24. ENVIRONMENTAL MANAGEMENT AND MONITORING PLANS

This chapter describes the conceptual Environmental Management System (EMS) and the associated Environmental Management and Monitoring Plans (EMMPs) for the Murray River Coal Project (the Project). An EMS and EMMPs are requirements described in the Project Application Information Requirements (AIR) (September 2013) (Section 2.5.11 and Section 17 respectively).

The EMS will guide the development and implementation of EMMPs required to maintain environmental protection during Construction, Operation, Decommissioning and Reclamation, and Post Closure of the mine.

EMMPs are the specific and detailed goals, objectives, and procedures for the protection of worker health and safety, environmental monitoring, which will demonstrate to the regulatory agencies how legislation and regulations will be met at the Project site. EMMPs are managed collectively under the umbrella of the EMS.

HD Mining's Murray River Bulk Sample site is considered an active mine site under the coal exploration permit. Consistent with requirements of this permit, the company has taken steps to develop a Health, Safety and Environmental Management System. As well, a set of management plans are being implemented, including the following environmental and health and safety plans:

- Environmental
  - Erosion and Sediment Control Plan
  - Water Quality Monitoring/Sampling Plan
  - Construction Phase Environmental Supervision Plan
  - Fugitive Dust Management Plan and Fugitive Dust Control
  - Wildlife Mitigation and Monitoring Plan
  - Water Treatment Ponds Management Plan
  - Environmental Effects Monitoring Plan
  - Water Management Plan
  - Operational Surface Water Quality Monitoring Plan
  - Reclamation and Closure Plan
  - Waste Rock Management Plan
  - Waste Rock Storage Facility Re-Vegetation Plan and Noxious Weed Management
  - Effluent Treatment Management Plan
- Health and Safety
  - Occupational Health and Safety Management Plan
  - Training Plan

- Mine Emergency Response Plan
- Spill Contingency Plan
- Hazardous Material Management Plan
- Communications Plan

The EMS developed to support the bulk sample permit will provide the basis for building the full mine EMS and EMMPs. Accordingly, the following sub-sections are consistent with EMMPs developed for the Bulk Sample program. As described in Section 24.1.2, these plans will be adjusted and augmented over time to support additional permitting requirements and new Project phases/activities, and to incorporate learnings from continual improvement.

24.1 ENVIRONMENTAL MANAGEMENT SYSTEM FRAMEWORK

This section discusses the conceptual EMS and associated EMMPs for the Project. An EMS is the high level framework for development and implementation of component EMMPs.

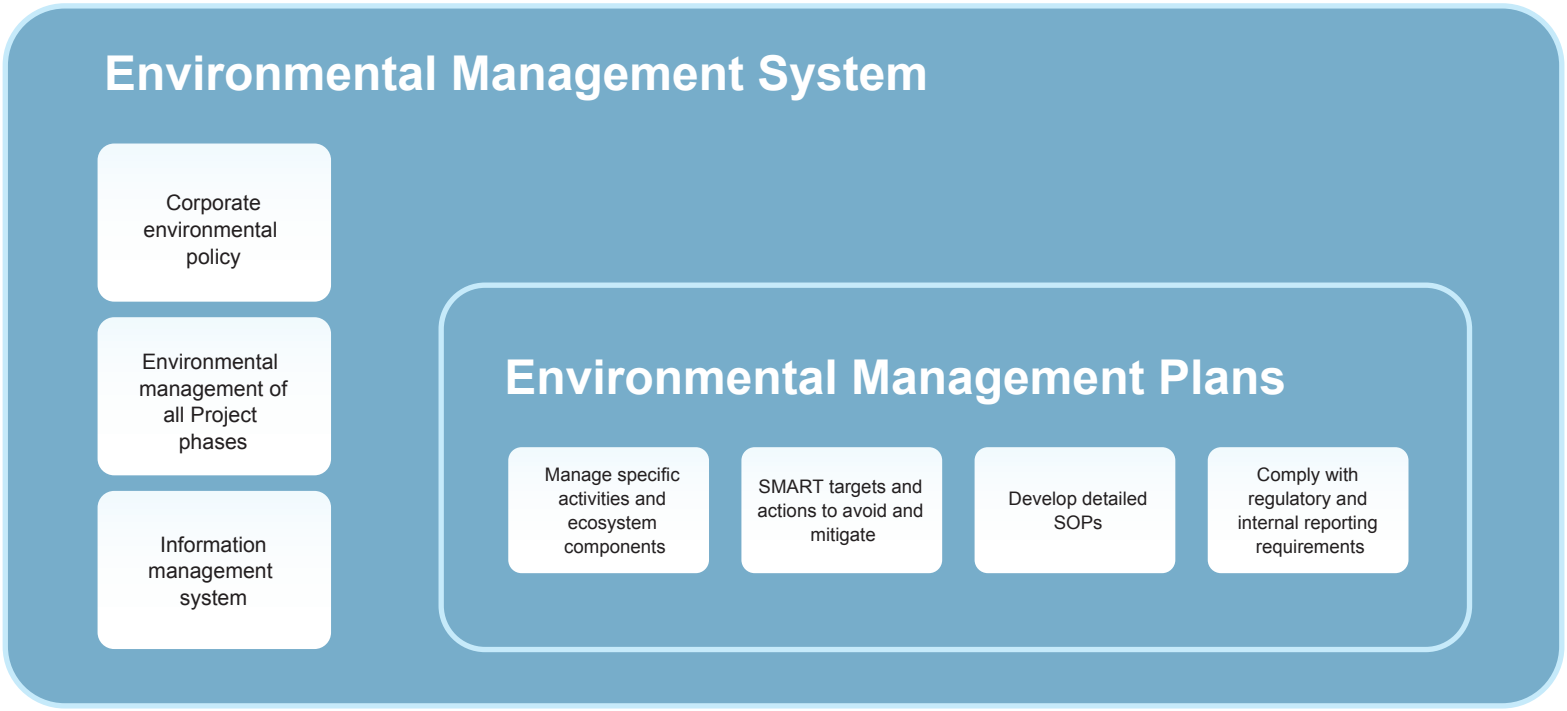
It is necessary and prudent planning to have an EMS in place to guide project environmental performance from Construction through to Post Closure. An integrated system is required because there are inherent overlaps in activities where the objectives of multiple plans meet. For example, emergency response plans address spills to the environment; in addition to this objective, planning emergency response for spills will also affect worker safety objectives. Similarly, traffic safety and driver training programs can significantly reduce risks to workers and to the public, as well as spills to the environment.

The EMS will ultimately provide the organizational structure and procedures for implementing environmental management strategies, ensuring compliance with environmental regulations and permit commitments and continuously improving environmental performance of the Project (Figure 24.1-1). The management system for the Project will include:

- **Environmental Policies**: regulatory framework and government permitting requirements and corporate principles relating to environmental management.
- **Environmental Management Planning and Structure**: methods to evaluate environmental practices, procedure, and processes environmental effects; and objectives, and strategies to mitigate environmental effects.
- **Implementation and Reporting**: resources, organizational and reporting structure, roles and responsibilities, information management, and communication protocols.
- **Evaluation**: Monitoring environmental performance against established objectives, and evaluation of compliance with company commitments and legal requirements.
- **Adaptive Management and Continual Improvement:** correction of environmental management strategies, as deemed necessary during evaluation, to improve environmental performance.

Figure 24.1-1

Conceptual Environmental Management System Framework



24.1.1 Environmental Policies

24.1.1.1 Permitting Requirements

An EMS is a requirement of a *Mines Act* permit for mines in BC, and the EMS will be based primarily on *Mines Act* (1996h) and *Environmental Management Act* (2003) permit requirements. Specific objectives will be developed in the EMS's component EMMPs and be based on authorizations, licences, and approvals and commitments made in relation to Project activities. The general approach to environmental compliance within the EMS and component EMMPs is based on avoidance, control, and mitigation of environmental effects.

24.1.1.2 Health, Safety and Environment Policy

Health, safety and environmental protection are corporate priorities for HD Mining. HD Mining is committed to strive to preserve and protect the environment for the future, while providing a safe and responsible operation.

The mine, designed for eventual permanent closure, will be managed to minimize risk of potentially harmful incidents, and HD Mining will manage its business as follows:

1. Integrate health, safety and environmental policies, programs, and practices into all activities of the organization.
2. Monitor the performance of programs and management systems to ensure compliance with company and legislative requirements.
3. Establish an ongoing program of review and improvement of performance.
4. Identify, assess, and manage risks.
5. Develop, maintain, and test emergency preparedness plans to ensure protection of the environment, workers, and the public.
6. Work with government and the public to develop effective, efficient, and equitable measures to protect the environment based on sound science.
7. Require contractors to comply with company policies and work cooperatively to improve environmental performance.
8. Encourage dialogue on health, safety and environmental issues with employees and public and be responsive to concerns.
9. Ensure that all employees understand and are able to fulfill their responsibilities.
10. Reclaim sites in accordance with site-specific criteria in a planned and timely manner.

24.1.2 Environmental Management Planning and Structure

24.1.2.1 Environmental Management Planning

The EMMPs contained within the EMS will define the Proponent's environmental approach through all phases of the Project. The EMS is based on prevention, mitigation, and management of risks identified by the company with input from regulatory agencies reviewing the Application/EIS.

The following three-step process has been used for the development of EMMPs.

- **Step One:** High-level Framework: To be included in the Application/EIS, the high-level framework will commit the Proponent to specific and detailed goals, objectives, and procedures for producing EMMPs.
- **Step Two:** Production of the detailed EMMPs: May be initiated after the issuance of the Environmental Assessment Certificate, but initiated before Construction begins. This step will follow the procedures and commitments developed in Step One.
- **Step Three:** Development of Standard Operating Procedures: Development of the Standard Operating Procedures will fulfill obligations as defined in Step Two.

24.1.2.2 Environmental Management Structure

The EMS is to be applied during the planning, Construction, Operation, Decommissioning and Reclamation, and Post Closure phases of the Project and will be living documents throughout these phases. Conceptual level EMMPs that will be used to guide the development of more detailed EMMPs are provided in this chapter and include:

- air quality and dust control;
- noise;
- site preparation and soil salvage;
- erosion and sediment control;
- water management;
- metal leaching and acid rock drainage;
- flocculent;
- explosives and nitrogen;
- selenium;
- invasive plants;
- wildlife;
- waste management (including hazardous materials/waste, construction waste, sewage);
- archaeological resources;
- subsidence;
- recruitment, training and employment;
- site access;
- spill response; and
- emergency response.

Conceptual EMMPs presented in this chapter generally include the following sections:

- **Purpose**: Identify the purpose of the plan and how it will relate to mine activities and minimizing risk to the health and safety of the environment, employees and the public.
- **Legislation and Standards**: Outline the relevant legislation, regulations and policies the plan intends to comply with.
- **Objectives**: Establishes objectives against which Project performance can be measured.
- **Actions to Avoid, Control and Mitigate**: Describes the actions that will be implemented in order to comply with relevant regulations and policies and meet performance objectives.
- **Monitoring and Reporting**: Describes environmental indicators that will be monitored, monitoring frequency and reporting requirements.
- **Responsible Person**: Describes responsibilities of the management team

24.1.2.3 Implementation

Implementation of the EMS will be the responsibility of the HD Mining Management Team. Additional key personnel as outlined below in the roles and responsibilities section will assist with the implementation of the EMS and EMMPs. Within each management plan, EMMP reporting responsibilities for each position are described.

24.1.2.4 Roles and Responsibilities

A list of key management personnel and their environmental responsibilities is provided below. This reporting structure may be adapted or superseded for the Project's Operation and Decommissioning and Reclamation phases.

<u>Chairman/CEO</u>

- The Chairman/CEO is responsible for overall project governance.

<u>Mine Manager</u>

- The Mine Manager has overall responsibility for the construction and operation of the Project, and responsibility for on-site environmental monitoring and compliance relating to construction activities. The Mine Manager reports to the Chairman/CEO and coordinates with the Vice President, Environmental and Regulatory Affairs to ensure that objectives are being met.

<u>Vice President, Environmental and Regulatory Affairs</u>

- The Vice President, Environmental and Regulatory Affairs is responsible for the overall management of Project environmental programs and permits, and reports to the Chairman/CEO.

Environmental Manager

- The Environmental Manager is responsible for the day-to-day management of environmental programs and permits, and will:
  - act as a resource to the construction teams by providing guidance relating to permit conditions, commitments, regulations, acts, and interpretation of legislation;
  - be responsible for obtaining the required environmental permits for Construction and Operation;
  - oversee timely delivery of Project permits applications for submission to regulators;
  - serve as HD Mining primary liaison with regulatory agencies with respect to compliance with permits and approvals, including non-compliance incidents;
  - work with Project management to identify and resolve environmental issues in a manner that fulfills HD Mining's expectations of environmental performance; and
  - ensure that applicable regulatory requirements and commitments are properly identified, tracked, documented.

24.1.2.5 Monitoring and Reporting

The focus of environmental monitoring and reporting is to achieve a seamless and consistent means for reporting the information defined in the EMMPs to the HD Mining Management Team.

Reporting completed by HD Mining will ensure consistent implementation of the EMMPs listed in the following sections. Summary reports of monitoring activities and results will be compiled annually.

24.1.3 Evaluation

A review of the EMS will be completed by the management team on an annual basis.

24.1.4 Adaptive Management

A philosophy of adaptive management and continual improvement will be adopted to ensure that management plans and mitigation measures are consistently meeting or exceeding performance targets. This will be achieved through periodic reviews of the EMS and the results of monitoring programs.

24.2 AIR QUALITY AND DUST CONTROL

24.2.1 Purpose

The purpose of the Air Quality and Dust Control Plan is to outline:

- the legislation and standards relevant to air emissions associated with the Murray River Project;
- the legislative context for reporting greenhouse gas (GHG) emissions in British Columbia and Canada;

- the main emission mitigation methods that HD Mining will implement; and
- the continual assessment, monitoring and reporting of emissions that will take place throughout the Project life.

This plan is dynamic and it will be updated based on management reviews and associated costing of the mitigation and monitoring activities relative to the long-term strategy for the Project, regulatory requirements, and Project operational needs.

24.2.2 Legislation and Standards

24.2.2.1 Air Quality and Dust

The applicable standards relating to the Murray River Project include:

- National Ambient Air Quality Objectives (NAAQOs; CCME 1999);
- Canadian Ambient Air Quality Standards (CAAQS; CCME 2013b);
- BC Air Quality Objectives and Standards (BC MOE 2009), and
- Dustfall Objectives (BC MOE 1979).

CAAQSs are intended to be achievable targets that will reduce health and environmental risks within a specific timeframe, whereas NAAQOs identify benchmark levels of protection for people and the environment. The CAAQS for $PM_{2.5}$ were adopted in 2013 and will be effective from 2015 and 2020. In addition, British Columbia (BC) has also developed air quality objectives for a number of contaminants. Federal and Provincial air quality criteria are summarized in Table 24.2-1

Other than the objectives and standards for criteria air contaminants (CACs), BC also has an objective for dustfall levels. The *Pollution Control Objectives for the Mining, Smelting, and Related Industries of British Columbia* (BC MOE 1979) was developed with the goal of protecting the quality of BC's environment. The ambient air control objective for dustfall is defined to be between 1.7 mg/dm^2/day to 2.9 mg/dm^2/day, averaged over 30 days.

24.2.2.2 Greenhouse Gas

In support of Canada's GHG mitigation targets, since 2010, facilities emitting over 50,000 t CO_2e have been required to report emissions to Environment Canada for the *Greenhouse Gas Emissions Reporting Program* (Environment Canada 2014a), under the jurisdiction of Section 46 of the *Canadian Environmental Protection Act* (1999).

In BC, since January 1, 2010, facilities emitting over 10,000 t CO_2e must report to the BC Ministry of Environment, and those emitting over 25,000 t CO_2e must also have to have emissions verified by an independent and accredited third party under the BC Reporting Regulation (BC Reg. 272/2009) of the *Greenhouse Gas Reduction (Cap and Trade) Act* (2008).

Table 24.2-1. Federal and Provincial Ambient Air Quality Criteria

Pollutant	Averaging Time	Canada			British Columbia		
		National Ambient Air Quality Objectives[a]		Canadian Ambient Air Quality Standards[b]	Provincial Air Quality Objectives[c]		Pollution Control Objectives[d]
		Maximum Desirable	Maximum Acceptable		Level A	Level B	
SO_2 (µg/m³)	1-hour	450	900	-	450	900	-
	24-hour	150	300	-	160	260	-
	Annual	30	60	-	25	50	-
NO_2 (µg/m³)	1-hour	-	400	-	-	-	-
	24-hour	-	200	-	-	-	-
	Annual	60	100	-	-	-	-
CO (µg/m³)	1-hour	15,000	35,000	-	14,300	28,000	-
	8-hour	6,000	15,000	-	5,500	11,000	-
TSP (µg/m³)	24-hour	-	120	-	150	200	-
	Annual	60	70	-	60	70	-
PM_{10} (µg/m³)	24-hour	-	-	-	50		-
$PM_{2.5}$ (µg/m³)	24-hour	-	-	28[g] (2015) and 27[g] (2020)	25[e]		-
	Annual	-	-	10[h] (2015) and 8.8[h] (2020)	8[f]		-
Dust deposition (mg/dm²/day)	30-day	-	-	-	-	-	1.7

Notes: (-) dash indicates not applicable

[a] Environment Canada (1999).

[b] CAAQS adopted in 2013 and will be in effect from 2015 and 2020 (CCME 2013b).

[c] BC MOE (2013).

[d] Mining, Smelting, and Related Industries of British Columbia (BC MOE 1979).

[e] Based on annual 98th percentile value.

[f] BC objective of 8 µg/m³ and planning goal of 6 µg/m³ was established in 2009

[g] The 3-year average of the annual 98th percentile of the daily 24-hour average concentrations

h The 3-year average of the annual average concentrations.

The above provincial and national reporting regulations only pertain to facility-level emissions, and so do not include land use change. The reporting emissions are required to disaggregate by the following source categories:

- Stationary fuel combustion;
- Industrial process;
- Venting;
- Flaring;
- Fugitive;
- On-site transportation;

- Waste; and
- Wastewater.

24.2.3 Objectives

The objective of the Air Quality and Dust Control Plan is to monitor emissions from Project activities and establish measures to mitigate emissions from Project activities to meet air quality legislative requirements and to reduce the Project effects to reasonable levels.

The main source of emissions of the Project will be from underground equipment and coal dryer including pollutants of carbon monoxide, nitrogen oxides, sulphur dioxide, particulate matter and GHGs. Main source of fugitive dust would be from vehicles travelling on unpaved roads. Fugitive coal dust will be generated from coal processing and handling. Fugitive methane be emitted from the coal seam and may liberate during coal processing and handling.

24.2.4 Actions to Avoid, Control, and Mitigate

The main sources of emissions during Construction and Operation will be from diesel equipment exhaust, coal dryers, unpaved road dust, bulldozing, material handling and methane emissions from coal seams. In an effort to mitigate emissions during the various phases of the Project, HD Mining is currently implementing, or will implement, the following mitigation methods. Other additional mitigation may take place if deemed appropriate.

24.2.4.1 Equipment and Vehicles Exhaust

- Equipment and vehicles used for the Project will be maintained on a regular basis. Regular inspection will be conducted and all parts showing signs of wear will be promptly replaced. Poorly maintained engines can use up to 50% more fuel (D. Coop Enterprises 2004).
- Vehicle and equipment idling will be minimized. Cabin heaters may be added to reduce idling.
- Vehicles and equipment will use low-sulphur diesel, as required by law (Environment Canada 2014b).
- Older engines will be retrofitted, as required in BC for models 1989-1993 that weight over 8,200 kg (BC Ministry of Transportation and Infrastructure 2014).
- Vehicle aerodynamics may be improved which can improve efficiency by 10 – 15% (EEX 2014).
- Tire pressure will be checked regularly as for every 10 PSI reduction in tire inflation, about 1% improvement in mileage ensues.

24.2.4.2 Unpaved Roads

Mitigation control for unpaved roads, described in Chapter 13, Section 2 of AP-42 (US EPA 2006), include vehicle restriction, surface improvement, and surface treatment. HD Mining will contribute to road maintenance via road use agreements. Vehicle operators will be required to:

- Minimize rapid starts and stops.
- Adhere to local speed limits.

By watering the road, the moisture content increases causing the conglomeration of particles and reducing the likelihood of them becoming resuspended. Road watering is particularly effective, with a control efficiency of 75% (US EPA 2006). When the roadway is properly graded, compacted and maintained, the silt content will reduce which will lead to lower road dust emissions.

24.2.4.3 Stockpiles

Dust emissions may be generated by wind erosion when stockpiled materials have small particle sizes. Dust from stockpiles can be mitigated by the following methods:

- Cover or enclose stockpiles to shelter them from wind, thereby reducing airborne dust.
- Install a fog/sprinkler system that releases small droplets of water. (It is important to keep the water droplets' size small in order to supress airborne dust and not cause water seepage. It is recommended that the water droplets be less than 100 microns.)
- Optimize the shape of the piles to reduce loss in moisture content of the material.

24.2.4.4 Conveyors

The transport of run-of-mine raw coal from underground to the CPP will be completed by a system of conveyors. Dropping material from height and material handling in general will generate fugitive dust. The Project has the following mitigation measures in place:

- The conveyor system will be covered.
- The conveyor drop locations (between conveyors) will be enclosed.

24.2.4.5 Coal Dryer

The coal dryer could be a significant source of emissions if not mitigated. For this Project:

- A wet deduster will be installed. The deduster will have cyclones to recover coal particles in the exhaust. Before the exhaust is discharged to the atmosphere, the wet deduster will reduce total suspended dust to less than 100 mg/m^3 (data provided by Taggart Engineering).

24.2.4.6 Material Handling

General best practices to help reduce fugitive dust emissions include:

- Enclosing or covering loads carried by vehicles.
- Reducing drop heights when unloading.

24.2.4.7 Methane Liberation

Methane and coal are formed together during coalification, a process in which plant biomass is converted by biological and geological force into coal. Methane within the coal bed seams are referred to as coalbed gas (CBG). Methane stored within coal seams and the surrounding strata are liberated when pressure above or surrounding a coal bed is reduced. Sources of methane emissions from coal mines in the US include: ventilation (58%), surface mining (19%), post-mining for underground mine (9%), post-mining for surface mine (3%), degasification underground vented (4%) and others (7%) (US EPA 2013). For this Project, methane released from underground will be vented to surface at the Shaft Site.

There is uncertainty regarding the actual gas content that will be encountered underground, and it is anticipated to be variable throughout the various mine panels. Over the mine life, the following methods will be investigated and implemented where feasible/practical to manage methane liberation and reduce GHG emissions:

- Monitoring of methane concentrations in active mining areas, and in general ventilation air;
- CBG drainage in advance of mining (see Section 3.6.2.9);
- Methane conversion to CO_2 using catalytic oxidizer systems.
  - A case study has shown that the catalytic oxidizer is able to remove up to 98% of the methane that passes through the system (US EPA 1999).
- Methane conversion to CO_2 through flaring of CBG drainage.

24.2.5 Monitoring and Reporting

24.2.5.1 Air Quality

Should compliance testing of the stacks be required, it will be conducted by qualified personnel in accordance with permit conditions. Data will be kept and made available for review upon request. Air quality monitoring, including the occurrence of dust, will be carried out to establish the emissions associated with the site activities during Operation.

Dustfall monitoring will be conducted throughout the life of mine. Dustfall stations will be placed at similar locations to the baseline monitoring; however, locations may shift due to the development of the mine. Monitoring will occur on a monthly basis and results of the monitoring program will be recorded and reported annually. If adverse conditions are found in a particular area or process, adaptive management policies will be implemented.

Monitoring of underground air quality will be conducted. CBG content in the ventilation airflow will be monitored and reported in real-time at the surface control center. CBG management will employ an inter-connected drainage system to collect CBG and vent it to the surface via the ventilation shaft.

If the amounts of pollutant released are above the reporting threshold, reporting to the National Pollutant Release Inventory (NPRI) is required. Based on the emission inventory in this

environmental assessment (Chapter 6), reporting to NPRI Part # 4 pollutants of NO_X, SO_2, CO, TSP, PM_{10}, and $PM_{2.5}$ is required.

24.2.5.2 Greenhouse Gas

If the Project facility-level GHG emissions surpass 50,000 t CO_2e/yr, to satisfy federal and provincial reporting requirements, Project GHG emissions will need to be assessed, verified, and reported. Project GHG emissions will also be able to be reported through the online one-window reporting system, which was introduced in 2010 to harmonize the needs of federal and provincial reporting, prevent duplication, and reduce the reporting burden on industry (BC MOE 2011).

Note that *Final Essential Requirements for Mandatory Reporting* (Western Climate Initiative 2011) indicated that in addition to the information required by regulation, the annual emissions data report shall contain the following information:

- Quarterly methane destruction at all ventilation and degasification system destruction devices or point of offsite transport (tonnes CH_4).
- Quarterly methane emissions (net) from all ventilation and degasification system (tonnes CH_4).
- Quarterly CO_2 emissions from onsite destruction of coal mine gas CH_4, where the gas is not a fuel input for energy generation or use (e.g., flaring) (tonnes CO).

24.1.1 Responsible Persons

Environmental Manager

The Environmental Manager will:

- coordinate dustfall monitoring;
- liaise with other industrial activities in the area to coordinate road watering requirements;
- maintain the database of emissions and prepare required NPRI and GHG reporting;
- coordinate with the Mine Manager to identify further mitigation measures to address air quality concerns; and
- record any community complaints in relation to fugitive dust and air quality, and coordinate appropriate follow-up.

Mine Manager

The Mine Manager is ultimately responsible for the success of the plan. Their responsibility is to:

- approve all relevant policies and documents, auditing, action planning and the verification process; and
- review and approve implementation of additional mitigation measures in relation to fugitive dust or methane.

24.3 NOISE

24.3.1 Purpose

Noise is generally defined as undesirable sound that may adversely affect people and wildlife in the local area. A change in the noise environment may be irritating, disturb rest or sleep patterns, cause loss of hearing, or otherwise affect the quality of life of individuals. Noise can result in psychological and physiological effects (e.g., stress), mental health effects, and effects on residential behavior (Berglund, Lindvall, and Schwela 1999). In addition, noise may negatively affect wildlife by causing them to avoid important habitats and/or take time away from their key behaviours such as feeding, breeding, or watching for predators, which can ultimately lead to reduced reproduction and increased mortality.

In order for there to be an adverse impact from noise there must be a noise source (e.g., a passing truck), a pathway for the noise to travel along (typically through the air), and a receptor (i.e., something to be affected by the noise, such as people or wildlife). By controlling or removing any of these (source, pathway or receptor), the impact of the noise will be mitigated.

The purpose of the Noise Management Plan is to outline a framework for: proactively minimizing project-related noise through identification and management of noise sources; and tracking and responding to complaints that may arise related to noise.

24.3.2 Legislation and Standards

There is currently no federal or provincial legislation that stipulates noise levels for mine development projects. However, the *Canadian Environmental Assessment Act* (2012) requires that the environment is protected from significant adverse environmental effects caused by a designated project.

This management plan takes account of current best practice and relevant guidelines. Typically, noise effects are assessed for human receptors not employed by the Project and outside of the Project boundaries. Human receptors in the immediate Project area include: recreation users, outfitters/ trappers, other industrial activities. Wildlife VCs may also be sensitive to Project noise.

Noise modelling of Project-related noise to support the Application/EIS (Appendix 18-C) and subsequent effects assessments (Chapter 13 and Chapter 18) have been based on the legislation and guidelines presented in Table 24.3-1.

24.3.3 Objectives

The objectives of this plan are to:

- proactively manage and minimize the impact of noise from mining operations on possible human receptors and the environment so that no reasonable noise complaints are received;
- maintain an effective response mechanism to deal with any issues and complaints to ensure that any complaints are responded to promptly and a plan to investigate and address the issue is developed as soon as is feasible; and
- monitor noise at receptor locations and compare actual noise levels against applicable criteria.

Table 24.3-1. Regulations and Guidelines Associated with Noise Management

Legislation and Regulations	Applicable Information
Canadian Environmental Assessment Act (2012)	Requires that the environment is protected from significant adverse environmental effects caused by a designated project.
Workers Compensation Act (1996o)	Contains the Occupational Health and Safety Regulations.
Occupational Health and Safety Regulations (B.C. Reg. 297/97)	Noise at a work place is limited to 85 dBA for 8-hour equivalent continuous sound level and 140 dBC peak sound level.
Health, Safety and Reclamation Code for Mines in British Columbia (BC MEMPR 2008)	Places workplace limits on noise at mine sites.
Useful Information for Environmental Assessments (Health Canada 2010)	Advises that noise mitigation measures be considered when a change in the calculated %Highly Annoyed (%HA) at any given receptor location exceeds 6.5% or if the Project Ldn exceeds 75 dBA.
Environmental Code of Practice for Metal Mines (Environment Canada 2009)	Suggests that to minimize potential effect to wildlife, sites in remote locations should work to meet noise limit suggested for residential areas which is an L_d of 55 dBA and an L_n of 45 dBA.

24.3.4 Actions to Avoid, Control, and Mitigate

24.3.4.1 Mobile Equipment

The following recommendations will be followed concerning mobile equipment:

- consider noise ratings when selecting equipment;
- properly maintain equipment to minimize noise, including lubrication and replacement of worn parts, especially exhaust systems;
- optimize the operation of equipment to minimize noise, e.g., reducing vehicle speeds;
- optimize site procedures to minimize the noise impact, e.g., keeping doors closed;
- conduct loud procedures indoors where possible;
- optimize hours of operation for loud procedures to minimize noise impact;
- use barriers to minimize noise impact; and
- turn off equipment when not in use and avoid unnecessary idling.

24.3.4.2 Stationary Equipment

The following recommendations will be followed concerning stationary equipment:

- ensure that stationary equipment, such as generators for light and power, incinerators, etc., are not placed in close proximity to any possible human receptors;
- fit all diesel-powered equipment with silencers (mufflers) meeting manufacturers' recommendations for optimal attenuation, and maintaining these silencers in effective working condition;

- clad bins and conveyors;
- reduce drop heights of material to piles or bins, or between conveyors; and
- use low noise conveyors.

24.3.4.3 Indoor Equipment

All equipment located indoors should not exceed an interior reverberant level of 85 dBA for unprotected ears, or as specified by occupational noise limits.

24.3.4.4 Controlling Noise at the Receptor

If further controls are required, the most effective options will be evaluated in order to maximize the effectiveness of mitigation. This would be undertaken on an as-needed basis and could include noise mitigation measures such as increasing the thickness of window glazing, reviewing HVAC systems, and improving the construction of exterior facades. This plan focuses on controlling noise at the source to reduce noise.

24.3.5 Monitoring and Reporting

24.3.5.1 Monitoring

The objective of noise monitoring is to make sure that noise levels propagated from the Project will meet appropriate criteria to minimize potential effects to human and wildlife receptors. Noise monitoring will provide information that indicates whether the environmental management plans developed to mitigate negative effects are on track to achieve their stated objectives.

Periodic noise monitoring will be performed to assess noise levels at receptor locations and should include monitoring of overnight noise, instantaneous noise, vehicle pass-by noise, and interior noise levels at production facilities. Initially, noise monitoring frequency is recommended to be at least every six months during Construction, and annually during Operation. This may decrease over time based on observed results.

The number and siting of monitoring locations will be selected to adequately assess the varying noise environment of the human and wildlife receptors within the study area based on the location of receptors and predictions from the noise modelling study (Appendix 18-C). Monitoring equipment should be located outdoors, approximately 1.5 m above the ground and no closer than 3 m to any reflecting surface (e.g., a wall).

Noise monitoring measurements will be performed in compliance with the International Organization for Standardization standard (ISO 1996-2:2007) which provides guidelines for the measurement of environmental sound and encompasses the following aspects:

- instrumentation system;
- calibration;
- monitoring locations;

- evaluation of measurement results;
- measurement uncertainty; and
- documentation.

There is the chance that atypical events will be captured during the monitoring period, which can then reduce the overall validity of the monitoring program. Atypical events are not representative of the wide-area noise environment being assessed. The risk of capturing these occurrences is increased when the noise environment is relatively quiet. These events may result from sound created close to the microphone by humans, plants and trees (due to wind), rain, or animals.

Records of noise-monitoring activities and associated management action, including operational controls and mitigation, shall be retained to ensure the continued safe and economical management of noise-generating activities.

In situations where noise monitoring results are identified as exceeding the specified criteria applicable to the Project, the following actions will be undertaken:

- The Environmental Manager must be notified as soon as practicable of any exceedance identified during attended or unattended noise monitoring.
- The Environmental Manager will investigate the results of the noise monitoring for the potential causes of the exceedance.
- If no recognizable causes can be identified, further investigations may be undertaken to identify the cause, e.g., specific weather or atmospheric conditions.
- Where the cause is identified, additional controls will be implemented or the operational method will be altered.
- Additional monitoring may be required as a follow-up to determine the effectiveness of any corrective actions implemented.
- Any corrective action will be recorded and reported to the Environmental Manager, who will keep a record of all significant proactive and reactive actions.
- The Environmental Manager will be informed of any complaint and details must be recorded in the site event management database, in addition to response and actions taken.

24.3.5.2 Complaint Tracking

The following information related to noise complaints from the public will be recorded:

- name;
- address;
- contact telephone number;
- date and time of registering complaint;
- date and time when noise occurred;

- subjective assessment of magnitude; and
- detailed description of noise.

Upon receipt of a complaint from possible human receptors, preliminary investigations should commence as soon as practicable to determine the likely causes using information such as prevailing climatic conditions, the nature of activities taking place, and recent monitoring results. A response will be provided as soon as possible, which may include the provision of relevant monitoring data, if requested.

When specific complaints are received in relation to noise at a particular receptor site, noise monitoring may be undertaken at or near the site if the Environmental Manager deems the complaint likely to be valid.

Every effort will be made to ensure that concerns are addressed in a manner that facilitates a mutually acceptable outcome for both the complainant and the Project.

24.3.5.3 Reporting

An appropriate measurement report for each monitoring session will be developed in compliance with the Noise Management Plan. The measurement report contents will include:

- the relevant noise limit (if applicable);
- the reference time interval(s), e.g., eight-hour period, as per the criteria;
- a description of the noise source(s) included in the reference time intervals;
- a description of the operating conditions of the noise sources;
- a description of the assessment site including the topography; building geometry; ground cover; and condition and locations, including height above ground, of the microphone(s) and source(s);
- the time, day, year, and place of the measurements;
- the instrumentation used (i.e., models and serial numbers) and calibration results;
- the measurement time intervals;
- a description of weather conditions during the measurements, particularly wind direction and speed, cloud cover, and whether precipitation was present; as well as temperature, barometric pressure, humidity, and the location of the weather instrumentation;
- a description of the residual sound;
- whether or not the measurement demonstrates compliance with the noise limit (if applicable);
- a figure showing monitoring locations on a map;
- discussion of uncertainties in the monitoring results; and
- a photograph of microphones as set up.

Many of these items can be recorded while at the site on a field data sheet. All measurement data, photographs, and field data sheets should be stored electronically to permit future access as required.

Annual reports should be submitted to the Environmental Manager using a consistent template. The annual reports will include:

- noise monitoring results and comparison to performance criteria;
- noise-related complaints and management/mitigation measures undertaken;
- management/mitigation measures undertaken in the event of any confirmed exceedance of performance criteria; and
- review of the performance of management/mitigation measures and the monitoring program.

This Noise Management Plan will be reviewed annually and, if necessary, revised.

Operational noise-mitigation plans should be developed based on the above best practice guidelines. Mitigation plans will be triggered if the noise monitoring program records levels that exceed the relevant criteria or if complaints have been received by the community or stakeholders.

24.3.6 Responsible Persons

Environmental Manager

The Environmental Manager will:

- record all community complaints into a site event management database;
- maintain the database to include all reporting, incident/event notifications, close-out tracking, risk management, audits, and document managing; and
- coordinate any necessary testing to follow up on community complaints.

Mine Manager

The Mine Manager is ultimately responsible for the success of the plan. Their responsibility is to:

- approve all relevant policies and documents, auditing, action planning and the verification process.

24.4 SITE PREPARATION AND SOIL SALVAGE

24.4.1 Purpose

Soil salvage is anticipated for all areas, where existing soils will be either excavated, filled or subject to levelling (minor cuts/fills) operations. Salvaged soils, and possibly, suitable overburden, will be used during mine reclamation to facilitate the restoration of functioning ecosystems. To achieve this goal, these materials (soils and suitable overburden) must be salvaged, handled, transported, stored and re-distributed in the reclaimed areas in a manner that does not result in excessive losses of

quality and future productivity. This plan describes the measures that will be taken to salvage and store soils for reclamation purposes.

24.4.2 Legislation and Standards

A number of federal and provincial regulations provide guidance regarding the development of a mine site and the management of associated terrain and surface soil disturbance. A short list of these and their major applicable components are provided in Table 24.4-1.

Table 24.4-1. Key Regulations Related to Soil Salvage and Handling

Legislation and Regulations	Applicable Information
Canadian Soil Quality Guidelines for the Protection of Environmental and Human Health (CCME 2007)	Provides guidelines related to contamination of the terrestrial habitat.
BC Environmental Management Act (2003)	Prohibits the introduction of waste into the environment in a way that will cause pollution, except in accordance with a regulation, permit, approval or code of practice issued under the Act.
Contaminated Sites Regulation (B.C. Reg. 375/96)	Lists Soil Criteria for Toxicity to Soil Invertebrates and Plants.
BC Forest and Range Practices Act (2002)	Contains provisions on the protection of riparian areas.
BC Mines Act (1996h)	Requires that the stability of man-made structures (e.g., impoundments, dumps, slopes), are planned in advance, inspected, monitored, and maintained throughout the operations and at the time of project closure.

24.4.3 Objectives

The main objectives of the Site Preparation and Soil Salvage Plan include the following:

- preserve adequate volumes of soil, and suitable overburden as required, for use in reclamation;
- retain beneficial soil structure by salvaging soil under appropriate weather and soil moisture conditions;
- retain native fertility of soils during storage by preventing mixing with lower quality material; and
- prevent soil erosion during salvage operations and from stockpiles.

24.4.4 Actions to Avoid, Control, and Mitigate

Salvaged soils will be used during mine reclamation to facilitate the restoration of functioning ecosystems. In order for this to be achieved, soils must be salvaged, transported, stored and redistributed in a manner that does not result in excessive losses of its fertility.

24.4.4.1 General Measures

Environmental protection measures are specific actions and practices that mitigate environmental damage. For soil salvage, specific measures will include the following:

- site preparation activity will be adequately supervised and will follow a predetermined soil salvage plan;
- soil salvage will include mineral and organic materials identified in the soil salvage plan. In practice, this means humus form (if present) materials will be salvaged and stored with the salvaged mineral soil, while excess vegetation (e.g., large tree limbs, root-balls, logs, etc.) will not be placed in the soil stockpile but may be retained for spreading as part of the final reclamation;
- prolonged exposure of bare soil to the elements will be avoided; whenever possible, soil salvage will immediately follow vegetation clearing;
- soil salvage will not be conducted when soils are too wet or too dry, as working in these conditions can degrade soil quality; and
- when practical, "boulder" mineral coarse fragments larger than 25 cm diameter will be separated during salvaging. This will enable equipment operators to effectively shape the soil stockpile. It will also improve the quality of the soil for use in future reclamation efforts.

Where possible, planning and management strategies employed during mine development and operation will attempt to minimize surficial disturbance and reclaim affected areas early by maximizing direct placement of salvaged material. Direct placement of salvaged soil and progressive reclamation helps maintain soil quality, increases effectiveness of erosion control, and reduces closure-related capital costs at the cessation of mining activities.

Soil and suitable overburden storage will comply with the following guidelines:

- stockpiles will be designed to be geotechnically stable;
- stockpiles will be located on stable foundations, on level ground where possible, outside of active floodplains and riparian areas;
- stockpile design will incorporate setbacks to ensure materials are not inadvertently displaced outside approved areas;
- soil and suitable overburden will be segregated in separate stockpiles;
- stockpiles will be constructed as soil salvage activities progress. As portions of the stockpile become completed, the slopes will be contoured to ensure stockpile stability, minimize erosion, and to help vegetation establishment;
- traffic in stockpile areas will be limited to stacking and shaping the stockpiles in an effort to minimize compaction. If required, stockpile areas will be lightly ripped (using a sub-soiler) to mitigate compaction, prior to seeding/planting activities;

- stockpiles will be surrounded by runoff diversion and collection ditch catchments and shaped in a way that will promote slow, efficient drainage of the slopes;
- completed portions of stockpiles (both slope and top) will be re-vegetated to minimize soil erosion, maintain soil quality, and control weeds. The overburden stockpiles will require fertilizer for vegetation establishment. No further maintenance will be required unless erosion and/or excessive establishment of invasive species are reported; and
- stockpiles will be accessible and will be marked in the field with permanent signs. Information on stockpile quantity and quality will be recorded.

24.4.4.2 Sequencing and Handling Criteria

Direct placement of salvaged soil and progressive soil replacement and reclamation helps maintain a healthy environment, increases effectiveness of erosion control, and reduces closure-related capital costs at the cessation of mining activities. Where possible, planning and management strategies employed during mine development and operation will attempt to minimize surficial disturbance and reclaim affected areas early by maximizing direct replacement of salvaged material.

Mixing surface and subsurface soils during salvaging operations (admixing) will be avoided, where possible, as excessive mixing of surficial organic (O, LFH) and mineral horizons (A and B) with deeper soils (C) can degrade the quality of the topsoil and reduce the potential productivity of the salvaged material. A designated person will be responsible for determining salvaging depth by visual inspection of the material as it is being salvaged.

Mechanically disturbing excessively wet soils can result in soil compaction and the promotion of "massive" soil structure. Mechanical disturbance of excessively dry soils can result in wind erosion and destruction of soil aggregates. Where practical, soil salvage scheduling will consider preferred soil moisture content and occur in moderate weather conditions as soon as possible after vegetation removal to avoid prolonged exposure of bare soils. In areas either affected by natural seepage or where the water table is near the surface, soil salvaging operations will be preferentially scheduled during dry or frozen conditions.

Salvaged soil and overburden will be stockpiled and re-vegetated in a timely manner. Stockpiles will be located outside of the general work areas so they will not be re-disturbed by or interfere with construction and/or operation activities or with infrastructure expansion.

To retain the quality of the soil during reclamation, the soils will be reapplied in a manner that preserves their value. A "rough and loose" replacement technique will be used to minimize compaction and increase microsite variability. Compaction, if encountered, may be mitigated by ripping or other means to encourage deeper rooting.

24.4.5 Monitoring and Reporting

A Monitoring Program will be developed during the permitting phase and will complement the management plans. The results of the monitoring program will be used to measure the success of the management strategies and to identify where additional mitigation is necessary.

Specific monitoring outcomes will be used to ensure the soil salvage objectives are achieved (Table 24.4-2). When required, corrective management action will be taken.

Table 24.4-2. Soil Salvage and Reclamation Monitoring Variables, Frequency, and Expected Outcomes

Monitoring Variables	Monitoring Frequency	Outcomes
Reconciliation of target soil salvage volumes with soil stockpile volumes	Annually during Construction	Target volumes will be provided in Decommissioning and Reclamation (Section 3.9)
Number of occurrences of soil salvaging during excessively dry or wet conditions	Weekly during stripping operations	No occurrences
Length of time the salvaged soil awaits transportation to stockpile area	Weekly during stripping operations	< 2 weeks
Length of time between completion of stockpile construction and seeding with erosion control mix	Monthly* during stripping operations	< 1 month
Occurrence of standing water on soil stockpiles	Monthly until re-vegetated, then annually	No occurrences
Presence of sheet erosion on soil stockpiles	Monthly until re-vegetated, then annually	No occurrences
Presence of rills and gullies on soil stockpiles	Monthly until re-vegetated, then annually	No occurrences
Soil stockpile photographic record	Annually	Representative record
Acidity or metal concentration in stockpiled soil that exceeds the CSR guideline limits	Every fifth summer	No occurrences

** Seeding will be delayed during winter conditions (e.g., frozen ground snow cover) or inclement weather (e.g., strong winds, intense rain).*

Annual reporting of reclamation and environmental monitoring work conducted during Construction and Operation is required by the *Mines Act* (1996h) as part of the Environmental Protection Program (Sections 10.1.5.(4) and (5) of The *Health, Safety and Reclamation Code for Mines in British Columbia* (BC MEMPR 2008).

Annual inspection reports will include a description of completed mitigation activities and a log of photographs related to soil salvaging and stockpiling. The monitoring results will be summarized and recorded. The monitoring results and corrective actions will be included in the site documentation management system and reported to senior management and regulatory agencies as required.

