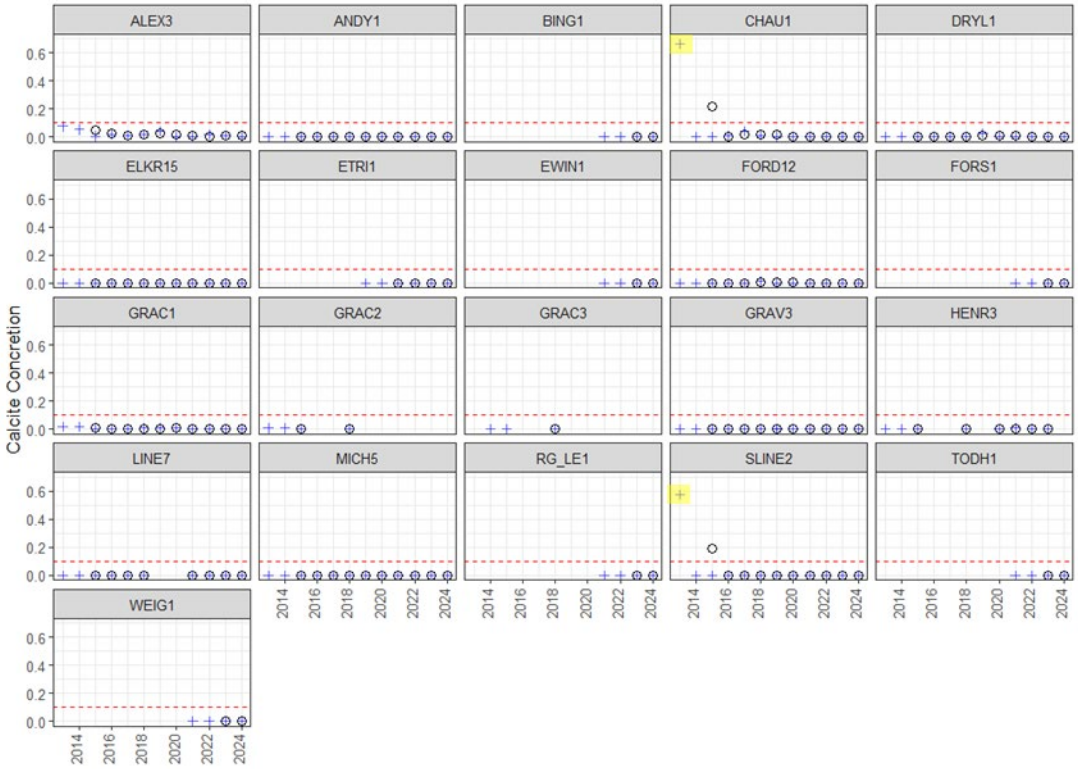


Figure 2: *Annual average (blue cross) and three-year rolling average (open circles) of calcite concretion in reference reaches. Red dashed line indicates 0.1 Cc. Yellow-highlighted annual average points are considered extreme outliers (those greater than three times the interquartile range). Reference locations with fewer than three data points were excluded from the plot for brevity (all these locations had a mean Cc near zero): ALDR1, ALEX1, ALEX8, CARB1, CARB2, DRIN1, DRYL5, DRYL6, HART2, LIZA1, MCOO1, MORI1, RG_UCWER1, SNOW1, WHEE1, WHEE2, and WHEE3. MCOO1 had one sampling event in 2021 with a mean Cc of 0.05.*

Table 1: *The ten most concreted reference reaches based on data from 2013-2024 and calculated using a three-year moving average of calcite concretion. Red text indicates a three-year moving average value influenced by a singular extreme outlier datum, as visualized in Figure 2.*

Creek	Stream Reach Segment	Year	Three-Year Moving Average (Cc)
Chauncey	CHAU1	2015	0.22
South Line	SLINE2	2015	0.19
Alexander	ALEX3	2015	0.05
Alexander	ALEX3	2016	0.03
Alexander	ALEX3	2019	0.02
Chauncey	CHAU1	2018	0.02
Alexander	ALEX3	2020	0.02
Chauncey	CHAU1	2019	0.02
Alexander	ALEX3	2018	0.02
Chauncey	CHAU1	2017	0.02

Based on this assessment, the value of 0.1 Cc was recommended as a conservative upper limit for reference conditions as it contains the maximum non-outlier 3MA concretion value (0.05 Cc at ALEX3) and considers rounding the data to the tenth place (i.e., from 0.05 to 0.1) to better align with the monitoring precision of the field data collection method.[8] Because 3MA Cc values since 2017 have been at or below 0.02 Cc in reference reaches, an exceedance of 0.1 Cc 3MA is a likely indicator of either calcite accumulation due to mining activity or an observation error during sampling. ENV is aware that EVR has improved both the calcite monitoring methodology and QA/QC and now requires calcite monitoring field staff to attend a training workshop with the intent of reducing the likelihood of uninformed or erroneous calcite sampling.

