3. DETAILED PROJECT DESCRIPTION

3.1 INTRODUCTION

3.1.1 Project Summary

KAM Ajax Mining Inc. (KAM) plans to develop the Ajax Project (the Project), an open pit copper-gold mine at the historic Afton Mine south of the City of Kamloops, British Columbia (BC). The design of the Project has evolved with the advancement of engineering analysis, alternatives assessments, field investigations, and the incorporation of input from Aboriginal Groups, government and the public. Basic engineering design of the Project is currently underway, and details of the design are subject to change as work continues. However, the primary components and activities of the Project are well-developed, and the Project, as described in the following sections, represents the design basis for the purposes of the environmental assessment carried out within the Application / Environmental Impact Statement (EIS).

The Project is located in the South-Central Interior of BC, southeast of the junction of the Trans-Canada Highway (No. 1) and the Coquihalla Highway (No. 5), within the Thompson Nicola Regional District. The coordinates for the centre of the Project area are approximately 50°36' N latitude and 120°24' W longitude. The primary components of the mine include an open pit, mine rock storage facilities, processing facility and truck shop, process water intake and line, and tailings storage facility (TSF). These primary components will be located outside of the Kamloops city limits, largely on private land owned by KAM, with some utilization of Crown land. Some ancillary facilities, including, administration building and explosives storage, may be located just within the city boundaries. Access to the mine site will be via the Inks Lake Interchange off Highway 5 and then along service roads to the plant Ajax Mine Access Road (AMAR) (a historic haul road from the old Afton Mine). In 2012, KAM purchased the Sugarloaf Ranch lands, as well as adjacent land parcels held by Teck Resources. KAM, in conjunction with the Sugarloaf Ranch, now holds the majority of lands within the Project footprint.

The proposed mine plan for the Project predicts an operation based on a mill throughput of 65,000 tonnes of ore per day. Total material movement from the pit is estimated at approximately 90 Mt on an average annual basis. Average annual production of the mine is estimated at 140 million pounds of copper and up to 130,000 ounces of gold in concentrate, based on a conceptual mine plan supplying up to 24 million tonnes of ore per year to the mill. For the purpose of a conservative approach to the environmental assessment these rates have been assumed for a mine life of 23 years. Although it is not assumed that the mill will operate continuously at 65,000 tonnes for the full 23 years.

Mine rock will be blasted to produce a suitable particle size distribution for loading and transportation in haul trucks. Mineralized material will be blasted to comply with fragmentation requirements and a specified particle distribution for crushing. Primary loading of mine rock and ore on the benches will be accomplished by electric rope and/or hydraulic shovels.

The ore will be delivered from the mine by haul trucks to an ex-pit primary crusher. Ore will be crushed to the size which meets process requirements and will be transferred to the covered coarse ore stockpile by belt conveyors. Mine rock will be transported by haul trucks to the TSF embankment and mine rock storage facilities. Four mine rock storage facilities are planned within the Project footprint: the South Mine Rock Storage Facility (SMRSF), East Mine Rock Storage Facility (EMRSF), West Mine Rock Storage Facility (WMRSF), and In-Pit Mine Rock Storage Facility (IPMRSF). Overburden and topsoil will primarily be stored within the footprint of the EMRSF.

The processing facility will consist of stage-wise crushing and grinding, followed by a flotation process to recover and upgrade copper from the feed material. A gravity circuit will be included within the flotation circuit to enhance gold recovery, with a gravity gold concentrate being filtered and shipped or the gravity gold concentrate may be combined with the copper concentrate The flotation concentrate will be thickened and filtered and sent to the concentrate stockpile for subsequent shipping by truck to the Port of Vancouver.

The TSF will be located approximately 1 km south west of the open pit and east of Lac Le Jeune Road. The TSF will consist of four (4) embankments ranging in height from 10 m to 122 m. Collection ditches will direct surface runoff and seepage from the embankments to collection ponds for use as process makeup water. The tailings embankments will use approximately 230 Mt of mine rock material for construction. The maximum elevation of the tailings will reach approximately 1,065 masl.

3.1.2 Project Schedule

The overall life of the Ajax Project is 30 years (including construction, decommissioning and closure) as indicated in Table 3.1-1.