24.4.6 Responsible Persons

Environmental Manager

Implementation and associated reporting of the soil management and handling components of the Site Preparation and Soil Salvage Plan will be the responsibility of the Environmental Manager. The Environmental Manager will:

- ensure that designated, trained personnel oversee the soil salvaging and stockpiling operations, and maintain inspection reports;
- provide guidance with the support of a qualified soil/geotechnical specialist, when required, and;
- coordinate the implementation of the BMPs for soil handling in the field, including
  - oversight of soil salvaging and stockpiling operations; and
  - oversight of compilation of inspection reports.

24.5 EROSION AND SEDIMENT CONTROL

24.5.1 Purpose

The Erosion and Sediment Control Plan (ESCP) for the Project describes the guidelines that HD Mining will adhere to in order to minimize erosion and sediment loss during the life of the Project. The plan is designed to be dynamic, and will be updated with additional criteria and mitigation measures should changing requirements or project scenarios warrant plan modification. This plan builds upon the Erosion and Sediment Control Plan prepared for the Technical Assessment Report (TAR; EDI 2012). A site-specific erosion and sediment control plan will be developed during the permitting phase, and will be built off of this plan.

The purpose of the ESCP is to:

- protect the health and safety of employees and the public; and
- prevent the release of sediment that may harm intrinsic ecosystem functioning, including components of the biophysical environment such as water quality, and vegetation communities, as well as the fish and wildlife that depend on them.

24.5.2 Legislation and Standards

A number of legislative requirements are applicable to erosion and sediment control in British Columbia. A short list of these and their major applicable components are provided in Table 24.5-1.

Table 24.5-1. Key Regulations Related to Erosion and Sediment Control

Legislation and Regulations	Applicable Information
BC *Environmental Management Act* (2003)	Prohibits the introduction of waste into the environment in a way that will cause pollution, except in accordance with a regulation, permit, approval or code of practice issued under the Act
BC *Forest and Range Practices Act* (2002)	Provides direction on the construction of resource roads
Canada *Fisheries Act* (1985c)	Prohibits the release of a deleterious substance to fish habitat
BC *Water Act* (1996k)	Requires protection of habitat and water quality
BC *Mines Act* (1996h)	Provides guidance on the operation and reclamation of existing and abandoned mines

(continued)

Table 24.5-1. Key Regulations Related to Erosion and Sediment Control (completed)

Legislation and Regulations	Applicable Information
Health, Safety and Reclamation Code for Mines in British Columbia (BC MEMPR 2008)	Provides direction regarding the protection of worker health and safety at mines and exploration sites
Standards and Best Practices for Instream Works (BCMWLAP 2004b)	Provides best management practices to avoid causing damage to instream habitat during construction
Canadian Environmental Protection Act (1999)	Provides guidance on the preparation of pollution prevention plans

24.5.3 Objectives

The primary objective of the Erosion and Sediment Control Plan is to ensure that through planning and maintenance, best efforts are used to prevent erosion in the first instance. The secondary objective is to implement appropriate sediment control measures in areas where there remains likelihood for erosion to occur.

The following goals are implicit in achieving these objectives:

- conservation of soil quantity and quality in areas that are subject to erosion (e.g., stockpiles and disturbed areas located on slopes);
- minimizing erosion along access roads and in non-vegetated areas around mine infrastructure;
- stabilizing exposed erodible materials; and
- minimizing sediment delivery into watercourses.

24.5.4 Actions to Avoid, Control, and Mitigate

24.5.4.1 General Actions to Avoid, Control, and Mitigate

The proposed development area is located on narrow and undulating river terraces. Slope gradients within the immediate area of the proposed site facilities range from 0 to 10% and generally slope to the east towards the Murray River. There will be no facility constructed on steep slopes with the exception of segments of the diversion and collection ditches that will carry non-contact and contact water to appropriate locations around the site.

Erosion control Best Management Practices (BMPs) will be implemented where needs are identified. Many of the BMPs recommended in this document are based on those presented in the *Land Development Guidelines for the Protection of Aquatic Habitat* (Chilibeck, Chislett, and Norris 1993). Erosion prevention depends on careful planning to minimize the amount of disturbance and to mitigate those disturbances as soon as possible through re-vegetation and installation of erosion and control structures. These may range from simple devices such as soil covers, geotextile fabric, and hydroseeding to more engineered devices such as riprap, slope drains, and water diversion structures.

Vegetation cover plays a vital role in erosion control. Thus, soil and associated vegetation disturbance will be minimized where possible in both areal extent and duration. Riparian vegetation will be

retained to stabilize soil around watercourses. Areas where vegetation has been temporarily removed (e.g., road shoulders, ditches, and soil stockpiles) will be re-vegetated with an appropriate seed mix as soon as possible. Where required, additional means of soil surface stabilization (e.g., mulch, geo-textiles, or soil binder) will be used to hold the soil in place while the vegetation is established.

Erosion and sediment transport may also be avoided by ceasing some activities during periods of high rainfall or snowmelt. Activities such as land-clearing and road building may generate increased sediment loads that are difficult to contain with erosion and sediment control structures; therefore, a work stoppage may be required to limit the generation of sediment.

Some amount of soil erosion will occur, even with the erosion control strategies outlined above. Therefore, where required, sediment control measures will be implemented to ensure the capture of sediments before they are released to the receiving environment. Sediment control measures include installing and/or constructing:

- sediment fences;
- straw bales;
- check dams;
- fabric-covered triangular dikes;
- gravel-filled burlap bags; and
- sedimentation basins.

Critical to the management of erosion and sediment is the prompt installation of erosion and sediment control structures. Crews should be prepared with adequate materials to address scheduled work, and contingency materials should be kept on hand for emergency situations such as major precipitation events. Runoff, erosion control, and sediment control structures should be installed concurrently with the construction being done so that it captures all potential disturbances generated. Disturbed areas should be restored or reclaimed as soon as possible after the disturbance to minimize further generation and transport of sediment.

An environmental monitoring program will be implemented to detect potential erosion and sediment control problems and to monitor water quality in settling ponds and downstream receiving environments. Turbidity and total suspended solids will be managed in order to meet the *Ambient Water Quality Guidelines (Criteria) for Turbidity, Suspended and Benthic Sediments* (BC MOE 2001).

24.5.4.2 Construction

Site preparation activities during Construction will include:

- clearing the land surface within the Coal Processing Site and Coarse Coal Rejects North footprint areas;
- constructing temporary construction infrastructure such as access roads, power, water supply, drainage, site grading;

- constructing a temporary hoist house, air compressor house, lighting, washroom, mine dry, explosive magazine, fuel station, boiler houses, maintenance shop, office building, cafeteria, warehouse, etc.;
- constructing a temporary surface transportation and waste rock stockpiling system;
- constructing water management structures;
- constructing the concrete batch plant and water pump house; and
- other temporary infrastructure on site.

In addition, various components of the underground mining infrastructure will be completed during this phase.

Development activities will be kept away from hydrologically important features (e.g., seepage, springs, rivulets, and open water), if practicable. In areas affected by seepage or where the water table is near the surface, construction activities or soil salvaging operations will preferentially be performed during dry or frozen conditions. Where disturbance of wet areas occurs, measures such as drainage ditches, sediment fences, and erosion cloth will be used to minimize surface erosion. Rip-rap may be used along stream banks. Low ground pressure equipment or other methods may be used to minimize the degree of ground disturbance in areas with sensitive soils.

In addition to the comprehensive baseline data on soils, visual surveys of construction activities will help identify potential sites that require focused attention on erosion and sedimentation. Attention will be given to potential erosion sites, ditch failure, culvert blockage, or outside seepage to reduce the potential of slope/road failure and sediment transport. A communications strategy will be established on the construction site to report concerns to the Environmental Manager.

Stormwater runoff and sediment control measures, including isolation of work areas from surface waters and the use of temporary diversion methods (i.e., lined ditches, flumes, dam-and-pump) will be implemented as required. Sediment traps, geotextile cloth, sediment fences, gravel berms, straw bales, check dams, fabric-covered dikes, gravel-filled burlap bags, sumps, ditching/culverting, rip-rap, and other appropriate methods will be used, as required, to prevent sediment from entering waterways. Personnel will be trained in the use of these measures.

Erosion protection measures shall be implemented on soil stockpiles. Stockpiles will be located outside of riparian zones and away from surface water. Sediment fences may be used at the toe of stockpiled soils. The stockpiles will be constructed to be stable and the surface will be stabilized using short-term measures such as tracking, seeding, mulch, geo-textiles, or a soil binder, and will be re-vegetated with a rapidly establishing erosion control mix for longer periods (greater than six months).

Roads will be constructed according to the *Forest Road Engineering Guidebook* (BC MOF 2002) and will be maintained to ensure low landslide risk and continuous, efficient, controlled water drainage. Road design and construction will include consideration of the following:

- existing slope stability, drainage patterns, and soil types;
- potential impact of proposed structures on streams during and after construction;

- potential for adverse upslope, downslope, and downstream drainage effects;
- confinement of sensitive operations in anticipation of weather and snow melt events;
- proper disposal of slash and debris;
- adequate supply and proper installation of erosion and sedimentation control devices; and
- timely re-vegetation of disturbed slopes.

When the road is no longer required, it will be deactivated according to standards outlined in the *Forest Road Engineering Guidebook* (BC MOF 2002). This will include, but will not be limited to:

- removing all culverts and bridges;
- contouring potentially unstable road shoulders;
- installing water bars (interceptor dikes);
- ripping the road surface; and
- re-vegetation.

Water diversion structures will be constructed according the following BMPs:

- excavation will be completed in isolation of flowing water;
- installing energy dissipating structures such as check dams and settling ponds to reduce erosive power;
- diverting sediment-laden water to flat, vegetated areas where water is allowed to seep into the ground;
- excavating ditches in an upslope direction; and
- excavating ditches in isolated sections.

24.5.4.3 Operation

Much of the operational phase erosion control measures will be related to the maintenance of the established erosion and sediment control facilities. The monitoring of the functionality of these facilities will be conducted routinely to assess continued functionality. If repairs and or improvements to the type, sizing and frequency of installations of some systems are identified then these will be undertaken as required. Some new construction activity may be anticipated during the operations phase and measures, as noted previously, will apply.

If they are no longer required, temporary laydown areas and obsolete travel corridors will be deactivated, ripped, and re-vegetated with an appropriate seed mix.

24.5.4.4 Adaptive Management

The ESCP will be continually revised and updated in an adaptive management approach that will ensure that the highest standard of environmental protection is achieved.

24.5.5 Monitoring and Reporting

An Erosion and Sediment Control monitoring program will be initiated prior to the start of Construction. Monitoring of construction projects will be conducted by the Environmental Manager

Workers will be encouraged to communicate concerns related to erosion and sedimentation, debris or snow jams at stream crossings, and contaminant releases.

Ditches, culverts, and adjacent slopes will be inspected as required, especially after high rainfall or melt events. Identified erosion and sediment concerns, such as blockages, siltation, gullying, or slope failure, will be addressed as soon as possible to protect road infrastructure and the adjacent environment.

Evidence of erosion on disturbed and sparsely vegetated non-rock areas will be assessed; if erosion is observed, affected areas will be treated as soon as possible to avoid acceleration of erosion. Temporary measures, such as straw bales and sediment fences, will be checked regularly to ensure that they are functioning properly. These will be replaced or serviced, as required. Long-term measures, such as rip-rap, gabions, and ditches will be installed and monitored at the beginning and end of each season or after high rainfall events to ensure that they are operating properly.

Recommendations will be established for work stoppages during heavy precipitation events. These recommendations should be made in consultation with the Environmental Manager and construction managers, and should be based on the potential for sediment to be generated and transported to adjacent watercourses. The Environmental Manager will be responsible for the monitoring of weather forecasts so that potential shut-downs can be anticipated and mitigation measures put in place.

Monitoring observation and sampling sites will be located on a map and information including their GPS coordinates, erosion type, intensity, and the extent of the affected area, as well as existing control measures and assessment of their performance, may be documented. Affected sites will be checked regularly for evidence of erosion, particularly after high rainfall events, until erosion is not a concern. Targeted field measurements or sediment sampling may be recommended as required. Monitoring results may be used to trigger an appropriate adaptive management response.

Road embankment condition and potential for sediment transport into watercourses will be assessed along water diversion channels, drainage ditches, ponds, and waterway crossings along roads. The waterbodies adjacent to construction sites will be visually inspected for introduced sediment. Water sampling and/or turbidity testing may also be carried out if noticeable turbidity occurs. Regular inspection of areas releasing sediment will be carried out until sediment is no longer released. Information will be documented and reported to the designated person.

Inspection reports will include a description of erosion type, intensity, existing control measures and assessment of their performance, extent of the affected area, undertaken mitigation activities, and a log of dated photographs. The monitoring results and corrective actions will be included in the site documentation management system and reported to senior management and regulatory agencies, as required. Monitoring variables, monitoring frequency, and performance objectives are outlined in Table 24.5-2.

Table 24.5-2. Monitoring Variables, Frequency, and Objectives

Monitoring Variables	Monitoring Frequency	Objectives
Supplies of erosion/sedimentation control materials in disturbed areas	monthly	sufficient supply is always locally available
Evidence of non-mitigated erosion or sedimentation occurrences in disturbed areas	monthly or after high rainfall events	no occurrences
Presence of unused, disturbed surfaces (>100 m^2) remaining bare (un-vegetated) for more than six months	beginning and end of each season	no occurrences
Number of incidents of sediment entering waterways	monthly or after high rainfall events	no occurrences
Detailed record of erosion/sedimentation occurrences documented during monitoring of water turbidity	monthly or after high rainfall	record of all erosion occurrences

A communications strategy will be established on the Project site to report on the effectiveness of the plan(s) to the Environmental Manager. In the event of a sediment and erosion control failure, notifications will be given immediately to appropriate supervisors. As appropriate, these notifications will be extended to the management team, and regulatory agencies, such as for incidents in which fish and aquatic habitat could be adversely affected, or if potential geohazards result from the erosive event.

24.5.6 Responsible Persons

Environmental Manager

The Environmental Manager holds overall responsibility for the oversight of environmental monitoring programs. As such, responsibilities with regards to erosion and sediment control include:

- communicating performance objectives and measures related to erosion and sediment control to personnel;
- communicating with regulatory agencies as required regarding compliance with performance objectives;
- ensuring that mine site staff have the appropriate resources to monitor and implement best management practices for erosion and sediment control; and
- directing the following activities:
  - monitoring of active construction areas;
  - maintaining an appropriate inventory of erosion and sediment control materials and ensuring that they are available at active work sites;
  - monitoring weather forecasts and communicating with mine site staff regarding potential weather-related work stoppages;
  - routine monitoring of construction sites, erosion and sediment control measures, and water quality; and
  - compiling daily monitoring reports into weekly summaries for regulatory agencies.

Mine Manager

The Mine Manager will:

- liaise with the Environmental Manager to inform personnel about upcoming construction schedules and locations;
- communicate environmental performance objectives and best management practices to personnel; and
- ensure that incidents involving erosion and sediment are communicated promptly to the environmental team.

24.6 WATER MANAGEMENT

24.6.1 Purpose

Water is a key component in mining projects as it is required for, and affected by, mining activities. Effective water management is important for a variety of reasons including: uninterrupted operation of the mine, compliance with operation permits and applicable legislation, and minimization of effects on the receiving environment.

The purpose of the Water Management Plan is to provide an operational guide for management of surface water quantity during Construction, Operation, Decommissioning and Reclamation, and Post Closure of the Project. Water management infrastructure and the water balance model are presented in Chapter 3 and in Appendix 8-E. This document focuses on actions for avoidance, mitigation, and control, as well as a water management monitoring program. By incorporating principles of adaptive management, this Water Management Plan provides a framework for ongoing review and improvement of management practices. It is intended to be used in conjunction with the Erosion and Sediment Control Plan (Section 24.5), the Metal Leaching/Acid Rock Drainage (ML/ARD) Plan (Section 24.7), and the Selenium Management Plan (Section 24.10), in addition to any other applicable plans.

This Water Management Plan addresses the following goals:

- to protect water-related ecologically sensitive sites and resources, and avoid harmful impacts on fish and wildlife habitat;
- to supply and retain water for mine operations;
- to define water-related environmental control structures; and
- to manage water to ensure that any discharges are in compliance with the applicable water quality levels and guidelines.

24.6.2 Legislation and Standards

The Water Management Plan has been developed to support guidelines and requirements specified by the following legislation:

- **BC *Environmental Management Act* (SBC 2003).** Regulates the discharge of air contaminants, liquid effluent, and refuse into the environment, and regulates the management of hazardous wastes.
- **BC *Mines Act* (RSBC 1996h).** Provides guidance and approvals for all activities on the mine site, including exploration, development, production, closure, and reclamation.
- ***Health, Safety, and Reclamation Code for Mines in British Columbia* (BC MEMPR 2008).** Under the *Mines Act* (1996h), requires the proponent to provide:
  - designs and details for water management structures, water storage, and water treatment facilities;
  - the source, use, and water balance for any water required in the operation;
  - a plan for erosion control and sediment retention; and
  - a reclamation plan.
- ***Fisheries Act* (RSC 1985c).** Provides Fisheries and Oceans Canada with the responsibility to ensure sufficient flows for fish by preventing permanent alteration to, or destruction of fish habitat.
- **Canada *Water Act* (RSC 1985b).** Provides the framework for joint federal-provincial management of Canada's water resources. Approvals and licenses under provincial water acts are required to authorize the construction of works for the purposes of diverting, storing, or using water, or causing changes in and about a stream for any purpose.
- **BC *Water Act* (RSBC 1996k).** Administers the allocation and management of surface waters in British Columbia. It is the primary legislation for regulating surface water diversion, storage, and use, and managing water quality.
- ***Navigation Protection Act* (RSC 1985e).** Regulates works that interfere with navigation built in, on, over, under, though, or across navigable waters in Canada. Navigable waters are defined as all bodies of water that can be navigated by any type of floating vessel for transportation, recreation, or commerce.
- **BC *Forest and Range Practices Act* (SBC 2002).** Requires that road construction adheres to codes provided in the Forest Service Road Use Regulation (BC Reg. 70/2004), which focuses extensively on erosion prevention.

The following documents were used as primary sources for mitigation and management measures:

- *Water and Air Baseline Monitoring Guidance Document for Mine Proponents* (BC MOE 2012);
- *Forest Practices Code of British Columbia Forest Road Engineering Guidebook* (BC MOF 2002); and
- Operational Statement for Maintenance of Riparian Vegetation in Existing Rights-of-Way (Fisheries and Oceans Canada 2007).

24.6.3 Water Management Infrastructure

Project components and activities that have the potential to alter surface water quantity and quality are within three areas: Decline Site, Shaft Site, and Coal Processing Site (Figure 24.6-1). As part of Bulk Sample activities that are already permitted, the Service Decline and ventilation shaft will be constructed to provide access to the coal seams from surface. With initiation of Construction for the full mine development, a new Production Decline will be constructed from the east side of the Murray River (Coal Processing Site) down toward the base of the shaft. The Production Decline will be the primary means of hauling coal to the surface for processing. It will also provide an alternative route for transport of personnel and materials, and serve as a fresh air intake.

A drainage system will be used in the underground mine. A central water sump and a main water pump station will be constructed at the bottom of the Production Decline. A portion of water from the sump will be pumped back within the mine to be used by the sprinkler system and for general fire water and dust suppression purposes. Excess seepage water will be pumped to surface via water pipes.

A water balance model for the Project was developed using a monthly time-step (Appendix 8-E). The model schematic is presented in Figure 24.6-2. Water balance volumes during the Construction, Operation, Decommissioning and Reclamation, and Post Closure are presented in Appendix 8-E, and summarized in the following sections.

24.6.3.1 Underground Mine

It is recognized that there is a high degree of uncertainty associated with estimating seepages rates into the underground mine. Under the base case scenario (average precipitation and moderate seepage values), seepage into the underground mine is expected to grow up to 6,002 m^3/day at the end of Operation (Appendix 7-B Figure 24.6-2). Under the low and high seepage scenarios, seepage estimates at the end of Operation are 1,891 and 12,748 m^3/day, respectively (Appendix 7-B). For the low seepage scenario, the underground mine will be at water deficit conditions (Appendix 8-E). Water withdrawal from Murray River (up to 1,275 m^3/day) will be required to support for underground activities (Appendix 8-E) if the low groundwater seepage scenario occurs.

Seepage to the underground mine will be collected in a central water sump that is equipped with a main water pump station. Under the base case scenario, up to 6,002 m^3/day of groundwater seepage will enter the underground mine, 162 m^3/day of which will be lost to evaporation. Up to 2,075 m^3/day of seepage water will be circulated back within the mine through the sprinkler system and for general fire water and dust suppression purposes. From the 2,075 m^3/day sprayed water, 1,376 m^3/day will be stored as moisture in raw coal, and conveyed to the surface (Figure 24.6-2).

During the first year of Construction, excess seepage water will be pumped to the Decline Site pond, consistent with current water management during Bulk Sample. Once construction of the Production Decline is complete, excess seepage will be pumped to the Coal Processing Site for the remainder Construction and during Operation. Water will not be pumped to the surface once mining is complete (Decommissioning and Reclamation and Post Closure).

Figure 24.6-1
Decline, Shaft, and Coal Processing Sites within the Project Area

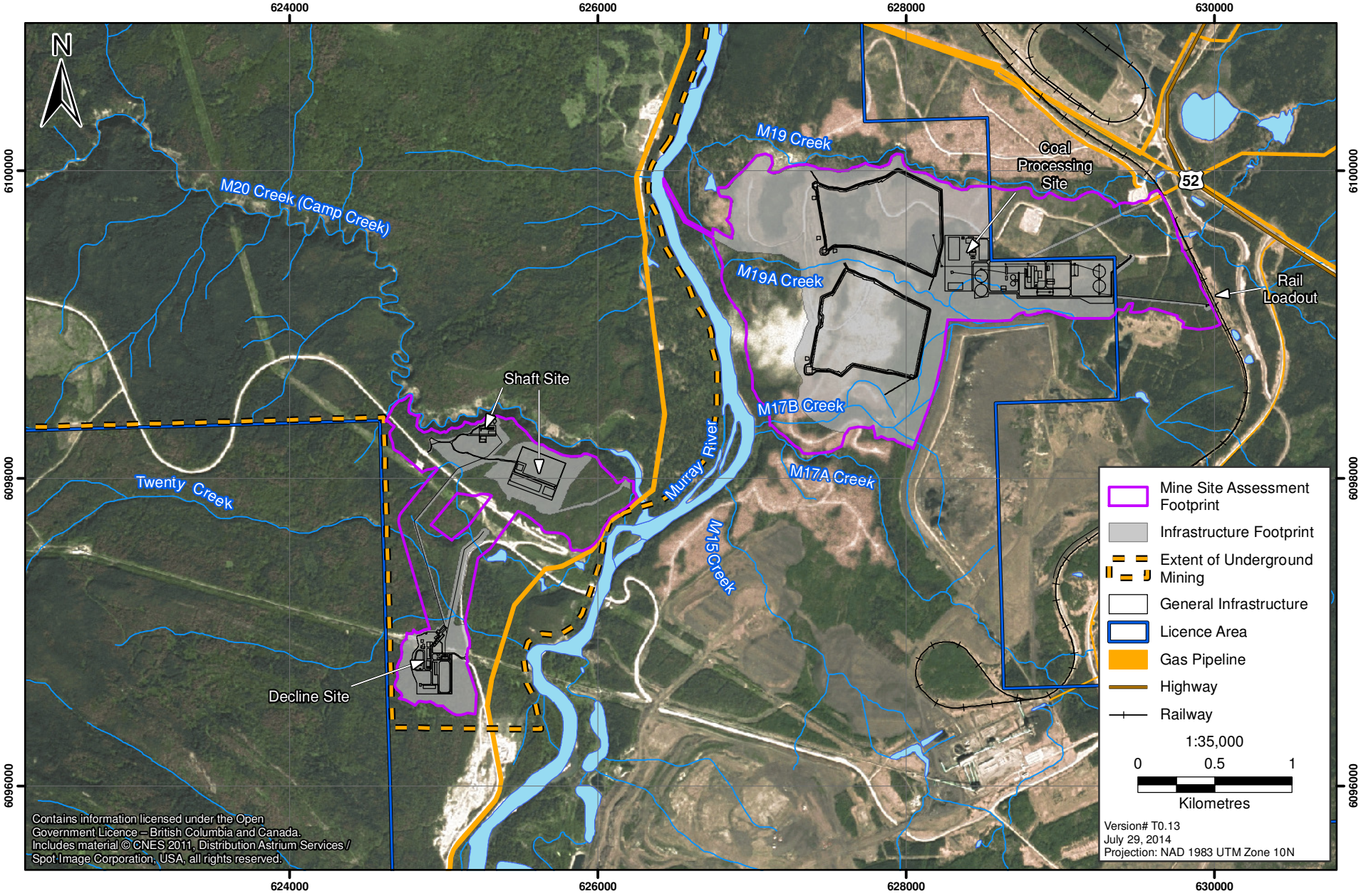
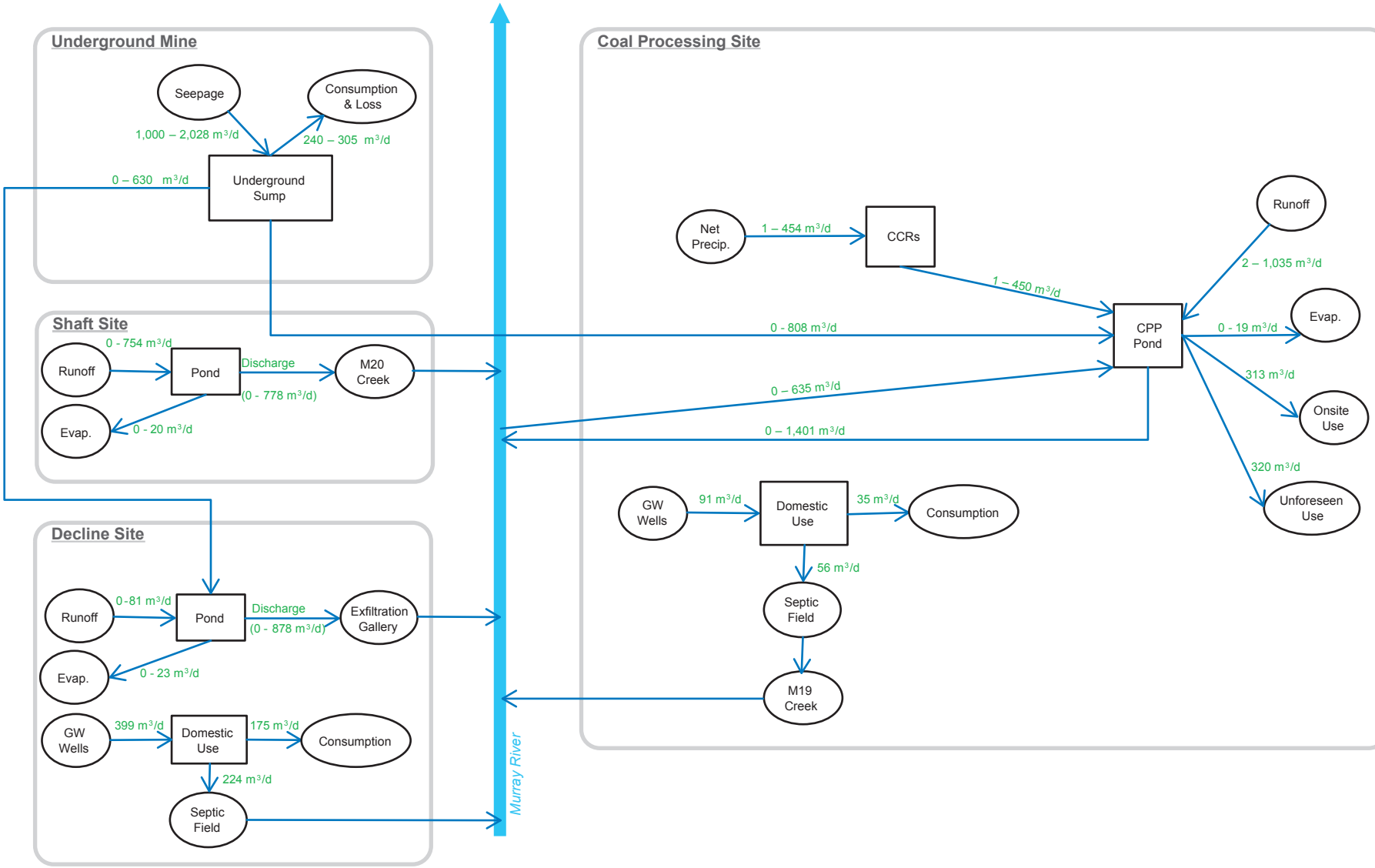


Figure 24.6-2a
Water Balance Model Schematic

a) Construction



b) Operation

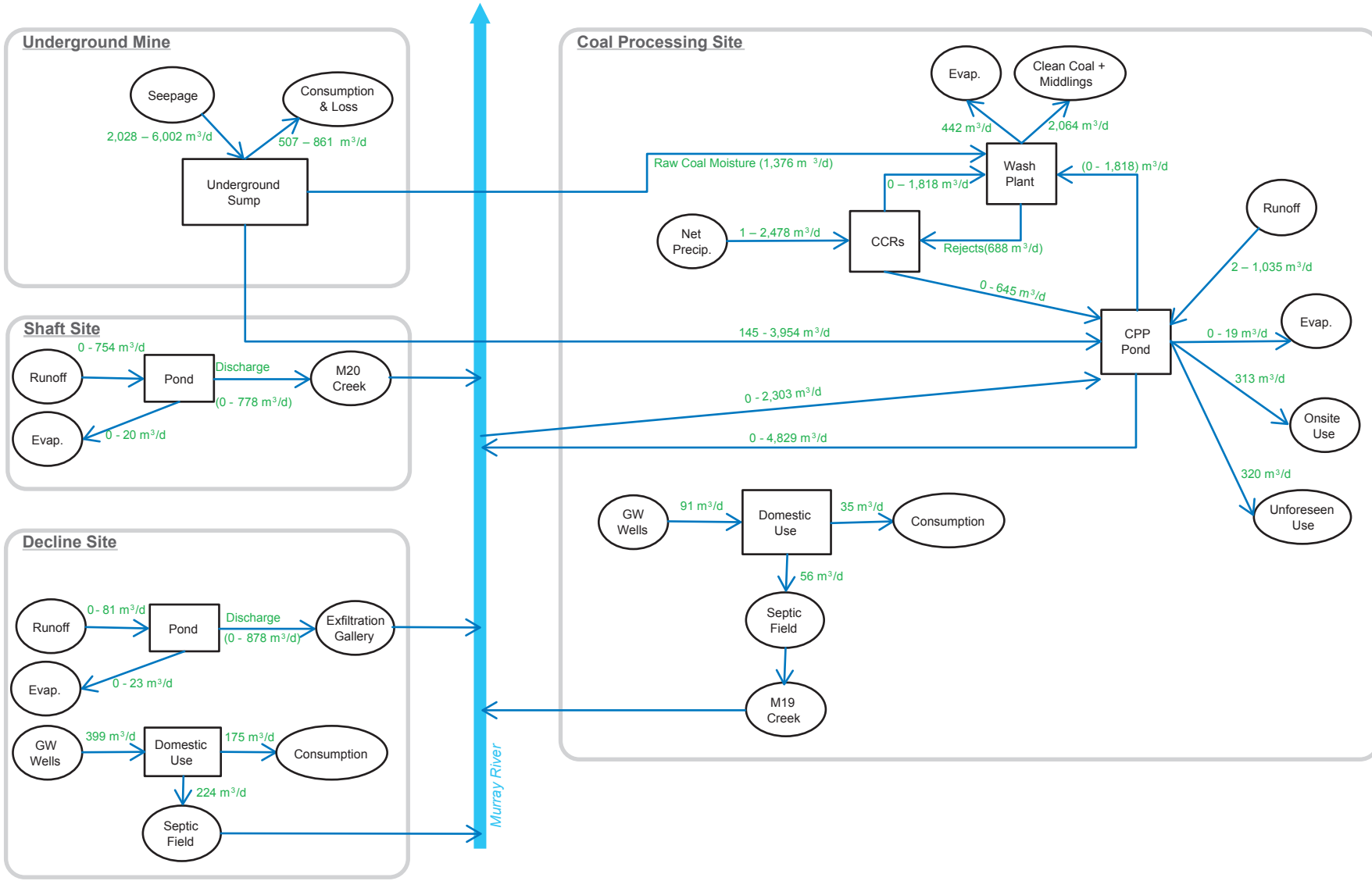
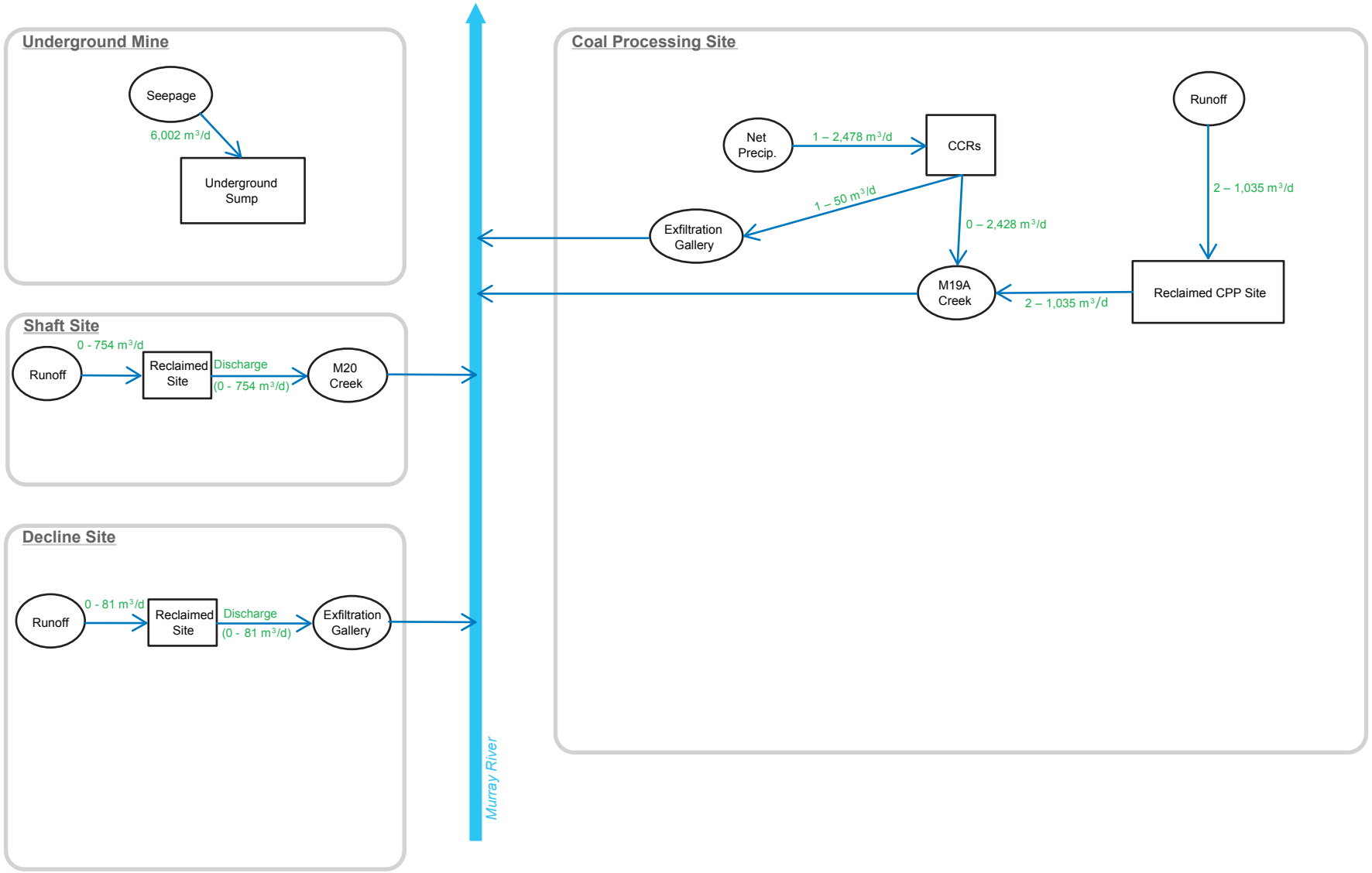

Underground Mine
Seepage
2,028 – 6,002 m³/d
Consumption & Loss
507 – 861 m³/d
Underground Sump
Shaft Site
0 - 754 m³/d
Runoff
Pond
Discharge
(0 - 778 m³/d)
M20 Creek
Evap.
0 - 20 m³/d
Decline Site
Runoff
0 - 81 m³/d
Pond
Discharge
(0 - 878 m³/d)
Exfiltration Gallery
Evap.
0 - 23 m³/d
GW Wells
399 m³/d
Domestic Use
175 m³/d
Consumption
224 m³/d
Septic Field
Murray River
Coal Processing Site
Evap.
Clean Coal + Middlings
442 m³/d
2,064 m³/d
Raw Coal Moisture (1,376 m ³/d)
Wash Plant
(0 - 1,818) m³/d
0 – 1,818 m³/d
Net Precip.
1 – 2,478 m³/d
CCRs
Rejects(688 m³/d)
0 - 645 m³/d
Runoff
2 – 1,035 m³/d
145 - 3,954 m³/d
CPP Pond
0 - 19 m³/d
Evap.
313 m³/d
0 - 2,303 m³/d
Onsite Use
0 - 4,829 m³/d
320 m³/d
Unforeseen Use
GW Wells
91 m³/d
Domestic Use
35 m³/d
Consumption
56 m³/d
Septic Field
M19 Creek

Figure 24.6-2c
Water Balance Model Schematic

c) Closure



Current water management planning does not account for storage of excess seepage (underground or on surface). This is seen as a future opportunity that could be used to help optimize water management and reduce potential effects to the surface water system.

24.6.3.2 Decline Site

HD Mining is currently advancing development of a Bulk Sample on site. Permitted Bulk Sample activity has included site preparation at the Decline Site and Shaft Site. During the first year of Construction, excess groundwater seepage will be pumped into the Decline Site pond (Figure 24.6-1). The pond outflow will be discharged on the ground via an exfiltration gallery. This water will eventually reach Murray River. After the first year of Construction, the Production Decline will be complete, and groundwater seepage will be pumped into the Coal Preparation Plant (CPP) pond instead of the Decline pond. The Decline pond is decommissioned at the end of the first year of Operation.

Groundwater wells will provide 399 m^3/day of water for domestic use from which 175 m^3/day will be discharged to a septic field as domestic sewage.

24.6.3.3 Shaft Site

A waste rock storage area and sedimentation pond have been constructed at the Shaft Site as part of Bulk Sample. During Construction and the early part of Operation, surface runoff from the waste rock pile will report to the Shaft Site pond (Figure 24.6-1). The pond outflow will be discharged to M20 (Camp) Creek.

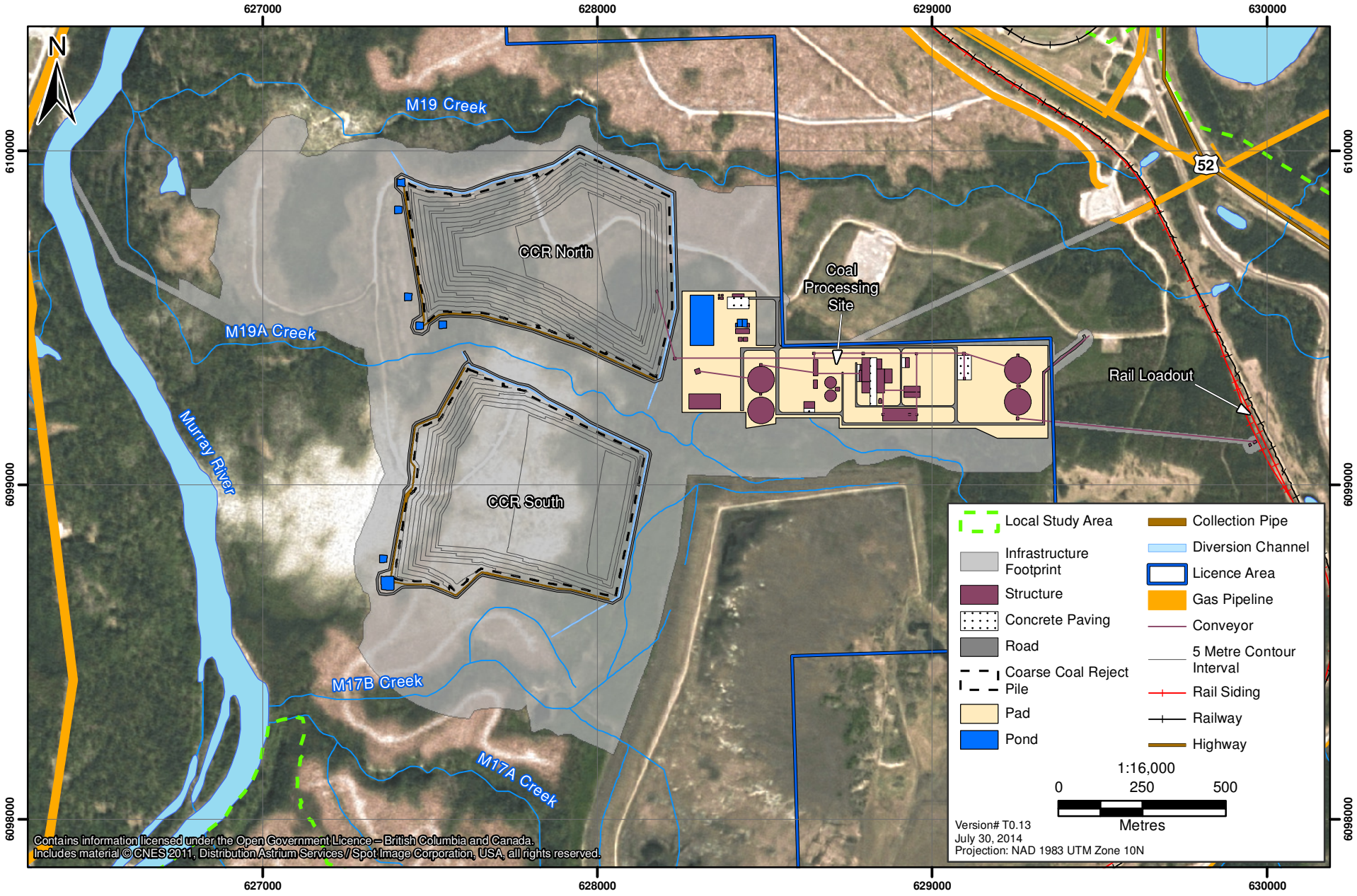
The waste rock pile is planned to be reclaimed after the end of Construction. In the water balance model, the Shaft Site pond is decommissioned at the end of the second year of Operation, after which seepage and runoff will naturally flow to M20 Creek.

24.6.3.4 Coal Processing Site

During mining, the Project will process approximately 148 Mt of coal in the 25 years of Operation. The mass of coal rejects per year is approximately 30% of the total coal mined each year. The coal rejects are split with 70% in the coarse fraction (coarse coal rejects; CCR) and 30% in the fine fraction (tailings). Coarse and fine coal rejects will be comingled and stored sub-aerially in two stockpiles within the Coal Processing Site (Figure 24.6-1 and 24.6-3). CCR North will be in operations from year 1 through year 14 and the CCR South will be in operations from year 15 through year 25. Diversion ditches around the CCR North will divert non-contact water to M19 Creek and M19A Creek (a tributary of M19 Creek; Figure 24.6-3). For the CCR South, non-contact water will be diverted to M19A Creek and M17B Creek (Figure 24.6-3).

The CCR piles are designed with a geosynthetic liner. It is expected that more than 98% of the effective precipitation (i.e., rainfall plus snowmelt minus evaporation) on CCR piles will be captured by the seepage collection system either as surface runoff or seepage through the piles (Appendix 3-E). The seepage collection system will drain contact water into a collection sump. Contact water in this sump will be pumped to the Coal Preparation Plant, and excess water, beyond the Coal Preparation Plant need, will be pumped into the CPP pond.

Figure 24.6-3
Infrastructure within the Coal Processing Site



The CCR North and CCR South piles will be covered and re-vegetated at the end of years 15 and 25, respectively. It is assumed that only 2% of annual effective precipitation will infiltrate this cover, and 98% will run off the surface. After the end of mining (i.e., year 25), surface runoff from the reclaimed CCR piles is rerouted to M19A Creek, and infiltrated water will be recharged to groundwater through exfiltration galleries.