4.4. Aquatic Effects

EVR has submitted annual calcite biological effects assessments to ENV since 2014. A table of cited works and respective conclusions is provided in Section 6. Relevant findings on the potential effects of calcite on benthic macroinvertebrates and fish are summarized here.

[8] Field observations of calcite concretion are recorded categorically as integers (0 = not concreted, 1 = concreted but removable, 2 = concreted to streambed and immovable). It is understood that calculations and summary statistics conventionally align with the sampling precision. However, it was decided to round values to the tenths place rather than the ones place to better represent the gradient of conditions between 0 and 1 concretion based on hundreds of observations within a reach.

4.4.1. Benthic Macroinvertebrates

Deviation from reference or expected benthic macroinvertebrate community (BIC) structure was first observed at CI scores above 1.0 (Barrett et al., 2016), which ENV has approximated as equivalent to 0.2 Cc.[9] A visual assessment of the plots provided in **Figure 3** suggests that below a Cc of approximately 0.3, the percent of EPT[10] generally remains within reference conditions. These plots have not been recreated using post-2016 data, limiting the amount of data and confidence in assessing the threshold of calcite impacts on benthic invertebrates.

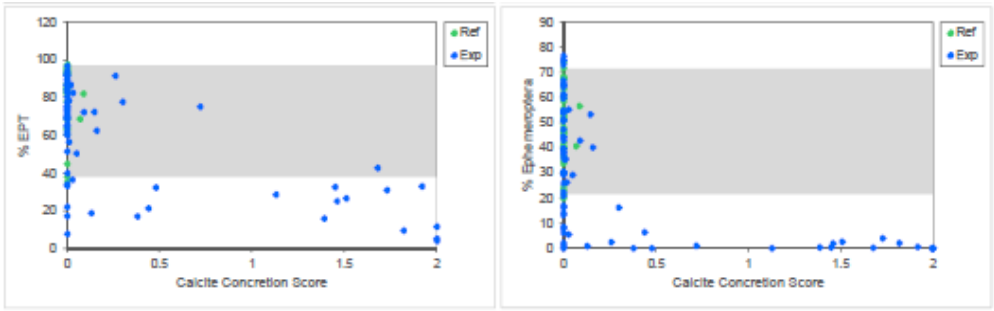
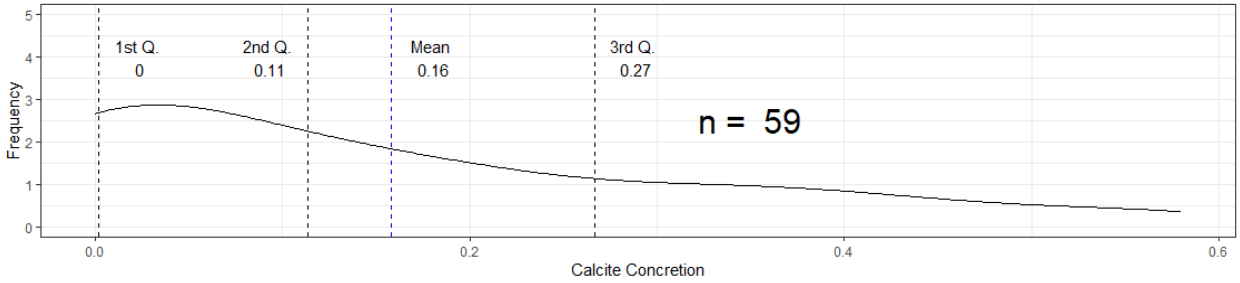


Figure 3: *Plots from Figure C.7 of (Barrett et al., 2016) showing pollution intolerant benthic invertebrate endpoints (%EPT and %E) as function of calcite concretion score. Calcite data from samples collected at reference (n = 40) and mine-exposed areas (n = 74) in 2015. Shading represents the normal range defined as the 2.5th*

Due to confounding impacts from water quality, there remains uncertainty in the relationship between calcite concretion and adverse effects on BIC, especially at low concretion values (0 – 0.5 Cc). However, developments in BIC predictive modelling have facilitated a decoupling of water quality and calcite effects. During the first calcite workshop on February 27, 2024, EVR presented a focused evaluation of potential calcite

[9] ENV completed an independent assessment with more recent data (up to the year 2024) by calculating quantiles for Cc values for samples with CI in the range of 0.9 - 1.1 (59 reaches). For reaches with a CI of ~1.0, the mean is ~0.2 Cc and the 75th percentile (3rd quartile) of Cc values is ~0.3.