Table 3.1-1. Life of Project

Activities	Duration
Construction	2.5 years (year -2 to 1)
Operation	23 years (year 1 to 23)
Decommissioning and Closure	5 years (year 24 to 29)
Post-Closure	to be determined

Construction of the Project—from commencement of field construction to substantial mechanical completion—is estimated to take thirty (30) months, which includes the period when access roads will be constructed and early earthworks will commence. For the purpose of this assessment, the first full year of commercial production is termed “Year 1.”

The anticipated operational phase of the Project is approximately twenty-three (23) years based on resource definition and engineering planning to date, which is the basis of this assessment. As with all mining projects, KAM will continue exploration and refinement of mining and processing methods, with aim of optimizing extraction of the resource. Any material changes over the life of the Project will be subject, as required, to the appropriate regulatory processes.

Decommissioning and closure activities are expected to take approximately five (5) years, followed by Post-Closure monitoring to ensure that all mitigation and closure facilities and structures are functioning properly.

Post-Closure will begin after decommissioning and closure activities are completed, as determined by the on-site plans and regulatory requirements described in Section 3.17.

3.1.3 Construction Activities

Activities undertaken during the construction phase include, but are not necessarily limited to:

- installation of temporary construction offices and ancillary facilities on- and off-site, with associated waste and sewage management systems. These facilities may include an RV park and dormitory style rooms. Off-site facilities are not directly included in this assessment, however, their presence contributes to the traffic pattern for the Project, which is considered;
- main access road improvements including construction of Inks Lake Interchange and parking areas, haul road upgrades, and construction of the Lac Le Jeune Road/Haul Road crossing;
- revising public access to Jacko Lake;
- transportation of workers and goods in and out of the mine site and associated parking areas;
- clearing, grubbing, and stockpiling of topsoil and salvage of seed stock;
- bulk earthworks (site clearing and pad construction – blasting, earth-moving, loading, hauling, and placement);
- pre-stripping of the open pit, stockpiling of topsoil, and generation of construction crushed aggregate, mainly for tailings embankment construction. These activities will focus on the historic open pit areas;
- ore stockpiling;
- mine rock placed in WMRSF, EMRSF and used in TSF embankment construction;
- construction of the main substation at the plant site and a 9 km high voltage power line to the BC Hydro transmission line corridor. Power supply during construction will be provided by generators and/or temporary line power;
- construction of a natural gas pipeline with connection to the Fortis pipeline near Knutsford;
- operation of an on-site concrete batch plant and/or delivery from off-site third-party;
- forming and placement of concrete foundations;
- supply and installation of buildings with associated waste and sewage management systems;
- construction, installation and implementation of site security and emergency services;
- supply and installation of primary crushing, grinding, flotation, regrind and concentrate dewatering circuits;
- fuel tank installation and commissioning;

- explosives storage installation and use;
- earthworks for the TSF North and East Embankments;
- installation of conveying and piping systems and other waste and contact water management structures (tailings discharge pipeline, reclaim water intake and pipeline, collection ponds, ditches);
- installation of conveying and piping systems and other water management structures (water intake and pipeline);
- installation of a dyke (sheet pile and dam) within Jacko Lake to allow removal and relocation of the Kinder Morgan Pipeline. The relocation of the pipeline is a separate third-party project and therefore not part of this assessment, however, the dam (JLD2) will remain in place throughout mine life and into closure to provide a barrier and buffer between Jacko Lake and the open pit boundary. Another dam will be installed (JLD4) in the southeast area of Jacko Lake to provide a similar buffer between the open pit and lake.
- These dams with two additional dams (JLD 1 in the area of the existing irrigation dam in Petersen Creek and JDL3 in the northwest area) also provide storage of the Probable Maximum Precipitation event within Jacko Lake;
- Peterson Creek diversion including installation of a floating pump in Jacko Lake, pump house and pipeline to carry the excess Jacko Lake discharge along the north boundary of the open pit, and a discharge area and new dam installed on Peterson Creek (Petersen Creek Downstream Pond);
- environmental monitoring and construction of any habitat offset/compensation structures; and
- removal of temporary construction offices and ancillary facilities.