On-site groundwater wells will provide 91 m^3/day of water for domestic use from which 56 m^3/day will be domestic sewage, which will discharged to the environment along with excess seepage water (Figure 24.6-2).

There will be six stockpiles in the coal processing area, two for raw coal and four for coal product (Figure 24.6-3). Raw coal and clean will stockpiles will have a maximum capacity of 60 kt each with a turnover time of 3 days. The flotation clean coal and middling coal stockpiles will have maximum capacities of 42 kt and 45 kt, respectively, with two-week turnover times. Runoff from the stockpiles will be directed to the CPP pond. Diversion ditches around the plant area will divert non-contact water to M19A Creek (Figure 24.6-3).

The coal preparation plant requires 3,194 m^3/day of water to replace the volume of water that leaves the plant as clean coal and middlings moisture (2,064 m^3/day), reject moisture (688 m^3/day), and evaporation loss (442 m^3/day). This demand is supplied by raw coal moisture (1,376 m^3/day), water collected from the CCR seepage system (variable volume), and makeup water from the CPP pond (variable volume; Figure 24.6-2).

The CPP pond will be used as the water source for wash plant make-up water, onsite uses (313 m^3/day), and unforeseen uses (320 m^3/day). Total water uses from the CPP pond are variable during Operation, particularly because make-up water needs for the wash plant are variable. During Operation, the CPP pond may be in either a positive balance status (i.e., excess water from the pond is discharged into the Murray River) or a negative balance status (i.e., water from Murray River is pumped to the CPP pond to be used in the wash plant).

24.6.4 Objectives

The Water Management Plan provides guidance for achieving the following performance objectives during all phases of the Project:

- ongoing compliance with regulatory commitments, guidelines, and objectives;
- implementation of environmental protection measures in a timely, effective, and cost-efficient manner;
- integration of water management activities with other management and monitoring programs;
- interception and diversion of non-contact water (freshwater) away from work areas using ditches, berms, or other diversion structures;

- collection of contact water from disturbed areas and preferential use of it in the coal preparation plant. Contact water will meet discharge standards prior to release to the environment;
- maintenance of an adequate supply of water for mine operations; and
- reduction of freshwater use through water recycling whenever possible.

Specific measures that will be implemented to achieve performance objectives are summarized in Table 24.6-1. These measures are described in Section 24.6.5.

24.6.5 Actions to Avoid, Control, and Mitigate

Water management activities to ensure environmental protection during the Construction will emphasize Best Management Practices (BMPs) to minimize disturbance to vegetation, soil, and natural drainages. Erosion and sediment control measures are described in detail in the Erosion and Sediment Control Plan (Section 24.5).

Environmental protection measures during Operation will primarily focus on monitoring and maintenance of established water management structures and facilities. If necessary repairs and/or improvements to these systems are identified, these will be undertaken on a timely basis.

Decommissioning and Reclamation will involve the removal of all structures and equipment, flooding of the underground mine workings, and site rehabilitation. The primary goal of water management activities will be to minimize the long-term effects on the environment and return the site to as close to its pre-disturbance condition as practical.

24.6.5.1 General Actions to Avoid, Control, and Mitigate

Effective water management requires environmental protection measures within an integrated adaptive approach. These measures are broadly applicable to all activities on the site and are described in more detail below.

<u>Adaptive Management</u>

Adaptive management is a process for continually improving management practices by learning from the outcomes of operational approaches (e.g., Bunnell et al. 2009, BC MOF 2013). To be effectively implemented, it requires a prompt response to field observations of changing environmental conditions and limitations or deficiencies in existing water management structures.

When properly implemented, adaptive management enables a cost- and time-effective hierarchical response to potential water management issues. BMPs and a corresponding inspection, maintenance, and monitoring program constitute the basis of water management planning. The adaptive management approach promotes proactive measures, with the caveat that contingency plans and materials should be in place prior to the initiation of work so that additional measures can be quickly implemented if needed.

Table 24.6-1. Water Management Performance Objectives and Corresponding Management Measures

Action type	Environmental Protection Activity	Performance Objectives	Management Measure	Other Applicable Management Plans
General actions applicable to all Project activities	Adaptive management	Ongoing compliance with regulatory commitments, guidelines, and objectives[1] Implementation of environmental protection measures in a timely, effective, and cost-efficient manner[1] Integration of water management activities with other management and monitoring programs[1]	Implement scheduling and staging for all site-specific work plans prior to beginning work Familiarize all site personnel with the purpose and content of the Water Management Plan, and their responsibilities in its implementation Maintain collaboration and communication among site manager/supervisors, environmental personnel, and contractors Regularly assess and modify Water Management Plan to adapt to changing work plans and site conditions	Erosion and Sediment Control Plan (Section 24.5), Selenium Management Plan (Section 24.10)
	Maintaining site resources	Reduction, elimination, or mitigation of flow blockage or erosion	Maintain caches of equipment and materials for water management/erosion and sediment control in locations that are easily identifiable and accessible Inventory and maintain caches on a regular basis	Erosion and Sediment Control Plan (Section 24.5)
	Adverse weather shutdown	Reduction, elimination, or mitigation of environmental effects due to extreme weather conditions	Conduct work activities in susceptible areas (e.g., adjacent to streams, areas with high erosion potential) during dry weather or frozen conditions when possible	n/a
	Snow handling	Reduction, elimination, or mitigation of fine materials erosion into stream channels	Pile snow in areas where snow melt will be captured by site ditching and water management infrastructure Install perimeter sediment control (e.g., sediment fencing or berms) around snow piles where necessary	n/a

(continued)

Table 24.6-1. Water Management Performance Objectives and Corresponding Management Measures (completed)

Action type	Environmental Protection Activity	Performance Objectives	Management Measure	Other Applicable Management Plans
Actions applicable to specific Project components/ activities	Diversion and collection ditch construction	Interception and diversion of non-contact water Collection, use, and discharge of contact water	Non-contact (freshwater) diversion channels will be constructed around the plant site and CCR piles. The diverted water will discharge to M19A, M19, and M17B creeks. Surface contact water at CCR piles will be captured by a seepage collection system and pumped to the coal wash plant to be used as make-up water; excess water will be pumped to the CPP pond and discharged to Murray River. Water management and sediment control structures and facilities will be regularly inspected and maintained according to the monitoring schedules specified in this plan and the Erosion and Sediment Control Plan (Section 24.5)	Erosion and Sediment Control Plan (Section 24.5), Selenium Management Plan (Section 24.10)
	Process water supply system	Maintaining an adequate supply of water for mine operations Minimizing use of freshwater	Water requirements for the coal wash plant will be met with a) recycled water, b) raw coal moisture, c) contact water collected from the CCR seepage collection system, and d) CPP pond water which is supplied by excess underground seepage, excess CCR seepage, surface runoff on the plant site, and water withdrawal from Murray River.	n/a
	Road upgrades and maintenance	Reduction, elimination, or mitigation of erosion and sediment yield Interception and diversion of non-contact water	Adhere to best practices as specified in the Erosion and Sediment Control Plan (Section 24.5) Construct roads in accordance with the *Forest Road Engineering Guidebook* (BC MOF 2002) Follow guidelines specified in the *Operational Statement for Maintenance of Riparian Vegetation in Existing Rights-of-Way* (DFO 2007)	Erosion and Sediment Control Plan (Section 24.5)
	Domestic water supply system	Maintaining an adequate supply of water for domestic water use	Potable water will be supplied from groundwater wells and treated as necessary prior to delivery	n/a

Note: Information is from Chapter 3 (Project Description) unless otherwise noted.
n/a: not available (no separate management plan currently exists; topic is addressed in Water Management Plan)
[1]Performance objective is applicable to all activities throughout all phases of mine

Communication is essential to successful application of the water management plan. All personnel working at the site, including cross shifts, should be advised and trained about the plan's goals and purpose, and their responsibilities in order to implement the plan successfully. Personnel should be informed of changes in a timely manner. Appropriate training and field supervision are important elements of the water management plan. Personnel should understand why water management measures are needed and how to implement them correctly.

Site Resources

Caches of equipment and materials for water management should be maintained in locations that are easily identifiable and accessible (e.g., in storage sheds adjacent to work sites). These caches should include materials for routine BMP maintenance and repair as well as contingency supplies to be used in the event of an emergency. The on-site caches of materials should be regularly inventoried as part of the maintenance and monitoring program, and materials that are depleted should be promptly replaced.

Adverse Weather Shutdown

The potential for environmental impact increases markedly during periods of severe weather. Shutdowns of ground-disturbing activities may be required during periods of very high rainfall (e.g., >50 mm/day) or extended periods of high rainfall. Adverse weather shutdown procedures are triggered by severe weather criteria. Shutdown will be based on safety concerns, environmental effects, and protection of infrastructure. A shutdown instruction would be issued by the Mine Manager, however, individual workers have the responsibility of notifying supervisors if they have reasonable cause to believe that safety or environmental protection would be endangered by severe weather.

Snow Handling

During the winter, proper handling of cleared snow is required. Gravel, topsoil, and organic matter can be entrained during snow removal. As snow melts, coarse materials drop out and fine materials may be transported with meltwater. To prevent the delivery of fine materials into stream channels, snow should be piled in areas where snow melt will be captured by site ditching and water management infrastructure.

Given the typical snow accumulations locally, and the expected rate of melt from a snow stockpile, it is expected that spring melt conditions would generally be accommodated within the peak flow design parameters of on-site ditching (e.g, 1-in-100-year 24-hour storm).

24.6.5.2 Actions to Avoid, Control, and Mitigate Specific Project Components or Activities

Diversion and Collection Systems

Perimeter water diversion structures will be established as a first step to Construction activities. Freshwater diversion ditches will be constructed around the plant site and CCR piles (Figure 24.6-3). The diverted water will discharge to M19A, M19, and M17B creeks. Channels will have a trapezoidal shape with a bottom width of about 1.0 m, and side slopes of 1H: 1V. Culverts will be designed so that the hydraulic grade line does not overtop the roads.

Contact water collection ditches and the associated contact water collection pond will be designed for the 24-hour, 200-year storm event. Channels will be armoured as required to prevent damage from erosion and equipment used to maintain and clean out the channels.

The CCR seepage collection system will drain the contact water into lined collection sumps. Water in these sumps will be pumped to the coal preparation plant (i.e., used as make-up water) or the CPP pond. Contact water from all areas within the Coal Processing Site, including the CCR piles, is collected in the CPP pond before being discharged to Murray River. Current water quality predictions (Appendix 8-E) show that the CPP pond water can be discharged to Murray River without treatment for dissolved parameters. If these predictions do not hold valid during next stages of the Project design, or during the monitoring program, a water treatment plant can be added to the system.

After mining is complete, all diversion channels will be decommissioned. Reclamation of the CCR piles will be implemented in such a way that surface runoff from reclaimed piles will report to M19A Creek. Following the removal of all above-ground buildings and structures, all gravel surfaces (e.g., the roads), will be ripped to increase shallow water infiltration and reduce the potential for surface erosion and instability.

Process Water Supply System

The coal preparation plant requires 3,194 m^3/day of water to replace the volume of water that leaves the plant as clean coal and middlings moisture, reject moisture, and evaporation loss. This demand is supplied by raw coal moisture, water collected from the CCR seepage system, and make-up water from the CPP pond (Figure 24.6-2).

The CPP pond will be used as the water source for wash plant make-up water, onsite uses, and unforeseen uses (Figure 24.6-2). Total water uses from the CPP pond are variable during Operation, particularly because make-up water needs for the coal preparation plant are variable. During Operation, the CPP pond may be in either a positive balance status (i.e., excess water from the pond is discharged into the Murray River) or a negative balance status (i.e., water from Murray River is pumped to the CPP pond to be used in the wash plant).

Road Upgrades and Maintenance

Road will be constructed, upgraded, and maintained according to the *Forest Road Engineering Guidebook* (BC MOF 2002) and maintained to ensure low landslide risk and continuous, efficient, controlled water drainage. Road design and construction will include consideration of the following:

- existing slope stability, drainage patterns, and soil types;
- potential impact of proposed structures on streams during and after construction;
- potential for adverse upslope, downslope, and downstream drainage impacts;
- confinement of sensitive operations in anticipation of weather and snowmelt events;
- proper disposal of slash and debris;

- adequate supply and proper installation of erosion and sediment control devices; and
- timely re-vegetation of disturbed slopes.

When roads are no longer required, they will be deactivated according to standards outlined in the *Forest Road Engineering Guidebook* (BC MOF 2002). These standards include, but are not limited to:

- removing all culverts and bridges;
- contouring potentially unstable road shoulders;
- installing water bars (interceptor dikes);
- ripping the road surface; and
- re-vegetating with an approved native seed mix.

Domestic Water Supply System

There will be two domestic water supply systems — one located in the Coal Processing Site, a second at the Decline site. Potable water will be supplied from wells for each site, and will be treated to achieve the necessary quality for human consumption.

- Coal Processing Site: On-site groundwater wells will provide 91 m^3/day of water for domestic use from which 56 m^3/day will be discharged to the environment as domestic sewage.
- Decline Site: Groundwater wells will provide 399 m^3/day of water for domestic use from which 175 m^3/day will be discharged to the environment as domestic sewage.

Domestic discharge rates during Construction are assumed to be similar to Operation discharges.

24.6.6 Monitoring and Reporting

A Water Management Monitoring Program will be implemented with a focus on inspection and maintenance of structures related to water management, and an emphasis on adaptive management to quickly evaluate and respond to changing conditions and requirements. The key objectives of the Water Management Monitoring Program are to:

- assess the performance of water management structures and systems;
- identify and promptly address areas where maintenance, upgrades, modifications, or additional mitigation measures are necessary; and
- measure actual water use on-site (intake, recycling, discharge).

Additional mitigation and management measures relevant to the Water Management Plan are provided in the following environmental monitoring and management plans:

- Section 24.10, Selenium Management Plan;
- Section 24.7, ML/ARD Management Plan; and

- Section 24.5, Erosion and Sediment Control Plan;

The Environmental Manager or other designated person will be responsible for overseeing the water monitoring program, maintaining inspection and maintenance records, ensuring water monitoring reporting, and providing guidance on any changes or needs to the program.

Trained technical staff will be employed at the Project. They will inspect, evaluate, and report on the effectiveness of water management strategies and mitigation measures, with respect to regulatory permits, approvals, and authorizations. Under the supervision of the Environmental Manager or other designated person, the technical staff will have the responsibility of confirming that water management measures are properly implemented, and will have the authority to stop work if conditions are not met or if, in their technical opinion, the continuation of work will lead to conditions not being met.

All site employees and contractors will be encouraged to communicate concerns to their supervisors related to erosion and sedimentation, improper site drainage, debris or snow jams in drainage-ways and at stream crossings, and contaminant releases.

24.6.6.1 Work Planning and Schedule

Visual inspection and assessments of water management structures and systems will be incorporated on an ongoing basis as part of general site operations. On active work sites, these informal visual surveys will be augmented by formal, regularly scheduled inspections to be performed by environmental technicians on a monthly basis or more often as dictated by site conditions. In frozen conditions, formal inspection frequency may be reduced. Inspections of all sites will be conducted within 24 hours of any rainfall event of greater than 50 mm in a 24 hour period.

Water management and erosion and sediment control structures will be regularly inspected and maintained. Maintenance procedures will include prompt attention to potential ditch or culvert blockage or failure, or outside seepage, because such problems could lead to structure failure and sediment transport. Maintenance will also include routine removal of accumulated sediment from ditches and retention structures.

Water management indicators and their monitoring frequency are outlined in Table 24.6-2. Monitoring frequency may be increased as required based on the results of the Selenium Management Plan (Section 24.10) and other relevant monitoring programs. Inspection criteria may be modified on a site-by-site basis or as conditions require.

24.6.6.2 Reporting Requirements

The Project's Environmental Manager will ultimately be responsible for reporting on observations and monitoring results (Table 24.6-3). Reporting of all environmental monitoring data will be conducted in accordance with all permit and approval conditions. Regulatory requirements are anticipated to entail formal annual reports, including disclosure of issues of non-conformance.

Table 24.6-2. Water Management Monitoring Variables, Frequency, and Expected Outcomes

Monitoring Variable	Monitoring Frequency	Outcomes
Performance of water management structures and systems (e.g., diversion ditches, site collection pond)	Monthly[1] or after high rainfall/runoff[2] events	functioning as required
Site and Road drainages[3]	Monthly[1] or after high rainfall/runoff[2] events	positive drainage maintained at all times; no ponding
Supply of water management/erosion prevention and sediment control materials	Monthly	sufficient on-site supply is always available

[1]Frequency may be decreased during winter when ground is frozen
[2]Combined rainfall and snowmelt runoff events (rain-on-snow events) pose the most significant risk to water management structures and systems. Surveys of structures and systems prior to winter break-up are required to assess functionality and potential maintenance requirements (e.g., removal of excess snow/ice from ditches and basins, repair or replacement of blocked/frozen culverts and pipes).
[3]For more information, see the Erosion and Sediment Control Plan (Section 24.5)

Table 24.6-3. Water Management Reporting Requirements, Frequency, and Responsibilities

Report Type	Frequency	Reporting Responsibilities	Submitted to
Site inspection and maintenance logs	After each inspection	Techincal Staff	Environmental Manager
Water management materials inventories	After each inventory	Techincal Staff	Environmental Manager
Annual report	Annually	Environmental Manager	Mine Manager, regulatory authorities
Environmental incident report	As soon as possible after occurrence	Initial notification by attending manager	Environmental Manager

Water management records will be maintained during all Project phases, including a description of surface water flow paths in relation to each major infrastructure footprint, existing surface water management measures and assessment of their performance, undertaken repairs or mitigation activities, and a log of dated photographs. The reports will be kept in the Project office or another designated area.

A log of all site inspections, recording the date and pertinent observations, will be established. At a minimum the form will include the work site, time, date, weather conditions, current site activity, list of water management practices or structures, and a date-stamped photo.

Environmental incidents will be communicated by the individual who detects an incident to their supervisor who will report to the appropriate environmental department individual.

All formal documents and reports will follow version-control procedures to ensure they are approved before use and the internal and external users are accessing the most current information.

24.6.7 Responsible Persons

Environmental Manager

The Environmental Manager will hold overall responsibility for implementation of the Water Management Plan. As such, their responsibilities include:

- communicating performance objectives and measures related to water management to department heads and personnel;
- ensuring that all Project personnel are given an overview of the Water Management Plan as part of site orientation;
- ensuring that Project personnel are kept informed of changes or new procedures and receive retraining as necessary; and
- coordinating and supervising the following activities:
  - routinely inspecting, evaluating, and reporting on the effectiveness of water management strategies and mitigation measures, with respect to regulatory permits, approvals, and authorizations;
  - maintaining an appropriate inventory of water management materials and ensuring that they are available at active work sites; and
  - training and orientation of site personnel with regards to the Water Management Plan.

Mine Manager

The Mine Manager will:

- supervise monitoring and reporting for the mine and other industrial components;
- provide annual reports to the Environmental Manager; and
- communicate environmental performance objectives and best management practices to personnel.

24.7 METAL LEACHING AND ACID ROCK DRAINAGE

24.7.1 Purpose

The Metal Leaching and Acid Rock Drainage (ML/ARD) Management Plan will be implemented in Construction, Operation, Decommissioning and Reclamation, and Post Closure of the proposed Murray River Project to monitor, mitigate, and adaptively manage the potential effects of ML/ARD on surface water quality, groundwater quality, aquatic resources, wetlands, fish and fish habitat, wildlife, and human health. The ML/ARD Management Plan is intended to be used in conjunction with the Erosion and Sediment Control Plan (Section 24.5), the Water Management Plan (Section 24.6), and the Selenium Management Plan (Section 24.10), in addition to the approved Waste Rock Management Plan under the Bulk Sample Permit CX-9-44.

The ML/ARD Management Plan covers the following materials and wastes produced during Construction and Operation:

- waste rock, including material excavated or exposed during construction of shafts, declines, and any surface infrastructure;
- raw and processed coal;
- coarse and fine coal rejects; and
- exposed underground mine faces and workings.

24.7.2 Legislation and Standards

Whenever significant bedrock or unconsolidated material will be excavated or disturbed in BC, an ML/ARD characterization program must be conducted so that, if necessary, prevention, mitigation, and monitoring plans can be implemented.

The guiding BC provincial and federal principles for ML/ARD prediction and management applicable to long-term environmental management of the proposed Murray River Project include:

- the prevention of ML/ARD through prediction, appropriate design, and effective implementation of appropriate mitigation strategies throughout the life of the proposed Project;
- the demonstration that the proposed mitigation strategies meet the environmental objectives for the proposed Project and are compatible with the proposed Project plan and site conditions;
- the evaluation of ML/ARD potential on a site-specific basis; and
- the requirement that water discharge into the receiving environment meets applicable BC provincial and federal objectives.

ML/ARD prediction, prevention, and mitigation in BC are guided by the following documents:

- *Policy for Metal Leaching and Acid Rock Drainage in British Columbia* (BC MEM and BC MELP 1998);
- *Guidelines for Metal Leaching and Acid Rock Drainage at Minesites in British Columbia* (Price and Errington 1998); and
- *Prediction Manual for Drainage Chemistry from Sulphidic Geologic Materials* (Price 2009).

24.7.3 Objectives

The objective of the ML/ARD Management Plan is to minimize adverse effects on regional surface water quality, groundwater quality, and other linked valued components (VCs) due to drainage from geologic materials produced or exposed during any phase of the proposed Project.

The plan will strive to:

- achieve compliance with legislation and BC provincial and federal ML/ARD prediction, prevention, and mitigation policies;
- provide general management recommendations to minimize ML/ARD;
- minimize alienation of land and watercourses; and
- achieve receiving environment objectives.

24.7.4 Actions to Avoid, Control, and Mitigate

24.7.4.1 Waste Rock

Waste rock includes development material produced during the excavation of the Service Decline and Ventilation Shaft for the Bulk Sample program. Additional waste rock will be generated throughout Construction and Operation from excavation of the Production Decline and secondary shafts.

Metal Leaching and Acid Rock Drainage Assessment

Potential waste rock materials were assessed through four years of geochemical baseline studies, incorporating acid-base accounting (ABA) tests, waste rock humidity cells, short term leaching tests by shake flask extraction, and waste rock field leach barrels (Appendix 3-B). The formations from which waste rock will be generated are as follows, in stratigraphic order:

- Overburden (unconsolidated glacial till);
- Hasler Formation;
- Boulder Creek Formation;
- Hulcross Formation;
- Upper Gates Formation; and
- Middle Gates Formation (interburden between coal seams).

Table 24.7-1 defines the criteria for waste rock ARD classification. The sulphide net potential ratio (SNPR) is the ratio of modified Sobek neutralization potential to the sulphide sulphur acid potential. The laboratory analyses required for ARD classification are outlined in the monitoring section below.

Table 24.7-1. Acid Rock Drainage Potential Classification

Sulphide Net Potential Ratio	Paste pH	ARD Potential Classification
≥ 2	> 6	NPAG
< 2	Any	PAG
Any	< 6	PAG

NPAG = Not potentially acid generating
PAG = Potentially acid generating

The results of ML/ARD characterization of overburden and waste rock are summarized in Table 24.7-2, and detailed in Appendix 3-B. Approximately 50% of waste rock samples submitted for ABA testing were classified as PAG. Overburden material and waste rock from the Upper and Middle Gates formations are predominantly NPAG. Hasler and Hulcross formations have the highest potential for ARD, and are operationally classified as PAG. In the Boulder Creek Formation, approximately 30% of samples were classified as PAG, and the formation will also be operationally classified as PAG. The largest mass of PAG material will be from the Hasler Formation, and the largest mass of NPAG waste rock is expected to be from the Gates Formation. Of an estimated 483 kt of waste rock to be produced, approximately 60% (286 kt) is expected to be PAG. Over 90% of PAG material is predicted to be from the Hasler, Boulder Creek, and Hulcross formations. These formations, operationally classified as PAG, will be segregated as PAG material whenever encountered.

Table 24.7-2. Waste Rock Acid Rock Drainage Potential Summary

Formation	Overburden	Hasler	Boulder Creek	Hulcross	Upper Gates	Middle Gates Interburden
Mass proposed waste rock (kt)	31	238	42	43	129	
ARD Potential†						
PAG Proportion	14.3%	86.7%	30.0%	90.3%	18.5%	
NPAG Proportion	85.7%	13.3%	70.0%	9.7%	81.5%	
Estimated PAG Mass (kt)	4.5	206	12.6	38.7	23.9	
Estimated NPAG Mass (kt)	26.8	31.7	29.5	4.1	105	

† ARD potential is based on SNPR, where SNPR ≥ 2.0 = not potentially acid generating (NPAG), SNPR < 2.0 = potentially acid generating (PAG)

Waste rock sampling and geochemical analysis is currently ongoing as part of the geochemical inventory for the permitted Bulk Sample program, and these results will be used to further refine of the operational classifications of waste rock, if appropriate.

Management Considerations

ML/ARD from development and waste rock will be managed through a combination of materials handling, monitoring, and mitigation measures. These management strategies are described in the following sections.

Materials Handling

Waste rock will be generated during the Bulk Sample, from the establishment of the Service Decline and Ventilation Shaft. Additional waste rock will generated to construct the Production Decline, for an estimated total of 141,000 m^3 of waste rock combined between the Bulk Sample and Construction.

Waste rock material generated during the Bulk Sample work will be hauled out from the Service Decline and transported 3.4 km by trucks to the waste rock storage area at the Shaft Site. Material will be segregated as presented in the approved Waste Rock Management Plan.

Waste rock from the Production Decline will be segregated into PAG and NPAG based on operational classifications and geochemical sampling, as detailed in the Monitoring section below. PAG waste rock will be hauled 10 km by truck to the waste rock facility at the Shaft Site. NPAG waste rock will remain at the Coal Processing Site within the footprint for use as fill and cover material in the CCR piles. Some NPAG waste rock may be used for fill material and grading of the Shaft Site. Once the Production Decline is completed, the waste rock facility will be closed and reclaimed.

Approximately 48,500 tonnes of waste rock will be produced each year during the Operation phase from development activities, including working faces collapse and caving gobs. This material will be transported by mainline coal conveyor to the CPP and conveyed onto the CCR piles after processing. Material that is expected to be PAG, based on operational classifications, data collected for the geochemical inventory, and additional geochemical sampling, will be preferentially stored underground where storage capacity is available.

During the first year of Operation, the waste rock pile at the Shaft Site is planned to be reclaimed. The closure cover will include a 30 cm thick till layer and a 30 cm thick clay liner or geomembrane to prevent water infiltration into the pile.

Monitoring

A geochemical inventory of waste rock and overburden material excavated within the mine site will be maintained, using the methods approved in Permit CX-9-44 section 10.a.iv. Geochemical inventory analyses will allow for ongoing ARD characterization and management of waste rock, and segregation of waste rock into PAG and NPAG will be based on the results of these analyses, in conjunction with operational classifications based on existing geochemical studies. ARD characterization methods will be completed at off-site commercial labs and will follow standard practices outlined in ML/ARD guidance documents (Price 2009).

Random composite samples will be collected during surface preparations and shaft and decline development. Material excavated will be segregated and placed on temporary, discrete stockpiles. Composite samples of 1 to 2 kg will be collected from within 5 m segments of the shafts and declines. Samples will be collected at 10 m intervals in the operationally PAG units, and at 5 m intervals in the Gates Formation, and analysed for ABA and SFE. Once analytical results have been received, PAG material will be disposed to the waste rock pile, and NPAG material will be used for construction material.

Material that is operationally classified as PAG (Hasler, Boulder Creek, and Hulcross formations) will be disposed directly to the waste rock facility. Sampling and testing for ABA and SFE will be conducted on random 5-point composite grab samples from waste rock deposited directly in the waste rock facility. Rock units to be sampled will be defined by stratigraphic formation.

Water in the Shaft Site pond will be sampled weekly for TSS and turbidity and monthly for metals and non-metals during Construction. Water quality monitoring of the receiving environment is presented in the Selenium Management Plan (Section 24.10).

Mitigation

ML/ARD management of waste rock includes prevention, control, and reduction mitigation measures that are summarized in Table 24.7-3.

Table 24.7-3. Waste Rock Metal Leaching and Acid Rock Drainage Management and Mitigation Measures

Management Component	Actions	Construction	Operation	Decommissioning and Reclamation	PostClosure
PAG waste rock	Material will be hauled to the waste rock storage area at the Shaft Site.	X	-	-	-
	After completion of the Production Decline, further PAG waste rock will be preferentially stored underground, where possible.	-	X	X	X
	Contact water from the waste rock pile will be diverted to the Shaft Site pond.	X	-	-	-
NPAG waste rock	Material will remain at the Coal Processing Site for use as construction material and in the CCR pile	X	X	-	-
	Some material will be hauled to the waste rock storage area to cover PAG waste	X	-	-	-

PAG = potentially acid generating
NPAG = not potentially acid generating
CCR = coarse coal rejects.

The Project is designed as an underground mine, allowing the Project to generate much smaller volumes of waste rock than would be generated by an open pit project. Limiting the overall amount of waste rock produced serves as a means of limiting ML/ARD from waste rock.

Control measures include the following:

- **Surface Water Management:** Water management is a key component of ML/ARD management for the Project. A sedimentation pond has been constructed at the Shaft Site as part of the Bulk Sample work. During Construction and the early part of Operation, surface runoff from the waste rock pile will report to the Shaft Site pond. The pond outflow will be discharged to M20 Creek in compliance with Permit PE-106666 under the *Environmental Management Act*. The Shaft site pond will be decommissioned after the pile is closed and reclaimed, after which runoff will naturally flow to M20 Creek. Further details are presented in the Water Management Plan (Section 24.5).
- **Waste Segregation:** Waste rock will be segregated based on ML/ARD potential. Material will be identified as PAG or NPAG using the ARD classification criteria in Table 24.7-1.

Material assessed as PAG will be transported to the waste rock storage area. NPAG material will be used as fill and cover material to encapsulate PAG material in the waste rock and CCR piles.

In general, segregation of waste rock will be achieved at an operational scale using the following steps, consistent with the approved Waste Rock Management Plan, as detailed in the Bulk Sample Waste Discharge Permit Application (Rescan 2011):

- *For operationally PAG units (Hasler, Boulder Creek, and Hulcross formation), all waste rock will be treated as PAG.*
  - *For all other stratigraphic formations, ARD potential will be determined by off-site geochemical ABA and SFE testing. Material will be classified as PAG or NPAG based on the ratio of modified Sobek NP to sulphide sulphur AP.*
  - *The results will be used by qualified personnel to determine the spatial distribution of material that can be segregated.*
  - *Daily mine plans, including the spatial distribution of material to be segregated, will be developed and communicated to equipment operators, who will move material from the designated temporary stockpiles to the appropriate permanent pile.*
  - *Disposal locations will be monitored to ensure that wastes are transferred to the appropriate facility.*

As a reduction measure, during the first year of Operation, the waste rock pile will be covered in a 30 cm thick till layer and a 30 cm thick clay liner or geomembrane to prevent water infiltration into the pile.

As the waste rock facility will be reclaimed in the first year of Operation, it will be unaffected by temporary or permanent early closure. Any additional waste rock will be disposed of underground or in the CCR piles.

24.7.4.2 Raw and Processed Coal

Raw, or run-of-mine (ROM), coal is the raw material that will be mined from the coal seams. During mining operations, raw coal will be transported from the mining face through the Production Decline to the surface, where it will be stockpiled prior to processing at the CPP.

After processing, approximately 70% of the material is expected to be recovered as clean coal and middlings. This processed coal will be directed to the rail loadout and transported off the Project site.

Metal Leaching and Acid Rock Drainage Assessment

As a part of geochemical baseline studies, raw and clean coal samples were collected and assessed for ML/ARD potential. Geochemical testing included one raw coal humidity cell and two clean coal humidity cells (Appendix 3-B).

The results of ML/ARD characterization of coal samples are detailed in Appendix 3-B. Table 24.7-4 summarizes the proportions of PAG and NPAG raw coal, clean coal, and coarse and fine rejects by seam, based on geochemical analysis. As discussed in Appendix 3-B, variability between seams was typically greater than variability between different materials (such as raw coal and coarse reject) within the same seam, with the most significant intra-seam variation identified between clean coal and other materials. A comparison of average values of sulphide sulphur and modified NP per seam determined a correlation coefficient of 0.8 between raw coal and CCR.

Table 24.7-4. Coal Acid Rock Drainage Potential Summary

Seam	D	E	F	G/I	J
Mass proposed coal (Mt)	9.0	13.6	42.0	8.2	75.1
ARD Potential†					
PAG Proportion	67.6%	60.0%	35.1%	17.4%	45.7%
NPAG Proportion	32.4%	40.0%	64.9%	82.6%	54.3%
Estimated PAG Mass (kt)	6,080	8,160	14,700	1,430	34,300
Estimated NPAG Mass (kt)	2,920	5,440	27,300	6,770	40,800

† ARD potential is based on SNPR, where SNPR ≥ 2.0 = not potentially acid generating (NPAG), SNPR < 2.0 = potentially acid generating (PAG)

Raw and processed coal samples from D and E seams had a strong potential for acid generation, F and J seam samples had a moderate to low potential for acid generation, and G/I seam raw coal samples had a low potential for acid generation. Raw coal material had a moderate potential for metal leaching, while clean coal samples had a low potential for metal leaching (Appendix 3-B). The minimum estimated lag time to the onset of acidic conditions in a Project humidity cell is 4.9 years. The turnover time for raw coal stockpiles is estimated as a maximum of two weeks, and consequently acid leaching is not expected in raw coal stockpiles.

Management Considerations

Prediction, prevention, and management of ML/ARD from raw and processed coal will be managed through a combination of materials handling, monitoring, and mitigation measures; these management strategies are described in the following sections.

Materials Handling

Two raw coal piles are located at the west side of the Coal Processing Site in advance of coal handling and preparation. They will provide a maximum of two weeks turnover storage capacity. Raw coal mined during Construction, prior to commissioning of the processing plant will be stored at these stockpiles.

Two clean coal stockpiles are located at the east side of the Coal Processing Site, close to the rail loadout station for coal removal from the Project site. A rectangular middling coal pile will have two weeks turnover storage capacity, and a rectangular flotation clean coal pile will also have two weeks turnover capacity, and will be used during summer months to allow the flotation clean coal to be dried naturally (by evaporation).

The piles will be on a lined pad, and all water will be collected at the CPP pond and reclaimed as process water or discharged to Murray River.

Monitoring

Samples will be collected from the raw coal stockpiles and analysed for ABA and SFE. A geochemical inventory of raw coal material will be maintained. As discussed above, raw coal and CCR samples were well-correlated, and therefore geochemical analyses of material in raw coal stockpiles will guide placement of material in the CCR piles. ARD characterization methods will follow standard practices outlined in ML/ARD guidance documents (Price 2009). Raw coal to be sampled will be defined by coal seam.

Contact water from the stockpiles entering the CPP pond will be sampled frequently for water quality.

Mitigation

ML/ARD management of raw and processed coal material includes control and reduction mitigation measures that are summarized in Table 24.7-5.

Table 24.7-5. Waste Rock Metal Leaching and Acid Rock Drainage Management and Mitigation Measures

Management Component	Actions	Construction	Operation	Decommissioning and Reclamation	Post-closure
Raw Coal	Raw coal will be stockpiled on the lined pad at the Coal Processing Site.	X	X	-	-
	Contact water will be collected and directed to the CPP pond.	X	X	-	-
Clean Coal and Middling Stockpiles	Processed material will be stockpiled on the lined pad at the Coal Processing Site.	-	X	-	-
	Clean coal and middlings will leave the Project site by the rail loadout.	-	X	-	-
	Contact water from the stockpiles will be collected and directed to the CPP pond.	-	X	-	-

As a control measure, a water collection pond will be constructed at the Coal Processing Site. Runoff from the raw and clean coal stockpiles will be directed to the CPP pond. Diversion ditches around the Coal Processing Site area will divert non-contact water to M19A Creek.

Reduction measures include the presence of a lined pad underneath the raw and processed coal stockpiles to allow collection of all contact water. In addition, the mass of raw and processed coal in stockpiles will be reduced by the continuous processing of raw coal and removal of clean coal from the Project site by railway.

In the case of early temporary or permanent closure, raw and processed coal material stockpiled at the Coal Processing Site will be removed from the Project site. At Decomissioing and Reclamation, raw coal will have been processed and clean coal and middlings will have been removed by rail from the site. Therefore there will be no raw or processed coal to manage once the Operation phase is complete.

24.7.4.3 Coarse and Fine Coal Rejects

At the CPP, fine and coarse rejects will be generated. These rejects will be co-mingled and directed to a Coarse Coal Reject (CCR) pile. CCR North will be operated from Year 1 to Year 14 and CCR South will be operated from Year 15 to Year 25.

Metal Leaching and Acid Rock Drainage Assessment

Geochemical characterization studies of coarse and fine rejects incorporated ABA testing of CCR and 19 fine reject samples (Appendix 3-B). CCR samples included processed coarse reject material in addition to drill core samples of roof, floor, and parting material. Fifteen CCR and fine reject humidity cells were also constructed, incorporating material from all seams targeted for mining (D, E, F, G/I, and J). The criteria for reject ARD classification are the same as for waste rock, as presented in Table 24.7-1. The results of ML/ARD characterization of CCR samples are detailed in Appendix 3-B, and are summarized for raw coal, clean coal, and coarse and fine reject material in Table 24.7-4. D and E seams have the highest potential for ARD, with at least 60% of samples from both coal seams classified as PAG. F and J seams have a moderate potential for ARD, with between 35 and 46% of samples classified as PAG. G/I seam has the lowest potential for ARD. Therefore, as the bulk of the seams with the highest potential for ARD is scheduled to be mined in the first five years of mining (Section 3.8), the CCR piles will contain the highest proportion of PAG material in the early years of mining.

Based on geochemical characterization of coarse and fine coal reject material, the interior of the CCR piles will be reducing. In a low permeability environment, with high organic carbon and water content, the availability of oxygen for oxidation reactions will be limited, as will the mobility of selenium. Therefore, the expected conditions of the CCR piles will assist in limiting selenium leaching and the oxidation of sulphides for ARD production.

Median NP and sulphide sulphur values for each seam were used to calculate annual SNPR values in the two CCR piles. The progressive change in total SNPR of each CCR pile is summarized in Table 24.7-6, indicating that the CCR North pile evolves from net-PAG in the first six years of mining to net-NPAG as mining progresses from the more PAG D and E seams to predominantly NPAG coal seams. CCR South is net-NPAG throughout its operation. Due to the net neutralizing conditions in both CCR piles, acid-generating conditions are not expected to develop. Current lag time estimates for D and E seam material are 4.9 to 6.7 years under laboratory conditions.

Geochemical characterization of reject material will continue during the Bulk Sample collection, and conclusions on ML/ARD potential will be refined as necessary based on the results of ongoing testing. As new humidity cells reach steady state, predictions of metal release rates and lag times to the onset of acidic leaching will also be refined.

Table 24.7.6. Annual Change in Sulphide Net Potential Ratio of the CCR Piles

CCR North Pile		CCR South Pile	
Mine Year	Annual Total SNPR	Mine Year	Annual Total SNPR
1	1.7	15	4.7
2	1.7	16	3.8
3	1.8	17	3.5
4	2.0	18	3.4
5	2.0	19	3.3
6	2.0	20	3.3
7	2.1	21	3.2
8	2.2	22	3.2
9	2.3	23	3.2
10	2.3	24	3.2
11	2.4	25	3.1
12	2.4		
13	2.6		
14	2.8		

Management Considerations

Materials Handling

Material will be transported to the CCR area on an extensible conveyor, and then reworked by dozers in 8 to 10 m lifts. Two piles within the CCR site (CCR North and CCR South) are currently planned to accommodate all the coal rejects during 25 years of Operation. CCR North will serve for the first 14 years during Operation to accommodate approximately 9.92 Mm^3 coal rejects, and CCR South is planned to serve for the next 11 years for about 7.06 Mm^3 coal rejects. Annual rejects output will be approximately 0.7 Mm^3.

PAG and NPAG rejects will be co-deposited in the CCR piles with the objective of creating a composite in which the acid produced by PAG materials is neutralized by excess NP and drainage alkalinity from NPAG materials, resulting in a reduction in metal solubility.

The CCR North and CCR South piles will be covered and re-vegetated at the end of years 15 and 25, respectively. At decommissioning of the piles, the surfaces will be graded to a smooth surface, and covered with two layers of material. The first layer will consist of 50 cm of NPAG fine reject to serve as a low permeability liner (Section 3.9.4.1 of the Project Description). Approximately 175,750 m^3 of fine reject will be required for the CCR North pile cover and 174,350 m^3 will be required for CCR South cover. It is estimated that in Year 14, the last year that reject will be placed on CCR North, approximately 211,497 m^3 of fine reject will be generated (Appendix 3-E). Of this, approximately 175,750 m^3 will be separated and stockpiled in a corner of the pile while the coarse coal reject and the remaining fines are placed on the pile. The stockpiled fines will then be re-worked to create the cover. Similarly, in Year 25, approximately 205,142 m^3 of fine reject will be generated of which 174,350 m^3 will be stockpiled as cover material.

Monitoring

Samples will be collected from the CCR piles and analysed for ABA and SFE. A geochemical inventory of coarse and fine reject material processed at the CPP and stored in the CCR piles will be maintained, and will allow for ongoing ARD characterization of rejects. ARD characterization methods will follow standard practices outlined in ML/ARD guidance documents (Price 2009). Coarse and fine rejects to be sampled will be defined by coal seam.

In addition, a minimum of one field leach barrel will be constructed from co-mingled CCR and fine reject material representative of material placed in the first five years of mining. Leachate from the barrel will be sampled on a monthly basis during open water months to monitor the potential water quality of seepage from the CCR piles.

Seepage from the CCR piles and in the CPP pond will be sampled monthly for water quality parameters. During Post-Closure, the water in the seepage collection ponds around the CCR piles will be checked quarterly for the first five years to assess the water quality. The sampling frequency will be evaluated after five years. Water quality trends will be used to identify any additional mitigation or adaptive management that may be required.

Mitigation

Control and reduction mitigation measures for ML/ARD management of coarse and fine rejects are summarized in Table 24.7-7.

Table 24.7-7. Coarse and Fine Coal Rejects Metal Leaching and Acid Rock Drainage Management and Mitigation Measures

Management Component	Actions	Construction	Operation	Decommissioning and Reclamation	Post-closure
Coarse and fine rejects	Blended rejects will be stored in two CCR piles. CCR North will contain the most PAG material, which will be predominantly stored at the toe of the pile and covered by predominantly NPAG seams.		X	-	-
	Piles will be covered and re-vegetated.		X	X	X
CCR pile contact water	Water will be captured in a seepage collection system and used in the CPP.		X	-	-
	Water infiltration to groundwater from the CCR piles will be limited by liners		X	X	X
	Excess water will be collected in the CPP pond before discharge to Murray River.		X	-	-
	At Closure, surface runoff will be rerouted to M19A Creek		-	X	X

NPAG = not potentially acid generating.

The following control measures will be applied to manage the CCR piles:

- **Surface Water Management:** At the Coal Processing Site, all contact water including runoff from the CCR piles will be collected in the CPP pond before being discharged to Murray River. Diversion ditches around the Coal Processing Site will divert non-contact water to the M19A Creek.
- **CCR Seepage Collection:** The CCR piles will be constructed on geomembrane liner (2.0 mm LLDPE) to prevent infiltration to groundwater. Water that infiltrates the CCR North and South piles, during Operation, will be captured in a seepage collection system (described in Appendix 3-C). The seepage collection system will drain contact water into lined collection sumps. Contact water in these sumps will be preferentially reclaimed and pumped to the CPP, and excess water, beyond the CPP water demand, will be pumped into the CPP pond. At Decommissioning and Reclamation (i.e. Year 25), surface runoff is rerouted to M19A Creek, and infiltrated water will be recharged to groundwater through exfiltration galleries.
- **Blending of PAG and NPAG Material:** The majority of PAG coal (seam D) will be mined in the first five years of mining; this material will be placed at the toe of the CCR North pile. This placement is a contingency to limit the infiltration of acidic leachate through NPAG materials if acid generating conditions developed (Section 3.8.4 in the Project Description). NPAG waste rock will be blended with PAG material in the CCR piles. Ongoing sampling of coarse and fine reject material for the geochemical inventory will allow for adaptive management of the CCR piles in the event of difference between predicted and encountered ML/ARD potential.
- **Cover**: Approximately 40 cm of topsoil will be spread over the fine reject cover, and re-vegetated. The fine reject and topsoil cover will have sufficient water storage capacity for both annual precipitation and snowmelt, and will therefore effectively limit infiltration to the CCR piles. It is assumed that only 2% of annual effective precipitation will infiltrate the topsoil and fine reject cover, and 98% will run off the surface. After the end of mining, surface runoff from the reclaimed CCR piles will be rerouted to M19A Creek. Infiltrated water will be recharged to groundwater through exfiltration galleries.