[10] Benthic invertebrate phylogenetic orders: Ephemeroptera, Plecoptera, and Trichoptera (EPT). Low %EPT or low %E is often an indicator of impacted or polluted aquatic conditions.

effects to BIC metrics, with a conclusion that "calcite concretion has a consistent relationship with BIC endpoints (e.g., %E), with thresholds on the predicted outcomes of between 0.1 - 0.3. However, the magnitude of effects attributed to calcite is small, even at sites with high concretion."

Based on the assessment of reference conditions, the available BIC information, the predictive BIC modelling results, it is recommended at this time that a calcite concretion limit no higher than 0.3 be used for the protection of benthic invertebrates.

4.4.2. Fish

The UFR is home to a fragmented, genetically-isolated population of WCT exposed to mining pressures. Redd surveys and statistical modelling completed by Hocking *et al.* (2022) indicate that calcite concretion is a stressor on both WCT redd presence and redd count. **Figure 4(a)** shows that for streams in mesohabitat units containing redds, average calcite concretion was 0.08, providing preliminary evidence that this level of concretion is not expected to impede WCT from digging redds. For mesohabitat units in which redds are absent, the average calcite concretion score was 0.3. However, it should not be concluded from this result alone that adverse effects to WCT from calcite occur at 0.3 Cc; **Figure 4(b)** shows that an absence of redds (i.e., 0.00 redd presence) is observed even in units without calcite, and **Figure 4(c)** illustrates that the highest probability of redd presence (20%) among all calcite bins was unexpectedly observed for calcite concretion between 0.25 – 0.5. To date, ENV is not aware of information identifying a concretion value at which WCT are physically unable to dig redds.

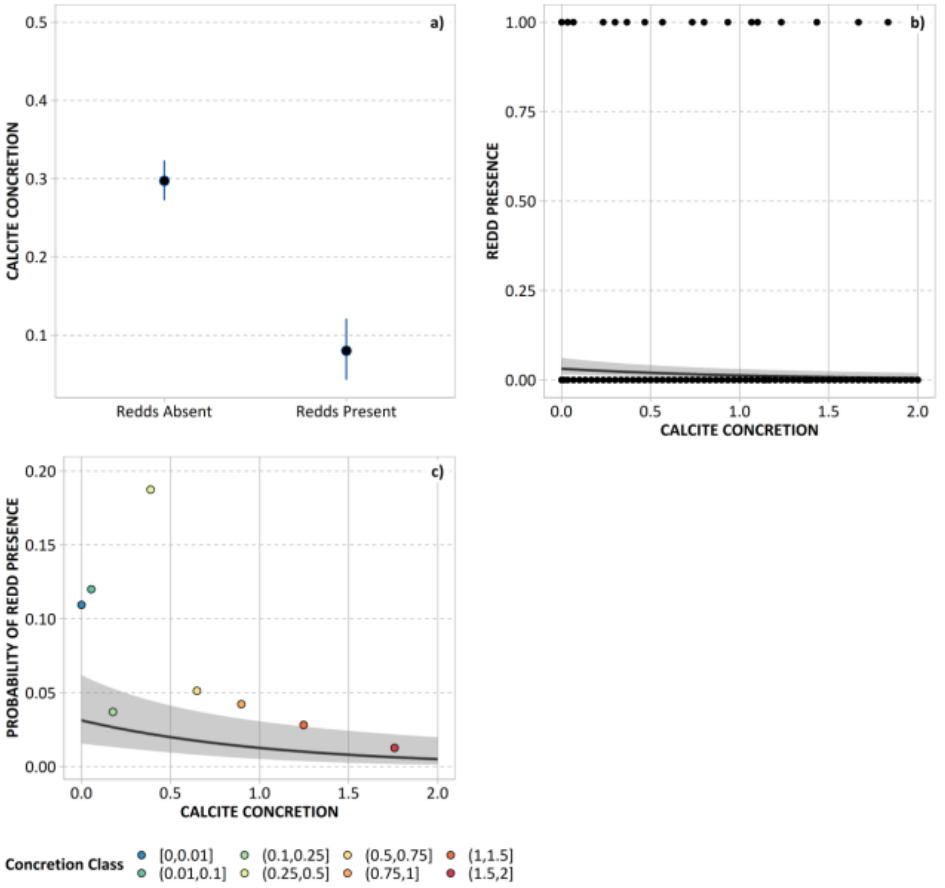


Figure 4: *From Figure 26 of Hocking et al. 2022 with original caption retained: (a) Average calcite concretion score (± 95% confidence interval, based on bootstrapping procedure) at mesohabitat units with redds present and with redds absent in tributaries of the Elk River, BC. (b, c) Probability of redd presence versus calcite concretion, including raw data in (b) and the average probability of redd presence by concretion class (p = # of units with redds present / total # of units by concretion class) in (c). The solid line represents the predicted probability of redd presence as a function of calcite concretion, where all other predictors are held at their means (estimated from a logistic regression model: model averaged parameter estimates for calcite shown in Figure 25). The shaded region represents the 95% confidence interval for the predicted probability of redd presence.*