Pre-stripping of the open pit using the permanent mine production equipment will begin after approximately six months of construction activity. Stripped material will, in part, be used for the construction of the large earthwork structures including haul roads, infrastructure pads and the TSF embankments. Pit development and mining is described in Section 3.5. Overburden and non-potential acid generating (NPAG) mine rock from the open pit will be used as much as possible during construction where it has been determined that sufficient material is available.

At least one of the production mining shovels and one of the production drills will operate under temporary power (portable generators or tie-in with the existing BC Hydro power line located along Lac Le Jeune Road) until the permanent BC Hydro transmission line connection that will provide the 230 kV to site is available later in construction phase. All other mobile equipment (trucks, loaders, dozers, graders and water trucks) will be diesel-electric, diesel or gasoline engines.

As a consequence of using the mine fleet to build certain areas, the haul roads will be built to mine standards for mine equipment (i.e., three times the width of the haul truck for two-way traffic, or two times the width of the mine truck for one-way traffic). The schedule anticipates that the assembly of the mine fleet to be used for construction and the associated construction of the haul roads will take about eight to nine months.

The starter TSF embankment will be completed by the time of start-up of processing. The water required for start-up of the process plant will be stored in the TSF provided and provided through the capture of one full freshet of site contact water combined with water from the historic mining pit (treated as necessary) and water from Kamloops Lake via a new intake and pipeline.

The majority of capital equipment will be shipped via Edmonton, Calgary or Vancouver to laydown areas on or near the Project site. Heavy loads during the construction phase include the mine equipment components, substation transformers, crusher parts, process plant and motor parts.

A peak of 1,800 workers will be required on site during the construction phase.

3.1.4 Operation Activities

Activities undertaken during the operation phase include, but are not necessarily limited to:

- development of the open pit and extraction of ore, including drilling, blasting, loading, and hauling;
- operation of the mine rock storage facilities (MRSFs), including loading and hauling from the open pit and stockpiling in the SMRSF, EMRSF, and WMRSF and later in the mine life placement of mine rock in the IPMRSF ;
- crushing and stockpiling of ore;
- ore processing and recovery of gold and copper concentrate;
- transportation of concentrate to the Port of Vancouver;
- operation of the TSF, including raising of embankment dams to increase capacity over mine life to contain and store the thickened tailings slurry and provide sufficient reclaim water for the Process Plant;
- transportation of workers and goods in and out of the mine site;
- freshwater pumping and distribution including make-up water for Process Plant, truck washing, dust management and treatment for potable use;
- domestic wastewater treatment and management;
- site water management including diversion around infrastructure, collection of contact water and open pit dewatering;
- collection, storage and transport of recyclable materials, hazardous materials, construction waste, solid waste, fuel, explosives and non-hazardous materials;
- implementation and maintenance of site security and emergency services;
- ongoing surficial mapping and exploration drilling; and
- environmental monitoring and progressive reclamation.

The operation phase will focus on the economic recovery of copper/gold concentrate and delivery to market with associated activities and components. Other activities during this phase will include ongoing exploration supported by the Project infrastructure and progressive reclamation.

Once the BC Hydro transmission line connection and associated pole line distribution is available, stationary electrical equipment and electric shovels and drills will be installed and supplied via the distribution network. Mobile and mining equipment (trucks, loaders, dozers, grader, and water trucks) will typically have diesel engines, while smaller trucks and personnel vehicles will be gas-powered.

From the starter TSF embankments, the four tailings embankments will be developed in approximately eight stages over the 23 year period, to a maximum height of 14 m (Southeast Embankment) to 122 m (for the North Embankment) surrounding and a surficial area of approximately six square kilometres.

The majority of capital equipment will continue to be shipped via Edmonton, Calgary or Vancouver to a laydown area at the Project site. Heavy loads during the operation phase include the mine equipment components, crusher parts, process plant and motor parts.

It is estimated that approximately 500 personnel will be employed during any typical operation phase year.