If there is a requirement for temporary closure, the CCR piles will continue to be managed for contact water and seepage. For premature closure, the CCR piles will be closed according to the plan for Decommissioning and Reclamation. The plan for decommissioning of the CCR piles requires sufficient fine reject material to be set aside near the end of construction of each pile to serve as a low permeability layer on top of the piles. Therefore, sufficient lead time will be required to produce the required volume of fine reject to cover the pile in its existing configuration. If sufficient fine material cannot be produce, additional options for a low permeability liner, including potentially a geomembrane, will be considered.

24.7.4.4 Underground Mine

The underground mine will contain infrastructure and facilities such as the Production Decline and the Underground Operations Hub. Waste rock will be excavated and coal seams will be mined using

longwall mining. Mine development activities are described in detail in Section 3.7.3 (Construction) and 3.8.2 (Operation).

Metal Leaching and Acid Rock Drainage Assessment

The ML/ARD potential of waste rock and raw coal excavated or mined from the underground was characterized as a part of the geochemical baseline program. The results of this characterization are discussed in Appendix 3-B and in the relevant sections of this management plan.

The materials present in the underground mine include waste rock produced during Operation, from working faces collapse and caving gobs, as well as excavation of secondary shafts. Some of this waste rock will be stored underground. Additional material of interest includes the mining faces, where raw coal and partings will be exposed. Partings, including roof and floor material, were assessed as part of CCR analyses.

Management Considerations

Materials Handling

Waste rock produced during Operation will be stored underground, and will be flooded during Decommissioning and Reclamation. Raw coal will be mined from coal seams, and transported by conveyor through the Production Decline to the CPP at the surface, and will not remain in the underground.

Groundwater inflows to the underground mine will be circulated for use underground, in a sprinkler system. Excess water will be pumped to the CPP pond for storage.

Monitoring

The CPP pond will be sampled monthly for water quality parameters.

Mitigation

ML/ARD management of the underground mine includes mitigation measures that are summarized in Table 24.7-8.

The following control and reduction measures will be applied:

- **Underground Water Management:** Groundwater inflows to the underground mine will be managed with a central water sump and a main water pump station constructed in the Underground Operation Hub. Water from the mine sump will be circulated back within the mine through a sprinkler system and for general fire and dust suppression purposes. Excess water will be pumped to the surface via pipes to be stored in the CPP Pond.
- **Flooding**: During Decommissioning and Reclamation and Post-Closure, the underground workings will be allowed to flood. Flooding will reduce the surface area of gob and underground workings exposed to oxygen and will decrease rates of sulphide oxidation and metal leaching. Some areas may be flooded during Operation depending on mine advancement.

Table 24.7-8. Underground Mine Metal Leaching and Acid Rock Drainage Management and Mitigation Measures

Management Component	Actions	Construction	Operation	Decommissioning and Reclamation	Post-closure
Underground workings	Groundwater inflows to the underground mine will be collected in a central water sump.	X	X	-	-
	Gob produced during Operation will remain underground	-	X	-	-
	Underground workings will be allowed to flood at closure.	-	-	X	X
Waste Rock produced during Operation	Waste rock produced after the closure of the pile at the Shaft site that is not stored in the CCR pile will be stored underground.	-	X	X	X

24.7.5 Reporting

The Project's Environmental Manager will ultimately be responsible for reporting on the ML/ARD materials characterization, sampling, and monitoring inventory. Reports will be submitted to the appropriate regulatory agencies as required. The primary regulatory agencies for ML/ARD are the BC MEM enforcing the *Mines Act* (1996h) and the BC Ministry of Environment enforcing the *Environmental Management Act* (2003).

24.7.6 Responsible Persons

Environmental Manager

The Environmental Manager is responsible for the day-to-day management of Project environmental programs and permits.

The Environmental Manager will:

- act as a resource to the construction teams by providing guidance relating to permit conditions, commitments, regulations, acts, and interpretation of legislation;
- be responsible for obtaining the required environmental permits for construction and operation;
- oversee timely delivery of project permits applications for submission to regulators;
- arrange for and oversee environmental sampling in relation to potential contamination from ML/ARD;
- serve as HD Mining primary liaison with regulatory agencies with respect to compliance with permits and approvals, including non-compliance incidents;
- work with Project management to identify and resolve environmental issues in a manner that fulfills HD Mining's expectations of environmental performance; and

- ensure that applicable regulatory requirements and commitments are properly identified, tracked, and documented.
- direct and supervise ML/ARD management inspections, which includes the following activities;
  - routinely inspecting, evaluating, and reporting on the effectiveness of ML/ARD management strategies and mitigation measures, with respect to regulatory permits, approvals, and authorizations;
  - ensuring that mining waste is handled correctly as per the segregation and management plans described above;
  - maintaining an appropriate inventory of ML/ARD management materials and ensure that they are available at active work sites; and
  - training and orientation of site personnel with regards to the ML/ARD Management Plan.

24.8 FLOCCULENT

24.8.1 Purpose

The Flocculant Management Plan for the Project describes the guidelines that HD Mining will adhere to in order to optimize flocculant usage during the life of the Project. The plan is designed to be dynamic, and will be updated with additional criteria and mitigation measures should changing requirements or project scenarios warrant plan modification. This plan builds upon the approved Effluent Management Plan prepared for the Bulk Sample under Permit PE-106666.

The purpose of the Flocculant Management Plan is to:

- protect the health and safety of employees and the public; and
- prevent the release of deleterious substances that may harm intrinsic ecosystem functioning, including components of the biophysical environment such as water quality, air quality, and vegetation communities, as well as the fish and wildlife that depend on them.

Effluent discharges will occur from the Decline and Shaft ponds primarily during Construction and from the CPP pond during Operation. Effluent discharges will be required to meet permit limits under the *Environmental Management Act*, which are expected to include a limit for total suspended solids (TSS) that is protective of water quality and freshwater aquatic life. Given the fine-grained nature of coal and overburden materials, it is expected that use of flocculant will be required to remove suspended solids and achieve permit limits.

The TSS sources will largely be coal-based (underground inflow, CCR seepage, stockpile runoff). The TSS treatment facility will include flocculent dosing and a thickener. For the Bulk Sample, water is currently being treated with a flocculent called Hydrex; testing has also been successful with Magnafloc. However, flocculant use to date has targeted TSS associated with decline development in sedimentary rock formations. As the Bulk Sample progresses into the coal seams, further testing will confirm the most appropriate flocculent product and optimal dose rate.

24.8.2 Legislation and Standards

A number of legislative requirements are applicable to flocculant management in British Columbia. A short list of these and their major applicable components are provided in Table 24.8-1.

Table 24.8-1. Regulatory Requirements — Selected Examples

Legislation and Regulations	Applicable Information
BC *Environmental Management Act* (2003)	Prohibits the introduction of waste into the environment in a way that will cause pollution, except in accordance with a regulation, permit, approval or code of practice issued under the Act
Canada *Fisheries Act* (1985c)	Prohibits the release of a deleterious substance to fish habitat
BC *Water Act* (1996k)	Requires protection of habitat and water quality
BC *Mines Act* (1996h)	Provides guidance on the operation and reclamation of existing and abandoned mines
Canadian Environmental Protection Act (1999)	Provides guidance on the preparation of pollution prevention plans

24.8.3 Objectives

The objectives of the Flocculant Management Plan are to:

- Implement best management practices related to water management;
- Achieve compliance with receiving environment targets;
- Identify procedures for flocculant addition; and
- Prevent and monitor discharge toxicity.

The objective for the Flocculant Management Plan is:

- no significant environmental effect related to the transportation, storage, and use of flocculant.

24.8.4 Actions to Avoid, Control, and Mitigate

The following actions will avoid, control, and mitigate potential effects to the receiving environment related to flocculant use:

- flocculant dosage will be optimized to manage TSS concentrations and minimize effluent toxicity; and
- during Decommissioning and Reclamation, all remaining flocculant will be taken off site and sold or taken to a designated facility for disposal.

24.8.5 Monitoring and Reporting

24.8.5.1 Monitoring

Monitoring during flocculant addition and effluent discharge will occur as described in Table 24.8-2.

Table 24.8-2. Monitoring During Flocculant Addition

Sample Location	Measurement	Frequency
Inlet to Pond	Field turbidity	Daily
	Lab TSS and turbidity	Weekly
Pond	Field turbidity	Daily
	Lab TSS and turbidity	Weekly
Discharge Pipe	Field turbidity	Daily
	Lab TSS and turbidity	Weekly
	Toxicity	Monthly

TSS and turbidity will be measured at the inlet of the pond, in the pond (after flocculant addition), and in the discharge pipe. At start-up, sampling will occur daily for 5 days. The dosing rates will be optimized until the TSS is between 20 and 40 mg/L. If TSS at the discharge is greater than 40 mg/L, then the dosage will be increased and the TSS re-measured. If observed TSS is less than 20 mg/L, then the dosage will be decreased and the TSS re-measured. The testing at the three locations will be compared and completed until the results for two consecutive samples are within the target range of 20 to 40 mg/L. Sampling will then resume as per Table 24.8-2.

Flocculant addition will be discontinued once the reagent dosing has been steadily decreased until it is not required at all while the TSS concentration in the pond is less than 40 mg/L.

Following a period when no reagents were added to the effluent while the TSS criterion was met, if a TSS reading is over 40 mg/L, the dosing optimization process will be repeated. During periods when flocculant is added to the water, TSS and turbidity will be monitored weekly at the discharge point. The field turbidity will be measured every day at the pond inlet and discharge point. As data becomes available, a TSS and turbidity curve will be generated which will allow operations to promptly adjust the dosing rates based on turbidity readings.

To minimize potential for effluent toxicity, flocculant will only be used when the concentration of total suspended solids is higher than 40 mg/L. When flocculant is in use, toxicity sampling will be conducted 24 hours after initiating use, and then monthly during use. The samples taken will be submitted for a rainbow trout 96 hour LC_{50} test.

If 50% trout survival is not achieved, a second test will be performed on the treated discharge water. The failed test will be recorded and submitted to the Director by e-mail within 24 hours of receiving the test results. In the event that 50% survival is still not achieved in the second test, flocculant dosage or type will be altered. Re-testing will be completed until the discharge meets the toxicity requirements. The volume buffer in each pond may be used, while available, to limit effluent discharge during dosing corrections.

24.8.5.2 Reporting

The Project's Environmental Manager will ultimately be responsible for reporting on the flocculant management and effluent quality. Reports will be submitted to the appropriate regulatory agencies as

required. The primary regulatory agency for effluent is the BC Ministry of Environment enforcing the *Environmental Management Act* (2003).

24.8.6 Responsible Person

Environmental Manager

The Environmental Manager holds overall responsibility for the oversight of environmental monitoring programs. As such, their responsibilities with regard to flocculant management include:

- communicating performance objectives and measures related to flocculant management to department heads and personnel;
- ensuring that all Project personnel are given an overview of the Flocculant Management Plan as part of site orientation;
- arranging for any necessary environmental sampling in relation to flocculant use;
- ensuring that Project personnel are kept informed of changes or new procedures and receive retraining as necessary; and
- directing the following activities:
  - routinely inspecting, evaluating, and reporting on the effectiveness of flocculant management strategies and mitigation measures, with respect to regulatory permits, approvals, and authorizations;
  - maintaining inventory logs; and
  - training and orientation of site personnel with regards to the Flocculant Management Plan.

Mine Manager

The Mine Manager will:

- supervise monitoring and reporting for the mine and other industrial components;
- provide annual reports to the Environmental Manager; and
- communicate environmental performance objectives and best management practices to department heads and personnel.

24.9 EXPLOSIVES AND NITROGEN

24.9.1 Purpose

Most of the mining, including the main tunnel systems, will be within the coal seams, where use of explosives is not necessary. Small amounts of explosives may be required when constructing the Production Decline, when excavating rock tunnels, and when mining between coal seams. Explosives will not be stored on site. When blasting is required, a local blasting company will be contracted to provide the necessary explosives and to conduct the blasting.

The purpose of the Explosives and Nitrogen Management Plan is to:

- protect the health and safety of employees and the public; and
- prevent the release of deleterious substances that may harm intrinsic ecosystem functioning, including components of the biophysical environment such as water quality, air quality, and vegetation communities, as well as the fish and wildlife that depend on them.

24.9.2 Legislation and Standards

Health, Safety and Reclamation Code for Mines in British Columbia (BC MEMPR 2008) outlines specific requirements for use of explosives. In particular, use of explosives in an underground coal mine is addressed in Part 8.11.

24.9.3 Objectives

The objectives of the Explosives and Nitrogen Management Plan are to:

- guide safe and secure transportation, storage, and use of explosives required for the Project; and
- minimize adverse environmental effects from the transportation, storage, and use of said explosives.

A successful Explosives and Management Plan will result in:

- no injury to employees or the public;
- no unintended property damage; and
- no significant environmental effect related to the transportation, storage, and use of explosives.

24.9.4 Actions to Avoid, Control, and Mitigate

HD Mining will contract a local blasting company to supply and perform all blasting required for the Project. Through the contracting process, HD Mining will:

- review the contractor's performance history;
- ensure the contractor is providing qualified and experienced individuals to complete the work;
- require the development of a Project-specific explosives management plan that complies with appropriate legislation and regulation in relation to the transportation, storage, and use of explosives; and
- review the contractor's explosives management plan to ensure it is coordinated and consistent with the larger Health, Safety and Environmental Management System for the Project.

24.9.5 Monitoring and Reporting

24.9.5.1 Monitoring

Manifests for delivered explosives will be maintained by the contractor, and inspected by HD Mining, to ensure that all explosives and related materials are accounted for. Inventories and logbooks will be maintained and any deficiencies reported to the Mine Manager or appointed designates immediately.

24.9.5.2 Reporting

Evidence of missing explosives will be reported to the appropriate regulatory authorities immediately.

All safety incidents with explosives will be reported immediately to the Mine Manager and subsequently to the Chief Inspector of Mines as required by the Code.

24.9.6 Responsible Persons

Mine Manager

The Mine Manager is responsible for the overall implementation of the Explosives Management Plan. Their responsibilities include:

- Ensuring all personnel responsible for explosives transport, storage, and use are appropriately qualified;
- ensuring that the Contractor's Explosives Management Plan is coordinated and consistent with the larger Health, Safety and Environmental Management System for the Project;
- documenting and reporting all safety incidents relating to explosives to the Chief Inspector of Mines;
- reviewing and approving blasting plans with appropriate personnel;
- oversight of the management of worker health and safety during explosives use;
- review and approve blasting plans and safety procedures related to blasting with safety personnel; and
- coordinate the investigation of health and safety complaints related to explosives use.

Environmental Manager

The Environmental Manager will:

- liaise with the Mine Manager regarding environmental aspects of blasting plans;
- arrange for any necessary environmental sampling in relation to potential contamination or noise from explosives use.

24.10 SELENIUM

Selenium (Se) is a naturally occurring element, and background concentrations in the environment may be highly variable across sites. Determinants of natural, background concentrations are mainly geology and geochemistry: the presence of Se-bearing minerals and the physico-chemical processes that mobilize Se, such as weathering, erosion, leaching of subsurface strata, and transport by surface runoff and groundwater. Large-scale terrain disturbance, such as construction and operation of a mine, may expose Se-bearing rock to air and water, and increase the potential for acid rock drainage or metal leaching.

Selenium became an emerging element of concern in the British Columbia (BC) mining sector in the 1990s when routine monitoring in the Elk River, in the southeast coal block, detected high and increasing concentrations of Se (Heinz et al. 1990; Lemly 1996; Hoffman and Heinz 1998; McDonald and Strosher 1998; Hamilton 2004). There, a government-industry task force guided investigation, by five coal mines, to determine the scale of the problem and the development of mitigation measures (Canton et al. 2008b). Investigators found that Se was causing developmental deformities in fish (Kennedy et al. 2000; Rudolph, Andreller, and Kennedy 2008) and a modest depression of productivity in some birds (Harding and Paton 2003; SciWrite Environmental Services Ltd. 2004, 2005). Government and industry attention quickly turned to the northeast coal block, where at least five existing coal mines, and all new coal mines, have investigated Se and developed Selenium Management Plans (SeMPs; Stantec 2011).

There are four oxidation states for Se including: Se(VI) [selenate], Se(IV) [selenite], Se(0) [elemental Se], and Se(-II) [selenide]. The oxyanions of selenate and selenite are the most common forms of Se in the aquatic environment when oxygen is present, with elemental Se and selenides predominating in anaerobic environments. One of the primary transformation processes is methylation into organic forms of Se, which is more active in lentic (still water) systems than lotic (flowing water) systems because of longer residence time of water, greater organic content of sediments, and more active and abundant bacterial communities in these environments (Maier, Ogle, and Knight 1988; Minnow Environmental Inc. 2004; Brix et al. 2005; Hillwalker, Jepson, and Anderson 2006; Orr, Guigure, and Russel 2006; Lorax Environmental Services Ltd. 2009; Martin et al. 2009; Martin et al. 2011).

Speciation and chemical form are important factors that influence the bioavailability and uptake of Se by biota. Organoselenium compounds are the most bioavailable; selenite is more bioavailable than selenate, and elemental Se is not readily taken up by aquatic organisms due to its stability in the environment. Most Se uptake into fish and birds is via the detrital food chain. Uptake is highly variable and site specific, since it is dependent on the transformation of Se within sediment and at the sediment-detritus/water interface (Adams et al. 2003; Brix et al. 2005; Toll et al. 2005).

Although Se is an essential element for vertebrates and is required for good health, it becomes toxic at high doses. There is considerable variability in the dose-response behaviour of different organisms due to species-specific sensitivity and a range of confounding physical, chemical, and biological environmental factors. Such factors include Se speciation, exposure profiles that change over time (e.g., annually or seasonally), habitat use, variations in diet or metabolism, changes in water composition, the bioavailability of Se, elevated concentrations of other contaminants of

concern, and fish or bird movement in and out of sites of contamination (Ohlendorf 2002; Adams et al. 2003; Ohlendorf 2003; DeForest et al. 2012).

Primary producers (e.g., periphyton, phytoplankton, and macrophytes) may take up Se directly from water. However, research suggests that the major pathway of Se bioaccumulation in organisms at higher trophic levels is via uptake through diet, not through the water column (Orr, Guigure, and Russel 2006; Chapman et al. 2009a; Orr et al. 2012). Thus, the food chain is one of the primary ways in which Se moves through both aquatic and terrestrial environments. Egg-laying vertebrates, such as fish and aquatic-dependent birds, are typically the most sensitive receptors; high levels of Se can cause mortality or deformities in developing embryos, reduced survival of fry, reduced hatchability of fertile eggs, and reduced fledging success of nestlings (Janz et al. 2009; Ohlendorf et al. 2011; Ohlendorf and Heinz 2011; DeForest et al. 2012).

24.10.1 Objectives

This document is the SeMP for the proposed Murray River Coal Project. As required by the federal Environmental Impact Statement (EIS) Guidelines, the Murray River Coal Project SeMP includes the following information:

- baseline description of Se concentrations within the local, regional, and downstream receiving environments;
- geochemical characterization of Se leaching potential from waste rock, coal stockpiles, coarse coal rejects, and tailings;
- predictions of Se in discharge water quality from each mine component, impacts on downstream water quality, and the potential for Se bioaccumulation in the aquatic ecosystem downstream of the Project; and
- monitoring and management practices and procedures that will be applied during all phases of the Project to prevent and manage potential environmental effects of Se releases and cumulative Se loadings.

The objective of the SeMP is to identify, characterize, and address potential environmental risks that Se may pose to the aquatic receiving environment of the Project. The framework of the SeMP is designed to meet best practices for environmental and technical performance objectives for the Project, in addition to ensuring statutory requirements are considered and addressed. The framework of the SeMP is supported by four aspects: prediction, prevention, mitigation, and monitoring, that together form an effective strategy to achieve environmental protection. Potential risks due to Se will be adaptively managed based on the results of the proposed monitoring plan to ensure that risks are mitigated before adverse effects occur in the aquatic receiving environment.

24.10.2 Legislation and Standards

Both statutory and policy-based approaches are used to regulate mining activities in BC, and in Canada. Statutory requirements (i.e., legislation, regulation, and codes of practice) are legal requirements that if breached, may result in enforcement action. Policies, guidelines, and best

practises are voluntary-based mechanisms that guide industry performance and encourage continuous improvement; however, there is no rule of law associated with these approaches.

Currently, the *Metal Mining Effluent Regulations* (MMER; SOR/2002-222), as prescribed under the *Fisheries Act* (1985c), do not apply to coal mines, although it is expected that this will change in the future with proposed amendments that are expected to make coal mines subject to the MMER. The MMER identifies maximum allowable end-of-pipe concentrations for eight parameters. Selenium, which is not currently regulated under the MMER for end-of-pipe discharge limits, has been proposed for inclusion in an upcoming update; however, discharge limits have not been publicly discussed.

Provincially, effluent discharges are regulated under the *Environmental Management Act* (EMA; 2003) and the associated Waste Discharge Regulation (BC Reg. 320/2004), which were introduced in 2004 and are intended to protect environmental and human health from changes in water quality that may result from effluent discharges. Mining effluent discharge permits issued by the BC Ministry of Environment Environmental Protection Division (BC MOE-EPD) identify Pollution Control Objectives (PCO) for end-of-pipe discharges, similar to the MMER.

24.10.2.1 Policy and Guidelines

The *Guidelines for Metal Leaching and Acid Rock Drainage at Minesites in British Columbia* (Price and Errington 1998) provide policy direction and a set of guiding principles to be considered during the environmental assessment planning phase of a mine. Three key objectives of this policy are to minimize environmental harm, ensure the long-term productive use of land, and protect the provincial government from liabilities associated with mining operations and reclamation requirements.

Other relevant guidelines include receiving environment guidelines developed by the province of BC (Ministry of Environment), and federally by the Canadian Council of Ministers of the Environment (CCME 2013a) or Health Canada (2012). These guidelines are intended to provide guidance on concentrations of parameters in the receiving environment that are considered safe and would be expected to protect the various uses of water (e.g., aquatic life, wildlife, drinking water, recreation, and agriculture). New provincial Se guidelines were approved in May 2014 (Beatty and Russo 2014) and are summarized in Table 24.10-1.

24.10.3 Baseline Studies

Baseline studies were conducted for the Project between 2010 and 2014. The purpose of the baseline studies was to characterize the existing environment, including metal concentrations in various media, as well as habitat and species distributions for aquatic resources, fish, and wildlife throughout the Project study areas. Selenium concentrations have been measured in multiple environmental media including water, sediment, and tissue (periphyton, benthic invertebrates, and fish). Baseline data is briefly summarized in the following sections, with reference to additional information in the Application/EIS.

24.10.3.1 Water

Baseline water quality data is summarized in Chapter 8 of the Application/EIS and associated appendices (Appendices 8-B, 8-C, and 8-D). A map of sampling site locations can be found in the Application/EIS, Chapter 8, Figure 8.5-2.

Table 24.10-1. Receiving Environment Selenium Guidelines

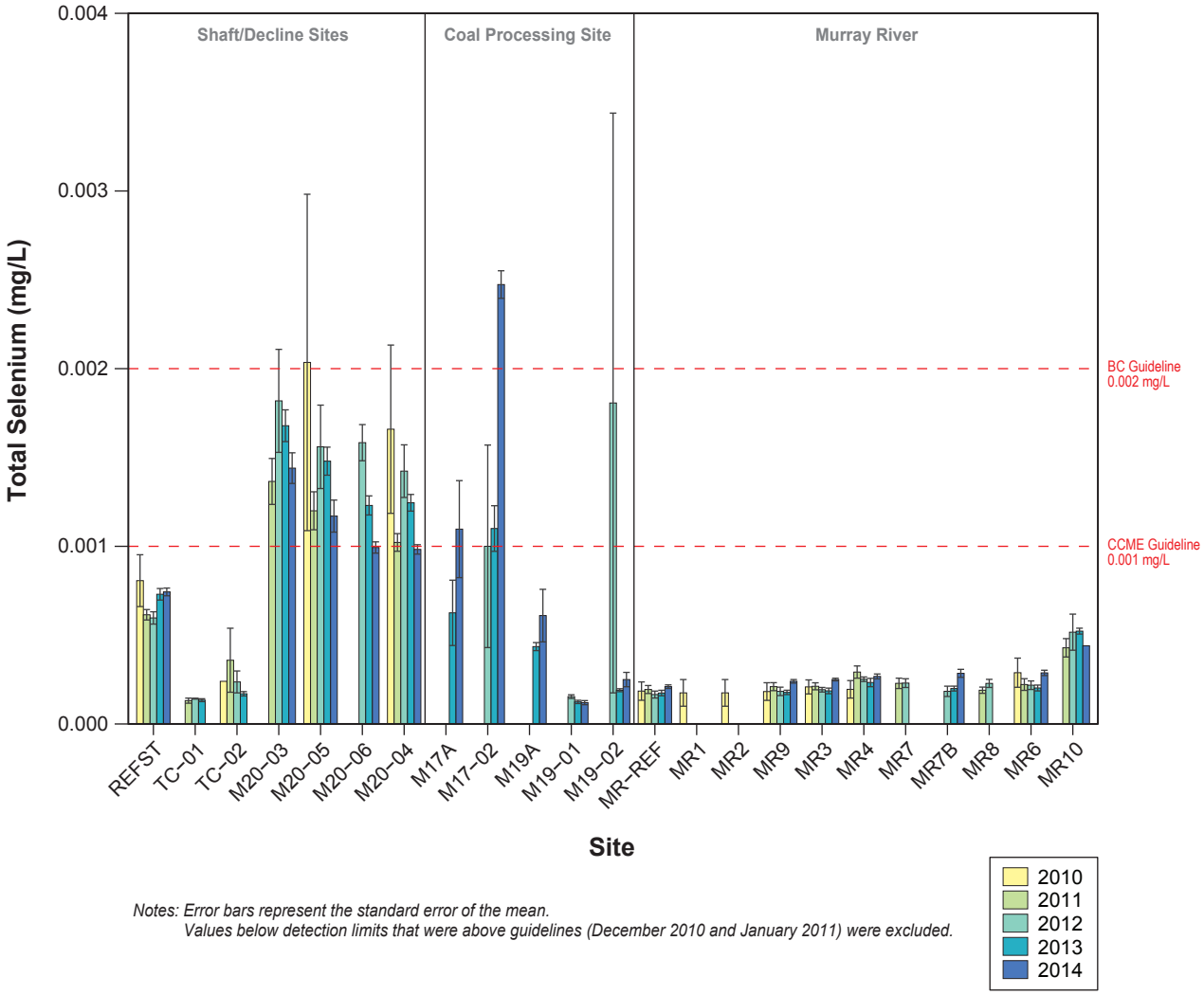
Media or Biota	BC Guideline [a]	CCME Guideline [b]
Water quality (aquatic life)	2 µg/L (30-day mean); 1 µg/L (alert concentration)	1 µg/L (chronic)
Water quality (wildlife)	2 µg/L (30-day mean)	N/A
Drinking water quality	10 µg/L	10 µg/L[c]
Sediment quality	2 µg/g dw (alert concentration)	N/A
Dietary intake for aquatic life (invertebrate tissue)	4 µg/g dw (interim)	N/A
Fish tissue (whole body)	4 µg/g dw	N/A
Fish tissue (muscle/muscle plug)	4 µg/g dw	N/A
Fish tissue (egg/ovary)	11 µg/g dw	N/A
Fish tissue screening values for human consumption	7.3 µg/g dw for high fish intake (220 g/day)	N/A
	14.5 µg/g dw for moderate fish intake (110 g/day)	N/A
	75.0 µg/g dw for average fish intake (21.5 g/day)	N/A
Bird tissue (egg/ovary)	6 µg/g dw	N/A

Notes:
N/A = not available; dw = dry weight
[a] Source: Beatty and Russo (2014)
[b] Source: CCME (2013)
[c] Source: Health Canada (2012)

Baseline water quality at the Project was collected at 23 sites between 2010 and 2014, with some sites sampled monthly and other sites sampled quarterly. Selenium concentrations in streams within the water quality RSA are shown in Figure 24.10-1 and can be summarized as follows:

- Murray River:
  - Annual total Se concentrations ranged from <0.10 µg/L to 0.72 µg/L.
  - The highest total Se concentrations were often measured during low flow winter months.
  - Total Se concentrations in Murray River did not exceed the CCME guideline of 1 µg/L or the BC MOE guideline of 2 µg/L (30-day mean).
- Smaller tributaries:
  - Annual total Se concentrations ranged from <0.10 µg/L to 5.07 µg/L.
  - Total Se concentrations peaked during freshet or late summer.
  - Total Se concentrations above the BC aquatic life alert level guideline (1 µg/L) occurred at sites: TC-02 (6% of samples), M20-03 (84% of samples), M20-05 (83% of samples), M20-06 (83% of samples), M20-04 (67% of samples), M17-02 (71% of samples), M17A (14% of samples), M19-02 (5% of samples), and REFST DS (4% of samples).
  - Total Se concentrations above the BC MOE guideline for aquatic life and wildlife (2 µg/L, 30-day mean) occurred at sites: M20-03 (27% of samples), M20-05 (17% of samples), M20-04 (10% of samples), M17A (7% of samples), M17-02 (19% of samples), and M19-02 (5% of samples).

Figure 24.10-1
Total Selenium Concentrations in Streams



Notes: Error bars represent the standard error of the mean.
Values below detection limits that were above guidelines (December 2010 and January 2011) were excluded.

24.10.3.2 Sediments

Baseline sediment quality data is summarized in Chapter 8 of the Application/EIS and associated appendices (Appendices 8-B, 8-C, and 8-D). A map of sampling site locations can be found in Appendix 8-B (Figures 3.2-1 and 3.2-2). Measured concentrations of Se in sediment samples are shown in Figure 24.10-2.

Overall, mean Se concentrations were greater in M20 Creek (Camp Creek) sediments (mean = 0.95 µg/g dw) than in Murray River sediments (mean = 0.66 µg/g dw). However, the highest sediment Se concentrations were measured at the upstream reference site, Club Creek (REFST; 1.62 µg/g dw).

Currently there is no Se CCME sediment quality guideline for the protection of aquatic life; however, BC MOE has set a provincial guideline for total Se in sediments of 2 µg/g dw (Beatty and Russo 2014). Mean Se concentrations in sediment samples were below the provincial guideline at all monitoring sites.

24.10.3.3 Periphyton and Benthic Invertebrates

Baseline tissue metal concentrations in aquatic resources were summarized in the Application/EIS in Chapter 8 and associated appendices (Appendices 8-B, 8-C, and 8-D). Tissue Se concentrations are presented in dry weight (dw) for periphyton and wet weight (ww) for benthic invertebrates. A map of sampling site locations can be found in Chapter 8, Appendix 8-B (Figure 3.2-1).

Periphyton and benthic invertebrate tissues had elevated Se levels in some tributaries to the Murray River compared to Murray River sampling sites (Figure 24.10-2). Selenium concentrations in periphyton tissues (in dw) were elevated in M20, M19, and M17 creeks compared to periphyton tissues sampled from the Murray River (Figure 24.10-2). Similarly, Se concentrations in benthic invertebrate tissue (in ww) was highest at sites in M20, M19, and M17 creeks, and lower in benthic invertebrates collected from the Murray River.

The BC water quality guideline for Se provides an interim dietary guideline for invertebrate tissue residue of 4 µg Se/g dw (Beatty and Russo 2014). Benthic invertebrate tissue samples were only reported in wet weight for most sampling years (no tissue moisture reported), therefore, a direct comparisons to the interim dietary guideline is not appropriate. Three samples collected in 2010 reported wet weight Se concentrations and moisture contents; samples had Se concentrations that were below the tissue residue guideline at MR REF (3.7 µg/g dw) and MR4 (3.1 µg/g dw), but slightly above the tissue residue guideline at MR6 (5.7 µg/g dw).

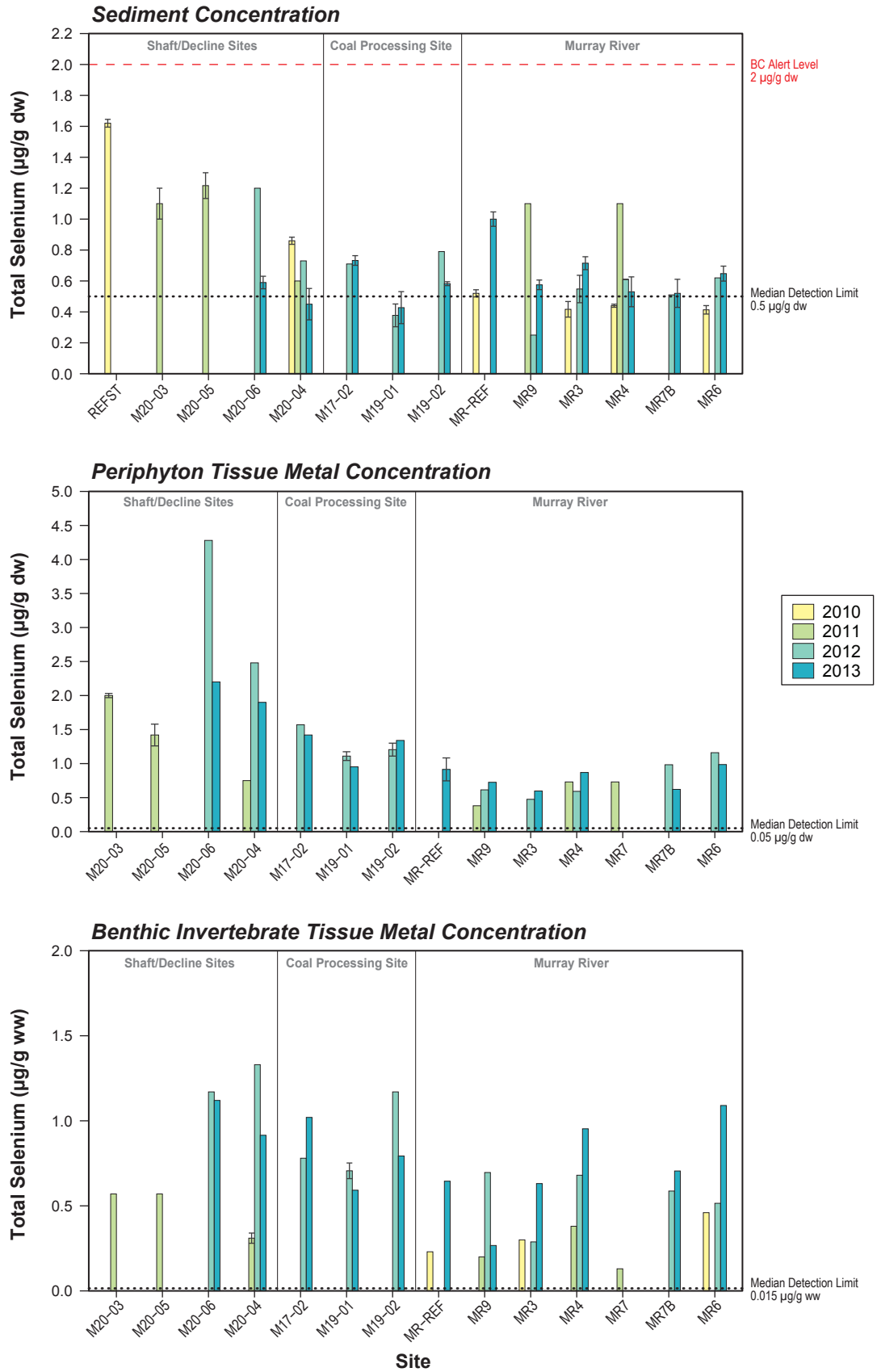
24.10.3.4 Fish

Baseline fish and fish habitat is described in the Application/EIS in Chapter 9 and associated appendices, including raw tissue metal data (Appendix 9-A).

Freshwater fish species presence and distribution in the Project area has been assessed since 2010 (Chapter 9, Table 9.5-2). In 2012, a total of five fish species were captured in the Murray River and surrounding tributaries: Bull Trout, Burbot (*Lota lota*), Dace spp. (*Phoxinus neogaeus* and *Rhinichthys cataractae*), Mountain Whitefish, and Slimy Sculpin.

Figure 24.10-2

Selenium Concentrations in Sediment, Periphyton Tissue, and Benthic Invertebrate Tissue in Streams



Notes: Error bars represent the standard error of the mean.
Dotted line represents the analytical detection limit; values below the detection limit were plotted as half the detection limit.

Species that were sampled within the RSA historically, but were not caught during 2010 or 2012 sampling include Arctic Grayling, Eastern Brook Trout (*Salvelinus fontinalis*), Lake Chub (*Couesius plumbeus*), Longnose Sucker (*Catostomus catostomus*), Rainbow Trout (*Oncorhynchus mykiss*), and Westslope Cutthroat Trout (*Oncorhynchus clarki lewisi*). Slimy Sculpin were the most abundant fish species in the Project local study area (LSA) during all sampling events and they utilize various habitats for all life stages (DES 2011).

Fish tissue (whole body) metals data were collected from the Project area in 2004, 2005, 2011, and 2012 (Appendix 9-A). Figure 9.5-2 in Chapter 9 shows the sampling locations for fish tissue residues between 2004 and 2012. Fish tissue Se data (in dw) is presented in Table 24.10-2.

Monitoring sites with the highest tissue Se concentrations were tributary sites and the lowest concentrations were measured in fish captured at Murray River sampling sites (Appendix 9-A). Selenium data for whole body Slimy Sculpin were converted from µg/g ww to µg/g dw for direct comparison with updated Se guidelines for British Columbia (Beatty and Russo 2014). Selenium concentrations in Slimy Sculpin were highest in M20 Creek at 7.93 µg/g dw in 2011 and 9.42 µg/g dw in 2012. Mean Se concentrations were lowest in Slimy Sculpin sampled from MR US in the Murray River at 3.44 µg/g dw in 2005 and MR DS at 3.71 µg/g dw in 2012. These Slimy Sculpin results and water quality data followed similar concentration trends (Chapter 8, Section 8.5.3), where Se concentrations in Murray River tributaries were higher than those in the Murray River.

Mean baseline Se tissue residues for Slimy Sculpin were greater than the BC tissue residue guideline of 4 µg/g dw at 60% of the sampling sites in the Murray River watershed (Table 24.10-3). Mean Se tissue concentrations exceeded the guideline for fish sampled from M20 Creek and Mast Creek during all sampling years. At Murray River sites, concentrations above the guideline were measured at MR US (2011 and 2012), MR3 (2012), MR4 (2012), and Murray RB (2011; Appendix 9-A). Mean baseline Se tissue residues for Bull Trout, Finescale Dace, Eastern Brook Trout, and Mountain Whitefish exceeded the BC tissue residue guideline at 33%, 20%, 50% and 50% of the sampled sites, respectively.

24.10.3.5 Birds

Baseline information on birds and bird habitat was described in the Application/EIS in Chapter 13 (Section 13.5.3.9 and 13.5.3.10) and in the 2010 to 2013 Wildlife Baseline Report (Appendix 13-A). During baseline studies, 117 bird species were detected: 10 raptor species, 35 species from six wetland bird groups, and 72 landbird species. The focus of the SeMP is on wetland birds that are dependent on waterbodies as habitat features for foraging, breeding, and staging, although a few landbird species may also be dependent on wetland habitat for various life history activities. Wetland birds include waterfowl and wading birds such as ducks, geese, swans, loons, and grebes; shorebirds such as Spotted Sandpiper (*Actitis macularia*) and Solitary Sandpiper (*Tringa solitaria*); and songbirds that breed in marshes (e.g., Northern Waterthrush, *Seiurus noveboracensis*) or along streams (e.g., American Dipper, *Cinclus mexicanus*).

Table 24.10-2. Baseline Tissue Selenium Concentrations in Fish (Whole Body) from the Murray River Watershed, 2004, 2005, 2011, and 2012

Fish Species	Sampling Location	Sampling Year	Number of Samples	Whole Body Tissue Selenium Concentration (µg/g dw)				
				Min	95th Percentile	Max	Mean	SEM
Slimy Sculpin	MR DS	2012	8	2.68	4.72	4.94	3.71	0.271
	MR3	2012	8	2.91	6.12	6.21	4.88	0.369
	MR4	2012	8	4.29	7.02	7.28	5.38	0.395
	MR US	2012	8	3.11	5.09	5.13	4.46	0.257
	M20 US	2012	8	7.80	10.8	10.8	9.42	0.432
	M20 US	2011	8	4.24	9.46	9.46	7.93	0.612
	Murray RB	2011	8	4.76	6.83	7.19	5.63	0.272
	Murray DS	2011	8	3.35	4.09	4.14	3.86	0.0818
	Murray US	2011	7	3.44	5.40	5.56	4.28	0.296
	Murray DS	2005	5	2.83	3.83	3.88	3.48	0.227
	Murray US	2005	5	2.61	4.22	4.41	3.44	0.288
	Murray RB	2005	5	3.31	4.54	4.63	3.88	0.238
	Mast CK	2005	5	3.99	4.82	4.86	4.48	0.152
	Sesyncline (SS-FT)	2004	5	3.06	4.16	4.17	3.84	0.201
	M20 DS (M20-FT)	2004	5	3.91	5.65	5.66	5.07	0.343
Bull Trout	M20 US	2012	3	3.27	4.43	4.50	3.84	0.360
	M20	2011	3	3.32	4.29	4.32	3.91	0.302
	FEL	2011	3	4.07	5.24	5.26	4.81	0.371
Finescale Dace	Wetland 00313	2011	8	1.21	2.06	2.09	1.68	0.104
	B2 Wetland	2011	8	2.16	2.78	2.86	2.44	0.0798
	M20 Wetland	2011	8	2.08	2.71	2.75	2.38	0.0824
	M14 Wetland	2011	8	3.28	4.08	4.27	3.59	0.114
	Barbour Wetland	2011	8	6.59	8.32	8.38	7.68	0.236
Eastern Brook Trout	M20	2011	3	2.02	3.39	3.42	2.85	0.424
	Waterfall	2011	3	5.36	6.08	6.15	5.66	0.248
Mountain Whitefish	Murray DS	2005	1	N/A	N/A	N/A	1.08	N/A
	Murray US	2005	3	4.40	5.10	5.14	4.76	0.214

Notes:
dw = dry weight; SEM = standard error of the mean; N/A = not applicable
Fish tissue (whole body) concentrations were converted from wet weight to dry weight using the following equation:

$$C_{dw} = C_{ww}/((100 - \% \text{ moisture})/100)$$

Grey shading indicates exceedance of the BC tissue residue guideline for fish (whole body, 4 µg/g dw, 11 µg/g dw; Beatty and Russo 2014).

Several species of landbirds that have been documented during baseline studies are associated with wetlands and other waterbodies for foraging, and nesting during parts of their life history. Northern

Waterthrush (*Seiurus noveboracensis*), Common Yellowthroat (*Geothlypis trichas*), and Tree Swallow (*Tachycineta bicolor*) nest in wetlands and swampy areas. American Dippers (*Cinclus mexicanus*) nest on boulders, cliffs, or bridge girders over pools of mountain streams. Spotted Sandpipers (*Actitis macularia*) nests on gravel bars and Solitary Sandpipers (*Tringa solitaria*) nests in swamps. The Red-winged Blackbird (*Agelaius phoeniceus*) nests in marshes. In addition, Hammond's Flycatcher (*Empidonax hammondii*), MacGillivray's Warbler (*Oporornis tolmiei*), Magnolia Warbler (*Dendroica magnolia*), and Rufous Hummingbird (*Selasphorus rufus*) were only detected in riparian/wetland habitat.

Measurement of bird egg Se concentrations was not part of the Project's baseline sampling program; however, other mining projects in the Murray River watershed have collected this type of data, which will be discussed in Section 24.10.4.3.

24.10.3.6 Wetlands

Baseline wetland data is summarized in Chapter 8 and 12 of the Application/EIS and in the cumulative Wetland Ecosystem Baseline Report (Appendix 12-A), which also contains the raw metal data. A map of wetland sampling site locations can be found in Appendix 12-A, Figure 3.1-1. Baseline aquatic vegetation quality data were summarized in the Application/EIS in Chapters 11 (Section 11.5.4.1) and 12 (Appendix 12-A), as well as the 2010 to 2012 Soil and Vegetation Tissue Metals Baseline Report (Appendix 11-C) and the Wetland Baseline Report. Baseline sampling of metals in aquatic plants occurred between 2010 and 2012, with 27 samples of sedge (*Carex aquatilis*) collected from eight wetlands.