Population-level WCT modelling using data available in 2023 show that calcite concretion was predicted to have decreased the total spawning habitat in the UFR by 7.8% (from 193,173 m^2 to 178,177 m^2) with the greatest predicted reduction in spawning habitat in the Fording River S4 Segment (Ewin Creek to S-bends) where average concretion was approximately 0.4 Cc (**Figure 5**).

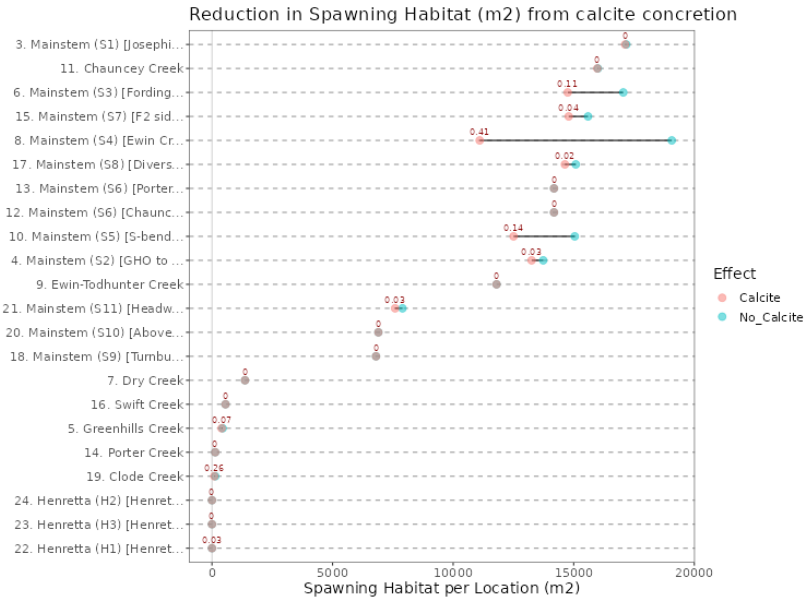


Figure 5: *Plot from ESSA Technologies Ltd. (2024) showing predicted influence of calcite concretion on spawning habitat at the stream segment and creek scale. Red points indicate predicted spawning habitat area after applying the WCT calcite redd model. Red text indicates calcite concretion scores at the respective location as of 2023.*

To better understand the long-term predicted impact of calcite concretion on WCT populations, ENV ran population simulations using the ShinyApp WCT Population Model (ESSA Technologies Ltd., 2024) with a range of calcite concretion[11] exposures during a 10-year event at both the regional scale and at 21 individual stream segments in the UFR. Due to the large available habitat in the upper Fording River and the model's assumed resiliency of the WCT population in the UFR,[12] population-level impacts were not predicted until calcite concretion values exceeded 1.9 (nearly fully concreted streambed). This high tolerance for concretion in the model is likely due to a generalization of the amount of

[11] The WCT Population Model interprets the effects of concretion scores as WCT spawning suitability using the WCT spawning suitability model developed by (Hocking et al. 2022).

[12] Information regarding model limitations based on a phone conversation with Dr. Brian Ma of ESSA Technologies Ltd. in August 2024.

available spawning habitat predicted in the UFR and does not consider habitat quality and localized impacts to preferred WCT habitats. The model considers calcite impacts to spawning habitat and redd density, but not direct impacts to WCT fry refuge or food availability resulting from reduced interstitial space. Finally, this model is restricted to the UFR and does not include options to simulate effects on fragmented tributary populations such as those found in upper Greenhills Creek and Gardine Creek. While it is understood that loss of available spawning habitat is detrimental to fish populations, there are insufficient data at this time to conclude the percentage and extent of spawning habitat (tributary and mainstem) in the Elk Valley that is impaired by calcite.

4.5. Spatial Extent of Assessment – Reach Level

Section 3.4 of the Permit references the word "streams" when describing management expectations, criteria for inclusion, and site performance objectives. ENV cautions against interpreting calcite effects at the stream-level due to the observed heterogeneity of calcite concretion among — and even within — stream reaches; changes in stream characteristics (e.g., temperature, turbidity, substrate, vegetation) at the reach-level may result in localized precipitation of calcite in sensitive fish habitat. As observed in Thompson Creek (**Figure 6**), signals of increasing concretion at the reach-level in THOM5 and THOM2(2a/4a) are buffered by the low and stable concretion in THOM6 when evaluated at the stream-level.