3.1.5 Closure Activities

3.1.5.1 Planned Closure Activities

Activities undertaken during the decommissioning and closure phase include, but are not necessarily limited to:

- contouring of Mine Rock Storage Areas, capping, covering with topsoil and re-vegetating;
- removal of most of infrastructure such as buildings, equipment, fuel tanks, which will involve blasting, earth-moving, loading, hauling, and appropriate disposal;
- storage and transportation of hazardous and non-hazardous materials for disposal in approved offsite facilities;
- implementation and maintenance of site security and emergency services appropriate for closure activities;
- changes to the site water management system such that surface contact water and tailings effluent is pumped to the open pit and passive drainage for Peterson Creek is re-established;
- reclamation of TSF surface with a cover system designed to minimize infiltration to underlying materials and provide a medium for establishing sustainable vegetation cover consistent with the final intended land use; runoff from the reclaimed surface will shed to the environment (Humphrey Creek);
- transportation of workers and goods in and out of the mine site; and
- environmental monitoring and progressive reclamation.

Activities undertaken during the Post-Closure phase (which will continue as necessary based on monitoring results and regulatory requirements) include, but are not necessarily limited to:

- pumping of surface contact water to the open pit for continued pit lake filling;
- maintenance of reclaimed areas where required (e.g., regrading and revegetation);
- transportation of workers and goods in and out of the mine site; and
- environmental monitoring.

3.1.5.2 Temporary Closure Activities

In the event of temporary closure (care and maintenance), activities that will be undertaken include, but are not necessarily limited to:

- access to the site will be controlled, all buildings and facilities will be secured and restricted to authorized personnel only;
- mechanical, hydraulic and electrical systems not required during the temporary closure period will be locked out and maintained in a secure state (i.e., in a no-load condition);
- mobile heavy equipment that is not required during temporary closure will be stored in appropriate areas in a no-load condition;
- warning signs will be posted around open pit(s) and other mine openings; openings without a gatehouse will be guarded or barricaded;
- routine site monitoring and inspections will continue throughout the period of temporary closure; the TSF and associated infrastructure monitoring systems will be maintained during the temporary closure period;
- an inventory of hazardous materials will be completed, including process chemicals and reagents and petroleum products; hazardous materials and other chemicals will be properly stored or removed from site;
- fluid levels in all fuel tanks will be recorded and routinely inspected for leaks or potential hazards;
- explosives will be relocated to the main magazine and secured, disposed of, or removed from site;
- MRSFs and ore stockpiles will be maintained such that they are physically stable; storage areas and stockpiles will be routinely inspected to ensure their stability or to implement any required contingency measures; and
- surface water management measures will continue through temporary closure, and will be monitored to ensure proper operation; surface water quality and quantity will be monitored to ensure that regulatory requirements are being met.

In addition, during the operation phase, a pond will be established within the TSF to allow recycling of the effluent to the process plant. In the event of temporary closure, this stored water will remain in the TSF pond. Recycling to the process plant will stop, and water levels in the TSF will be monitored to determine the net accumulation of water. If temporary closure is prolonged (i.e., more than a year), it may be necessary to treat and decant the tailings supernatant to maintain safe water levels. The need for treating and decanting the tailings supernatant is a function of the duration of temporary closure as well as how much capacity remains in the TSF and will be addressed through the appropriate regulatory processes.

Further details are provided in Section 3.17.

3.2 PROJECT DESIGN CONSIDERATIONS

In addition to technical and economic considerations, responsible development, operation, and closure of the Ajax Project is driven by the KAM core values:

- *ZERO HARM – We are committed to Zero Harm for our employees, our communities and the environment. We believe that the best mines are the safest mines.*
- *RESULTS DRIVEN – We are Results Driven and accountable for our results. We are skilled at problem solving and ready to take on new challenges to grow our company.*
- *SUCCESS THROUGH TEAMWORK – We achieve Success Through Teamwork. We build trust, act with respect and welcome constructive debate. We promote a collaborative work environment where we continuously learn and adjust.*
- *COURAGEOUS – We are Courageous. We are decisive, innovative and forthright with one another.*
- ACCOUNTABILITY - *We take full responsibility for our actions and commitments. We keep our promises and establish long-term relationships with integrity. We build trust amongst our fellow employees, stakeholders and the communities in which we operate.*

This section outlines the policy, environment and social considerations that have been incorporated into Project planning, and ultimately will be implemented during construction, operation and closure of the Project.