The Murray River is a lotic (flowing) river system. Within the Murray River drainage basin in the Project area, a total of 32 wetland (lentic habitat) ecosystem surveys were conducted in 2010, 2011, and 2012 (Rescan 2013b). These surveys resulted in the classification and mapping of 24 wetland ecosystems, with a further 25 wetland features identified using GIS, resulting in a total 139.38 ha of wetlands mapped in the wetland study area (Appendix 12-A; Rescan 2013b). All five BC wetland classes (bog, fen, marsh, swamp, and shallow open water) were observed in the wetland study area. Marshes and swamps accounted for the majority of all wetland observations, but swamps accounted for the largest mapped wetland.

The wetlands in the study area comprise the breeding habitat of most of the waterfowl mentioned above, except the Harlequin duck, which is a riverine species. In addition to birds, wildlife observed in wetlands included a number of mammalian species (e.g., beaver and moose) and herptofauna species (e.g., Wood Frog [*Lithobates sylvaticus*], Columbia Spotted Frog [*Rana luteiventris*], Western Toad [*Anaxyrus boreas*], and Long-toed Salamander [*Ambystoma macrodactylum*]). Approximately 50% of all wildlife observed was moose (*Alces alces*; Rescan 2013a). Western Toad was the most abundant species detected during ground surveys and five breeding sites containing tadpoles and toadlets were found, two of which were located in the LSA. The Western Toad is a federally listed species of special concern that is protected under Schedule 1 of the *Species at Risk Act* (2002; Government of Canada 2010).

Water quality samples among wetland sites had similar total Se concentrations, and were below both the BC guideline (2 µg/L), and the BC alert level and CCME guideline (1 µg/L; Figure 5.1-20 in Appendix 8-B). Mean sediment Se concentrations were higher than the BC alert level sediment

guideline at LW11 site (5.96 µg/g dw; Figure 5.2-6 in Appendix 8-B). Other wetland sites in the Project area had sediment Se concentrations below 1.5 µg/g dw. Sedge tissues reflected this, with the mean tissue Se concentration at LW11 2.1 µg/g dw. Sedges collected from other wetlands (i.e., Reference, RW3, MW01, MW07, MW12, MW14, MW22) had Se concentrations below the detection limit.

24.10.4 Predictive Studies

24.10.4.1 Geochemistry

The geochemical characterization of waste rock, raw and processed coal, coarse coal rejects (CCR) and tailings is described in the Geochemistry Baseline Report (Appendix 3-B) and in Section 3.5 of the Application/EIS. Since the proposed Project is an underground mine, characterization of pit walls was not required (i.e., there are no open pits). Selenium leaching potential was evaluated in waste rock, raw and processed coal, coarse coal rejects and tailings using short-term shake flask extraction (SFE) leachate tests (waste rock and CCR), long-term humidity cell tests (waste rock, raw and processed coal, CCR, and tailings), and field leach barrels (waste rock only). Details of laboratory analyses, results, and discussion are presented in Appendix 3-B.

In waste rock SFE leachate, Se concentrations were above BC 30-day mean water quality guidelines for multiple samples from each formation. Selenium concentrations were also elevated in raw coal and coal product samples from all coal seams.

Steady-state Se leach rates in waste rock humidity cells were approximately correlated with sulphide sulphur content, and did not correlate with initial Se content (Appendix 3-B). The highest Se leach rates were observed in the acidic Boulder Creek Formation humidity cell (HC4; Figure 5.1-26 in Appendix 3-B). Selenium also frequently exceeded the BC 30-day mean water quality guideline in leachate from waste rock field barrels (Figure 5.1-34 in Appendix 3-B).

In raw coal, coarse coal rejects, and tailings humidity cells, Se leach rates correlated with initial Se concentrations, but not with initial sulphide sulphur content. Selenium loadings in raw coal humidity cells were initially high, and decreased over the first 20 to 30 weeks of leaching before reaching a steady state.

24.10.4.2 Water Quality Model

A predictive water balance and water quality model was developed to the Project to assess the effect of the Project on water quantity and quality in the receiving environment (Chapter 8 and Appendix 8-E). The model considered key components and activities including: climate, hydrology, hydrogeology, water chemistry, rock chemistry, water management structures, mine operations, and water use. Model inputs were based on data collected from extensive baseline studies, field measurements, bulk sample results, engineering designs, and professional knowledge and experience.

The water balance model was used to simulate streamflows at the baseline conditions, as well as streamflows during Construction, Operation, Decommissioning and Reclamation, and Post Closure. Simulated baseline flows at Murray River, M20 Creek, M17A Creek, and M19 Creek matched the baseline flows that were observed and estimated in the 2013 baseline hydrology monitoring program.

Water quality predictions provided for a range of water quantity and quality scenarios, and model results were used to inform the design and refinement of mitigation strategies for the Project. Model predictions show that seepage from the CCR piles influences the concentration of Se in M19A Creek during Operation, Decommissioning and Reclamation, and Post Closure. Selenium concentrations in M19A Creek are predicted to be greater than both background concentrations measured during baseline studies and the BC water quality guideline for the protection of aquatic during low flow periods (January through March). This increase is subsequently observed in M19 Creek; however concentrations are not expected to be above background or the BC water quality guideline for the protection of aquatic life.

Murray River (site MR7) is the downstream receiving environment for the Project. Water quality model predictions for the base case model and all sensitivity scenarios at MR7 show that the water quality will be within the range of natural variability at MR7.

24.10.4.3 Bioaccumulation Models

Bioaccumulation models can be developed based on the relationship between Se concentrations in water and in fish or bird tissues, and these predictive models are frequently used for mining projects throughout BC. It may not always be possible to develop this type of predictive model based on only water and fish or bird egg Se residues, particularly in complex environments (e.g., where lentic and lotic environments are interspersed; Brix et al. 2005). It is recognized that this approach has some shortcomings, given the complexity of Se movement and uptake in the environment; however, this is currently the standard approach used by mining proponents in BC where SeMPs are necessary.

Fish

Bioaccumulation models, based on total Se water concentrations and Se whole body fish tissue residues, were prepared for the Murray River and surrounding tributaries. Different fish species may accumulate Se at different rates and to varying degrees; thus, the collected fish species were considered separately in the development of bioaccumulation models. Ideally, bioaccumulation models should be site-specific, since there are a number of factors locally that can influence the degree to which Se is taken up into the food chain.

Bioaccumulation models were developed for Slimy Sculpin sampled at Murray River water quality sites (i.e., MR2, MR3, MR4, MR7, and MR9) and tributary water quality sites (i.e., M20-04 and M20-06) in 2004, 2005, 2011, and 2012, and for Finescale Dace sampled at wetlands adjacent to the Murray River (i.e., W9.0, LW4, and Reference site) in 2010 and 2012.

Water quality data was matched to whole body fish tissue metal sampling sites to develop the bioaccumulation model. In addition to Project-specific baseline data, water quality data from the Hermann Mine Environmental Assessment from 2004 (site M20-04) and 2005 (site M14 and MR2) were also included in the fish bioaccumulation model because data was not collected for the Murray River Coal Project during those years. The Slimy Sculpin sampling site MR US in 2005 was closest to the Hermann Mine sampling sites M14 and MR2, which had an average total Se concentration in 2005 of 0.577 µg/L (WCCC 2007). The Slimy Sculpin sampling site M20 DS in 2004 was closest to the

Hermann Mine sampling site M20-04, which had an average total Se concentration in 2004 of 1.29 µg/L (WCCC 2007).

At each site, the water Se concentrations used in the models were based on samples collected during the high flow season (May to October) in the same years as fish sampling, rather than as an annual average or overall average. Dietary uptake is the primary route of Se exposure to fish and longer-term mean water concentrations provide a better match than short-term measurements (e.g., single samples); therefore, high flow mean water Se concentrations were used. High flow mean water Se concentrations were used because this is the period of the year when uptake of Se into the food chain is most active (i.e., periphyton and benthic invertebrate populations are more active and growing). Additionally, the regression relationship based on high flow mean Se water concentrations had a better fit than the regression relationship based on annual mean Se water concentrations.

Fish whole body Se concentrations were plotted as a mean of fish samples from each site. Three Finescale Dace were included for each site and eight Slimy Sculpin were included for each site (exceptions were: five fish at MR US and M20 DS in 2004 and 2005, and seven fish at the MR US site in 2011). The coefficient of variation for Slimy Sculpin and Finescale Dace whole body Se concentrations at all sites were less than 6% and 11%, respectively, which indicates low variability within sites. Figure 24.10-3 shows the bioaccumulation model developed for Slimy Sculpin using the high flow mean Se water concentrations and mean whole body fish tissue residues.

The bioaccumulation model using linear regression for untransformed Slimy Sculpin whole body Se residues (Figure 24.10-3) had the best fit (i.e., the model had an R^2 of 0.5514) and was significant ($p = 0.0219$) compared to other types of relationship that were attempted (e.g., non-linear or log transformed); thus the model can be used to predict whole body Se concentrations (Se_{WB}) as a function of total water Se concentration (Se_{Wat}). The Slimy Sculpin model equation is:

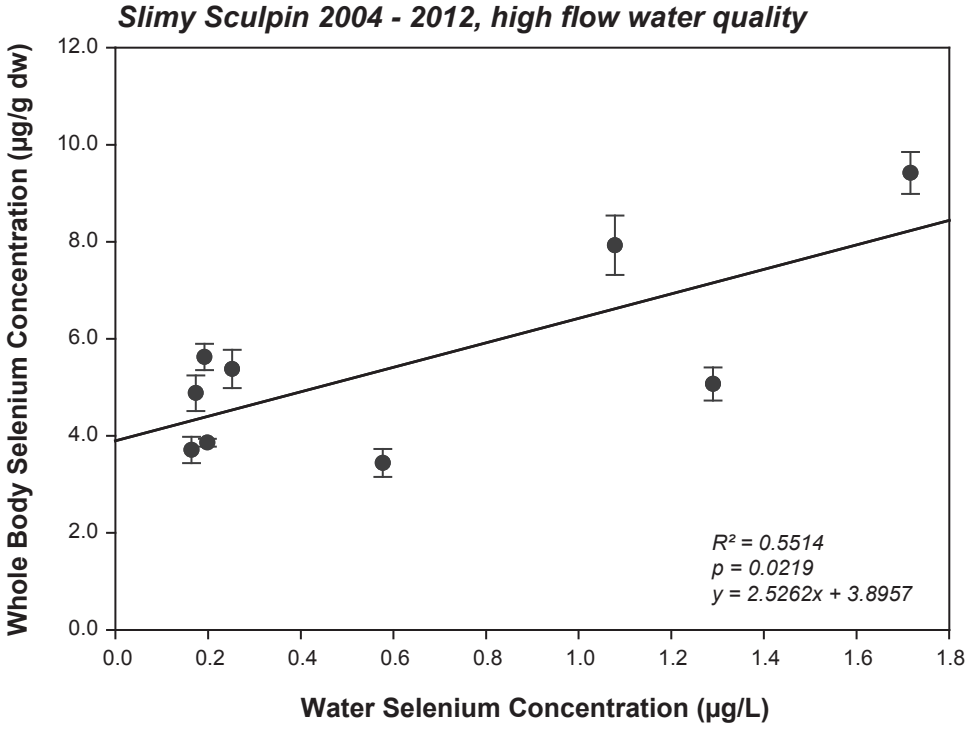
$$Se_{WB} = 2.5262 \times Se_{Wat} + 3.8957 \qquad \text{[Equation 1]}$$

The bioaccumulation model had a poor fit for Finescale Dace and the relationship between water and whole body Se concentrations was not significant (i.e., the model had a R^2 of 0.43 and p-value > 0.05). Additional data may improve the fit of the model; however, difficulty in developing a linear regression bioaccumulation model for fish species may also be due to confounding factors such as: habitat variability, mobility of fish between sampling areas, and other species-specific or site-specific factors. Data was insufficient for the other fish species (i.e., Bull Trout, Eastern Brook Trout, and Mountain Whitefish) to develop a bioaccumulation model.

The Project-specific bioaccumulation model for Slimy Sculpin was used to predict whole body fish tissue residues based on water quality model predictions (Section 24.10.4.2). The tissue residue predictions were used to support the effects assessment for Fish and Fish Habitat (Chapter 9) and Human Health (Chapter 18).

Figure 24.10-3

Bioaccumulation Model for Selenium in Slimy Sculpin



Birds

The Spotted Sandpiper is a riverine bird species that occurs in the Project area and is often used as a Se indicator species for lotic systems since this bird species is among the more sensitive species for Se toxicity. Other insectivorous, lotic-system birds that occur in the study area include the Harlequin Duck and the American Dipper. Harding, Graham, and Paton (2005) related aqueous Se concentrations to effects on Spotted Sandpiper and found a slightly reduced hatchability at the highest measured mean egg Se concentration , 7.3 µg/g dw, which corresponded to a mean surface water concentration of about 8.0 µg/L.

Baseline studies for the Project did not include the collection of bird eggs for metal residue analysis. Thus, a publicly-available Se bioaccumulation model for birds developed for the Quintette Mine was used as a proxy. Baseline studies for the Quintette Mine included the collection of Spotted Sandpiper and Red-winged blackbird eggs along the Murray River, and in surrounding tributaries and wetlands (Golder Associates Ltd. 2012). The Quintette Mine field data were used along with data from other studies (Harding, Graham, and Paton 2005; Minnow, IR, and PLA 2007) to develop a Spotted Sandpiper Se bioaccumulation model, which is similar to other models developed for birds (Brix et al. 2005). The fitted model equation was ($R^2 = 0.87$; $p < 0.001$; Teck Coal Ltd. 2012):

$$log_{10}(MES) = 0.478 \quad when\ Se_{WAt} \leq 0.5\ \mu g/L \qquad \text{[Equation 2]}$$

$$log_{10}(MES) = 0.269 \times log_{10}(Se_{WAt}) + 0.559 \quad when\ Se_{WAt} > 0.5\ \mu g/L \qquad \text{[Equation 3]}$$

where:
MES = mean egg selenium (µg/g dw)
Se_{WAt} = annual mean water Se concentration (µg/L)

This relationship implies that, at low water concentrations of Se (i.e., less than 0.5 µg/L; Equation 2) the concentration of Se in bird eggs is independent of the water concentration. As the concentration of Se in water increases, the concentration of Se in the egg also increases as shown in the second part of the regression relationship (for when Se_{Wat} is greater than 0.5 µg/L; Equation 3).

Red-winged Blackbirds are known to nest around marshes (lentic areas). Although Red-winged blackbird eggs were collected for the Qunitette Mine, a bioaccumulation model was not developed (Teck Coal Ltd. 2012). A Red-winged Blackbird bioaccumulation model has been developed based on studies conducted in the Elk Valley. Studies in the Elk Valley have shown that the toxicity threshold for this species is around 22 to 23 µg/g dw in the egg (Golder Associates Ltd. 2007; SciWrite Environmental Services Ltd. 2007; Harding 2008). These studies have also found that accumulation of Se in the egg of Red-winged Blackbirds appears to plateau at Se concentrations of approximately 24 µg/g dw, suggesting that this species may be able to regulate Se levels to prevent toxicity. The regression relationship between water and egg Se concentrations is a polynomial equation, where the rate of Se uptake into the egg decreases with increasing water concentrations. This relationship suggests that this lentic species can tolerate relatively high concentrations of Se in water without experiencing toxicity (i.e., > 60 µg/L).

Since bioaccumulation models for other lentic bird species are not available, the bioaccumulation model based on the lotic species, the Spotted Sandpiper, was adopted for use for the Project until a site-specific model can be developed.

24.10.5 Actions to Avoid, Control, and Mitigate

The strategy of this SeMP is aligned with the goals outlined in the *Guidelines for Metal Leaching and Acid Rock Drainage at Minesites in British Columbia* (Price and Errington 1998), which are to: achieve long-term protection of the receiving environment and minimize the 'alienation' of resources from productive use. Progressive mitigation measures will be implemented where potential effects to the receiving environment are first prevented, then controlled, and finally minimized (reduced) to the extent possible.

24.10.5.1 Prevention

The Project is designed as an underground mine, allowing the Project to generate much smaller volumes of waste rock than would be generated by an open pit project. Limiting the amount of waste rock produced serves as a means of preventing Se leaching from waste rock piles.

24.10.5.2 Control

Control measures for waste rock, raw and processed coal stockpiles, and coarse and fine reject material include the following:

- **Waste Segregation:** Waste rock will be segregated based on metal leaching and acid rock drainage potential. Material will be identified as potentially acid generating (PAG) or not potentially acid generating (NPAG). Material assessed as PAG or acid-generating will be transported to the waste rock storage area. NPAG material will be used as fill and cover material to encapsulate PAG material in the waste rock and CCR piles. As described in Section 24.10.4.1, steady-state Se leach rates in waste rock humidity cells were approximately correlated with sulphide sulphur content, and therefore by segregating PAG waste rock, material with a potential for high Se leaching will also be segregated. The majority of PAG coal (seam D) will be mined in the first five years of mining, this material will be placed at the toe of the CCR North pile to limit the infiltration of acidic leachate through NPAG materials (Section 3.8.4 in the Project Description).
- **Underground Water Management:** Groundwater inflows to the underground mine will be managed with a central water sump and a main water pump station constructed in the Underground Operation Hub. Water from the mine sump will be circulated back within the mine through the sprinkler system and for general fire and dust suppression purposes. Excess water will be pumped to the surface via pipes to be stored in the CPP Pond.
- **CCR Seepage Collection:** Water that infiltrates the CCR North and South piles, during Operation, will be captured in a seepage collection system. The seepage collection system will drain contact water into a collection sump. Contact water in this sump will be preferentially reclaimed and pumped to the Coal Preparation Plant, and excess water, beyond the Coal Preparation Plant water demand, will be pumped into the CPP pond. After reclamation, surface runoff is rerouted to M19A Creek, and infiltrated water will be recharged to groundwater through exfiltration galleries.
- **Surface Water Management:** Surface runoff from the waste rock pile during Construction and the first year of Operation will be diverted to the Shaft Site pond. The pond outflow will

be discharged to M20 Creek. At the Coal Processing Site, all contact water including runoff from the raw and clean coal stockpiles and the CCR piles will be collected in the Coal Preparation Plant (CPP) pond, and re-used as make-up water where possible; excess water will be discharged to Murray River. Diversion ditches around the Coal Processing Site will divert non-contact water to M19A Creek.

24.10.5.3 Reduction

- **Flooding**: During Decommissioning and Reclamation and Post Closure, the underground workings will be allowed to flood. Flooding will reduce the surface area of gob and underground workings exposed to oxygen, and will decrease rates of sulphide oxidation and Se leaching.
- **Cover:** The waste rock pile will be closed during the first year of Operation. The closure cover includes a 30 cm thick till layer and a 30 cm thick clay liner or geomembrane to prevent water infiltration into the pile and subsequent Se leaching. Closure covers are also planned for the CCR piles. For these piles, a layer of NPAG fine reject (tailings) will be used to create a low permeability cover. This will be subsequently covered with topsoil and vegetated. Closure of CCR North is planned in year 15, and CCR South at the end of mine life (Year 25).

24.10.6 Environmental Objectives

24.10.6.1 Site Performance Objectives

Based on the water quality model predictions (Section 24.10.2; Chapter 8 and Appendix 8-E), Se is predicted to be greater than both background concentrations measured during baseline studies and the BC water quality guideline for the protection of aquatic life only in M19A Creek during the Decommissioning and Reclamation and Post Closure between January and March (Appendix 8-G). M19A Creek ultimately flows into wetlands at the base of the Coal Processing Site before entering M19 Creek.

The potential for effects to fish due to Se in M19A Creek is assessed in Chapter 9, while the potential for effects to birds and amphibians is assessed in Chapter 13. Briefly, no fish were found in M19A Creek during baseline studies due to the presence of temporary fish barriers (i.e., beaver dams). Similarly, birds and amphibians are not expected to be present in or around M19A Creek during the winter months when Se is predicted to be greater than guidelines. Therefore, based on current conditions, there is no exposure pathway for sensitive receptors to water or the aquatic food chain during the months when Se is predicted to be greater than guidelines.

Although an exposure pathway does not exist for sensitive species (i.e., egg-laying vertebrates) at the time when guideline exceedances are predicted to occur, it is acknowledged that Se may accumulate and persist in the aquatic environment. Therefore, a site performance objective (SPO) is proposed for M19A Creek. A SPO is intended to identify the threshold for selenium concentrations in water that are not expected to result in population-level impacts to sensitive receptors, such as egg-laying vertebrates (i.e., fish or birds). The SPO can be used as a threshold in permits to trigger the need for additional monitoring, more stringent discharge requirements, additional mitigation

measures, or preparation of reports by permit holders regarding the influence of Se loading on the receiving environment (BC MOE 2013b).

Selenium concentrations in water are predicted to be either lower than the BC aquatic life guideline or lower than background concentrations at all other modelling nodes (including M19 Creek and the Murray River) throughout the life of the Project. The BC water quality guideline (aquatic life, 30-day mean) for Se (i.e., 2 µg/L) will be applied at these other sites for the Project and development of an SPO is not required.

Fish

It is acknowledged that some areas in the lower portion of M19A Creek is lentic habitat and may be at higher risk for selenium bioaccumulation and potential effects to sensitive receptors. However, since no fish were found in M19A Creek during baseline studies, there is currently no baseline data for fish in this creek. Therefore, it is not possible to develop a SPO for M19A Creek based on protecting fish from Se toxicity. If at some time in the future the fish barriers (i.e., beaver dams) were removed due to natural processes, a bioaccumulation model for resident fish species could be developed and a SPO could be proposed to protect the most sensitive fish population.

Birds

Bird eggs were not sampled during baseline programs for the Project. However, bioaccumulation models were developed for birds for other coal mining projects in BC and these were used in order to back calculate a proposed SPO for M19A Creek (Section 24.10.4.3). Toxicity thresholds based on the BC guideline for selenium and currently available scientific literature were used to determine the maximum acceptable tissue residues in birds that would not be expected to lead to toxicity. The toxicity thresholds were input into the Spotted Sandpiper bioaccumulation model regression relationship as the Se_{egg} concentration, and the equation solved in order to generate a Se_{Wat} concentration that is proposed as the SPO for receiving environments.

The BC MOE guideline for Se in bird eggs is 6 µg/g dw (Beatty and Russo 2014); this is much more conservative than other proposed toxicity benchmarks that range from 12 to 16 µg/g dw (King, Custer, and A. 1994; Wiemeyer and Hoffman 1996; Smith et al. 1998; US DOI 1998; Santolo et al. 1999; Fairbrother et al. 2000; Grand et al. 2002; Hoffman et al. 2002; Adams et al. 2003; Ohlendorf 2003; Harding, Graham, and Paton 2005; Ratti et al. 2006; Santolo 2007; Canton et al. 2008a; Chapman et al. 2009b).

Using the lowest literature-based toxicity threshold of 12 µg/g dw and the publicly-available Se bioaccumulation model for Spotted Sandpiper developed for the Quintette Mine (see Section 24.10.3 for why this model was selected), back calculations yield a proposed water SPO of 86 µg/L. Using the BC MOE guideline for Se in bird eggs, back calculation yields 6.5 µg/L as the SPO that would be protective of birds.

Therefore, the more conservative SPO of 6.5 µg/L based on the BC guideline for the mean bird egg Se concentration is the proposed SPO for the Project in M19A Creek. This proposed SPO is an interim value until bioaccumulation models that are Project-specific can be developed.

24.10.7 Monitoring and Reporting

24.10.7.1 Selenium Monitoring Program

The objectives of the monitoring program under the SeMP are to:

- verify the predictions of the water quality model and the conclusions reached in the effects assessment;
- detect changes in the aquatic receiving environment before there is the potential for effects to occur; and
- allow for the development of adaptive management and mitigation strategies, before adverse effects can occur in aquatic biota.

Precise sampling locations will be determined in consultation with appropriate regulatory agencies during the Mines Act permitting phase of the Project. Although the water quality model only predicts Se to be greater than guideline limits and baseline concentrations in M19A Creek during certain times of the year (i.e., January to March), a more extensive sampling program is proposed in order to ensure that any unforeseen changes in Se concentrations at other locations are detected. Therefore, sampling locations for Se monitoring are expected to be selected at one or more locations in:

- M19A Creek;
- M19 Creek;
- M20 Creek;
- Murray River:
  - upstream of all Project influences (reference site),
  - midway between potential influences from the Quintette Mine and the Project,
  - at the end of the initial dilution zone for the Project discharge point in Murray River,
  - upstream of the confluence with M19 Creek,
  - downstream of all potential influences of the Project; and
- one or more reference sites that are not expected to be influenced by activities of the Project or other projects in the area (current or foreseeable future developments).

Wherever possible, the sampling locations selected as part of the SeMP monitoring program will coincide with the sampling locations selected for other purposes (e.g., compliance monitoring under the *Environmental Management Act* for discharge permits). This ensures the most efficiency and minimizes the redundancies in sampling programs.

The monitoring program is based on the guidance provided in Section 3.0 of the *Companion Document to: Ambient Water Quality Guidelines for Selenium Update* (BC MOE 2014). The environmental media or biota to be monitored and the frequency of sampling will vary depending on the concentration of Se measured in water. To the extent possible, all samples required at a site should be collected concurrently and sampling sites for multiple media or biota sampling should be

co-located. Table 24.10-3 outlines the media or biota to be sampled at each site and the frequency of sampling.

Table 24.10-3. Proposed Selenium Monitoring Program

Environmental Media or Biota	Parameters to be Analyzed	Frequency of Sampling		
		When Water [Se] are <2 µg/L	When Water [Se] are ≥ 2 µg/L but < 6.5 µg/L	When Water [Se] are ≥ 6.5 µg/L
Water	Physical parameters, dissolved anions, organic carbon, total and dissolved metals	Monthly	Monthly	Twice per month
Sediment (63 µm fraction)	Particle size, total metals, moisture content, total organic carbon	Once every 5 years[b]	Once every 2 years	Annually[c]
Periphyton or Aquatic Plant Benthic Invertebrates Fish Tissue (whole body) [a] Fish Egg[a] Bird Egg[a]	Tissue metal analysis , moisture content			

Notes:
[Se] means concentration of total selenium
[a] Fish or bird tissues/eggs will only be sampled provided that necessary permits can be obtained and the adequate number of fish or bird eggs can be located and sampled without affecting the local population status.
[b] Frequency assumes that [Se] are below applicable guidelines for sediment, benthic invertebrates, fish tissue or egg, or bird egg (see Table 24.10-1 for guidelines). If [Se] are greater than the applicable guidelines, frequency of sampling for sediment and biota should be increased to once every 2 years.
[c] Additional parameters, indicators, or studies may be added to the monitoring program if the SPO is exceeded such as periphyton or benthic invertebrate taxonomy, fish population studies, and laboratory- or field-based toxicity studies. Additional parameters, indicators, or studies to be added will be determined in consultation with the appropriate regulatory authorities.

Although M19A Creek is the only waterway predicted to have Se concentrations that are greater than baseline concentrations and guideline limits, fish sampling (whole body or egg) may not be done in this area. This is because no fish were captured in M19A Creek during baseline studies due to the presence of a series of beaver dams that presently restrict fish access (Chapter 9). Therefore, sampling of fish in M19A Creek will only be done if, and when, the beaver dams no longer restrict access and resident fish populations are established. Sampling of bird eggs will be done in this area.

Generally, the recommended fish species for ongoing monitoring is the Slimy Sculpin. This fish species is recommended because of habitat preferences or physiology that put them at greater risk of accumulating Se (Beatty and Russo 2014); this species typically accumulates Se to a greater extent than other fish species so offers an overestimate of the tissue residues in most other fish species. Slimy Sculpin are also present throughout study area and have higher site fidelity (i.e., are less

migratory with small home ranges) and, therefore, Se in the tissues may be more reflective of influence from a localized area (Chapter 9, Section 9.5.3).

The recommended species of birds for bird egg sampling are the Spotted Sandpiper (lotic environment) or Red-winged Blackbirds (lentic environment). Other water-dependent bird species could also be considered as sentinel species if they are abundant and shown to be breeding in the sampling area. Prior to collection of bird eggs, investigation must be done to ensure that the local population can support regular monitoring, potential nesting areas should be identified or nesting boxes installed, and appropriate permits must be obtained. Since data on Se concentrations in bird eggs was not collected during baseline studies for the Project, bird egg collection will need to be done over the next several years to establish baseline levels in both lentic and lotic habitats. If adequate populations of breeding birds cannot be found in the area to be sampled, alternative monitoring strategies may need to be considered.

Data collected under the monitoring program would be used to develop or refine Project-specific bioaccumulation models. Since Se concentrations in M19A Creek are predicted to remain below BC water quality guidelines (2 µg/L) until the Reclamation and Decommissioning phase, there is time available to more fully develop site-specific models and ensure that the proposed SPO is protective of the aquatic environment.

The monitoring program associated with the SeMP should be re-evaluated and adjusted periodically (e.g., every three to five years) in order to ensure that the sampling locations, types, and frequencies are sufficient to meet the objectives of the program. Any changes to the monitoring program will be made in consultation with appropriate regulatory agencies.

24.10.7.2 Reporting

Details of the environmental monitoring under the SeMP will be reported internally on an annual basis. Where possible, practical, and acceptable to regulators, the monitoring and reporting required under the SeMP will be combined with other regulatory monitoring and reporting requirements (e.g., under the Environmental Management Act for discharge permits).

24.10.8 Responsible Persons

Environmental Manager

The Project's Environmental Manager will ultimately be responsible for the development and implementation of the SeMP, including the monitoring of environmental media and biota. The Environmental Manager will:

- ensure that the SeMP is refined, developed, and implemented in a manner that supports the objectives (Section 24.10.1);
- define the appropriate adaptive management practices, strategies, and mitigation measures that may be required in the event that environmental monitoring indicates that thresholds defined by the SeMP (e.g., guideline or SPO) are being approached or exceeded;

- consult and communicate with appropriate regulatory agencies as required during the development, implementation, and ongoing refinement of the SeMP;
- ensure that other environmental personnel have the appropriate resources and appropriate permits to conduct monitoring programs and implement adaptive management strategies, as required;
- oversee or conduct a periodic review of the SeMP to ensure that adaptive management strategies are relevant and that the monitoring program is achieving the goals of the SeMP;
- coordinate the implementation of all adaptive management strategies to support the SeMP; and
- coordinate environmental sampling of media or biota as outlined by the SeMP (Section 24.10.7).

24.11 INVASIVE PLANTS

24.11.1 Purpose

The purpose of the Invasive Plant Management Plan is to maintain ecosystem functions to avoid the introduction and spread of invasive plants resulting from the Construction, Operation, Decommissioning and Reclamation, and Post-closure activities of the Project. This plan provides strategies and mitigation measures for the ongoing management of invasive plants at the Project site, and is based on the guiding principles outlined by the Invasive Plant Committee of the Peace River Regional District (IPCPRRD), the Invasive Species Council (Invasive Species Council of British Columbia 2014), the Pest Management Plan (PMP) for Invasive Alien Plants on Provincial Crown Lands in Central and Northern British Columbia (BC MOFR 2010b), as well as the Invasive Alien Plant Program: Reference Guide (BC MOFR 2010a).

24.11.2 Legislation and Standards

Several legislation, guidelines, management plans, and governing agencies are of relevance for the provincial management of invasive plant species. A list of these regulations and their major applicable components is provided in Table 24.11-1.

Table 24.11-1. Key Regulations Related to Invasive Plants

Legislation and Regulations	Applicable Information
BC Forest and Range Practices Act (2002)	Specifies that activities should not encourage the establishment or spread of invasive plants.
Weed Control Act (1996m)	Administered by the Ministry of Agriculture, and imposes a duty on all land occupiers to control designated noxious plants; they may not be introduced or spread to unaffected areas.
Seeds Act (1985f)	Regulates the grading of seed sold, imported, and exported in Canada, requiring that seed in Canada is free of prohibited noxious weeds and ensuring standards of purity.

(continued)

Table 24.11-1. Key Regulations Related to Invasive Plants (completed)

Legislation and Regulations	Applicable Information
Species at Risk Act (SARA) (2002)	Specifies that invasive plant species that threaten rare wildlife species' habitat must be controlled.
BC *Integrated Pest Management Act* (BC Hydro 2003)	Regulates the use of herbicides to control weeds (invasive plants).

In addition to these regulations and acts, the following documents also have implications for the management of invasive plants:

- The Dawson Creek LRMP provides a guide for managing and directing resource development and conservation for each of the region's distinct landscape areas. The Dawson Creek LRMP was completed in 1999 as a strategic long-term planning framework for Crown land resource access, development and management (BC MFLNRO 1999). The Dawson Creek LRMP provides General Management Directions (GMDs) to guide the management of key resources, interests and activities throughout the planning area.
- Ministry of Forests and Range (2010): PMP for Invasive Alien Plants on Provincial Crown Lands in Central and Northern British Columbia (BC MOFR 2010b). This plan, prepared in association with the Ministries of Environment, Agriculture and Lands, and Transportation and Infrastructure, "…provides the ability to meet obligations for invasive plant management as outlined in the *Weed Control Act* and the *Forest and Range Practices Act.* It is developed in accordance with the *Integrated Pest Management Act* and accompanying regulations."
- Ministry of Forests and Range (2010): The Invasive Alien Plant Program: Reference Guide (BC MOFR 2010a) *is a.* A resource manual for all agencies and partners involved in invasive plant management in British Columbia.
- Invasive Species Council of British Columbia (ISCBC) is a registered charity with the primary goal of educating the public and professionals about invasive species and their risk to ecosystems and economies. Relevant outreach materials include a variety of brochures, pamphlets, and booklets, including the T.I.P.S. series.
- The Invasive Plant Committee of the Peace River Regional District (IPCPRRD) has established guidelines for invasive plant prevention, eradication, containment, rehabilitation and control (Peace River Regional District 2014). The IPCPRRD categorizes invasive plants according to their level of invasiveness and management priority.

24.11.3 Objectives

The Invasive Plant Management Plan is designed to provide environmentally responsible, realistic, and operationally feasible guidance for ecosystem, soils, and vegetation management related to invasive plants.

The objectives of the invasive plant management plan are to:

- avoid the introduction, and prevent the establishment and spread of invasive plants through ecology based management of Project activities during all phases;

- remove invasive plants that are present at site through consultation with qualified personnel; and
- restore ecosystem integrity at sites altered by Project activities.

24.11.4 Actions to Avoid, Control, and Mitigate

24.11.4.1 General Measures

To reduce the likelihood of invasive plant establishment and spread, impacts to ecosystem integrity will be minimized through the following actions:

- identification of ecosystems with low resiliency to invasive plants using resources such as soil mapping units (Appendix 10-D and Chapter 11), ecosystem mapping (Appendix 11-A) and the project design;
- minimization of all clearing dimensions during construction activities as invasive species thrive in recently disturbed areas where there is little shade and competition from other plant species;
- minimization of soil degradation by adhering to the Site Preparation and Soil Salvage Management Plan and Erosion and Sediment Control Management Plan (Sections 24.4 and 24.5, respectively);
- conduct periodic vehicle inspections for target invasive plants, and ,if present, ensure vehicles are properly washed at an appropriate location where the removal of dirt or plants can be effectively achieved without harm to natural ecosystems;
- detection and eradication of invasive plants through implementation of an effective early detection system, inventory, control, and monitoring program
- provision of appropriate education, educational materials, and training through a central resource for employees and contractors, including those responsible for moving equipment to the site, in a brief document (a series of fact sheets or small handbook) defining invasive plants are, why they matter, and how to avoid their introduction and spread during regular operations;
- invasive species references currently available for use include, but are not limited to the following:
  - Invasive Plant Committee Peace River Regional District (IPCPRRD) Strategic Plan and Profile of Invasive Plants and Noxious Weeds (Peace River Regional District 2014);
  - Best Practices for Managing Invasive Plants Along Roadsides: A Pocket Guide for British Columbia's Maintenance Contractors (Invasive Species Council of British Columbia 2014);
  - Invasive Species Council of BC website (T.I.P.S. brochures); identification of key plant species, with pictures and brief habitat and management information (Invasive Species Council of British Columbia 2014);

  - Forest and Range Practices Act (FRPA): Invasive Plants Identification Field Guide (Province of BC 2008); developed to help identify the FRPA-listed invasive plants throughout BC; also provides basic habitat and impact information;
  - Field Guide to Noxious Weeds and Other Selected Invasive Plants of British Columbia (Cranston, Ralph, and Wikeem 2002); and
  - Guide to Weeds in British Columbia (BC Ministry of Agriculture Food and Fisheries 2002); and
- Provision of enhanced training in existing provincial legislation, ecology, available data entry tools, and reporting programs related to invasive plant management to the Project's Environmental Manager, to ensure that the Manager is qualified to assume responsibility for the Invasive Plant Management Plan and achievement of its stated performance objectives.

The primary focus of the Invasive Plant Management Plan is to maintain and/or restore ecosystem integrity in order to avoid the introduction and spread of invasive plants. However, due to the amount of ground disturbance and traffic associated with Project activities, ecosystem integrity at times may be compromised and thus susceptible to invasive plant introduction and spread. The following section outlines ways in which to address invasive plant populations in the event that they occur.

24.11.4.2 Pre-construction Baseline Inventory

An invasive plant survey will be conducted pre-Construction to determine the presence and extent of invasive species. This will ensure that existing invasive species in these locations are not erroneously reported as Project-caused, and will enable spot treatments to minimize potential for further spread. Optimal inventory dates specific to the Project area and/or target species will be determined through consultation with the IPCPRRD. Surveys of vulnerable (e.g., along roads) or cleared areas will be conducted to identify whether or not invasive plants have been established.

24.11.4.3 Treatment and Control

In the event invasive plants are identified on site, the IPCPRRD or an appropriate authority will be consulted to determine if control or monitoring is required. If control is required, appropriate treatment options and timing will be addressed. The appropriate treatment for invasive plants depends on several factors, including the species involved and the size of infestation. Invasive plant species vary in their aggressiveness and ability to dominate a site, so some are inherently easier to eradicate than others. Larger infestations are also more difficult to control than smaller ones. The IPCPRRD ranks species and site conditions, and provides a guide for determining if, when, and how to control different invasive plants in northeast BC (Peace River Regional District 2014).

Potential treatment options include mechanical, biological, and chemical methods. Mechanical control adopts physical means of removal, such as pulling by hand. Biological control uses living organisms, such as insects, to control pest populations of invasive plants, and chemical control uses herbicides to reduce and eradicate plant populations.

If herbicide use is deemed a recommended treatment, the Handbook for Pesticide Applicators and Dispensers (BC MOE 2005) provides detailed methodology for treatment activities and includes measures (including designation of pesticide-free and no-treatment zones) to protect water-bodies and riparian areas. To the extent possible, approved herbicides will be applied using spot-control methods rather than broad spraying techniques to minimize adverse effects to the surrounding environment.

24.11.5 Monitoring and Reporting

The aim of the Monitoring Program is to evaluate and document if the Invasive Plant Management Plan is successfully preventing the introduction and spread of invasive plants resulting from the Construction, Operation, Decommissioning and Reclamation, and Post-closure activities of the Project.

Monitoring of cleared sites will be conducted once per year to ensure they are re-vegetated 1) with seeds (and/or plants) suitable for the local area and ecosystems; 2) during the appropriate growing season and conditions to ensure maximum survival rate and to avoid establishment of invasive plants; and 3) to facilitate the re-establishment of ecological functions and their associated attributes (e.g., species diversity and productivity). The results of the annual site visits will determine if follow-up monitoring in the same year is required to ensure that the stated objectives are being achieved, and to determine if future monitoring is required. This information will be collected using a monitoring form designed specifically for the Project.

Additional monitoring will occur annually at the Mine Site to determine the presence/absence of invasive plants. The timing of the surveys will be determined by the Environmental Manager (or designated qualified personnel) based on plant phenology (e.g., timing of biological activities such as flowering, propagation, and seed dispersion).

To further develop the provincial invasive species database, occurrences will be entered into the "Report-a-Weed" Program, a provincial online mapping and reporting tool associated with the Invasive Alien Plant Program (IAPP) Application within the same year as the surveys. Once the data (report) are entered, they are automatically compared to known locations of the reported species in the IAPP Application, and are then sent directly to a provincial Invasive Plant Specialist for the region.

Treatment (mechanical, biological, and chemical IPM) areas will be monitored annually post treatment to determine the efficacy of efforts. Monitoring will be documented using one of the IAPP forms, available through the Ministry of Forest, Lands and Natural Resources (BC MFLNRO 2013), to ensure that the data are collected in accordance with the required data fields for the provincial IAPP database resource. Depending on the status of the site, follow-up monitoring and treatment may be required.

The Environmental Manager (or designated qualified staff) will disseminate the performance objectives and actions with all Project personnel that have the potential to directly or indirectly influence vegetation, soils, or ecosystems on site.

Monitoring will occur once annually (between June and September) during Construction and Decommissioning and Reclamation. Monitoring during Operations will occur once every two years. Additional monitoring schedules will be determined for Post Closure depending on the amount of ground disturbance activities, but will occur at least once every five years.

The following items will be included in the annual reporting of the environmental monitoring inspection reports.

- Records of inventory, treatment, monitoring, and restoration activities will be summarized into an annual report. A photographic record of surveyed locations as well as a copy of all data forms filled in for that year will be included in the report. Collectively, this information will be used as a means of tracking progress and determining future management activities.
- Quality assurance and quality control protocols will be employed to ensure data accuracy, such the correct use of plant species names, accurate transcription of data from field cards, and an assessment of data completeness
- The effectiveness of the inventory, treatment, and monitoring methodologies will be assessed, and actions taken to improve the program will be described if relevant.
- Emerging negative environmental trends will be identified that are likely attributable to the Project. Changes to the Invasive Plant Management Plan through the continual improvement process will be discussed.

24.11.6 Responsible Persons

Environmental Manager

The Project's Environmental Manager will ultimately be responsible for the development, implementation, and monitoring of the Invasive Plant Management Plan and will

- ensure that the Performance Objectives are achieved and reported; and
- ensure invasive plant management strategies are implemented.

24.12 WILDLIFE

The wildlife management plan outlined below was developed for the bulk sample phase of the Project and will continue to be implemented for the full mine development and operation.

24.12.1 Purpose

The Plan is designed to minimize the potential effects on wildlife during the construction and operation of the Project while taking into account operational requirements and the safety of Project employees. The Plan focuses on reducing the risk of direct wildlife mortality, mitigating the potential for human-wildlife conflicts, and minimizing the level of disturbance to wildlife during Project construction and operation. Consistent with HD Mining's commitment to continual improvement, wildlife management for the Project will take an adaptive management approach and incorporate best management practices. It is recognized that wildlife management strategies will need to be periodically reviewed and updated based upon the outcome of initial management practices and revisions to best management procedures and methods. The review process will be guided by re-examining up-to-date best management practices as further research findings and guidelines from regulatory agencies and scientific studies become available.

24.12.2 Legislation and Standards

The BC Ministry of Forests, Lands and Natural Resource Operations (BC MFLNRO) Region 7B (Peace Zone) manages wildlife in the area. The Pacific/Yukon Region of Environment Canada is the federal agency responsible for wildlife and species at risk in the area. Legislation, regulations, policies, standards, and guidelines pertaining to the protection of wildlife and wildlife habitat are enforced under both federal and provincial legislation, as listed in Table 24.12-1. Standards and best practices are guiding statements that allow development to occur in a way that will avoid, limit, or mitigate effects on aquatic and riparian habitats, water quality and quantity, fish and wildlife species, and public safety and property. Standards are defined as a regulatory requirement that must be followed or achieved in the design and completion of developments (BC MWLAP 2004b). Best management practices are recommended methods or techniques that should be followed to ensure the standards are met and effects are mitigated (Table 24.12-1).

24.12.3 Objectives

24.12.3.1 Objectives

1. Reduce disturbance and mortality during sensitive wildlife periods.
2. Reduce disturbance and mortality related to roads and traffic.
3. Reduce disturbance and habitat avoidance related to traffic and mine noise.
4. Reduce human-wildlife conflicts.
5. Monitor Project effects on wildlife.

24.12.4 Actions to Avoid, Control, and Mitigate

24.12.4.1 Management of Project Activities during Sensitive Wildlife Periods

For each wildlife VC, there are time frames during which wildlife are particularly sensitive to disturbance and habitat alteration (e.g., breeding). Table 24.12-2 summarizes the key sensitive periods for each wildlife VC applicable to the Project, and highlights legislation or best management practices relevant to each VC.

Where possible, Project activities will avoid disturbing wildlife VCs during sensitive periods, particularly during construction (e.g., vegetation clearing). If avoidance is not possible, pre-construction clearing surveys should be conducted (e.g. to identify nests or dens that must be avoided). These surveys are described for each VC.