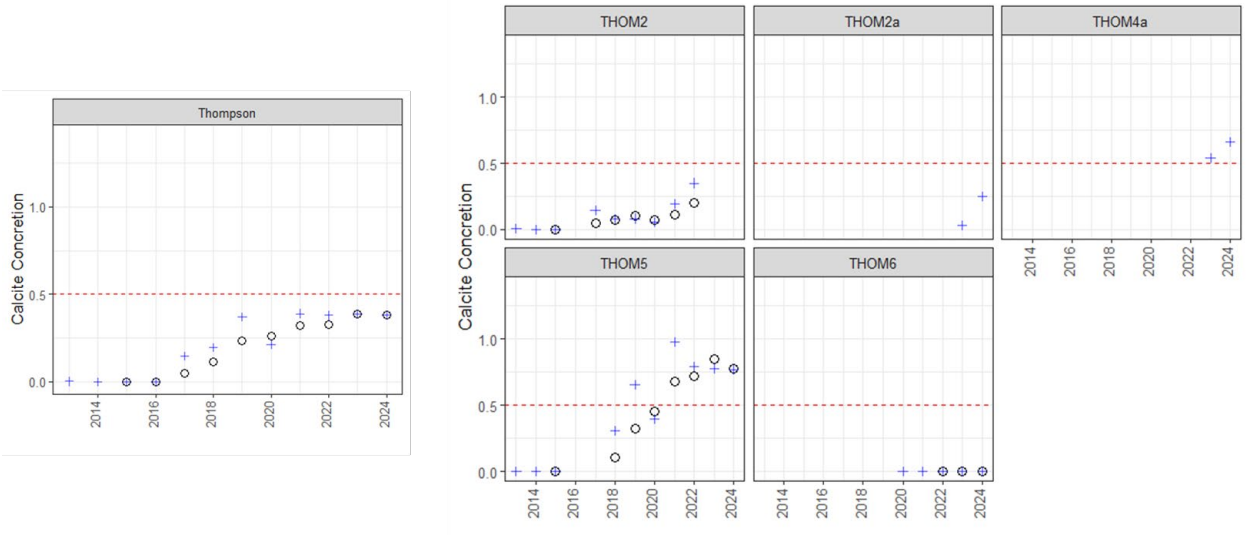


Figure 6: *Thompson Creek stream-level (left) and reach-level (right) calcite concretion summaries. Reach names were updated to reflect the reach reassessment completed in 2023: THOM2 was split into THOM2a and THOM4a, but was provided to illustrate continuity in the data; THOM3 was renamed to THOM5; THOM4 was renamed to THOM6. Blue crosses indicate the annual average, and circles indicate the three-*

year moving average. The red line shows an example 0.5 Cc limit to illustrate differences between stream- and reach-level interpretations (i.e., exceedance of the limit at the reach-level in THOM5, but not the stream-level).

Additionally, stream-level averaging of Cc is not appropriate for larger tributaries (LCO Line Creek, Michel Creek) or mainstems (Fording River, Elk River) that contain considerable variation in concretion and habitat conditions. The exposed portion of the Fording River is composed of 11 calcite monitoring reaches covering approximately 66 stream kilometers.[13] Averaging Cc at the stream level in the Fording River may dilute or exclude reach-level concretion signals and potentially impacted habitat units. Although nearly all reaches in the Fording River have an annual average and a 3MA Cc below 0.3 Cc, concretion at the FORD6 has increased since 2020, with an annual average Cc exceeding 0.5 in 2023 (**Figure 7**).