3.2.1 Environment

KAM believes that protection of the natural environment is fundamental to the success of operations and projects. Emphasizing KAM's core value of Zero Harm, environmental and natural resource management tools and practices will be incorporated to minimize environmental risk during the evaluation, exploration, planning, design, construction, operation and closure phases of new and existing projects.

KAM management is accountable for providing environmental leadership by measuring performance against recognized industry standards and communicating commitments and results to employees, contractors, local communities, regulators, and the general public. Environmental professionals and committees will support the drive to Zero Harm to create workplaces where everyone personally commits to a culture of environmental protection.

This leadership is based on the implementation of an environment, health and safety (EHS) management system. The EHS provides the high-level framework to manage the Project's EHS risks and opportunities in a comprehensive, systematic, planned and documented manner. This framework includes the organizational structure, planning and resources for developing, implementing and maintaining minimum EHS performance and compliance expectations for the Project. The EHS management system is the overall framework within which Environmental Management Plans (EMPs), Occupational Health and Safety Management Plans, and other EHS programs applied to the construction, operation and closure phases are developed, implemented, and maintained. The Ajax Project will align to the ISO 14001 standard, an international standard that governs environmental management. Alignment to ISO 14001 will provide assurance that the Ajax Project conforms to recognized practices and standards for monitoring environmental aspects such as noise, air, water and the soil. As a member of the Mining Association of Canada, KGHM and the Ajax Project will also align with the Towards Sustainable Mining (TSM) program. As stated in KAM's Environment Policy:

"In fulfilling our environmental commitment to "Zero Harm" we will:

- *Develop, implement and regularly evaluate environmental management systems to continually improve performance, consistent with defined objectives and targets.*
- *Prevent and minimize environmental impacts.*
- *Respond to public inquiries regarding environmental matters in an open and forthright manner.*
- *Meet or exceed all environmental laws and regulations and other requirements to which we subscribe."*

A number of considerations in project design, operational safeguards, and contingency plans have been incorporated to mitigate potential impacts. Highlights of these mitigation measures include:

- minimizing the Project footprint, thus minimizing the loss of habitat and reduction of habitat effectiveness;
- siting facilities to minimize interaction with populated areas;
- to the extent possible, avoiding known archaeological sites and prioritizing avoidance of important (unique and/or old) sites;
- maintaining a buffer from streams and waterways where possible;
- maximizing sourcing of aggregate and borrow materials from the open pit;
- withdrawing Project water from water sources chosen to minimize the potential for drawdown and effects to fish habitat and the aquatic environment;
- maximizing water recycling to minimize freshwater requirements; and
- implementing dust suppression measures to reduce dust generated along the road corridors, the crusher and conveyor and the TSF.

Where possible, permanent support infrastructure will be built during the construction phase, to be used during both construction and operation phases of the Project. Temporary infrastructure needed only for construction purposes will be removed at the completion of the construction phase.

3.2.2 Climate Change

It is widely acknowledged that climate change is occurring in Canada, with reported changes in air temperature, precipitation, snow, and ice cover (Warren and Lemmen 2014). The Federal-Provincial-Territorial Committee on Climate Change and Environmental Assessment (2003) states that "climate change has been recognized internationally and by the federal, provincial and territorial governments in Canada as an important environmental issue." Incorporating climate change considerations in an assessment can help determine if a project is consistent with jurisdictional initiatives for the management Greenhouse Gas (GHG) emissions (Federal-Provincial-Territorial Committee on Climate Change and Environmental Assessment 2003). Environment effects on Project are presented in Chapters 6 to 10. As a member of the Mining Association of Canada, KGHM and the Ajax Project will also align with the Towards Sustainable Mining (TSM) program and the Energy and GHG Management commitments.

3.2.3 Application of the Precautionary Principle

The Precautionary Principle stipulates that lack of certainty regarding threats of environmental harm should not be used as an excuse for not taking proactive steps to avert that threat. It also recognizes that delaying action until there is compelling evidence of harm will often mean that it is then too costly or impossible to avert the threat. The use of the Precautionary Principle promotes action to avert risks of serious or irreversible harm to the environment.