During the construction phase and where required during operation, an Environmental Monitor will be on site to identify sensitive wildlife features and implement appropriate procedures to minimize potential adverse effects to these areas.

Table 24.12-1. Wildlife Legislation, Regulation, Policy, Standards, and Guidelines

Name	Year	Type	Level of Government or Industry	Description
Migratory Birds Convention Act	1994	Act	National	This Act prohibits the killing of migratory birds or depositing harmful substances in areas frequented by migratory birds, and also protects their eggs and nests.
Species at Risk Act (SARA)	2002	Act	National	This Act offers legal protection and conservation of wildlife species in Canada. Species are identified as special concern, endangered, threatened, and extirpated; species are managed for conservation and/or recovery. The Act prohibits the identified wildlife from being harmed or harassed and the residence (nest or den) of the species from being damaged or destroyed. SARA applies to federal lands, unless the identified species is also protected under the *Migratory Birds Convention Act*; SARA would then apply to both federal and provincial lands.
Wildlife Act	1996n	Act	Provincial	Multiple sections protect wildlife by outlining rules in regards to hunting, taking, trapping, wounding, and/or killing wildlife. Specifically, Section 34 of the Act protects birds, eggs, and occupied nests from possession, molestation, injury, or destruction.
Water Act	1996k	Act	Provincial	This Act ensures that water quality, fish and wildlife habitat, and the rights of license users are not compromised.
Forest and Range Practices Act (FRPA)	2002	Act	Provincial	Wildlife Habitat Areas (WHAs) are designated by the Ministry of Forests, Lands and Natural Resource Operation (MFLNRO) and are associated with the Identified Wildlife Management Strategy under the provisions of the *Forest and Range Practices Act* (2004). The RSA overlaps one approved WHA for the Quintette caribou herd. The *Government Actions Regulation*, from the *Forest and Range Practices Act* (2004), outline the authority for establishing Ungulate Winter Ranges (UWRs). An order was given, establishing an UWR (U-9-002) for mountain goat and northern population of woodland caribou that overlap the RSA (BC MOE 2006).
Management Unit Regulation	2012	Regulation	Provincial	British Columbia is divided into 225 Wildlife Management Units (WMUs). The RSA overlaps within the Peace Zone Region 7: WMUs 7-20, 7-21, and minor portions of 7-22.

(continued)

Table 24.12-1. Wildlife Legislation, Regulation, Policy, Standards, and Guidelines (completed)

Name	Year	Type	Level of Government or Industry	Description
BC Environmental Assessment Guidelines for Grizzly Bears and Black Bears	2001	Guideline	Provincial	Guidelines for project reports, Environmental Assessment project applications and Cumulative Effects Analysis in regards to grizzly and black bears and their associated habitat.
Best Management Practices for Amphibians and Reptiles in Urban and Rural Environments in BC	2004	Guideline	Provincial	Guideline to maintain amphibian and reptile populations in areas of development.
Best Management Practices for Raptor Conservation during Urban and Rural Land Development in BC	2005	Guideline	Provincial	Guidelines to maintain raptors and raptor habitat in areas of development.
Develop with Care 2012: Environmental Guidelines for Urban and Rural Land Development in BC	2012	Guideline	Provincial	Guideline to maintain environmental values in areas of development.
Environmental Best Management Practices for Urban and Rural Land Development: Special Wildlife and Species at Risk	2004	Guideline	Provincial	Guideline to protecting species wildlife and species at risk in areas of development.
Migratory Birds Environmental Assessment Guide	1998	Guideline	Federal	Guideline focuses on migratory bird requirements.
Riparian Management Area Guidebook	1995	Guideline	Provincial	Guideline for forestry activity in riparian areas.
Suggested Practices for Avian Protection on Power Lines: The State of the Art in 2006	2006	Guideline	Industry	Guideline to maintain or enhance avian populations in areas of electric power networks.
Standards and Best Practices for Instream Works	2004	Guideline	Provincial	This guideline outlines applicable legislation and promotes the best practice for conducting activities.
Wetlands Environmental Assessment Guideline	1998	Guideline	Federal	Guideline that incorporates wetland policy and the ecosystem component from the CEAA (2012).
Wetland Ways: Interim Guidelines for Wetland Protection and Conservation in BC	2009	Guideline	Provincial	Guideline for development near wetlands.
Wildlife Guidelines for Backcountry Tourism/Commercial Recreation	2006	Guideline	Provincial	Guideline for maintaining wildlife populations and wildlife habitat when conducting backcountry tourism or commercial recreation.

Table 24.12-2. Wildlife Sensitive Periods, Guidelines, and Recommended Minimum Target Buffer Distances for Important Species and Sensitive Wildlife Habitats

Species	Sensitive Period[1]	Sensitive Habitat	Guidelines	Target Buffer Distance	Applicable Legislation and Standards
Moose/Elk	January to March	High quality moose winter range	• Prior to construction, a map of environmentally sensitive habitat will be produced. This map will guide mitigation during clearing and for road management.	• 500 m from high quality winter range.	• Develop with Care: Environmental Guidelines for Urban and Rural Land Development in BC
	May 15 to July 15	Spring calving period	• Vegetation clearing within areas of moderately high to high quality moose winter habitat will be scheduled outside of the designated wildlife sensitive periods. • If construction must occur during the sensitive period, preconstruction surveys will be conducted, followed by intensive monitoring of the construction area if moose are observed. A buffer around high quality winter range will be maintained when moose are present.	• 500 m from spring calving range.	
Grizzly Bear	Fish species and site dependent	Salmon spawning reaches during spawning period	• Work crews will not undertake work within or adjacent to riparian areas of salmon bearing streams at times and in locations that contain multiple numbers of bears feeding. • Should areas where grizzly bears are feeding on spawning salmon be observed, work crews will avoid disturbing the feeding bears by adhering to the "no work" setback buffer zones.	• Minimum block size of 20 ha recommended. • 60 m to 100 m from salmon bearing streams during feeding.	• Develop with Care: Environmental Guidelines for Urban and Rural Land Development in BC • Wildlife Habitat Features – Summary of Management Guidelines – Northern Interior Forest Region

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Table 24.12-2. Wildlife Sensitive Periods, Guidelines, and Recommended Minimum Target Buffer Distances for Important Species and Sensitive Wildlife Habitats (continued)

Species	Sensitive Period[1]	Sensitive Habitat	Guidelines	Target Buffer Distance	Applicable Legislation and Standards
Black Bears	December to April (Hibernation period)	Dens	• Vegetation clearing will be scheduled outside of the black bear hibernation period within high quality denning habitat (i.e., cedars and hemlocks found in the Interior Cedar Hemlock (ICH) biogeoclimatic (BEC) zone). • If clearing must be completed during the hibernation period, pre-construction surveys for dens will be conducted to identify areas where tree clearing will be prohibited. A forested buffer zone will be maintained around active dens. • If an active den cannot be avoided or work must be undertaken within buffer areas, the relevant regulators will be consulted to develop appropriate strategies.	• Forested buffer zones of 1 tree length radius or 100 m around any identified active dens trees will be maintained.	• Wildlife Habitat Features – Summary of Management Guidelines – Northern Interior Forest Region • Develop with Care: Environmental Guidelines for Urban and Rural Land Development in BC
Fisher & American Marten	March 1 to May 31 (Birthing period)	Dens	• Vegetation clearing will be scheduled outside of the fisher and marten birthing period within high quality denning habitat such as cedars and hemlocks found in the Interior Cedar Hemlock (ICH) biogeoclimatic (BEC) zones. • If clearing must be completed during the breeding period, pre-construction surveys for dens will be conducted in high quality denning habitat to identify areas where tree clearing will be prohibited. A forested buffer will be maintained around identified active dens. • If an active den cannot be avoided or work must be undertaken within buffer areas, the relevant regulators will be consulted to develop appropriate strategies.	• Forested buffer zones around any identified active dens will be maintained.	• Wildlife Habitat Features – Summary of Management Guidelines – Northern Interior Forest Region • Develop with Care: Environmental Guidelines for Urban and Rural Land Development in BC

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Table 24.12-2. Wildlife Sensitive Periods, Guidelines, and Recommended Minimum Target Buffer Distances for Important Species and Sensitive Wildlife Habitats (continued)

Species	Sensitive Period[1]	Sensitive Habitat	Guidelines	Target Buffer Distance	Applicable Legislation and Standards
Bats (including Northern myotis)	October to May	Hibernaculum	• Pre-clearing surveys will be conducted for bat hibernaculum if construction activities are to occur between wildlife sensitive periods. Surveys will only be conducted if there are known roosting sites in the area, and surveys for hibernaculum will only be conducted in summer months to avoid disturbing hibernating bats.	• A buffer of at least 125 m radius will be maintained around hibernacula and maternity roosts.	• Wildlife Habitat Features – Summary of Management Guidelines – Northern Interior Forest Region (BC MWLAP 2004d)
	June to August	Maternity Roosts	• If hibernacula or maternity roosts are identified in the Project area, a buffer will be maintained. The loss of high quality bat habitat will be minimized. Some snags and stumps will also be retained to provide additional habitat for bat species such as long-eared myotis that use tree crevices.		
Raptors	March 1 to August 15	Nesting/ fledging	• Vegetation clearing, construction, blasting, and other disturbance will be avoided within these buffer zones between wildlife sensitive periods. • Prior to construction activities, a reconnaissance survey for large raptor nests will be conducted. Intact nests are protected under Section 34 of the Wildlife Act. • If nests of raptors are found within the Project area a forested buffer zone free of human disturbance will be established around the tree of occupied nests to provide perching and roosting sites and security cover. • If raptor nests are found outside of the nesting period, BC MOE will be contacted for a permit to move or destroy the nests in order to conduct clearing activities.	• Avoid construction, blasting, or helicopter disturbance within 200 to 500 m of the nest tree within sensitive period. • Establish a forested buffer around the tree of 100 to 300 m (dependent on species).	• BC *Wildlife Act* Section 34: protects the nests of eagles, peregrine falcons, gyrfalcons and ospreys year round (1996n) • Develop with Care: Environmental Guidelines for Urban and Rural Land Development in BC • Wildlife Habitat Features – Summary of Management Guidelines – Northern Interior Forest Region (BC MWLAP 2004c)

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Table 24.12-2. Wildlife Sensitive Periods, Guidelines, and Recommended Minimum Target Buffer Distances for Important Species and Sensitive Wildlife Habitats (continued)

Species	Sensitive Period[1]	Sensitive Habitat	Guidelines	Target Buffer Distance	Applicable Legislation and Standards
Waterbirds	April 1 to 30 (Breeding period)	Breeding wetlands & nests	• Vegetation clearing activities will be scheduled outside of the general breeding bird period for waterbirds. • If clearing must be completed during the breeding period, pre-construction surveys will be conducted to identify locations of active nests, ideally a maximum of seven days prior to the scheduled clearing. • If any nests are identified, buffer zones will be maintained throughout the breeding season.	• Buffer zones of 30 m around any identified active nests will be maintained.	• Wildlife Habitat Features – Summary of Management Guidelines – Northern Interior Forest Region (BC MWLAP 2004c) • Migratory Birds Environmental Assessment Guideline (Milko 1998)
Landbirds	May 1 to July 31 (Breeding period)	Tree and ground nests; fledging	• Vegetation clearing activities will be scheduled outside of the general breeding bird period for landbirds. • If clearing must be completed during the breeding period, pre-construction surveys will be conducted to identify locations of active nests, ideally a maximum of seven days prior to the scheduled clearing. • If any nests are identified, buffer zones will be maintained throughout the breeding season.	• Buffer zones of 30 m around any identified active nests will be maintained.	• Wildlife Habitat Features – Summary of Management Guidelines – Northern Interior Forest Region (BC MWLAP 2004c) • Migratory Birds Environmental Assessment Guideline (Milko 1998)
Western Toads	May to August	Breeding ponds	• Construction activities will be avoided in areas adjacent to potentially high quality western toad breeding habitat during sensitive periods.	• If breeding ponds are observed, a buffer zone of 150 m will be established.	• Best Management Practices for Amphibians and Reptiles in Urban and Rural Environments in BC (BC MWLAP 2004a)

(continued)

Table 24.12-2. Wildlife Sensitive Periods, Guidelines, and Recommended Minimum Target Buffer Distances for Important Species and Sensitive Wildlife Habitats (completed)

Species	Sensitive Period[1]	Sensitive Habitat	Guidelines	Target Buffer Distance	Applicable Legislation and Standards
Western Toads *(cont'd)*	August to October	Fall toadlet dispersal	• Where avoidance of sensitive time periods is not possible, pre-construction surveys will be conducted for amphibian presence. • If toads are observed, working areas will be outside the established buffer zone and, where required, temporary fencing may be used to prevent access to critical toad habitats. • A salvage program for adult western toads will be implemented in the spring if wetlands will be lost due to infrastructure displacement or loss of functionality. Salvaging may occur at discrete times corresponding to construction activities.		• Develop with Care: Environmental Guidelines for Urban and Rural Land Development in BC • SARA (Schedule 1)

[1]*Wildlife Sensitive Periods were selected based on those reported by the Ministry of Forests, Lands, and Natural Resource Operations for the Omineca-Peace Region (BC MFLNRO 2011).*

The following are the goals of managing Project activities during wildlife sensitive periods:

- Avoid and/or reduce human-caused disturbance in areas that contain known wallows, particularly during the ungulate breeding season (Table 24.12-2);
- Minimize loss of high quality habitat and disruption to movement;
- Maintain known and potential mineral licks in a natural state and ensure ungulates have access to them during the season when they are most used (Table 24.12-2);
- No destruction or disruption of active black bear dens during site clearing in the construction phase and during the operation phase of the Project;
- No destruction or disruption of active fisher or marten dens during site clearing in the construction phase and during the operation phase of the Project;
- No destruction or disruption of bat hibernacula or maternity roosts during site clearing in the construction phase and during the operation phase of the Project;
- No destruction or disruption of active raptor nests during construction and operation. Inactive raptor nests or nests found outside of the breeding season will also be maintained or relocated, in consultation with appropriate regulators (BC Wildlife Act, 1996n; BC MOE 2013).
- No destruction or disruption of active landbird and wetland bird nests during site clearing for the construction phase and during the operation phase.
- No mortality of amphibians, particularly protected species (western toad).

24.12.4.2 Road and Traffic Management

Management protocols for the access road and highways are outlined in this section. If repeated wildlife conflicts or observations are found in particular areas, the wildlife mitigation and monitoring plan will be reviewed and adapted as necessary. Additional mitigation measures could include increasing the line-of-sight, altering speed limits, and active wildlife warning systems.

The primary objective of Road and Traffic Management, as it applies to wildlife, are to avoid vehicle/wildlife interactions and to minimize disturbance to wildlife. The following wildlife-vehicle interaction protocols will be implemented to minimize and monitor wildlife mortalities:

- Wildlife will be given the right-of-way along access roads and the highway;
- Speed limits will be posted and enforced along Project specific roads. Project vehicles will also adhere to open road speed limits for highways. Road signs will be installed along Project roads to alert drivers of speed limits and of wildlife sensitive areas such as migration routes and seasonal feeding areas. Workers will be informed about potential wildlife travel corridors along the access roads and applicable mitigation;

  Collisions between vehicles and wildlife will be documented and will include information on the location of the collision along the access roads and along the highway. All information on collisions and carrion spotted by Project vehicles along all project roads, Murray River Road, Mast Road or Hwy 52 will be shared with relevant government agencies

(Ministry of Transportation and Infrastructure). Locations where wildlife collisions take place will be prioritized for adaptive mitigation. Road kills will be reported and disposed of as quickly as possible to avoid the attraction of carrion feeders to the road. Carcasses will be disposed of in an appropriate manner, or moved as far away as possible from the roadside;

- Any encounter with wildlife (including observations or interactions) will be reported and recorded. Reports should be made over the radio to alert other operators that there is wildlife in the area and to travel with caution. These records will provide a basis for identifying locations of considerable risk for wildlife/vehicle collisions, if they occur, and for developing appropriate mitigation strategies for those areas. When large numbers of wildlife (e.g., moose) are present on or adjacent to the road, a temporary road closure may be instigated at the discretion of the Environmental Monitor;
- Ditches and culverts along the Project roads will be designed to minimize pooling of water. Roadside pools that are formed will be monitored for toad breeding activities;
- Vegetation management will be incorporated on Project roads to reduce site attractiveness, and road way edges will be cleared to increase visibility of wildlife to drivers (e.g., a cleared buffer zone of appropriate size, such as 3 m). Refuge areas will be ploughed along Project roads during winter and gaps in snow banks on roads will be created at best spacing to allow an escape for wildlife such as moose;
- The use of road salts along Project specific roads for winter road management will be avoided to reduce the potential of attracting ungulates to the road. Sand or stone chippings will be used as the preferred methods to provide winter traction; and
- Dust production from moving vehicles will be managed through enforced speed limits and the use of dust suppressants. Water will be used as the preferred dust suppressant to avoid calcium chloride or other chemicals attracting wildlife to the road. If this approach is not successful, alternatives will be investigated taking into account wildlife sensitivities.

Monitoring

All truck drivers will be required to report wildlife sightings, encounters, and collisions/mortalities along the access road and highways. The location (nearest 1 km road marking, landmark or GPS location), species identified, number of individuals, and behaviour and condition of the animal will be recorded, and monthly sightings/mortalities will be summarized to identify encounter "hot-spots". This information may be used to further mitigate conflicts between road users and wildlife. Additionally, descriptions of any potential wildlife attractants along the road (e.g., food resources), and any potential wildlife hazards along the road (e.g., high snow banks) will be reported when observed and will be mitigated using appropriate measures.

24.12.4.3 Noise Management

During construction and operation, wildlife may be disturbed by traffic and mine operation noise. Blasting related noise will occur during the initial decline shaft development. As the site development continues underground, airborne noise and vibration will decrease as it is absorbed by the ground. The objective of Noise Management for wildlife is to ensure that noise levels during all phases of the Project are acceptably low for wildlife receptors of concern in the vicinity of the

Project. The following noise mitigation measures for construction and operation will be implemented where applicable and practical:

- Excessive noise generating activities will be avoided during sensitive wildlife periods;
- "Best Available Control Technologies" will be used for noise control where practical, such as silencers and mufflers; and
- If fixed-wing aircraft and helicopters are being used for the Project in areas identified as sensitive to wildlife, flight paths and schedules will be set to minimize disturbance.

24.12.4.4 Waste and Attractant Management

Features or substances that interest or may be resources to wildlife are considered to be wildlife attractants. Within the Project area, the following may be potential wildlife attractants: standing waters, waste, waste storage facilities, buildings, and lights. The following potential effects and concerns exist for wildlife due to Project-specific attractants:

- Potential for wildlife to be attracted to Project sites by the presence of waste and waste management facilities.
- Potential for wildlife to ingest or use poor-quality water sources as habitat, and thereby become exposed to metals and/or other substances.
- The road may act as an attractant (scavenging road-killed carrion) which may increase risk of vehicle-wildlife interactions and road-related mortality (direct mortality).
- Artificial light on infrastructure as an attractant to migratory birds, which may result in bird disorientation and increase risk of direct mortality (i.e., collisions and disruption of migration).

Effective waste and attractant management is essential in areas where wildlife, particularly bears, overlap with development. The best way to deal with the potential for negative human-bear interactions is to avoid them through waste management. Construction Waste Management Plans would be followed and adhere to Waste Disposal (Part 2, Section 6) and Hazardous Waste Storage and Disposal (Part 2, Section 9) of the BC *Environmental Management Act* (2003) in addition to other federal and provincial regulations guiding Construction Waste Management. The objectives of waste and attractant management are to ensure that no interactions between wildlife and construction and operation waste occur, and that there are no impacts to wildlife due to project construction and operation waste. The following actions will be implemented to minimize interactions between wildlife and the Project:

- All waste will be stored inside buildings, bear-proof compounds, or in wildlife-proof containers;
- All workers will be educated on waste management policies that limit human-wildlife interactions and will assist in keeping the risk of encounters to a minimum;
- Waste disposal facilities will be inspected for signs of wildlife presence (i.e., chew marks on waste, wildlife mediated waste dispersion, wildlife scat or tracks, etc.);

- Monitoring of waste bins, incinerators and landfills will be conducted every two weeks. If evidence of wildlife presence or access to waste disposal facilities is detected, or a waste disposal compliance problem is detected, survey frequency will be increased. If no wildlife attraction or permit compliance issues are detected over a consecutive three month period, monitoring frequency will be reduced to once per month for waste bins, incinerators, and landfills;
- For each case where misdirected waste is observed, the location, date, and time of the observation, as well as the type and amount of waste will be recorded;
- If wildlife is observed interacting with waste, the species observed and number of individual animals will be recorded along with the behaviour and condition of the animal(s), and any damage to the property resulting from wildlife attraction to waste; and
- When monitoring identifies situations where wildlife are accessing waste, and waste disposal practices are not in compliance with permit requirements, a management response will be triggered. The response will assess the situation and determine the cause of the problem. Adaptive management will be developed on a case-by-case basis when waste misdirection is identified.

Standing and Contaminated Water Management

Wildlife, especially waterbirds and bats, may be attracted to standing water. Mitigation measures to reduce the potential for wildlife being exposed to contaminated water include:

- Monitoring the quality of standing water in Project areas, as outlined in the Surface Water Management Plan.
- Employing wildlife exclusion measures if wildlife are observed to be using contaminated water or hazardous liquids.

Sensory Disturbance

Lights are an attractant to many species of wildlife, especially birds and bats. Lighting on infrastructure will be designed to minimize potential impact to wildlife while ensuring safe operating conditions. The following sensory disturbance mitigation measures to reduce sensory disturbance to wildlife include:

- The use of directed lighting rather than broad lighting whenever possible.
- The use of low-pressure sodium lamps, or fitting lamps with UV filters, whenever possible to reduce the effect on bats.
- Directing all lighting into the facility and toward the ground to limit stray light as a visual disturbance.
- Avoiding the design of tall towers requiring the use of solid and pulsating red lights, which seem to be more attractive to birds at night during inclement weather conditions than are white strobe lights (Erickson et al. 2002).
- Limiting times during which lighting is used, particularly between April and September when bats are active.

24.12.4.5 Employee Education

An education program for all employees and contractors will be developed to promote stewardship and limit human conflicts with wildlife. This program will be supported by standard operating procedures (SOPs), standard reporting forms, information sheets, posters, and signage. The education program will include an emphasis on the following points:

- Employee awareness of wildlife sensitive locations and times of year;
- Waste management/wildlife attractant protocols;
- No feeding of or intentionally attracting wild animals;
- Policies banning firearms and hunting;
- Bear awareness training and response plan;
- Operating protocols for the roads; and
- Incidental wildlife reporting and response procedures.

24.12.5 Monitoring and Reporting

The primary objectives of Wildlife Effects Monitoring are to:

- Monitor the direct effects of the Project on wildlife VCs, including mortality, disturbance, and human/wildlife interactions; and
- Monitor the indirect effects of the Project on federally listed wildlife species and species of high value to First Nations in the area.

Monitoring the potential effects of the Project on wildlife VCs includes both incidental observations of wildlife on the Project site, and systematic facilities monitoring to ensure that no Project infrastructure is a danger to wildlife species. This monitoring also evaluates the effects of animals on the infrastructure, such as animals that nest, burrow, or enter facilities buildings. Finally, this monitoring evaluates the usage rate of certain high-profile species in order to drive adaptive management, such as monitoring waterbirds use of water treatment ponds. These monitoring activities include:

- Monitoring of ungulates within the Project footprint will occur throughout construction and operation of the Project. Any incidental observations of ungulates and any interactions with ungulates and infrastructure (e.g., roads, buildings, sedimentation ponds) will be recorded, monitored, and reported to the Environmental Monitor. Areas of predicted high quality habitat will be flagged prior to construction for monitoring and implementation of road signage and other mitigation to reduce wildlife vehicle interactions.
- Moose mortality due to the Project will be reported to the BC MOE, and additional road signage or mitigation will be implemented.
- Moose population and distribution in winter and calving habitat will be monitored within the Project RSA during the lifetime of the Project;

- Moose monitoring will be conducted in relevant Project areas prior to construction activities in high quality habitat that may disturb ungulate species (as per Table 24.12-2);
- Monitoring of grizzly and black bear occurrence, incidents, and mortality will be conducted during construction and operation by the Environmental Monitor. Bear monitoring will include recording bear observations within the development footprint and transportation infrastructure;
- Mortality events involving furbearers will immediately be reported to the Environmental Monitor. Effectiveness of skirting along buildings will be inspected regularly to ensure furbearers are prevented from accessing buildings. Skirting will be repaired as necessary;
- Any incidental observations of large groups of bats will be recorded and reported to the Environmental Monitor. Mortality events of bats will immediately be reported to the Environmental Monitor, and carcasses of unidentified bat species will be sent to the RBC Museum as voucher specimens when possible. Bat interactions with Project infrastructure (e.g., sedimentation ponds, buildings, lighted areas) will be monitored by the Environmental Monitor every two weeks in the evening (because bats are nocturnal) between May and September. Adaptive management may be required if bats are using infrastructure;
- Project infrastructure will be monitored for raptor (and other bird) nests during Project operation by the Environmental Monitor. If raptor nests are observed on Project infrastructure, the Environmental Monitor will be notified immediately and he/she will contact the appropriate regulatory agency for advice;
- Bird monitoring will include recording sightings of large or unusual concentrations of birds, any nests, and any interactions of birds with Project infrastructure, including the access corridors. Bird mortalities will be immediately recorded by the Environmental Monitor and be subject to further investigation. Bird monitoring will also include weekly surveys of Project infrastructure during the nesting season to evaluate if any birds are nesting on infrastructure and guide adaptive management at these locations;
- Wetland bird use of the sedimentation/treatment ponds will be monitored through the migration and breeding periods by the Environmental Monitor during operation, and appropriate steps will be taken to deter birds from the sedimentation/ponds and water treatment areas if deemed necessary. Deterrent systems will be adapted over time and the need to deter birds will be evaluated based on operating experience;
- All incidental observations and mortalities (if any) of western toads will be recorded and reported to the Environmental Monitor. Prior to construction, a comprehensive survey for potential western toad breeding ponds will be conducted in the MSDA and monitored regularly for toad use and success of tadpoles. If breeding ponds are identified in an active development area, an adult salvage program may be implemented if the pond cannot be avoided. If breeding ponds are found during pre-construction surveys, appropriate work buffers and mitigation, including possibly a salvage operation, will be conducted;
- Road-side drainage ditches will be monitored for the presence of toadlets during breeding periods (May to August) by the Environmental Monitor. If aggregations of toads are observed in road-side ditches, mitigation in the form of fencing and work buffers will be

initiated. Once the toads have migrated, the section of ditch will be re-graded to prevent ponding in that area;

- All roads on the Project site will be monitored by the Environmental Monitor for Western toad migrations during periods of peak post-breeding movement (August). Road mortality surveys will be conducted every 2 days through August until toad migration is complete, which usually occurs over a 2 to 3 day period. If migration routes cross the road, appropriate mitigation measures will be implemented.
- All incidental wildlife observations and wildlife incidents will be reported quarterly by the proponent to the BC MOE; and
- The results of all monitoring, incidental wildlife observations, mitigation, and the success of mitigation practices will be reported yearly to the BC MOE.

24.12.6 Responsible Persons

Environmental Manager

The Environmental Manager will:

- maintain the incidental wildlife observations log;
- manage and report on wildlife mitigation and management activities;
- be responsible for monitoring programs and keep a record of all monitoring activities both for on-site technicians and external consultants;
- maintain the database of all on-site monitoring activities; and
- be responsible for periodic reporting to applicable agencies.

24.13 WASTE MANAGEMENT

24.13.1 Purpose

This Waste Management Plan documents the Proponent's approach to waste management and outlines strategies that will be used to process the various waste streams to ensure maximum environmental protection. It will be reviewed regularly and revised as required to incorporate new waste streams and to ensure continued best practices and compliance.

This plan defines "waste" as any material that can no longer be used for its original purpose. It should be noted that this plan focuses on the management of waste generated by normal Project activities. However, emergency response procedures are addressed in the Spill Response Plan (Section 24.18) and Emergency Response Plan (Section 24.19).

The purpose of the Waste Management Plan (WMP) is:

- to protect workers and the public from any potentially adverse effects associated with wastes produced by Project-related activities; and

- to minimize potentially adverse effects to the biophysical environment, particularly fish and wildlife and their associated habitat, while ensuring compliance with regulatory requirements, permit and license obligations, and the Proponent's Environmental Policy; and
- to minimize the risk and cost associated with the recycling, storage, handling, removal, and disposal of waste from all aspects of the Project.

24.13.2 Legislation and Standards

A number of legislative requirements are applicable to waste management and disposal. A short list of these and their major applicable components are provided in Table 24.13-1.

Table 24.13-1. Regulatory Requirements — Selected Examples

Legislation and Regulations	Applicable Information
BC Environmental Management Act (2003)	Prohibits the introduction of waste into the environment in a way that will cause pollution, except in accordance with a regulation, permit, approval or code of practice issued under the Act
Hazardous Waste Regulation (BC Reg. 63/88)	Addresses the proper handling and disposal of hazardous wastes, under the EMA
Waste Discharge Regulation (B.C. Reg. 320/2004)	"Prescribes" which industries and trades are regulated under the EMA
BC Public Health Act (2008)	Provides direction on the management of health hazards
BC Forest and Range Practices Act (2002)	Provides direction on the management of forest insects, disease, animals or abiotic factors causing damage to a forest
Canada Fisheries Act (1985c)	Prohibits the release of a deleterious substance to fish habitat
BC Water Act (1996k)	Provides guidance on wells and groundwater protection
BC Mines Act (1996h)	Provides guidance on the operation and reclamation of existing and abandoned mines
Health, Safety and Reclamation Code for Mines in British Columbia (BC MEMPR 2008)	Provides direction regarding the protection of worker health and safety at mines and exploration sites
BC Wildlife Act (1996n)	Provides guidance on the disposal of animal remains
Canadian Environmental Protection Act (1999)	Provides guidance on the preparation of pollution prevention plans
Canada Hazardous Products Act (1985)	Provides direction on the sale, importation, and advertising of hazardous products
Controlled Products Regulation (SOR/88-66)	Defines regulations respecting controlled products, including provision of material safety data sheets
Transportation of Dangerous Goods Act (1992), Transportation of Dangerous Goods Regulations (SOR/2001-286)	Includes a substance classification system and specifies requirements for transportation of dangerous goods

24.13.3 Objectives

The objectives for waste management on the Project site include:

- to comply with all applicable federal and provincial legislation, regulations or permit conditions;

- to ensure all employees and contractors on site receive task-appropriate training in waste management practices and are informed of updates to procedures on a timely basis;
- to ensure every work area will have a designated waste collection or disposal area and that every waste collection or disposal area will have designated and secure areas or containers for disposal of specific waste types; and
- to use information on generation of waste to inform reduction policies that will improve the efficiency of the use of project resources.

In order for the Waste Management Plan and its associated procedures to function to their full efficiency, all personnel on the site must be made aware of the plan and their corresponding responsibilities. All Project personnel, including contractors, need to be active participants in implementation of the Waste Management Plan.

24.13.4 Actions to Avoid, Control, and Mitigate

The Waste Management Plan focuses on the wise use of resources, which includes the four R's: reduce, reuse, recycle, and recover. Where possible, all of these methods will be used to minimize the quantity of waste materials that must be disposed of. The following section contains an overview of the anticipated types and sources of waste that will be generated over the life of the Project, a description of general actions incorporating the four R's. Where possible, all of these methods will be exhausted before disposing of waste materials.

24.13.4.1 Overview of Waste Types and Sources

The Project will generate several forms of industrial and domestic waste throughout the life of the Project. The types of waste that will typically be generated during Construction, Operation, Decommissioning and Reclamation, and Post Closure of the Project are listed in Table 24.13-2. With respect to hazardous materials, note that the table refers to the types of wastes generated rather than the type of management that the materials may require.

Waste Reduction

Reducing the amount of material that is consumed is the most effective way of reducing the amount of waste that is generated. Consumption will be assessed by evaluating all procedures, processes, and consumed materials for possible reductions in raw material usage, as well as possible reductions in generated waste volumes. Examples of waste reduction include:

- product review, selection, and substitution - recyclable/reusable and non-hazardous materials will be used instead of non-recyclable/non-reusable and hazardous materials;
- ordering chemicals or lubricant products in bulk/returnable containers;
- keeping a workable minimum inventory to prevent expiration of products and resulting generation of waste;
- decreasing the amount of solid waste by reducing the use of disposable items;
- training personnel on waste minimization and reuse; and

- decreasing the amount of packaging on supplies by requesting that the suppliers provide less packaging materials on over-packaged products.

Table 24.13-2. Potential Domestic, Industrial, Chemical and Hazardous Waste Generated at the Murray River Project

Type of Waste	Example of Waste	Type of Waste	Example of Waste
Domestic Waste	Aluminum cans and glass	Industrial Waste *(cont'd)*	Scrap wood
	Domestic garbage		Steel balls
	Paper materials		Tires
	Plastics		Transformers
	Treated sewage		Vehicle parts
	Putrescible food waste		Wiring
Industrial Waste	Aerosols	Chemical and Hazardous Waste	Acids
	Batteries		Biohazardous waste (first aid room waste)
	Building materials and bulk debris		Glycol
	Cement		Hydraulic oil
	Conveyor belt parts		Laboratory chemicals
	Culvert pieces		Oil filters
	Fluorescent light ballasts		Oily rags
	Glass		Sharps (razors, needles)
	Insulation material scraps		Solvents
	Packaging		Used absorbent pads
	Rebar		Used oil
	Scrap metal		

24.13.4.2 General Actions to Avoid, Control, and Mitigate

Material Reuse

Materials brought to the Project site should be used to the maximum extent possible, and where applicable, reused on the site. Examples of reusable materials include:

- scrap metal, conveyor belt parts, and wood;
- chemical containers that can be returned to the supplier to be refilled; and
- waste oils, glycols, and solvents that can be reused.

Recycling

A recycling program will be incorporated at the Project in order to minimize waste streams efficiently. The program will recycle as many products as possible on site (e.g., salvageable lumber and scrap metal, paper, cardboard, and salvageable parts from vehicles).

Other recyclable materials will be shipped off-site to the nearest recycling facility. Products that will be shipped off-site include:

- used oil filters (oil removed, crushed, and recycled separately);
- used batteries;
- plastic petroleum pails;
- used/damaged auto parts;
- oil-based paints; and
- empty drums.

Recovery

Recovery is the final level of waste minimization and involves extracting usable material or energy as a by-product for other uses. Opportunities for recovery will be evaluated throughout the life of the Project.

24.13.4.3 Waste Collection Areas

The waste collection areas will function as a temporary storage area for waste until it is recycled/ reused, processed, or transferred to the appropriate approved recycling or disposal facilities or landfill. The waste collection areas will be properly designed to contain and prevent contamination of the environment.

They will also be designed to adequately and safely store a sufficient quantity of waste over a prescribed time limit of one to three months. Where required, the waste collection areas will be covered and fenced to prevent attraction of wildlife and to provide protection from weather.

Additionally, hazardous waste disposal facilities will be adequately designed to contain spills.

The waste collection area will consist of three parts:

1. Recycle/Reuse Area: This area will contain the items that can be recycled/reused on the site. Inert materials to be stored in this area include: tires, scrap metals, and waste wood. These items will be placed in designated containers or areas within the recycle/reuse area of the waste collection area. This method will allow personnel to search the recycle/reuse area of the waste collection area for materials to reuse. Once these containers or areas become full, the contents will be either disposed of in a designated on-site facility or shipped off-site for recycling at an approved facility.
2. Hazardous Waste Area: The hazardous waste area will contain hazardous waste that is required to be shipped off-site. Hazardous waste, including used glycol, acids, solvents, oil that cannot be burned in incinerators, oily rags, absorbent pads, hydraulic fluid, and any other hazardous chemicals, will be stored in a secondary containment area. Hazardous waste will not be permitted to accumulate to excessive volumes, but will be shipped off-site to avoid crowding.

3. Removal Area: This area will contain waste that will be disposed of in an off-site facility. Waste temporarily stored for removal will include domestic and industrial waste that is not hazardous or recyclable.

The waste in the waste collection areas will be segregated and stored using accepted management practices including, but not limited to, the following:

- Fire prevention systems adequately designed for the materials being stored will be used.
- Spill kits, protective equipment, and other necessary equipment to clean and mitigate spills will be used.
- Only containers in good condition will be used to store items.
- Containers and liner materials will be compatible with the waste being disposed.
- Containers and drums will be labelled to identify the waste content and initial date of storage.
- Sufficient storage space between containers to allow for safe access and handling of containers.
- Incompatible waste will not be stored in the same containers and will be stored at a safe distance from each other.

24.13.4.4 Transporting Waste

Reputable certified transportation contractors will be used for the transport of goods and materials to and from the site. Project personnel will periodically inspect the transporters' performance and compliance with British Columbia and federal transport regulations, contract requirements, and overall performance.

24.13.4.5 Management of Hazardous Waste

Hazardous waste will be produced in all Project phases. It includes materials such as waste oil, solvents, lead-acid batteries, oil filters, and used oily rags and absorbent pads. The Hazardous Waste Regulation (BC Reg. 63/88) under the *Environmental Management Act* (2003) provides the relevant definition of hazardous waste.

Hazardous waste requires special handling and training procedures. All employees, contractors, and sub-contractors who are handling hazardous waste for the Project will be provided with Workplace Hazardous Materials Information System (WHMIS) training or required under contract to have that training, so they can identify hazardous waste and know how to handle it appropriately.

Transportation of Dangerous Goods (TDG) training will be provided, or required of employees, contractors, and sub-contractors who are receiving, off-loading, and storing potentially hazardous materials, or involved in the storage and shipment off-site of hazardous waste.

Hazardous waste will be transferred to an approved hazardous waste facility that will issue a certificate of destruction. Periodic audits of this facility to ensure proper handling and destruction of hazardous waste will be considered.

All hazardous materials and dangerous goods will be stored in clearly labelled containers or vessels and handled in accordance with regulations appropriate to their hazard characteristics. Hazardous waste that needs to be disposed of off-site will be transferred to an approved hazardous waste facility that will issue a certificate of destruction.

Table 24.13-3 provides an overview of hazardous waste types, treatment, and disposal. Hazardous waste management is described in more detail below.

Table 24.13-3. Hazardous Waste Types, Treatment and Disposal

Type	Treatment	Disposal
Petroleum Waste		
Used oil	Waste oil shop heaters/off-site recycling otherwise	Oil storage tank at vehicle maintenance shops
Oily rags and absorbent pads	Off-site disposal	Waste collection areas
Oil and fuel filters	Off-site recycling	Waste collection areas
Hydraulic fluid	Waste oil shop heaters/Off-site recycling	Waste collection areas
Chemical Waste		
Glycol	Off-site recycling	Waste collection areas
Acids	Off-site recycling	Waste collection areas
Solvents	Off-site recycling	Waste collection areas
Waste batteries	Off-site recycling	Waste collection areas
Aerosol cans	Off-site disposal in an approved facility	Can puncher/Waste collection areas
Paints	Reuse/off-site recycling	Waste collection areas
Biological Waste	Off-site disposal in an approved facility	Waste collection areas

Petroleum Waste

Petroleum products will be used widely at the Project. The waste generated from the petroleum products will be used oil, diesel fuel, lubricants, gasoline, kerosene, oily rags and absorbent pads, and solvents. These products have to be handled with caution because they can potentially adversely affect the environment. The handling, storage, and spill contingency for petroleum products are outlined in the Emergency Response and Spill Response Plans. To properly manage the petroleum waste stream and make the individual waste streams easier to reuse, recycle or recover, the waste will be segregated into the following classes:

- **Used oil.** Oil will be used for every vehicle, piece of equipment, and generator on the Project site. Used oil will be generated from regular maintenance to these sources. The used oil will be collected and stored in used oil storage tanks located in the vehicle maintenance shops with secondary containment areas. Used oil generated during Construction will be collected in barrels in secondary containment areas at staging areas. The used oil will be reused where possible, such as for fuelling shop heaters, or shipped off-site to a licensed disposal facility for recycling.

- **Oil and fuel filters.** Used oil filters and fuel filters will be crushed and stored in marked barrels. The barrels will be inventoried and stored in the bermed hazardous waste section of the waste collection areas until they are shipped off-site to a licensed disposal facility for recycling. Oily rags and absorbent pads will also be shipped off-site to a licensed disposal facility.
- **Hydraulic fluid.** Hydraulic fluid that is not reused will be stored in marked drums in secondary containment in the vehicle maintenance shops or within the bermed hazardous waste section of the waste collection areas, until it is shipped off-site to a licensed disposal facility for recycling.
- **Petroleum-contaminated soil and rock.** The amount of petroleum-contaminated soils and rocks will be minimized by procedures outlined in the Spill Response and Emergency Response Plans (Sections 24.18 and 24.19). These procedures include precautionary principles such as lining of storage facilities and using secondary containment for fuel storage areas, regular inspection and maintenance of equipment, strategically placed spill kits and absorbent matting, etc. Even with precautions, soil and rock contamination can still occur. Petroleum contaminated soil will be removed to the waste collection area for off-site treatment and disposal.

Chemical Waste

Typical chemical waste will comprise glycol, acids, and solvents. Materials or containers that have chemical implications include spent batteries, aerosol cans, and paints.

- **Glycol.** Glycol (antifreeze) is used in vehicles and various types of equipment. It is a toxic substance that has a negative effect on the environment and can be a wildlife attractant if spilled because of its sweet smell and taste. Used glycol will be stored in labelled containers, which will be inventoried and stored in secondary containment areas of the vehicle maintenance areas or in the bermed hazardous waste section of the waste collection areas until they are shipped off-site to a licensed disposal facility for recycling.
- **Acids.** Old lead acid batteries from vehicles will be labelled, inventoried, and stored in the bermed hazardous waste section of the waste collection areas, until they are shipped off-site to a licensed disposal facility for recycling.
- **Solvents.** Solvents are used as degreasing agents for vehicle and equipment parts. Non-toxic citrus based alternatives, detergents, and jet-streams will be used as much as possible in lieu of petroleum-based solvents. Where petroleum-based solvents are required, they will be recycled to the greatest extent possible until they no longer have their desired cleaning properties before being considered waste. Waste solvents will be stored in labelled containers, which will be inventoried and stored in the bermed hazardous waste section of the waste collection areas until they are shipped off-site to a licensed disposal facility for recycling.
- **Waste batteries.** Rechargeable batteries will be used to minimize the amount of waste produced. Containers will be placed in buildings around the Project site to collect the old batteries. Spent batteries will be stored in the waste collection areas until they are shipped off-site to a licensed disposal facility for recycling.

- **Aerosol cans.** Pump bottles will be used as much as possible in place of aerosol cans to reduce the amount of waste produced. Separate waste containers for aerosol can collection will be placed around the facilities, and cleaning staff will be alerted to separate aerosol cans that make it into the waste stream. Empty aerosol cans will be shipped off-site to a licensed disposal facility for disposal.
- **Paints.** When the paint cans are completely emptied and dried they will be disposed of in an off-site facility. Residual paint from latex-based paints will be dried before disposal. Residual paint from oil-based paints will be collected for off-site recycling. The cans from oil-based paints will be properly sealed and stored in a crate in the waste collection areas until they are shipped off-site to a licensed disposal facility for recycling.

Biological Waste

The first aid areas will generate small amounts of hazardous waste in the form of needles, syringes, scalpel blades, and blood- and tissue-contaminated materials. This waste will be properly contained in biohazard containers in the first aid area under the supervision of the first aid staff, and will be shipped off-site to an approved disposal facility.

24.13.4.6 Management of Non-hazardous Waste

Non-hazardous waste will be produced in all phases of the Project. It includes materials such as domestic garbage, food waste, paper materials, aluminum cans, glass, plastics, and inert bulk waste.

Table 24.13-4 provides an overview of non-hazardous waste types, treatment, and disposal. Non-hazardous waste management is described in more detail below.