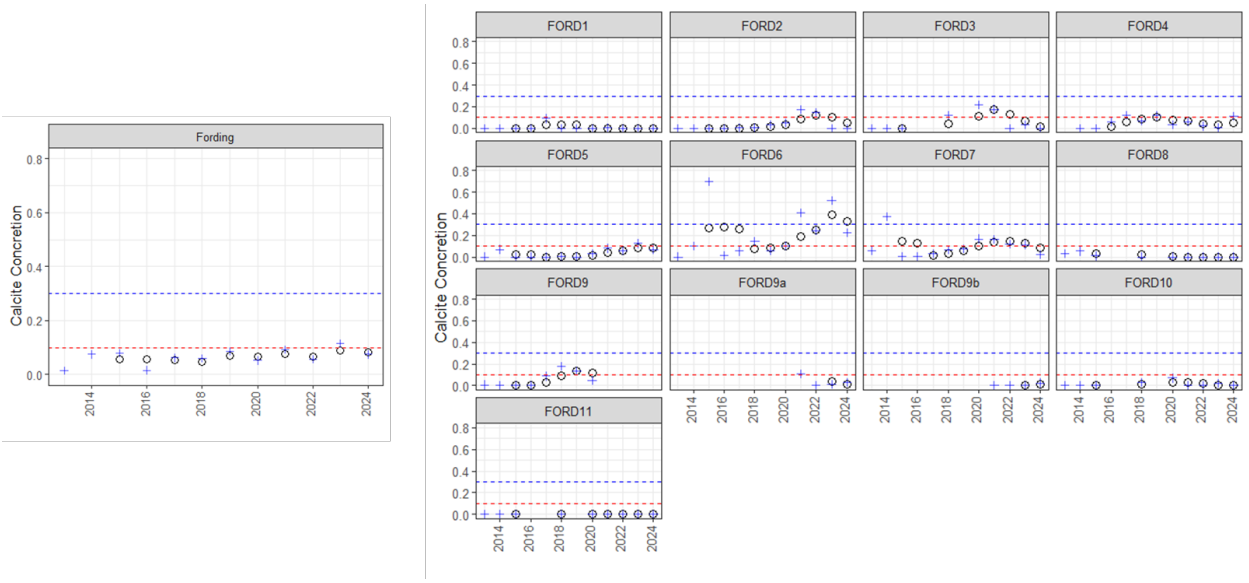


Figure 7: *Fording River stream-level (left) and reach-level (right) calcite concretion for exposed reaches FORD1 through FORD11 reported as annual average (blue cross) and three-year rolling average (open circles) calcite concretion. The red dashed line indicates 0.1 Cc (the proposed limit for mine exposure), blue dashed line indicates 0.3 Cc (the proposed limit for potential aquatic effects).*

ENV technical reviewers have proposed new limits for the Permit that consider concretion levels at the reach level (e.g., FORD2-FORD5, FORD7, FORD9,[14] and FORD10 to meet a 0.3 Cc 3MA limit; FORD6 to meet a 0.5 Cc 3MA limit). Reaches with lower historical concretion levels would be expected to be maintained at or below these levels (e.g., FORD1, FORD8,

[13] Excludes FORD12 (reference reach) and redundancies of sub-reaches FORD9a and FORD9b (captured as FORD9).

[14] FORD9 was split into sub-reaches FORD9a and FORD9b after 2020.

and FORD11 to meet a 0.1 Cc 3MA limit). In addition to prescribing limits on concretion, ENV has required that EVR provide a plan for reducing concretion in reaches with a 3MA above 0.3 Cc.

4.5.1. Application of Limits

A detailed discussion on how limits may be applied in an amended Permit is included in the ministry assessment for the internal amendment of the calcite SPOs. ENV continues to evaluate the implications of implementing these limits based on feedback from rightsholders, stakeholders, and provincial and federal regulators.

A preliminary assessment of annual average Cc and 3MA Cc was completed for streams categorized as unimpacted, minimally, or moderately impacted by calcite concretion. Unimpacted streams were classified as having less than a 0.01 Cc score based on the maximum of annual averages from the last three years (2022-2024, inclusive). Consistent with ENV's interpretation that unimpacted, reference streams should remain below 0.1 Cc, a limit of 0.1 Cc was applied to unimpacted, mining-exposed streams (**Figure 8**).