KAM integrates the application of the Precautionary Principle throughout the design of the Project and forms the basis for project design criteria, the effects assessment, the alternatives assessment and management practices. To this end, the precautionary approach has been used throughout the environmental assessment by applying conservative factors in design, assessment inputs and modelling, including:

- conducting research to establish baseline data, and where data is not yet available, incorporating examples from other similar, established operating mineral resource facilities;
- engagement with communities and First Nations so that accessible local and traditional knowledge is evaluated and incorporated, in order to support the goal of achieving scientific consensus where possible;
- where there is uncertainty or some plausible risk, implementing conservative approaches, together with a dynamic process of adaptive management. This flexible approach supports the design of monitoring programs to address areas of uncertainty, provide a process for mitigation, and further the ongoing collection of scientific data;
- promoting responsibility and accountability of managers, employees and contractors to protect the environment and make environmental performance an essential part of the management/contractor review process, as well as promoting the development and implementation of systems and technologies to reduce environmental risks; and
- formal monitoring and compliance reviews by environmental professionals enhanced by a culture of encouraging all employees, contractors or stakeholders to report to management any known or suspected departures from this policy or its related procedures.

Ongoing engagement and consultation, adaptive management and the application of the precautionary approach in decision-making is aimed at protecting the health and safety of the local population, as well as minimizing any impact of the Project on the environment and local ecosystems.

3.2.4 Worker Health and Safety

People who work for KAM are the key to the company's success and the company is committed to the health, safety and well-being of the entire workforce. KAM requires and enables each of its employees and contractors to promote the health and safety of all individuals engaged in its operations and to strive to achieve an incident/accident free workplace.

KAM believes that the best mines are the safest mines and holds "Zero Harm" as a core value for employees, contractors and local communities.

KAM management is accountable for providing safety leadership through comprehensive systems of loss control, risk assessment and high energy engagement with employees. Safety professionals and committees will support the drive to "Zero Harm" to create workplaces where everyone personally commits to a culture of safe behaviour. KAM will hold each employee accountable for the choices they make and the actions they take toward reaching the goal of "Zero Harm." As stated in KAM's Health and Safety policy:

"In fulfilling our health and safety commitment to "Zero Harm" we will:

- *"Show the World" by embracing a health and safety culture and measuring our actions for everyone to see.*
- *Continually improve our health and safety performance by setting objectives and monitoring our performance results.*
- *Utilize risk assessment techniques to identify hazards and implement controls to mitigate them so as to prevent injury and ill health.*
- *Meet or exceed all health and safety legislation."*

3.2.5 Socio-economic Conditions

KAM believes in "Success Through Teamwork." This is achieved by working collaboratively with employees, contractors, local and indigenous people, and other stakeholders in the communities in which KAM operate.

Social responsibility means holding KAM accountable for the impacts of decisions on society and the environment. KAM is committed to transparent and ethical behaviour that contributes to sustainable development and governing business as a natural resource developer throughout all operations and daily activities. As stated in KAM's Social Responsibility policy;

"In fulfilling these commitments, KAM will:

- *Recognize the impacts, and respect the interests and expectations of society on our activities.*
- *Respect the rule of law and conduct our business with honesty, integrity and fairness.*

- *Develop and implement policies and procedures to address: corporate governance, human rights, labour practices, including health and safety, environmental protection, and community involvement and development, in all aspects of our business and supply chain.*
- *Report our performance according to applicable standards".*

3.2.6 Archaeological and Heritage/Cultural Sites

Archaeological and heritage sites provide a strong link to the people who lived on the land in the past. It is important to protect these resources by maintaining the integrity of any known and newly discovered sites and/or artifacts. Archaeological and heritage sites known to exist in the area include:

- hunting blinds, tent rings, stone flakes, tool making or using, and other evidence of people living in the area;
- caches and cairns;
- culturally altered trees and other trail markers;
- historical buildings (ranches, churches); and
- fence lines and wagon trails.

KAM has incorporated archaeological/heritage site programs as part of the ongoing baseline data collection and implemented a Standard Operating Procedure for all employees, contactors and visitors. If an archaeological artifact or heritage site is found, it is not removed or disturbed and the location reported to the Project archaeologist who will evaluate the find and determine what action needs to be taken, including reporting that may be required to the BC Government Heritage Branch.