Table 24.13-4. Non-hazardous Waste Types, Treatment and Disposal

Type of Waste	Treatment	Waste Disposal Area
Inert Solid Waste		
Paper and corrugated cardboard	Reuse/off-site recycling	Waste collection areas
Plastics	Reuse/recycle/disposal	Waste collection areas
Tires and conveyor belts	Reuse/recycle/disposal	Waste collection areas/tire recycling facilities
Vehicles	Reuse/recycle	Waste collection areas
Scrap metal	Off-site recycling	Waste collection areas
Waste lumber	Recycling/disposal	Waste collection areas
Electrical equipment	Recycle	Waste collection areas
Solid Domestic Waste		
Food waste	Disposal	Off-site disposal
General camp waste	Disposal	Off-site disposal
Sewage and Sewage Sludge		
Sewage	Water treatment plants	Septic field
Sewage sludge	Disposal	Off-site licensed lagoon

Inert Solid Waste

- **Paper.** Paper waste consists of office paper, newspaper, general packaging, and food packaging. Paper waste will be reduced in a number of ways, such as minimizing the use of paper, recycling, and reusing. Minimizing the use of paper will be achieved by using voice message devices, telephone or verbal messaging, emails, and printing and photocopying on both sides of the paper. Recycling will be achieved by placing paper recycling boxes in all the buildings where paper will be used. The recycle boxes will be emptied into a crate in the waste collection areas to be shipped off-site to a paper recycling facility. Reusing paper waste will be achieved by such approaches as using shredded paper as packaging material and reusing paper from the recycling bins for notepads. Paper packaging from food products will be transported off-site to a disposal facility.
- **Corrugated cardboard.** Corrugated cardboard waste will be generated mainly from packaging of materials. Cardboard will be collected along with the paper for recycling and will be stored in a crate in a dry location in the waste collection areas to be shipped off-site to a paper recycling facility.
- **Plastics.** Plastic waste will mainly be generated from food packaging, cleaning products, and lubricants. To reduce the amount of waste produced, the maximum practical package size will be purchased for product, and disposable plastic dishes will not be used. Some of the plastics, such as pails and barrels, will be reused. Clean materials of appropriate plastic types will be collected at waste collection areas for off-site recycling. Plastics that contained non-hazardous materials will be sent off-site for disposal. Plastics that contained hazardous materials will be fully drained and stored in the waste collection areas before being shipped off-site to an approved disposal facility.
- **Tires and conveyor belts.** Tires will be re-treaded and repaired as many times as feasible. When they are no longer safe to use, they will be reused for different purposes such as for storing material in the parts laydown area, or as impact barriers at road intersections. The tires that are not reused in some part of the Project will be inventoried and stored in the waste collection areas for transport to a tire recycling facility. Conveyor belts have a finite life. When they can no longer be used, the belts, along with other large rubber items from the mine operation, will be assessed for other uses such as floor pads and protective material in loading docks, etc. Rubber that cannot be reused will be sent to an off-site disposal facility.
- **Vehicles.** Regular maintenance will prolong the life of vehicles and equipment. When they are no longer usable for the Project, they will be driven or shipped off-site to be reused or recycled. The unusable vehicles and equipment will be stored in a laydown area until they are shipped off-site.
- **Air filters.** Air filters will be collected in bins in the truck shops and disposed of off-site.
- **Scrap metal.** Scrap metal will be generated during the construction and maintenance processes and from equipment (siding, piping, equipment parts, etc.) and will contain ferrous and nonferrous types. Scrap metal will be minimized by prompt maintenance of equipment, and will be reused wherever possible for on-site needs and projects. The scrap metal will be segregated and placed in designated laydown areas and bins for reuse or salvage. The unused scraps will be shipped off-site to a licensed disposal facility for recycling.

- **Waste lumber.** Waste lumber will be generated during construction and throughout the Project life from building by-products. Waste lumber will be reused as much as possible on the Project site. Waste lumber not immediately reused will be placed in designated bins in the waste collection areas.
- **Electrical equipment.** Waste electrical equipment will consist of generators, transformers, and distribution lines that have reached the end of their service. When they are no longer functional or re-buildable; usable parts will be extracted for reuse and the rest of the parts will be shipped off-site to a licensed disposal facility for recycling.

Solid Domestic Waste

Domestic waste will include putrescible food waste, recyclable containers (cans and bottles), packaging, inert non-combustible domestic waste, and paper products.

- **Food waste.** Putrescible food waste and packaging from food materials will be transported off-site for disposal in a timely manner to minimize the attraction of wildlife.
- **General waste.** General waste will consist of waste from offices lunch rooms, and other work areas. Personnel will be informed of the items that are recyclable and need to be placed in the recycling containers. The remainder of the materials will be disposed of off-site.

Sewage and Sewage Sludge

The domestic sewage generated on-site will be treated in a water treatment system prior to being discharged to the sewage disposal area. The biosolids from the sewage treatment plant (STP) will be periodically pumped and disposed of off-site in a licensed facility.

24.13.5 Monitoring and Reporting

Monitoring, reporting, and enforcement of the waste management procedures are fundamental in ensuring that the plan is functioning to its optimum efficiency. A monitoring program will alert management when enforcement is necessary to ensure compliance with the plan and procedures. The Mine Manager and Environmental Manager will appoint an internal audit team whose responsibility will be to:

- inspect Project facilities and waste disposal areas for proper waste segregation, storage and disposal;
- perform periodic reviews of the waste collection areas including procedures, training, equipment, records, and employee awareness; and
- review the inspection findings with area supervisors, operation personnel, transporters, and contractors to correct deficiencies, improve procedures, maintain awareness and communication, and recognize positive or negative performance.

Inspection reports will be delivered to the managers responsible for the inspected sites with copies to the Environmental Manager.

Waste will be monitored by each department and key sites with potential for procedural non-compliance will be inspected on a regular basis defined by the level of the risk. Off-site and on-site disposal will be documented by tracking waste type, volume, method of disposal, and location. Tracking of the waste streams by each department will show where changes can be made to continually improve the waste management system over the life of the Project. Tracking will also alert management to areas or departments that may require new procedures or particular attention. A summary of the tracking will be reported annually by each department head to the Environmental Manager and Mine Manager, along with an analysis of the effectiveness of the existing systems and any proposed improvements.

Routine reporting according to a schedule of monitoring inspections will be undertaken in a structured manner such that the management of waste can be accurately tracked. Inspections will cover on-site facilities (e.g., waste collection and disposal areas) and documentation (e.g., inventories, manifests and logbooks). The frequency of scheduled inspections will be dictated by the relevant policies, plans, and procedures but are unlikely to be more than three months apart.

All reports will be reviewed internally by the responsible line manager and the Environmental Manager, in order to identify necessary improvements in the monitoring system. Where required, reports will be forwarded to relevant government agencies as stipulated by regulations and licenses.

Any emergency or spill incidents will be reported per the requirements of the Spill Response Plan (Section 24.18).

24.13.6 Responsible Persons

Environmental Manager

The Environmental Manager will hold overall responsibility for implementation of the Waste Management Plan. As such, their responsibilities include:

- communicating performance objectives and measures related to waste management to department heads and personnel;
- ensuring that all Project personnel are given an overview of the Waste Management Plan as part of site orientation (e.g., all personnel should receive instruction in how to direct waste to the correct waste stream);
- ensuring that Project personnel are kept informed of changes or new procedures and receive retraining as necessary; and
- coordinating and directing the following waste management audits and activities:
  - routine monitoring and reporting;
  - tracking of off-site and on-site disposal by waste type, volume, method of disposal, and location; and,
  - delivery of training and orientation of site personnel with regards to the Waste Management Plan.

Mine Manager

The Mine Manager will:

- supervise waste tracking and reporting for the mine and other industrial components;
- provide annual reports to the Environmental Manager; and
- ensure that industrial waste is handled correctly as per the waste management procedures.

24.14 ARCHAEOLOGICAL RESOURCES

24.14.1 Purpose

The purpose of the Heritage Management Plan (the Plan) is to mitigate potential adverse effects and to detail the protection for heritage resources (archaeological and paleontological sites) within and adjacent to the Project. The Plan will be reviewed and updated on an as-needed basis as the Project proceeds.

24.14.2 Legislation and Standards

The BC *Environmental Assessment Act* (2002) takes into consideration the potential for a project to cause adverse effects to heritage resources. Similarly, the *Canadian Environmental Assessment Act* considers effects that a project may cause on "any structure, site or thing that is of historical, archaeological, paleontological, or architectural significance" (2012). As such, heritage resources including archaeological sites, protected built heritage sites, and significant paleontological resources are considered (described further in Section 19.6). Legislation pertaining to the Environmental Assessment Application, as well as policies, standards, and guidelines pertaining to the protection of heritage resources are presented in this section.

In BC, the primary legislation protecting archaeological resources (both recorded and unrecorded) is the *Heritage Conservation Act* (1996e), which protects all sites predating 1846 CE on Crown and private land. Burials and Aboriginal rock art sites are protected regardless of age. The Archaeology Branch of the Ministry of Forests, Lands and Natural Resource Operations (Archaeology Branch) is responsible for the administration of the *Heritage Conservation Act* (1996e), issuing permits for heritage inspection and site alterations, and maintaining a database of known archaeological sites.

Under the *Local Government Act* (1996g), a local government may pass bylaws designating properties, buildings, and/or features within their jurisdiction as protected. The heritage designation protection is then formally given to the heritage site by the minister responsible for the HCA (1996e). No heritage sites designated under the *Local Government Act* (1996g) are located within the RSA.

The Project is within the *Dawson Creek Land and Resource Management Plan* area. The plan identifies three objectives for managing cultural heritage resources: to "recognize and conserve cultural heritage resources," "provide opportunities for the enjoyment of spiritual and cultural values," and "recognize and conserve significant natural heritage resources" (BC Ministry of Forests, Lands and Natural Resource Operations 1999).

The Land Tenures Branch of the BC Ministry of Forests, Lands and Natural Resource Operations has implemented a fossil management framework in the province (Land Tenures Branch 2013), with fossil management principles that recognize the importance of fossils as heritage resources and that makes their scientific value the most important factor when making management decisions about fossils (Deputy Ministers' Committee on Environment and Resource Development 2004). The province owns fossils found on Crown Land, and various provincial acts have policies and requirements for managing fossils, including the *Land Act* (1996f), *Park Act* (1996j), *Ecological Reserve Act* (1996b), *Protected Areas of British Columbia Act* (2000), *Wildlife Act* (1996n), and *Environmental and Land Use Act* (1996c). While not currently afforded any explicit protection, mineral tenure holders who discover fossils during the course of their activities are encouraged by the province to report the discovery to a local museum, university, or paleontology organization.

24.14.3 Objectives

The objective of the mitigation measures for archaeological and paleontological sites that may be directly or indirectly impacted by the Project is to reduce adverse effects to negligible levels. Project activities associated with the movement, excavation, or disturbance of soil, such as clearing and grading roads, building foundations and footings, earthworks, excavations, and blasting, or due to subsidence from longwall mining, have the potential to cause direct effects to archaeology and paleontological sites, if present. In addition, the Project could lead to increased human presence that could indirectly impact archaeological and paleontological sites. Therefore, several levels of direct and indirect impacts have been considered in the Plan.

Based on the type and condition of the sites, and the anticipated Project developments, archaeological and paleontological sites within 500 m of the LSA are the target of mitigation measures (Section 24.14.4). This includes both, known sites that have been formally recorded and as-yet unknown sites that may be identified at a later date.

Where a site is located:

- **Within the infrastructure footprint portion of the LSA**, there is a high potential for direct impacts due to ground disturbance during Construction;
- **Above the underground mine area portion of the LSA,** there is a low potential for direct impacts due to subsidence during Operation;
- **0 to 500 m from the LSA**, indirect impacts through increased human presence during Construction, Operation, and Decommissioning and Reclamation, with a low to moderate potential for adverse impacts are anticipated;
- **over 500 m from the LSA**, no impacts by the Project are anticipated and therefore are not considered.

24.14.4 Actions to Avoid, Control, and Mitigate

This section provides guidance pertaining to the management and mitigation for archaeological sites in relation to the Project. Mitigation measures for as-yet unknown paleontological sites, if present, will be provided in the Chance Find Procedure outlined in Section 24.14.5. Of the 86 known

archaeological sites located within the RSA (Figure 24.14-1, also see Appendix A of the heritage baseline report), there are two known archaeological sites within the LSA where direct effects may occur, and seven within 500 m of the LSA where indirect effects may occur. Due to the sensitive nature of archaeological sites, locational information is not provided in this document but will be illustrated on construction maps.

Archaeological sites that are within the RSA but are more than 500 m from the LSA are not considered in this plan. Should Project footprint components be revised during the course of Construction or Operation, additional AIA studies will be required that will include consulting the archaeological site inventory and construction maps to determine if any known archaeological sites will be impacted. If the revised footprint areas have not been assessed additional fieldwork may also be required.

24.14.4.1 Archaeological Sites within the LSA

The LSA is the area within which direct Project effects to archaeological and heritage resources could occur through activities such as clearing trees and vegetation, ground disturbance or ground subsidence. The LSA includes the infrastructure footprint area where surface infrastructure could be built, as well as the area above the underground longwall mining where potential subsidence of the land surface could occur as a result of mining (Figure 24.14-2). Although the development of the Project will cause subsidence to occur within portions of the longwall mining area, the exact extent of the subsidence has not been determined and the subsidence area has not been assessed as part of the AIAs.

There are two recorded archaeological sites within the LSA: GgRg-5 and GgRg-8 (described below). Both sites are situated above the underground longwall mining, but the sites are not currently at risk of direct effects caused by subsidence due to buffers built into the mine plan that will result in the avoidance of the sites. Additional AIAs will be carried out prior to longwall mining in areas where subsidence is anticipated and, if any additional archaeological sites are identified, mitigation measures will be developed in consultation with the Archaeology Branch.

To date no archaeological sites have been identified within the assessed infrastructure footprint portion of the LSA.

For any archaeological sites located within the LSA avoidance through Project redesign is the preferred option. If this is not feasible then it will be necessary to mitigate the adverse effect prior to impact. Mitigation measures may involve monitoring, detailed mapping, photography, and/or systematic data recovery through surface collection and/or controlled excavations of evaluative units. A methodology for the systematic date recovery will be developed in consultation with the Archaeology Branch. The Project Chance Find Procedure will be used in the unlikely event that an archaeological site is found within the areas that have been assessed.

In addition to further assessments of subsidence areas, any Project surface developments located outside the areas that have not been subject to AIAs, including the Secondary Shaft Site, gas pipeline to the Coal Processing Plant area, and water discharge pipeline to Murray River, will be assessed prior to Construction and any sites identified will be subject to the outlined mitigation measures.

Figure 24.14-1
Regional Study Area for Assessment of Heritage Effects

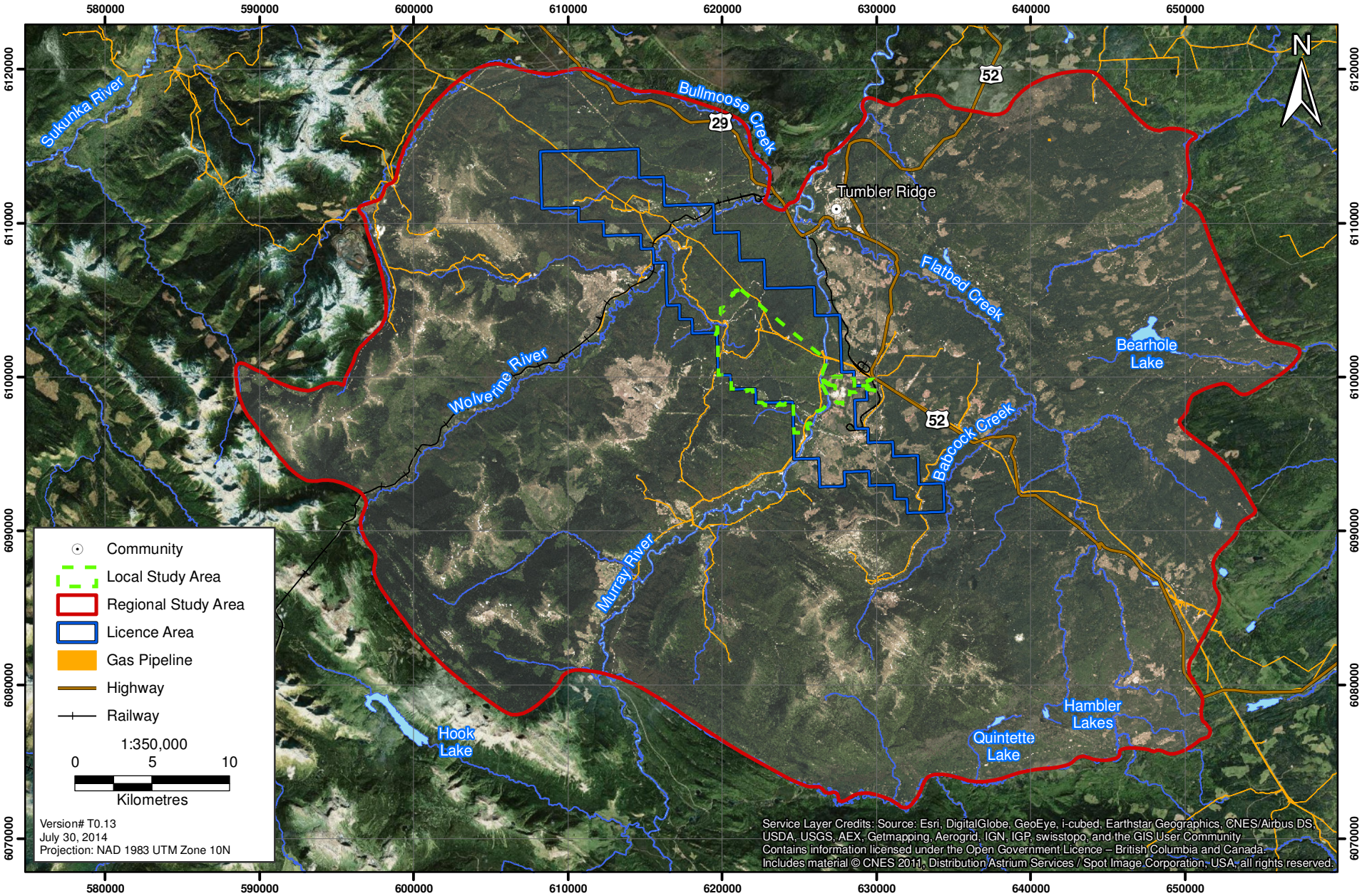
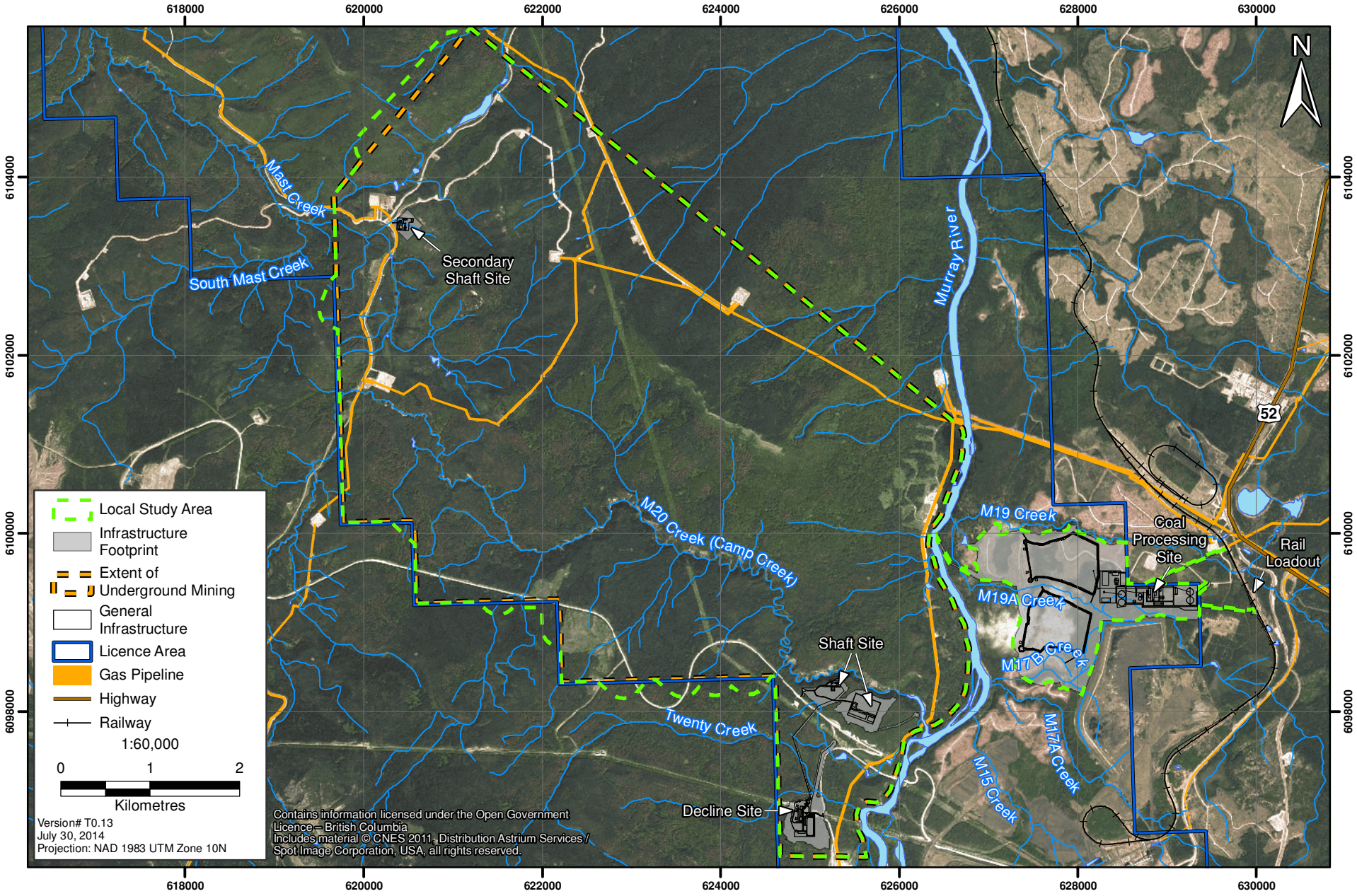


Figure 24.14-2
Local Study Area for Assessment of Heritage Effects



GgRg-5

Archaeological site GgRg-5 is protected by the *Heritage Conservation Act*. The site is within the LSA on the west side of the Murray River, however it is above the longwall mining exclusion zone and is therefore considered to be at low risk of direct impacts from subsidence during Operation. The site will be marked as a "No Work Zone" on Project maps and periodically monitored to ensure that no impacts have occurred. If any subsidence-related direct impacts occur or are anticipated, mitigation measures will be required.

GgRg-8

Archaeological site GgRg-8 is protected by the *Heritage Conservation Act*. The site is within the LSA on the west side of the Murray River; however, it is above the longwall mining exclusion zone and is therefore considered to be at low risk of direct impacts from subsidence during Operation. The site will be marked as a "No Work Zone" on Project maps and periodically monitored to ensure that no impacts have occurred. If any subsidence-related direct impacts occur or are anticipated, mitigation measures will be required.

24.14.4.2 Within 500 m of the LSA

Where heritage sites fall within 500 m of the LSA there is considered to be a low risk of indirect impacts through increased human presence during Construction, Operation, and Decommissioning and Reclamation. These site areas will be marked as "No Work Zones" on development maps. An Environmental Monitor will be present if Construction activities take place within 50 m of known sites and/or site boundaries will be flagged or fenced to limit any indirect impacts. Sites will be inspected on a case-by-case basis to determine if impacts have occurred. If direct impacts at these sites are anticipated during Construction mitigation measures developed in consultation with the Archaeology Branch will be required. The known archaeological sites within 500 m of the LSA are summarized below.

GgRf-2

Archaeological site GgRf-2 falls within 500 m of the Project footprint and is protected by the *Heritage Conservation Act*. The site is approximately 187 m north of the rail loadout, on the east side of the CN rail grade. The site is at low risk of indirect impacts from increased human presence during Construction and Operation. The site area will be marked as a "No Work Zone" on development maps. The site will be inspected to determine if impacts have occurred following Construction. If direct impacts occur during Construction or are anticipated prior to Construction, mitigation measures will be required.

GgRf-3

Archaeological site GgRf-3 falls within 500 m of the LSA and is protected by the *Heritage Conservation Act*. The site is approximately 192 m north-northeast of the rail loadout, on the east side of the CN rail grade. The site is at low risk of indirect impacts from increased human presence during Construction and Operation. The site area will be marked as a "No Work Zone" on development maps. The site will be inspected to determine if impacts have occurred following

Construction. If direct impacts occur during Construction or are anticipated prior to Construction, mitigation measures will be required.

GgRf-4

Archaeological site GgRf-4 falls within 500 m of the LSA and is protected by the *Heritage Conservation Act*. The site is approximately 260 m east-southeast of the rail loadout, on the east side of the CN rail grade. The site is at low risk of indirect impacts from increased human presence during Construction and Operation. The site area will be marked as a "No Work Zone" on development maps. The site will be inspected to determine if impacts have occurred following Construction. If direct impacts occur during Construction or are anticipated prior to Construction, mitigation measures will be required.

GgRf-5

Archaeological site GgRf-5 falls within 500 m of the LSA and is protected by the *Heritage Conservation Act*. The site is approximately 470 m southeast of the rail loadout, on the east side of the CN rail grade. The site is at low risk of indirect impacts from increased human presence during Construction and Operation. The site area will be marked as a "No Work Zone" on development maps. The site will be inspected to determine if impacts have occurred following Construction. If direct impacts occur during Construction or are anticipated prior to Construction, mitigation measures will be required.

GgRf-10

Archaeological site GgRf-10 falls within 500 m of the LSA and is protected by the *Heritage Conservation Act*. The site is approximately 382 m northeast of the rail loadout, on the east side of the CN rail grade. The site is at low risk of indirect impacts from increased human presence during Construction and Operation. The site area will be marked as a "No Work Zone" on development maps. The site will be inspected to determine if impacts have occurred following Construction. If direct impacts occur during Construction or are anticipated prior to Construction, mitigation measures will be required.

GgRg-6

Archaeological site GgRg-6 falls within 500 m of the LSA and is protected by the Heritage Conservation Act. The site is approximately 100 m northeast of the underground mine area on the west side of the Murray River. The site is at low risk of indirect effects from disturbance due to subsidence during Operation. The site will be periodically monitored to determine if impacts have occurred. If indirect impacts occur or are anticipated mitigation measures will be required.

GgRg-9

Archaeological site GgRg-9 falls within 500 m of the LSA and is protected by the *Heritage Conservation Act*. The site is approximately 288 m west-southwest of the Coarse Coal Rejects area, on the east side of the Murray River. The site is at low risk of indirect impacts from increased human presence during Construction and Operation. The site area will be marked as a "No Work Zone" on development maps. The site will be inspected to determine if impacts have occurred following Construction. If direct impacts occur during Construction or are anticipated prior to Construction, mitigation measures will be required.

24.14.4.3 Over 500 m from the LSA

Heritage sites which fall beyond 500 m from the LSA are not at risk of direct and/or indirect impacts from construction and/or human presence, unless the Project footprint is revised during Construction and/or Operation. Therefore, sites beyond 500 m of proposed infrastructure are not discussed further in this plan.

24.14.5 Monitoring and Reporting

24.14.5.1 Monitoring of Heritage Sites

HD Mining will work in collaboration with the Project Heritage Specialist to coordinate monitoring and site inspections and the documentation of any as-yet unknown heritage sites. HD Mining will maintain documentation regarding monitoring and any heritage sites which may be discovered during the course of Construction and Operation, and will report any impact to heritage sites to the Project Heritage Specialist. The location of heritage sites will not be publically disseminated except at the discretion of the Project Heritage Specialist. Monitoring activities will be summarized in a Heritage Site Monitoring Report to be written by the Project Heritage Specialist and provided, to the appropriate government agency.

24.14.5.2 Assessment and Monitoring of the Potential Subsidence Area

The objective of the heritage management plan for the potential subsidence area is to mitigate any impacts of subsidence on known and unknown archaeological sites. The land surface above any areas scheduled for longwall mining will be reviewed by a qualified professional archaeologist prior to mining, and if necessary archaeological assessments will be conducted.

Monitoring the effects of subsidence during Operation will identify if significant subsidence-related impacts to archaeological sites are occurring, or anticipated to occur. During Operation periodic (annual) heritage monitoring will be conducted in conjunction with the Project's required subsidence monitoring program. This will include a review of relevant and up-to date archaeological literature and databases, Project maps, and subsidence data. If any archaeological sites are located in an area experiencing subsidence, the Archaeology Branch will be contacted to determine the appropriate steps. All work associated with the heritage management plan for the potential subsidence area will be conducted by a qualified professional archaeologist under a Heritage Inspection Permit.

24.14.5.3 Training and Heritage Chance Find Procedure

HD Mining will arrange for site orientation and training of all employees and on-site personnel with regards to compliance with the *Heritage Conservation Act* (1996e) and the use of the Project's Heritage Chance Find Procedure (ERM Rescan 2014). Training and site orientation will be provided for all new employees during their induction and refresher training will be provided to all employees and on-site personnel on an annual basis. This training will focus on not disturbing known heritage sites (including protected archaeological, historic, and paleontological sites), the procedures in place for responding to newly identified sites, as outlined in the Project's Heritage Chance Find Procedure, and how to report

these sites or observed site impacts. Copies of the Project's Heritage Chance Find Procedure will be kept on-site for reference and on file by HD Mining. In general, if personnel suspect archaeological, historic, or paleontological materials or human remains have been discovered they will:

- stop all work in the area to reduce/minimize impacts to the site;
- leave the material in place and protect and/or mark the area around the site; do not disturb or collect any heritage material or human remains; and
- report the discovery to a supervisor.

The Environmental Manager, the Mine Manager, and the Project Archaeologist/Paleontologist will also be notified. If the discovery is archaeological, the Mine Manager or Project Archaeologist will inform the Archaeology Branch and local Aboriginal organizations of the discovery.

24.14.5.4 Revisions to the Project Footprint

If there are any revisions to the Project surface footprint, these revisions will be reviewed by a qualified professional archaeologist prior to development to determine whether further archaeological work is required. Any sites discovered as a result of revisions to the Project footprint during Construction, Operation, and Decommissioning and Reclamation will be subject to the same level of management and mitigation afforded to protected sites outlined in this plan. Should they be found, such sites will be inspected by the Project Archaeologist and documented under a *Heritage Conservation Act* Heritage Inspection Permit, issued by the Archaeology Branch.

24.14.6 Responsible Persons

In the unlikely event that during Project activities heritage sites are located or adverse effects to heritage sites occur the Environmental Manager will contact the Heritage Specialist. The Heritage Specialist will be a registered professional archaeologist.

24.15 SUBSIDENCE

24.15.1 Purpose

The Subsidence Management Plan (SMP) for the Project describes the guidelines and procedures that HD Mining will adhere to in order to manage the effects of subsidence on the surface during the life of the Project. The plan is designed to be dynamic, and will be updated with additional criteria and mitigation measures should changing requirements or project scenarios warrant plan modification. This plan builds upon the preliminary report provided by Xtraction Science and Technology[1].

[1] "Draft Report Part 2 – Prediction of Mining Induced Surface Movements and Ground Deformations Associated with the Proposed Mining Plan for the Murray Coal Project" Prepared for HD Mining International Ltd by Xtraction Science and Technology, Bethel Park, Pennsylvania, June 23, 2014.

The purpose of the SMP is to:

- protect the health and safety of employees and the public;
- promote communication with other land users and stakeholders in advance of subsidence; and
- prevent or mitigate the effects of surface movements caused by the mining process that may damage existing infrastructure, or effect intrinsic ecosystem functioning, including components of the biophysical environment such as water quality, and vegetation communities, as well as the fish and wildlife that depend on them.

24.15.2 Legislation and Standards

There are no legislative requirements directly applicable to subsidence management in British Columbia. However, the effects of subsidence may result in damage to infrastructure (e.g., roads, power lines), and changes to wetlands, watercourses, banks, and slopes, with the result that subsidence may result in changes to vegetation, erosion patterns and wildlife, all of which are subject to legislation. The SMP is therefore an important component of a number of other management plans to be developed.

24.15.3 Objectives

The primary objective of the Subsidence Management Plan is to ensure that through monitoring, assessment, prediction and, if necessary, control, the surface environment is maintained in a healthy condition and surface infrastructure is protected from damage.

The following goals are implicit in achieving these objectives:

- establishment of monitoring networks to detect and quantify amounts and patterns of subsidence over mine workings;
- analysis of monitoring data to enable a predictive capacity for subsidence at the Murray River Project;
- assessment of the potential for subsidence damage to surface environments and infrastructure in advance of mining;
- coordination with mine management, regulators and other land users to identify overlapping interests and plan for potential effects of surface subsidence
- development of mitigation and, if necessary, control measures to ensure that HD Mining's objectives are achieved.

24.15.4 Actions to Monitor, Predict, Mitigate and Control

24.15.4.1 Monitoring

In order to be able to predict more accurately the effects of subsidence on the surface, the prediction techniques must be calibrated to the site conditions; lithologies, structures, topography to name but three. In order to do this the effects of subsidence on the surface must first be measured.

Land based monitoring and remote monitoring techniques are available, and advances in both of these as the mine life extends will undoubtedly lead to greater precision in prediction. To start with, though, traditional survey levelling of specially erected monuments set out to collect the most meaningful data across a mining panel will be used. In the heavily forested areas which cover most of the proposed mine plan, cut lines will be required to ensure direct observation of the monuments, and some light mobile powered equipment (truck mounted augers, etc.) will be used for installation. Existing cut lines (tracks, power lines, roads, etc.) will be used where possible to minimise disturbance.

It is most likely that specialist contractors will be brought in to establish these lines of monuments and to survey them at intervals which will ensure that movement is captured to the required level of accuracy. Once reduced, the survey data will be incorporated into the subsidence models to improve prediction accuracy.

Remote monitoring techniques are becoming increasingly more precise and accessible to ordinary users. In particular, airborne Lidar and space-borne radar interferometry have been used in the past to measure the effects of surface subsidence and it is very likely that in the future these methods will be useful to HD Mining for subsidence monitoring.

24.15.4.2 Prediction

The most successful subsidence prediction tools have been those based on measurements taken in the same coalfield under similar mining conditions. None of these measurements currently exist. A major part of the SMP will be the integration of monitoring data into subsidence models and continuous verification and adjustment to provide the best possible prediction capability.

In addition to the development of a site specific subsidence model, HD Mining will keep abreast of other developments in subsidence prediction with a view to incorporating the best possible methods as they are developed and proved in other mining areas.

24.15.4.3 Mitigation

Where subsidence is predicted to cause surface disturbance, mitigation measures will be implemented by HD Mining in conjunction with regulators or the owners of affected infrastructure.

Existing infrastructure above the proposed mine workings is not extensive, nor is it of the type that is particularly sensitive to subsidence. Gravel roads, for example, might develop rutting or cracking due to compressional or tensile strains while being undermined, or adjacent ditches and culverts might become less efficient. Prior to undermining, consultation with the owner, posting of speed limits and warning signs ("Road Liable to Subsidence") will be considered. HD Mining will take responsibility to cover repairs required to the road and ditches or culverts.

Power line supports may be affected by tilting, but additional guying and careful monitoring of the tightening or relaxation of the conductors due to the change in length between the tops of the supports is likely to be all that is required. The amount of movement in response to mining and the timing of the movement will have to be the subject of consultation between stakeholders, HD Mining and their subsidence engineers.

Gas well infrastructure has been dealt with in the current mine plan by leaving substantial pillars of unmined coal to protect the surface facilities. Gas pipelines have also been protected in this way, but this results in a large amount of coal resource left in the ground. In fact, gas pipelines, or any other pipelines, are fairly easy to protect from subsidence effects. They are usually designed with a degree of elasticity and if they are exposed (if the trenches are opened and the earth pressures removed from the pipeline itself) while they are being undermined the strains imposed, both compressive and tensile, are usually manageable. The potential addition of coal that is currently left in pillars to support gas pipelines to the mineable resources will be an important benefit from accurate subsidence prediction models.

Subsidence effects on the environment are likely to include changes to slopes and erosion patterns, possible changes to the vegetation and some alteration of habitat. Both positive and negative changes to the environment may result. Subsidence predictions relayed to environmental staff will enable them to assess the potential for damage and propose the correct mitigation. In this respect, the linkage between technical services and their subsidence engineers and the environmental controls group is very important.

24.15.4.4 Control

Control of subsidence is possible only by modifying the amount and sequence of coal extracted. If it becomes apparent that only control measures will be effective to protect areas of the surface currently planned on being undermined, HD Mining will consider alternative mining methods or the option of leaving some of the coal in place, either as pillars or as reduced extraction height, in order to control the amount of surface change due to mining.

24.15.5 Monitoring and Reporting

The SMP will be initiated prior to the start of Operation. There will be regular interactions between HD Mining, regulators and stakeholders to ensure that all are aware of mining plans and the potential surface effects.

Monitoring of the surface effects of subsidence will proceed with mining and the monitoring results and the integration of the field data in the predictive models will be made available to regulators on request as there is currently no statutory obligation for reporting.

Environmental effects of subsidence and the mitigation measures implemented will form part of the environmental monitoring and reporting process discussed elsewhere.

24.15.6 Responsible Persons

Technical Services Manager (or equivalent employee/contract position)

The Technical Services Manager (or equivalent employee/contract position) holds overall responsibility for the oversight of the technical services provided to ensure the safe and orderly operation of the mine, including providing direction to mine planners responsible for ensuring that the mine plan achieves corporate objectives.

The SMP falls within this remit, and within the SMP responsibilities include:

- coordinating the permitting, design, construction and monitoring of surface subsidence monitoring stations;
- ensuring timely delivery of monitoring data to those responsible for its analysis and integration within the predictive tools;
- updating both the Mine Manager and the Environmental Manager of prediction results so that mitigation and/or control measures can be implemented in a timely manner; and
- "gatekeeping" advances in subsidence prediction methods and advanced remote monitoring methods which might prove useful to the objectives of the SMP and improve its efficiency and delivery.

Mining Engineers and Planners (or equivalent employee/contract positions)

Mining engineers and planners will be responsible for providing the subsidence modelers with up to date mine plans and for integrating recommended control measures into the mine plan.

Environmental Manager and Coordinators

The Environmental Manager and Coordinators will be responsible for:

- monitoring changing surface conditions;
- liaising with Technical Services staff and mining engineers to ensure that potential subsidence concerns are raised and acted upon;
- collating observations by stakeholders of surface subsidence effects for inclusion by Technical Services staff in the subsidence data base;
- providing mitigation measures for implementation in response to adverse effects of subsidence; and
- maintaining regular contact with environmental agencies with subsidence concerns and enlisting the assistance of Technical services to address them.

The Environmental Technicians will be responsible for:

- assisting Environmental Coordinators with monitoring and maintenance tasks;
- assisting with reporting tasks.

Mine Manager

The Mine Manager will:

- liaise with the Environmental Manager and the Technical Services staff to inform personnel about upcoming mining and potential subsidence affected areas;
- ensure that mitigation and control strategies are followed

24.16 RECRUITMENT, TRAINING, AND EMPLOYMENT

24.16.1 Purpose

The purpose of the Recruitment, Training and Employment (RTE) Plan is to enhance the employment opportunities and benefits of the Project for residents of local Aboriginal and non-Aboriginal communities, the Peace River Regional District and, more broadly, the Province.

The RTE Plan will focus on enhancing the capabilities of the local workforce. This is done through employment and investment in training of the local supply base by means of hiring local labour across Project job categories, to the extent feasible, and development of the local skill base.

The RTE Plan is a living document and will be updated as required based on management reviews, incident investigations, regulatory changes, or other Project-related changes. The RTE Plan will be revisited and updated (if warranted) on an annual basis. As HD Mining works to address impacts and enhance the benefits of the Project, changes may be made to this plan to better achieve desired outcomes.

24.16.2 Legislation and Standards

British Columbia Employment Standards Act 1995 (1995) sets out minimum standards of wages and working conditions for most workplaces in the province for both foreign and domestic workers. The Employment Standards Branch administers the *Employment Standards Act 1995 (*1995) and regulations. The purposes of the Act are:

- To ensure that employees in BC receive at least basic standards of compensation and conditions of employment;
- To promote the fair treatment of employees and employers;
- To encourage open communication between employers and employees;
- To provide fair and efficient procedures for resolving disputes over the application and interpretation of the Act;
- To foster the development of a productive and efficient labour force that can contribute fully to the prosperity of BC; and
- To contribute in assisting employees to meet work and family responsibilities.

Temporary Foreign Workers

Temporary Foreign Workers (TFWs) are foreign nationals who have gained vocational accreditation and work experience in other countries, and who have been permitted to work in Canada under specific conditions for an employer.

As there are currently no operating underground longwall mining operations in Canada, in order to meet the labour requirements of the Project, TFWs will be required for the underground mine development over the short-term to allow Construction and Operation to commence. A training and

transition plan has been developed to transfer employment from temporary foreign workers to local Canadian workers by 10 percent per year over 10 years.

TFWs are covered by the provisions of the *Employment Standards Act* (1995). In order to hire TFWs, HD Mining will be required to engage the Temporary Foreign Worker Program, overseen by the Government of British Columbia, which allows employers to hire foreign workers to fill temporary labour and skill shortages. In order to obtain temporary work permits for TFWs, HD Mining will be required to undertake a Labour Market Impact Assessment (LMIA), a process by which it will be required to illustrate a need to hire a foreign worker to fill available positions, and evidence that no suitable Canadian workers are available to do the job.

24.16.3 Objectives

The Project is expected to result in the enhancement of employment, skill levels and work experience within the region. A commitment to training and a focus on retention will also contribute to the overall success of the Project by supporting the development of a workforce that is able to meet the needs of the Project.

The overall objective of the RTE Plan is to enhance the employment and income benefits to the local Aboriginal and non-Aboriginal communities, the region, and the Province of British Columbia as a whole. Specific objectives are defined with respect to recruitment, training, and retention:

- Workforce recruitment – maximize the number of workers from the local communities and the region directly employed with the Project.
- Workforce training – enhance opportunities for training of the regional labour force to be employable by the Project, and provide on-the-job training opportunities to all employees to support career advancement.
- Workforce retention – maximize employee retention and minimize turnover, and provide equal opportunity for job placement and career advancement to all individuals employed by the Project.

At the current stage of Project design it is not possible to define specific and meaningful targets with respect to meeting these objectives, the one exception being the replacement of TFWs with a local workforce. HD Mining intends to utilize the services of TFWs for a period of ten years with the target of replacing 10% of the TFW workforce with locally-sourced workers per year. Retention of locally sourced workers will enable HD Mining to meet the workforce needs of the Project and make a long-term contribution to the skillset within the regional labour market. Other targets for recruitment, training and retention will be identified as part of the further development of the RTE Plan prior to the start of Project Construction.

24.16.4 Actions to Avoid, Control, and Mitigate

<u>Workforce Recruitment</u>

The ability to secure a workforce with the requisite skills and experience is a risk to the Project that will be mitigated with the use of TFWs and the implementation of the RTE Plan.

The Project's ability to meet the annual workforce composition target (i.e., replacing 10% of the TFW workforce each year with locally-sourced workers) will be enhanced through the following recruitment activities:

- Early communication activities (such as dissemination of information through a Project newsletter and email list serve, on a Project website, and/or at recruitment events) within local communities and the region to provide early notification of employment opportunities, hiring schedules, and expectations surrounding skill/certification requirements.
- Development of employment policies and programs that encourage recruitment, including providing a competitive compensation and benefits package for all workers that is consistent with mining industry standards in British Columbia.
- Provision of thorough on-boarding and orientation programs for new workers, so that new employees are provided with an understanding of what is expected in terms of work responsibilities, environmental protection, and health and safety management. Essential information (e.g., description of mine operations and work schedules, work conditions, health and safety, and resources for employees) will be provided during the recruitment process, and a description of the complete on-boarding and orientation programs communicated to all job candidates.

The provision of competitive compensation and benefits to workers will be an important cornerstone of recruitment efforts. It is anticipated that employee benefits will include, but not be limited to, a Health and Dental Care Plan (providing coverage for a range of health and dental care services and medications with options for extended health care) and an Employee and Family Assistance Program (providing access to counseling services for work-related issues).

Workforce Training

HD Mining will have ongoing communications with local Aboriginal and non-Aboriginal communities regarding prerequisite skills and entry requirements for employment with the Project.

To facilitate the successful incorporation of workers from the region, HD Mining has developed a co-operative working relationship with Northern Lights College (NLC).

Through NLC, and potentially other post-secondary education organizations, training will be made available to provide sector-related skills and training in the local communities and within the region. This partnership will have a positive effect on the regional workforce, which will be engaged to participate in programs specifically targeted at training for Project employment. Actual success in enhancing local employment will be based on the level of public interest and demand.

A Memorandum of Understanding (MOU) between HD Mining and NLC has been developed with the objective of working collaboratively on the development of an underground coal mining education program. Key aspects of the activities within the MOU include, but are not limited to, the following:

- development of relevant curriculum for both general and longwall mining specific skill sets;
- development of relevant simulations modules;

- identification of partners for program infrastructure including a simulated underground mining environment;
- delivery of underground mining training in Tumbler Ridge; and
- development of strong community partnerships within the town of Tumbler Ridge and the First Nations communities in the Tumbler Ridge area.