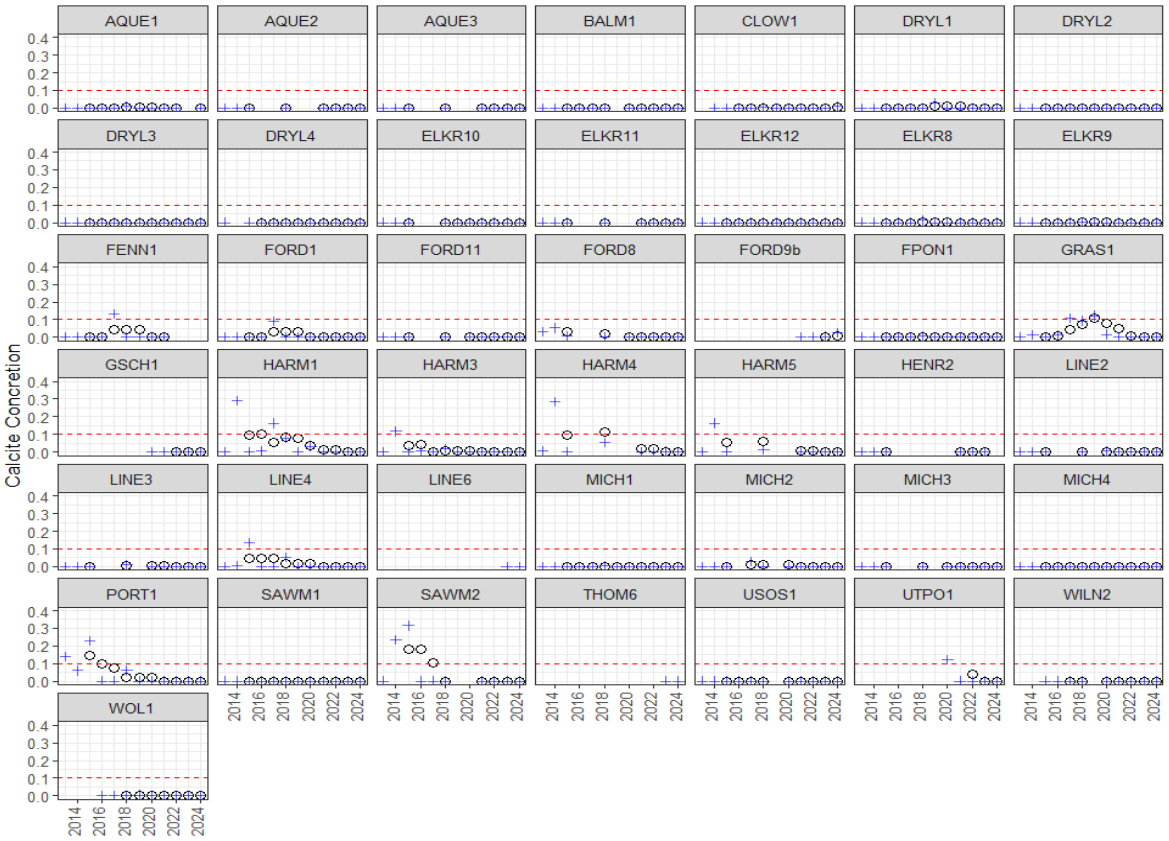


Figure 8: *Proposed stream reaches for management to a 0.1 Cc 3MA limit. Blue crosses indicate the annual average, and circles indicate the three-year moving average. The red line shows an example 0.1 Cc draft limit.*

Minimally impacted reaches were classified as having between 0.01 Cc and 0.2 Cc (max annual average) within the last three years (2022-2024). ENV technical staff have proposed applying the 0.3 Cc limit for these reaches as a protective measure to prevent further concretion (**Figure 9**).

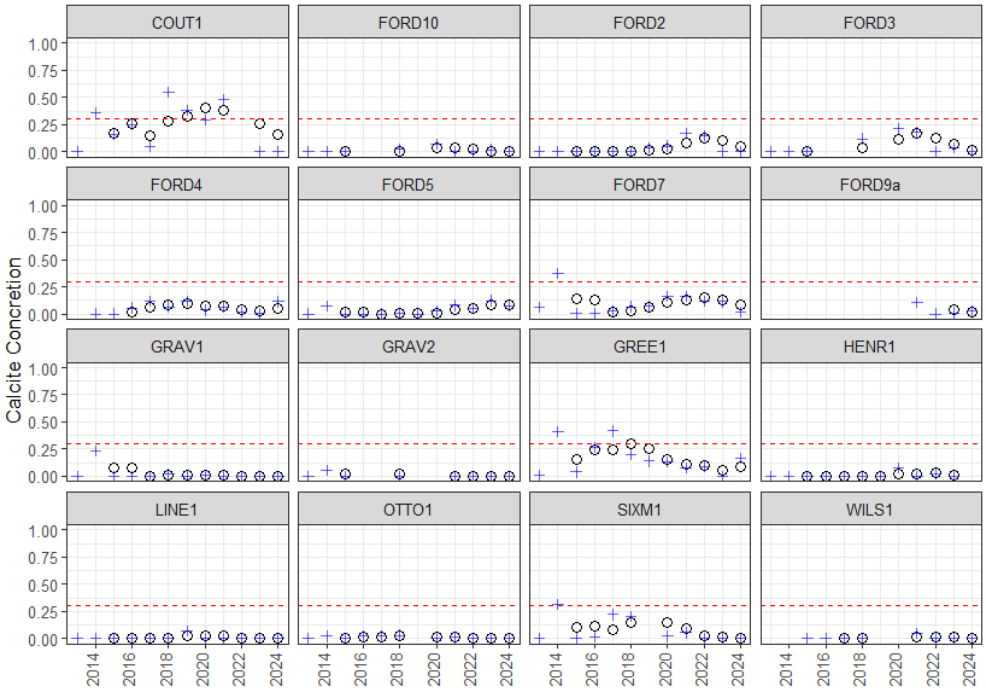


Figure 9: *Proposed stream reaches for management to a 0.3 Cc 3MA limit. Blue crosses indicate the annual average, and circles indicate the three-year moving average. The red line shows an example 0.3 Cc draft limit.*

ENV technical staff have also proposed Cc limits for stream reaches with concretion exceeding 0.3 Cc.