Other strategic partnerships with education institutions and/or additional programs may be developed with the NLC to support the availability of the worker training programs necessary to meet the requirements of the Project. Throughout the life of the Project, HD Mining will continue to work with NLC and others by providing information related to ongoing employment requirements to coordinate with the provision of additional programs, based on demand, that would enable individuals to increase their skills training, certification, supervisory, and management skills for employment.

In addition making training available to prepare local workers for employment with the Project, on-the-job training will be made available as it relates to an individual's job requirements and desired career development path. Career development opportunities will be available in all work areas.

Workforce Retention

The capability of the Project to retain workers from the local communities and the region will be enhanced through the following activities:

- clearly defined and delivered workplace benefits and commitments;
- recognition of employee performance;
- creation and maintenance of a safe working environment;
- flexibility for cultural and familial commitments and responsibilities of workers;
- provision of on-the-job training opportunities for workers;
- pre-screening of workers for drug and alcohol use;
- implementation of zero-tolerance policies for drug and alcohol use, including clear communication and commitment to the policies by workers; and
- provision of an Employee and Family Assistance Program.

Human Resources policies and procedures will be developed for the Project that will support the above activities. These activities will enable HD Mining to achieve the objectives of maximizing employee retention and minimizing turnover, and providing equal opportunity for job placement and career advancement to all individuals employed by the Project.

24.16.5 Responsible Person

The Director of Human Resources (or similar position or personnel with the requisite skills, experience, and authority) will be responsible for the ongoing development and successful

implementation of the RTE Plan. Specific activities and responsibility for certain components of the RTE Plan may be delegated to other staff, as appropriate.

24.17 SITE ACCESS

24.17.1 Purpose

The Project is located 12.5 km southwest of the town of Tumbler Ridge, BC. Tumbler Ridge is accessible via Highways 29, 97, and 52. It is accessed from Highway 52, and the existing Quintette / Murray Forest Service Road and Mast Road. There will be three short access roads leading to the Decline Site, Shaft Site and Coal Processing Site, respectively. They all are connected to the existing forest roads. A railway will link the loadout station with the CN railway line.

The purpose of the Site Access Management Plan is to:

- control access to the active mine site to ensure employee and public safety;
- ensure roads are used and maintained in a manner that minimizes adverse social and environmental effects.

24.17.2 Legislation and Standards

Several legislative requirements and guidelines apply to the construction of access roads and rights of way for mining projects. These requirements are presented in Table 24.17-1.

Table 24.17-1. Regulations Relevant to Site Access

Legislation and Regulations	Applicable Information
BC Mines Act (1996h)	Regulates permitting of roads on mineral claims registered to the proponent
Provincial Forest Use Regulation (BC Reg. 176/95) of the *Forest Practices Code of British Columbia Act* (1996)	Regulates the issuance of special use permits for roads on land not registered under a mineral claim to the proponent
Mining Right of Way Act (1996i)	Describes the necessary approvals for constructing a right of way across private and public land.
Fisheries Act (1985c)	Prohibits serious harm to fish that are part of a commercial, recreational, or Aboriginal fishery, including the permanent destruction of habitat
BC Water Act (1996k)	Provides guidelines for the issuance of approvals to make changes in or about a stream
Wildlife Act (1996n)	Regulates road and traffic effects on wildlife and requires mitigation of potential effects on specific wildlife species
Species at Risk Act (2002)	Regulates road and traffic effects on wildlife and requires mitigation of potential effects on specific wildlife species

24.17.3 Objectives

The Site Access Management Plan has the following goals:

- to protect workers and the public;
- to design, construct, and maintain Project access roads in accordance with appropriate guidance so that they are safe for designated uses and minimize potential effects to the environment;
- to ensure that all authorized users of roads behave in accordance with company policies;
- and minimize potential adverse effects of increased human presence on the environment
- to avoid the possibility of Project access roads becoming barriers to wildlife movement;
- to minimize wildlife mortality due to vehicle collisions; and
- to prevent access roads from becoming wildlife attractants.

24.17.4 Actions to Avoid, Control, and Mitigate

24.17.4.1 General Road Design, Use, and Maintenance

The existing road network will be used to access the site, including Murray FSR, Mast Road, and provincial highway network. HD Mining will secure road use agreements to support this use.

Internal roads leading to the Decline Site, Shaft Site and Coal Processing Site, respectively will be connected to the existing forest roads. A small bridge crossing may be required over M19A Creek, a default fish-bearing stream at the Coal Processing Site.

The site roads will be key components of the overall site infrastructure and will be subject to a comprehensive and ongoing maintenance program. This program will include regular inspection of the road surface, culverts and bridges, grading, snow ploughing, application of granular material for traction control in the winter, dust control (water sprays) in the summer, ditch cleaning, and shoulder vegetation management. The roads will have appropriate signage to establish speed limits and warn of road use hazards. These activities will be completed in a manner that is consistent with actions outlined in other management plans, including:

- Air Quality and Dust Control;
- Site Preparation and Soil Salvage;
- Erosion and Sediment Control;
- Water Management;
- Invasive Plants; and
- Wildlife.

Site roads will be deactivated when no longer required.

24.17.4.2 Access Management

Public access will be restricted on site roads. Access restrictions are necessary for worker and public safety at an active mine site.

Control of access points and minimization of the number of unauthorized users of Project roads and corridors will also be achieved through corporate policies and the following actions:

- installing gates, signs, and other security measures at entranceways to restricted roads, to prohibit entry by non-authorized vehicles, including snow machines and all-terrain vehicles.
- immediately reporting any observed unauthorized users to security, and having security respond by assigning appropriate personnel to notify unauthorized users of trespass.
- deactivating all non-essential roads at closure.

24.17.4.3 Vehicle Use by Employees and Contractors

The following actions will be implemented to address potential adverse effects of Project traffic on highways and roads near the Project:

- Posted speed limits will be enforced.
- All heavy vehicles travelling to and from the Project area will follow dedicated heavy vehicle routes.
- Vehicle load rates will be optimized to minimize the number of trips.
- Noise suppression technologies will be used where possible.
- Use of engine brakes and reversing (use of reverse -alarm) will be avoided in residential areas.
- Vehicle idling will be minimized.

Vehicle specifications and maintenance activities will include:

- Project trucks will meet or exceed Transport Canada's minimum requirements.
- Vehicle manufacturers' procedures and maintenance schedules will be followed.
- Vehicles will undergo regular, scheduled maintenance to ensure proper engine, brakes, and other wear and tear mechanical parts are in an acceptable working condition.
- Regular vehicle inspections (for leaks, secure cargo, etc.) will be conducted.
- Excess dust and dirt will be removed from vehicles before leaving site, if necessary.

Other traffic-related mitigation measures related to general safety procedures:

- Contractors and workers will be required to adhere to a zero-tolerance policy on alcohol and drugs on the Project site and while transporting goods and materials to and from the site.

- Policies regarding proper disposal of smoking materials will be implemented to prevent forest fires.
- A driver fire watch and reporting program as well as a response plan will be implemented.
- Workers and contractors will follow a specified journey management procedure, including departure and arrival check-ins.
- Information on weather and highway conditions will be made available to all drivers before departure. Drivers will be required to check road conditions prior to departure and adjust driving styles to conditions.
- Drivers and personnel will receive appropriate training (e.g., safe driving practices such as maintaining appropriate distances between vehicles, adjusting driving styles to suit road conditions, and noise awareness training).

Other mitigative measures to be implemented relate to communication with community and governments:

- If required, traffic control and/or temporary road closures will be used on roads near the entry to Project access roads during peak construction periods.
- Project traffic plans will be communicated to the provincial and local governments to ensure adequate signage is posted beside public roads.
- Local communities will be advised of driving routes, peak transportation periods, and potential road shutdowns when Project-related activities involve transporting heavy/wide loads.

24.17.5 Monitoring and Reporting

24.17.5.1 Monitoring

Monitoring will be implemented to track the effectiveness of the proposed mitigation, including:

- recording and tracking of road safety incidents to determine trends and to identify areas requiring further mitigation;
- tracking of unauthorized use of site roads;
- inspection of access gates for signs of effectiveness or forced entry;
- enforcement of access road speed limits;
- tracking of results of vehicle inspections to identify necessary improvements; and
- use of inspections, as required, for excess dirt and invasive plants on vehicles entering or leaving the Project site.

24.17.5.2 Reporting

Details of the monitoring will be reported internally on an annual basis according to the adaptive management framework of the EMS and will be available in the event that natural resource agencies

conduct inspections. The report will provide results of monitoring, including but not necessarily limited to maintenance/repairs required of controls at access points, as well as numbers, locations, and timing of unauthorized user access.

24.17.6 Responsible Person

Responsibility for the environmental, social, and heritage aspects of this plan will rest with the Environmental Manager. The Health and Safety Manager will be responsible for the health and safety aspects of the plan.

Environmental Manager

The Environmental Manager will be responsible for the environmental, social, and heritage aspects of site access management. As such, their responsibilities include:

- coordinating the implementation of environmental monitoring from other management plans that are relevant to site access and road us; and
- coordinating the inspection of road construction and maintenance activities in accordance with other management plans.

Health and Safety Manager

The Health and Safety Manager is responsible for the human health and safety aspects of this plan. As such, their responsibilities include:

- tracking and investigating health and safety incidents related to site access, including vehicle accidents, near-misses, and traffic enforcements; and
- liaising with Safety and Security Personnel to track incidents of unauthorized site access and to ensure that access points are secured.

Security Personnel

Security Personnel are responsible for:

- tracking authorized and unauthorized access to the Project site;
- maintaining access controls;
- communicating with drivers and contractors to ensure that site access protocols are followed; and
- reporting unauthorized access and vehicle incidents to the Health and Safety Manager.

24.18 SPILL RESPONSE

24.18.1 Purpose

This Spill Response Plan applies to all construction and maintenance activities where spills of dangerous or hazardous substances could occur and the spilled substance(s) could be released into the surrounding environment. This document is an initial plan and will continue to be developed more fully during the permitting of the Project and the associated construction phase, during which individual contractor input will be compiled into a Project-wide plan. The plan will continue to evolve during operation, based on changes in activities on the Project site and experience gained. This plan will enable site personnel to be prepared in the event of a spill or an emergency situation. It also provides one component of a comprehensive environmental management system for the site.

24.18.2 Legislation and Standards

A number of legislative requirements are applicable to accidental spills and emergency planning. A short list of these and their major applicable components are provided in Table 24.18-1.

Table 24.18-1. Legislation and Regulations Related to Spill Response

Legislation and Regulations	Applicable Information
Environmental Management Act (2003)	Provides overall direction on how wastes are to be managed
Spill Reporting Regulation (BC Reg. 263/90)	Stipulates threshold limits requiring reporting
Contaminated Sites Regulation (BC Reg. 375/96)	Specifies standards on how contaminated sites are to be remediated and managed, with the exception of mine wastes
Spill Cost Recovery Regulation (BC Reg. 250/98)	Outlines the fees that may be recovered from any party that engages Provincial resources in spill response activities
Pacific and Yukon Region, Environmental Emergency Regulations (SOR/2003-307)	Applies to 174 listed substances (possible triggers at the Project include propane and gasoline; explosives are regulated by the federal *Explosives Act* [1985]); Provides a list of requirements for compliance and prescribed timelines; Calls for a plan with specified contents
Fisheries Act (1985c)	Prohibits the release of a deleterious substance to fish habitat
Transportation of Dangerous Goods Act (1992), Transportation of Dangerous Goods Regulations (SOR/2001-286)	Includes a substance classification system and specifies requirements for transportation of dangerous goods
Workplace Hazardous Materials Information System (WHMIS) Safety Act	Outlines appropriate labelling of containers of hazardous substances, requirement for material safety data sheets, and worker education and training.
Hazardous Waste Regulation	Provides overall direction on how hazardous wastes are to be handled, stored, transported, treated and disposed.
Canadian Environmental Protection Act (1999), Environmental Emergency Regulations (SOR/2003-307)	Requires preparation of an Environmental Emergency Plan (see following text)

24.18.2.1 Environmental Emergency Regulations

The federal Environmental Emergency Regulations (SOR/2003-307) may be applicable to the Project based on whether one or more of 174 listed substances are present on site above threshold quantity limits. There are a number of exceptions (e.g., explosives, as covered by the *Explosives Act* [1985] under Natural Resources Canada). Possible candidate substances for the Project include propane, gasoline, and ammonium nitrate.

The Environmental Emergency Regulations (SOR/2003-307) have a number of requirements, including the preparation of an Environmental Emergency Plan. Contents of the plan (i.e., section headings) are also specified. HD Mining will prepare a Spill Prevention and Emergency Response Plan for the Project that satisfies the requirements of an Environmental Emergency Plan during permitting for the Project prior to any construction activities.

24.18.3 Objectives

This Spill Response Plan consists of two distinct parts:

1. a strategy for the management of the handling, transportation, and storage of solid and liquid materials to reduce the risk of spills that might adversely affect people and the environment; and
2. a conceptual plan for the emergency response to such spills.

The purpose of the emergency spill response part of the plan is to outline a pre-determined course of action to:

1. implement during an emergency situation related to a spill;
2. provide a practical plan on how to safely assess an incident;
3. implement an appropriate response; and
4. complete the follow-up and any corrective action in a safe and effective manner.

24.18.4 Actions to Avoid, Control, and Mitigate

24.18.4.1 Overview of Management Strategy

The preparation of this Spill Response Plan incorporates several assumptions. These assumptions include:

- best management practices have been adopted as the default tools for this management plan; and,
- further refinement of the plan will be undertaken during final permitting, and the final plan will continue to evolve over the life of the Project.

A number of associated Murray River Project Environmental Management Plans overlap with this plan. Overlaps include the Emergency Response Plan and the Waste Management Plan.

This Spill Response Plan is intended to provide guidance on spill prevention, initial spill mitigation and follow-up, as well as outline a spill-related emergency response plan for the Murray River Project. Actions will be outlined to avoid, control or mitigate spills and releases of unwanted substances (e.g., fuels, lubricants, waste oils, hydraulic fluids, etc.) into the environment that could contaminate soil, surface water, groundwater, vegetation, or wildlife habitat. It will be expanded and refined as part of the permitting and associated adaptive management process to ensure that evolving activities are properly addressed and that contractor input is properly included.

Response to an incident must be immediate and effective such that personnel, property, and environmental hazards are minimized.

24.18.4.2 Spill Prevention

The preferred manner to deal with spills is avoidance through appropriate storage, handling, and transportation measures. The prevention of spills is achieved through the implementation of initiatives such as:

- designing facilities to incorporate best management practices for spill containment including:
  - double containment of all fuels and dangerous or hazardous products, with protective barriers where there is potential for impact from vehicles;
  - secondary containment with capacity to accommodate 110% of the largest vessel in the area; and
  - separate storage and sump systems for storage areas of incompatible products;
- documenting operational procedures for tasks that have an identified risk, including fuel handling, explosives manufacturing and handling, or waste management. Some examples include:
  - machinery shall only be serviced, refuelled and washed in designated areas, located at a minimum of 30 metres away from any watercourse or wetland;
  - maximizing fuel containment by incorporating drip containment measures for fuel dispensing equipment;
- certifying vehicles and drivers for transportation of dangerous goods;
- ensuring equipment arrives on site in a clean condition and is maintained free of fluid leaks;
- monitoring of vehicles and equipment for leaks on a regular basis;
- ensuring that vehicle cargos are adequately contained and secured;
- implementing and documenting a preventative maintenance program;
- having a documented inspection schedule and procedures for dangerous goods and hazardous materials storage sites;
- regular housekeeping and environmental audits of facilities to ensure maximum protection is in place;

- having a risk assessment program for identifying vulnerabilities and management of improvements; and
- communicating Spill Response requirements to all employees and contractors at the start of work (orientation) and thereafter at regular intervals, which will be strictly enforced.

24.18.4.3 Risk Analysis and Management

The analysis of risk and development of management techniques is a standard component of both mitigation planning and emergency planning. A risk-based assessment of potential incidents, their failure mechanisms, and their potential impacts will be used on an ongoing basis to identify potential high risk areas and ensure procedures are in place to address these items.

Identification of potential failures is an integral component of preparing a management plan. An analysis of selected spill risks is provided in Table 24.18-2. The list is not inclusive, but provides selected materials of greatest concern.

Table 24.18-2. Analysis of Selected Spill Risks

Area of Concern	Cause of Spill	Potential Effect	Potentially Impacted Area	Preventive Measures	Available Response Resources
Moderate to High Risk of Occurrence					
Tailing spill	Pipeline break near Process Plant	Moderate	Absorbed into soil; enter local creeks	Instrumentation (differential flow and pressure alarms); preventive maintenance; visual inspections	Using dam construction equipment to contain and clean up; use vacuum truck for cleanup; call for assistance
Small hydrocarbon spills	Human error during handling; vehicle accident	Low	Absorbed into soil; enter local creeks; human health	Storage containers in secondary containment; handling procedures	Spill kits strategically located around site and on vehicles; call for assistance
Process reagents	Rupture of container during transport; spill in Process Plant	Low	Absorbed into soil; enter local creeks; human health	Transport safety procedures; proper storage areas in Process Plant	Spill kits; call for assistance
Low Risk of Occurrence					
Large diesel spill	Rupture of container during transport	Low	Contaminate soil; enter local creeks	Use of newer equipment; transport safety procedures	Spill kits on transport trucks; call for assistance
Ethylene glycol spill	Spill during transport; spill in shops; radiator puncture	Low	Absorbed into soil; enter local creeks; human health	Transport safety procedures; proper storage areas	Spill kits on transport trucks; spill kits strategically located at all sites; call for assistance

A formal risk assessment program will be established for the Murray River Project.

24.18.4.4 Material-specific Actions

Waste Rock and Tailings

Waste rock and tailings will be sited to avoid being placed upslope of freshwater diversion ditches or creeks. Prevention measures will include the design and operation of the tailings pipeline system with features such as:

- preventive maintenance program to ensure pipeline integrity;
- instrumentation to detect line breaks;
- scheduled visual inspections of pipeline route; and
- containment channel around the pipeline with periodic collection areas to assist in containment of any spills.

In the event of a tailings spill, site manpower and heavy equipment will be mobilized to contain and clean up the spill. Should pore water absorb into the ground, solids and contaminated soil will be recovered and transported to the TMF for disposal.

Petroleum Products

Petroleum products will be used at a number of locations around the Murray River Project. Significant spills may occur in the following locations:

- along roads leading to the project, where diesel fuel is transported by tanker truck to site;
- fuel storage areas;
- diesel fuel pipelines to underground storage tanks;
- fuelling stations;
- internal Project access roads where tanker trucks will transfer diesel fuel between fuelling stations;
- diesel generators;
- the explosives storage facility; and
- locations where fuel transfers occur using portable fuel containers or lube trucks.

Site fuel tanks will be built and installed to comply with all regulatory and best management practices, including the British Columbia Ministry of Water, Land and Air Protection's (BC MWLAP's; 2002) *Field Guide to Fuel Handling, Transportation and Storage.* All fuel storage vessels will include secondary containment with a sump, and all transfer stations will have concrete spill pads complete with oil/water separators. Tanks and sumps will have high-level alarms. All transfers from tanker trucks to tanks at remote fuelling stations will be done using enclosed lines, hoses, and pumps. All storage and transfer locations will also be equipped with appropriate spill kits.

An inspection schedule will be developed for each fuel storage site, taking into account the volume of fuel stored at each site and the respective risks related to that storage. Inspections will include

tanks, pipelines, connections, valves, gauges and meters, sumps and separators, and inventory records. Inspections will be recorded and filed with the Mine Manager or its delegate.

Fuel transfer procedures will include best management steps to ensure no overtopping of tanks or spillage. In addition, inventories will be tracked regularly to check on any possible losses. All spills or accidents will be reported immediately. Employees and contractors responsible for transporting or storing hydrocarbons or for fuelling vehicles will receive training in proper operating procedures and emergency response.

Dangerous Goods and Hazardous Materials

Proper storage procedures will be followed to minimize the risk of other dangerous goods and hazardous materials spills. They will be clearly labelled and stored in proper containers in secure locations, where they will be accessed by trained personnel. Secondary containment will restrict the spread of spilled product and conveniently located material safety data sheets and spill kits will facilitate safe and timely cleanup.

24.18.4.5 Spill Emergency Response Plan

If a spill does occur despite the above precautions, timely and safe response is the key to minimizing adverse effects. This conceptual spill emergency response plan provides a policy-level overview that will be further expanded and refined as the application and permitting processes progress. It will be updated and integrated into the full Mine Emergency Response Plan before construction starts.

An emergency response plan sets out the basic mechanisms, organizational structures, responsibilities, and procedures to guide staff in responding to emergencies. For the plan to be effective, all employees must be made aware of its provisions and their responsibilities under the plan.

Spills may happen as a result of a number of different reasons. These include:

- equipment malfunctions;
- human error; and
- natural events.

An emergency spill is a spill of materials that affects either the environment; the health, safety, or welfare of employees or the community; Project property; or operational efficiency, the magnitude of which requires a controlled and coordinated response. Many factors influence the intensity or complexity of an emergency spill.

In the event of an emergency spill, the Proponent will respond by:

- ensuring the safety of its employees, site personnel, and the public;
- mobilizing the necessary equipment and crews to contain and clean up the spill and rehabilitate the site to protect the environment; and

- ensuring the appropriate stakeholders are notified. These include government agencies and any nearby communities or landowners. The prompt notification of government agencies, most notably the BC Provincial Emergency Program, is essential.

A site-wide communication system (including access roads) will ensure rapid notification of any observed spills. The site will have a trained Emergency Response Team with resources to contain and recover spills, to reduce the size of any spill and thus reduce any potential adverse environmental or health effects. On-site equipment will include absorbent pads and booms, skimmers, and dike materials as part of comprehensive spill recovery kits that will be contained on a trailer or truck for rapid deployment to any spill scene. The kits will be easily transferable to enable delivery by helicopter, if required. Comprehensive spill recovery kits will be located throughout the Project to ensure availability in the event of an emergency spill.

24.18.4.6 General Spill Action Plan

The following actions will be taken in the event of a spill:

- identification and control of immediate dangers to human life or health;
- identification and control of spill source;
- elimination of additional potential spill sources;
- containment of spill;
- notification of authorities, as appropriate;
- recovery and cleanup; and
- incident investigation and reporting.

The following framework will be incorporated into the Spill Response Plan.

Initial Response

In the event of a spill on the Murray River Project, the following initial response steps will be taken:

- ensure the safety of the site for all personnel and the public by securing the area;
- mitigate immediate hazards associated with the spill material or near the spill (e.g., aromatic substances, flammable material, or ignition sources);
- notify responsible Environmental Manager and Health and Safety Manager;
- identify the spill material and source of the spill;
- if safe to do so:
  - take measures to stop the flow; and
  - construct barriers with available materials (e.g., snow, earth, or absorbent pads) to prevent the spread of material; in particular, prevent the spill from entering any watercourse; and

- if the material or circumstance is unsafe, notify relevant Environmental Manager and Health and Safety Manager that an Emergency Response Team is required.

Secondary Response

Environmental receptors will be identified and protected, particularly surface water bodies. If the spill cannot be handled by on-site trained personnel or on-site available spill response equipment, an external spill response contractor will be arranged to attend to the site. A plan for cleanup and remediation will be developed by the relevant Environmental Manager in coordination with external consultants, if required.

24.18.4.7 Spill Kits

A key component of spill response is having appropriate materials readily available to contain and abate a spill in a timely manner. Spill kits will be designed for specific areas, with contents selected to manage the potential materials, volumes, and environmental sensitivities of each area. Typical contents will include oil absorbent pads and booms, absorbent socks, granular absorbent, and protective equipment such as gloves, goggles, and suits. Kits will be stored in weather-resistant containers and located in visible locations. They will be inspected on a regular basis to confirm that they are complete and functional. Spill kits will be replenished after each use and in inventory of spill response materials will be updated regularly.

A list of suppliers of specialized spill response services and materials that can be contacted to provide support on short notice will be maintained regularly.

Training will be provided to all employees and contractors in the location and appropriate use of spill response equipment.

24.18.4.8 Spill Clean-up Procedures

Typical cleanup techniques for major or serious spills will include the following:

- construct berms around the spill with gravel, earth, or overburden using heavy equipment (e.g., loader, dozer, or excavator);
- excavate a sump using a backhoe, line it with appropriate impervious lining material (e.g., tarp or poly), and divert spill into the sump;
- block culverts with plywood, poly, and/or sandbags;
- divert spill into settling pond or tailing facility where it can be isolated;
- divert spill into site drainage sump and block inlet and/or outlet;
- use vacuum truck to collect spilled material;
- use absorbents (e.g., oil booms or pads) for hydrocarbon spills;
- use granular absorbents where appropriate;
- use emergency response kit; and

- use an overpack barrel (310-L size) for containing a leaking 205-L barrel if the leak cannot be stopped.

Specific spill cleanup and disposal procedures will be developed for:

- a fuel spill;
- a reagent spill; and
- an explosives spill.

Disposal of contaminated soil and special wastes (e.g., material with >3% oil by mass) must comply with the appropriate environmental waste management procedures such as the *Environmental Management Act* and Regulations.

If an emergency response is triggered, control of the situation will be transferred to the emergency response team. The team will be guided by the Proponent's overall Emergency Response Plan.

24.18.4.9 Triggering of Spill Prevention and Emergency Response Plan

Initiation of the Spill Response and Emergency Response Plans will be the responsibility of the Mine Manager (or designate). Response mobilization will depend on the nature of the spill, the substances involved, and the location. Members of the emergency response team will be called in for assistance, as they will have been trained in response methods and will have the knowledge of required resources and their locations. All other personnel will be directed to pre-determined locations.

Muster stations will be clearly identified around the Project site and site personnel will have been made aware of them during orientation and follow-up training programs.

24.18.5 Monitoring and Reporting

A Spill Report will be completed for all spills that occur on the Murray River Project site, regardless of quantity spilled or location. A report will be also submitted to the BC Provincial Emergency Program at 1-800-663-3456, if required (see Table 24.18-3) within 24 hours of the spill event.

Table 24.18-3. Reportable Quantities under the Spill Reporting Regulation

Substance Spilled	Examples	Reportable Spill Quantity
Explosives (Class 1)	Ammonium nitrate/fuel oil, stick powder, emulsions	Any
Flammable gases (Class 2, Div 1), other than natural gas	Propane	10 kg
Non-flammable gases (Class 2, Div 2)	Halon	10 kg
Poisonous gases (Class 2, Div 3)	Aerosols, ammonia, chlorine	5 kg
Corrosive gases (Class 2, Div 4)	Ammonia, chlorine	5 kg
Flammable liquids (Class 3)	Brake or hydraulic fluid, diesel fuel, ethylene glycol, gasoline, paints, solvents	100 L
Waste asbestos	Asbestos	50 kg

(continued)

Table 24.18-3. Reportable Quantities under the Spill Reporting Regulation (completed)

Substance Spilled	Examples	Reportable Spill Quantity
Flammable solids (Class 4)	Metal alkyds, aluminium metal	25 kg
Oxidizing substances (Class 5, Div1)	Ammonium nitrate	50 kg
Organic compounds (Class 5, Div 2)	Organic peroxides	1 kg
Poisons (Class 6)	Arsenic, mercury	5 kg
Infectious organisms	Raw sewage	Any
Radioactive materials (Class 7)	Instrumentation in Process Plant	All discharges or a radiation level exceeding 10 mSv/h at package surface and 200 uSv/h at 1 m from the package surface
Products of Class 8	Acids, battery acid, caustic	5 kg
Miscellaneous products (Class 9, Div 1)	Lead, ammonium hydroxide with not more than 10% ammonia	50 kg
Miscellaneous products (Class 9, Div 2)	PCBs, lead compounds, DDT	1 kg
Miscellaneous products (Class 9,Div 3)		5 kg
Waste oil	Waste oil	100 L
Waste containing a pest control product	Pesticides	5 kg
A substance not covered by items in the above categories that can cause pollution		200 kg
Natural gas	Natural gas	10 kg if there is a breakage in a pipeline or fitting operated above 100 psi that results in a sudden and uncontrolled release of natural gas

Sources: Environmental Management Act (2003), Spill Reporting Regulation (BC Reg. 263/90); Transportation of Dangerous Goods Act (1992), and Transportation of Dangerous Goods Regulations (SOR/2001-286).

The following information will be recorded on the Spill Report:

- the reporting person's name and telephone number;
- the name and telephone number of the company;
- the exact location and time of the spill;
- the type and quantity of the substance spilled;
- the cause and effect of the spill;
- details of action taken or proposed to comply with regulations;
- a description of the spill location and of the area surrounding the spill;
- the details of further action contemplated or required;
- the names of agencies on the scene; and
- the names of other persons or agencies advised concerning the spill.

A record of all spills, response activities and subsequent remediation and monitoring should be maintained by the Environmental Manager to support due diligence defence and to provide a basis for adaptive management of spill prevention and response planning. Document any site clean-up with photos, written notes and samples.

It is an individual's legal obligation to report a spill under the *Canadian Environmental Protection Act*. Failure to immediately report a spill could result in fines and criminal charges.

24.18.6 Responsible Persons

Planning for an emergency spill situation involves preparing detailed procedures on how and through whom information and instructions will flow. Responsibilities during an emergency spill situation will be divided among several pre-designated personnel.

Environmental Manager

The Environmental Manager will:

- ensure appropriate response to a spill incident, considering substance properties and environmental receptors;
- report to the appropriate regulatory agencies as required;
- consult with the Mine Manager to determine if additional resources are required;
- complete paperwork (i.e., spill/incident reports);
- conduct incident investigations;
- oversee all media and community communications regarding the incident,
- shut down work at the spill location, if required;
- act as a resource to the personnel responding to the spill by providing guidance relating to permit conditions, commitments, regulations, acts, and interpretation of legislation, and
- update the Spill Response Plan, as required.

Mine Manager

The Mine Manager will:

- assume overall responsibility for overseeing response;
- assume or designate command as Incident Commander;
- confirm resource personnel contacts;
- take charge of the deployment effort;
- confirm arrival and assignment of the emergency operations personnel;
- confirm availability of personnel in the rotation schedules;
- develop a plan of action that includes assignment of mine rescue teams and other appropriate personnel; and

- as required, obtain outside assistance, with the first contact to be the Inspector of Mines.

Health and Safety Manager

The Health and Safety Manger will:

- oversee the management of worker health and safety during the incident; and
- investigate health and safety complaints.

In response to incidents, the Health and Safety Manager will:

- ensure the removal of all persons affected by the incident;
- confirm contact with all resource personnel;
- confirm security, emergency medical services, and transportation;
- confirm Emergency Operations Centre arrangements and assign persons to log activity and emergency communications;
- assign messengers and runners;
- remove personnel not directly involved in the emergency response;
- implement the Emergency Response Plan;
- determine the extent to which the supervisor in the affected area has been able to comply with instructions;
- establish and maintain communication between the senior on-site official and the affected area supervisor;
- ensure that the evacuation procedure is activated when required and that rescue teams and emergency equipment are quickly and continuously available;
- schedule successive rescue teams; and
- keep a log of activities by time and event.

First Aid Personnel

- where applicable, notify a doctor and/or mobilize an ambulance;
- prepare first aid facilities to receive any casualties; and
- consult with a doctor about obtaining additional medical assistance, supplies, or transportation.

Security Personnel

- limit access to the affected area to authorized personnel only;
- obtain assistance from local law enforcement authorities as required; and
- keep a log of activities by time and event.

24.19 EMERGENCY RESPONSE

24.19.1 Purpose

This Emergency Response Plan (ERP) is intended to provide a conceptual framework for emergency response at the Murray River Project. It provides a policy-level overview that will be further expanded and refined as the application and permitting process progresses. This plan is closely associated with the Spill Response Plan (Section 24.18).

An emergency is a situation that affects:

- the environment;
- the health, safety, or welfare of employees or the community; or
- mine property; and
- whose magnitude requires a controlled and coordinated response.

Five core emergency planning principles are utilized:

- Identify emergencies with the highest likelihood of occurrence.
- Identify general measures to address the response to the emergency, and staged actions required to respond with the appropriate action.
- Focus on speedy response to an incident, with an appropriate build-up of resources in accordance with the response plan.
- Ensure processes for requesting outside emergency support, notification of officials and incident documentation is clearly defined, communication tools are understood and the appropriate action is taken.
- Ensure training is thorough and often with written instructions available in all areas to support immediate and effective response.

24.19.2 Legislation and Standards

The *Health, Safety and Reclamation Code for Mines in British Columbia* (the Code; BC MEMPR 2008), empowered under the *Mines Act* (1996h), requires that every mine have an ERP.

In summary, the *Mines Act* (1996h) and Code state that:

- the Mine Manager shall develop and maintain a Mine Emergency Response Plan;
- the Mine Manager is responsible for ensuring that sufficient people, equipment, and facilities are available for emergencies;
- the Mine Manager is responsible for providing training to all personnel involved in emergency operations;
- whenever mine rescue personnel are required at a mine, the mine rescue teams come under the direction of the Mine Manager unless otherwise directed by the Chief Inspector of Mines; and

- the Mine Manager has the financial responsibility for all costs related to establishing, equipping, operating, and maintaining mine rescue teams, apparatus, and equipment as prescribed by the Chief Inspector.

A number of other legislative requirements are applicable to accidental spills and emergency planning. A short list of these and their major applicable components are provided in Table 24.29-1.

Table 24.19-1. Legislation and Regulations Related to Emergency Response

Legislation and Regulations	Applicable Information
Environmental Management Act (2003)	Provides overall direction on how wastes are to be managed
Spill Reporting Regulation (BC Reg. 263/90)	Stipulates threshold limits requiring reporting
Contaminated Sites Regulation(BC Reg. 375/96)	Specifies standards on how contaminated sites are to be remediated and managed, with the exception of mine wastes
Spill Cost Recovery Regulation (BC Reg. 250/98)	Outlines the fees that may be recovered from any party that engages provincial resources in spill response activities
Fisheries Act (1985c)	Prohibits the release of a deleterious substance to fish habitat
Transportation of Dangerous Goods Act (1992), Transportation of Dangerous Goods Regulations (SOR/2001-286)	Includes a substance classification system and specifies requirements for transportation of dangerous goods
Canadian Environmental Protection Act (1999) Environmental Emergency Regulations (SOR/2003-307)	Requires preparation of an Environmental Emergency Plan (see following text)

24.19.3 Objectives

The MERP ensures that:

- effective communication, response coordination is planned and undertaken.
- appropriate tools and equipment are ready for immediate operation.
- workers are trained and capable of assessing the hazards and responding to an emergency situation immediately in a structured manner.
- all workers know their roles on the worksite in relation to an incident and are able to action it immediately.

24.19.4 Actions to Avoid, Control, and Mitigate

24.19.4.1 Overview of Management Strategy

The following sections describe how HD Mining will address these requirements in the ERP, which will be developed during the application and permitting process and will evolve as the Project progresses through Construction, Operation, Decommissioning and Reclamation, and Post Closure.

Emergency Response Policy

HD Mining establishes high safety standards. Long-wall mining technology itself introduces a new layer of equipment safety in the underground environment. HD Mining is committed to effective emergency response planning specific to the mine design and technology in use, and in accordance with the Code. Planning, honed through regular drills will reinforce roles and responsibilities, communication expectations and overall emergency response process.

In the event of an emergency, all activities unrelated to the emergency will be stopped to enable the effective, immediate response to the emergency. Staff will understand their role in the emergency response or rescue process, including in the command structure.

HD Mining's Mine Emergency Response Plan will comply with Code and maintain effective communications with the Ministry of Energy and Mines during rescue operations which will flow from the Mine Emergency Preparedness and Response Plan. HD Mining will have a number of control measures in place, however, if one fails, HD Mining shall have trained, competent emergency response teams in place. It is critical that HD Mining teams, together with first responders are able to effectively engage and implement a response command system and communicate with rescuers and workers. Plans will include multi-lingual signage on the worksite, on equipment, and ongoing English language training, with a particular focus on safety and emergency response terminology.

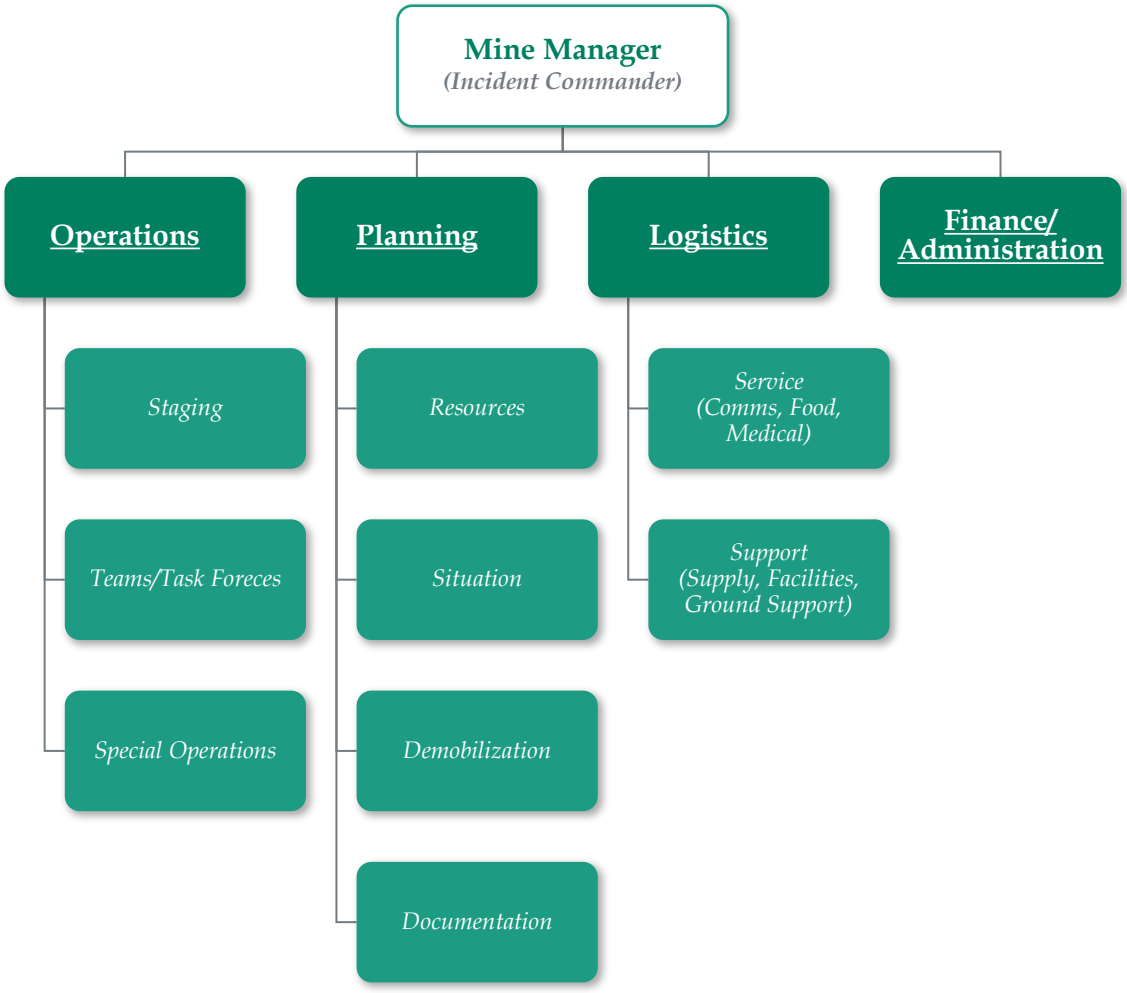
HD Mining will use the Incident Command System (ICS) Emergency Management Organization defining a chain of command with the Mine Manager or a designate as Incident Commander.

It is anticipated that the ICS Emergency Management Organization will expand or contract to meet the response needs of the incident (Figure 24.19-1)

The Incident Command Centre will be located on the Murray River Mine site. During an Emergency, the allocation of offices for specific purposes is as follows.

- Incident Command Centre – Mine Managers office
- Authorizations Room – Firebosses office
- Conference Room – Office Conference Room
- Briefing and Reporting Room – Mine Dry Conference Room
- Officials Refreshments – Second Office
- Rescue and Waiting – Mine Rescue Room
- Casualty Clearing – First Aid Room
- Other Space – to be determined.

The Murray River Emergency Operations Centre (EOC), if required in an emergency to support the ICS, will be established at the Murray River Mine Site. Supporting services will be provided by the HD Mining Offices in Tumbler Ridge. It will provide coordination to the ICS and will be staffed by persons who are proficient in English with interpretation services provided for the Chinese language.


Mine Manager
(Incident Commander)
Operations
Planning
Logistics
Finance/ Administration
Staging
Teams/Task Foreces
Special Operations
Resources
Situation
Demobilization
Documentation
Service (Comms, Food, Medical)
Support (Supply, Facilities, Ground Support)

24.19.4.2 Action Plans

The Mine Manager will develop Action Plans to successfully implement the Emergency Response Procedures developed in accordance with this Policy and in consultation with First Responders, Mine Management and Mine staff. Plans will include:

- Implementing the ICS Response;
- The Mine Evacuation Plan;
- The Map of Escape Routes; and
- Implementing the Check in/Check out Procedure.

24.19.4.3 Mine Rescue Equipment Inventory

The Mine Manager will complete a Mine Rescue Equipment Inventory once annually, or as required with development at the mine site.

24.19.4.4 First Responders

The Mine Manager will keep an up to date list of First Responders in the region.

Mutual Aid Agreements with neighbouring Mine Operations shall be in writing and address capabilities for a response, back-up teams, travel time and payment of costs incurred.

The Mine Manager shall will consult with the agencies listed below and provide:

- A copy of the MERP.
- Current mine plans including an up-to-date map identifying appropriate
- and safe route(s) of travel to the mine.
- A review of any hazards which may affect first responders.

The following First Responder Agencies will be consulted with regard to the MERP:

- Tumbler Ridge Fire Department – Fire Chief Matt Treit, 250-242-3939;
- BC Ambulance Service - Dawson Creek, 250-782-2211; and
- Helicopter Evacuation - Ridge Rotor 1-877-242-4211.

24.19.4.5 Communication Services

Proper communication is essential for control of a mine emergency operation. An effective communications system:

- Provides for the flow of information that occurs during the entire operation.
- Affects all orders, reports and assignments.

- Ensures the timely assessment of changing conditions.
- Speedily transmits reports used to monitor underground conditions and actions.
- Helps command officials keep track of available personnel, resources and services.

The Emergency Response Planning Coordinator shall identify personnel who are knowledgeable in the operation and maintenance of communication technology and able to communicate in both English and Chinese.

A Communications Coordinator fluent in both English and Chinese, who has a broad background in mining communications will be appointed.

Additional personnel should also be assigned as back-up support. The MERP's ICS Emergency Management Organization shall reflect these appointments

24.19.4.6 Training Program and Practice Drills

The Mine Manager will develop an Emergency Response training program for:

- Individuals named in the emergency procedures.
- Individuals in the ICS structure.
- All personnel such that they are familiar with their duties in an emergency must be able to verbally state those duties.

Training plans will be updated based on information gained from the Practice Drills.

HD Mining management will test the procedures and evaluate performance of personnel in practice drills on a regular basis to develop and build upon a reliable response system.

The Mine Manager will develop a plan for conducting and reviewing practice drills of all phases of Emergency Response. Information gained from the practice drills will be utilized to update the Training Plan. Workers will be consulted on areas of improvement for the practice drills and their perspective on training improvement.

24.19.4.7 Public and Media Relations

In the event of a serious or fatal emergency HD Mining will establish a media centre at the Head Office in Vancouver. The media centre will be staffed 24 hours per day, seven days a week over the course of the incident.

HD Mining will utilize a single person to provide media and other briefings based on information provided by the Incident Commander at the Murray River Mine site.

HD management will review information from the Murray River Mine site and prepare a media briefing. The media briefing must be signed by the Incident Commander before it is released to the media to ensure that it accurately reflects the situation.

The communication protocols will allow for consistency and accuracy and provide information first to the impacted workers' family, other workers, relatives of other workers and the public through the media.

HD Mining Management will have information channels directed separately to:

- Staff distribution.
- Staff family.
- External media distribution.

External communication to media will be initially through a consistent spokesperson and delivered through updates posted on HD Mining's website. Updates may evolve to a pre-scheduled report or post on HD Mining Website, or through direct press releases or interviews.

Media interviews would be considered based on the circumstance of the incident and would include key spokespeople knowledgeable about the incident, any rescue planning and activities to date and site details. Such interviews would likely occur in Tumbler Ridge or Vancouver.

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