5. Closure

This memorandum was published to support the ABMP Amendments Advisory Committee in understanding the most recent information ENV has considered for assigning calcite concretion limits and is being appended to the 2025 Elk Valley Water Quality Plan for context related to the updated calcite targets.

6. Reference Table

In addition to the references below, ENV reviewed annual submissions of the Regional Calcite Monitoring Programs and the triennial Calcite Management Plans. For these references, if multiple reports of the same type were available, the most recent or relevant report was listed.

Citation	Study Focus	Conclusion	Limitations
Barrett, T., S. Weech, P. Orr. 2016. **Evaluation of Calcite Effects on Aquatic Biota in the Elk Valley (2014 & 2015)**. Report prepared for Tech Coal Ltd. By Minnow Environmental Inc.	**Benthic invertebrates** Completed to meet requirements for the approval of the 2014 RAEMP report.	Calcite index > 1 is associated with a deviation in benthic invertebrate community metrics, but this is confounded with impaired water quality.	The assessment did not present or evaluate BIC metrics in terms of calcite concretion.
ESSA Technologies Ltd. 2024. **Westslope Cutthroat Trout - Population Model**. R Shiny Application. https://essa.shinyapps.io/wctpopmod3/#. Accessed August 20, 2024. Last updated May 21, 2024.	**WCT** Provides a user interface to adjust model parameters and events for simulating WCT population scenarios.	ENV applied the model to evaluate the concretion value at which the UFR WCT population may collapse. Simulations showed stable WCT populations up to 1.9 Cc.	The model does not consider habitat quality or localized impacts at preferred spawning areas. Impacts from concretion are interpreted as a reduction in total spawning habitat throughout the large area of the UFR.
Hocking, M., A. Tamminga, T. Arnett, M. Robinson, H. Larratt, and T. Hatfield. 2021. **Subject Matter Expert Report: Calcite. Evaluation of Cause – Decline in Upper Fording River Westslope Cutthroat Trout Population**. Report prepared for Teck Coal Ltd. by Ecofish	**WCT** Completed as part of the UFR Evaluation of Cause for the decline in WCT from 2017-2019. Evaluated spawning suitability, invertebrate prey availability (effects on rearing), incubation	Calcite is unlikely to be the sole cause (either direct or indirect) of the 2017-2019 WCT decline. However, calcite may be a contributing stressor on WCT.	Lack of an established dose-response curve for calcite. Concretion was generally low (mean CC of 0.06, max

Research Ltd., Lotic Environmental Ltd., and Larratt Aquatic Consulting Ltd.	conditions, and overwintering habitat. Utilized the WCT spawning suitability response curves for calcite concretion.		CC < 0.2) in the study area compared to tributaries. Limited geographical extent and limited data.
Hocking, M., J. Braga, E. Vogt, J. Row, J. Ings, and T. Hatfield. 2022. **Calcite Effects to Spawning Habitat Suitability of Westslope Cutthroat Trout – Summary Report.** Consultant's report prepared for Teck Coal Ltd. by Ecofish Research Ltd. and Minnow Aquatic Environmental Services, December 29, 2022	**WCT** Supports reduction of uncertainty for Management Question 4 of the Adaptive Management Plan, "*Is calcite being managed effectively to meet site performance objectives and to protect the aquatic environment?" a*nd Key Uncertainty 4.1, "*Are the calcite site performance objectives (SPOs) protective of fish and aquatic life?"*	The authors developed and refined a model for relating calcite concretion and impacts to WCT redds.	Site specific assessments are needed to validate model predictions.
Wright, N., T. Jensma, H. Wright, K. Akaoka, M. Hocking, T. Hatfield. 2018. **2017 Calcite Effects to Fish Spawning and Incubation**. Consultant's report prepared for Teck Coal Ltd. By Ecofish Research Ltd. June 18, 2018.	**WCT** Summarizes investigations on the linkage between calcite and fish incubation conditions to support an understanding of effects to WCT. Focused on potential effects of calcite on hyporheic flow and dissolved oxygen.	Sites with high levels of calcite are likely to experience some reduction in incubation conditions for WCT.	Limited dataset. Potential effects from calcite would be more likely at depths that are deeper than typical WCT redd depths.

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