3.2.7 Consideration of Current Land Use Activities

Other land uses in the area of the Ajax Project include agriculture, residential and traditional uses, and recreation/tourism. KAM is committed to open communication with its neighbours as outlined in its Social Policy (Section 1.2.7) and Community Policy (Section 1.2.10) and, where possible, will implement joint programs and share information for mutual benefit.

3.2.8 First Nation Engagement and Traditional Knowledge

Consultation activities proposed by KAM included funding for the execution of Traditional Land Use / Traditional Knowledge studies by Aboriginal Groups. The information shared with KAM has informed the Environmental Assessment process and influenced Project design. At the time of writing, SSN and MNBC had completed Project specific TK/TLU studies while negotiations with other Aboriginal Groups are on-going and, and KAM has committed to consider the results of additional studies in future Project planning activities.

Traditional Knowledge (TK) studies provide a valuable way of documenting spatial and temporal patterns of hunting, harvesting, fishing, habitation and travel in a given area. They can also provide detailed information on local ecological processes, socio-cultural patterns and institutions, spirituality, ethical and other matters.

In addition to Project specific studies, background information was also analyzed using standard approaches of literature review, secondary data collection, and data analysis. Based on feedback received from Aboriginal Groups and the public during the consultation process, KAM conducted additional engineering studies and changed the GA of the Project, as announced on May 29, 2014.

Examples of some of the changes made incorporating input from Aboriginal Groups include:

- As a result of concerns about potential effects to the Cherry Creek watershed, KAM relocated the TSF away from the Alkali Creek watershed (including Cherry Creek). The location and redesign to a thickened tailings storage facility reduces potential for dust by using wet tailings storage methods.
- To mitigate potential effects from dust fall, the TSF was relocated further away from key transportation infrastructure and residential areas and closer to mine operations. Redesigning the TSF from a dry stack (potential dust generation) to a conventional wet design storage facility also allows the recapture and recirculation of water. The updated GA proposes other mitigation to reduce dust generation. This includes covering crushed ore stockpile to reduce fugitive dust and associated potential for dispersing contaminants; spray/misting and vacuum systems will be used to minimize the opportunity for dust to escape from key ore transfer points; wetting roads; new design with fewer roads; and controlling vehicle speed limits to reduce dust production. With respect to concerns on traditional land use, the updated GA minimizes potential for dust-related project effects on traditionally-used plants, Jacko Lake, and grasslands.

3.2.9 Community Engagement

KAM considers itself part of the communities in which it operates. Success is dependent on the collaborative, team-oriented, partner-style working relationships with employees, contractors, local and indigenous communities, and other stakeholders. These relationships support the exchange of experiences, resources and efforts. Staying true to the core values of “Zero Harm” and “Success Through Teamwork,” a broad range of social, cultural and economic factors in the execution of each project is considered.

KAM management takes a leadership role to support community engagements, developments and general well-being with performance measured against applicable standards. Employees are encouraged to contribute and involve themselves with local programs for the betterment of their communities, and to communicate corporate commitments to all relevant stakeholders. As stated in KAM’s Community policy:

“In fulfilling our commitment to people and communities, KAM will:

- *Listen and respond to the needs of local communities and other affected parties.*
- *Build relationships and trust by engaging in objective, open and honest dialogue.*
- *Engage indigenous communities and respect their cultural knowledge and heritage.*
- *Support local initiatives that contribute to the sustainable development of society.*
- *Develop and implement Community and Social Responsibility (CSR) programs.”*

3.2.10 Future Development

As Project development advances it is anticipated that ongoing exploration activities and mineral resource definition will continue at the property to confirm and optimize the economic viability of the Project. As exploration continues throughout the life of the Project, it is possible that additional deposits (or extensions of those currently identified) will be discovered and become economic to develop. Ongoing economic assessment may also identify alternative mining methods, production rates, waste management, water management, and infrastructure to improve economic feasibility with the extraction of the known, and future, reserves/resources.

The Project, as described in this chapter, forms the basis of the environmental assessment carried out in the remainder of this Application/EIS. Conservative assumptions have been made to ensure that the assessment is able to account for known uncertainty in Project design. Any material changes that may arise as a result of future exploration or technology evaluation over the life of the Project would be addressed through the appropriate regulatory processes.

3.3 GEOLOGY

3.3.1 Regional Geology

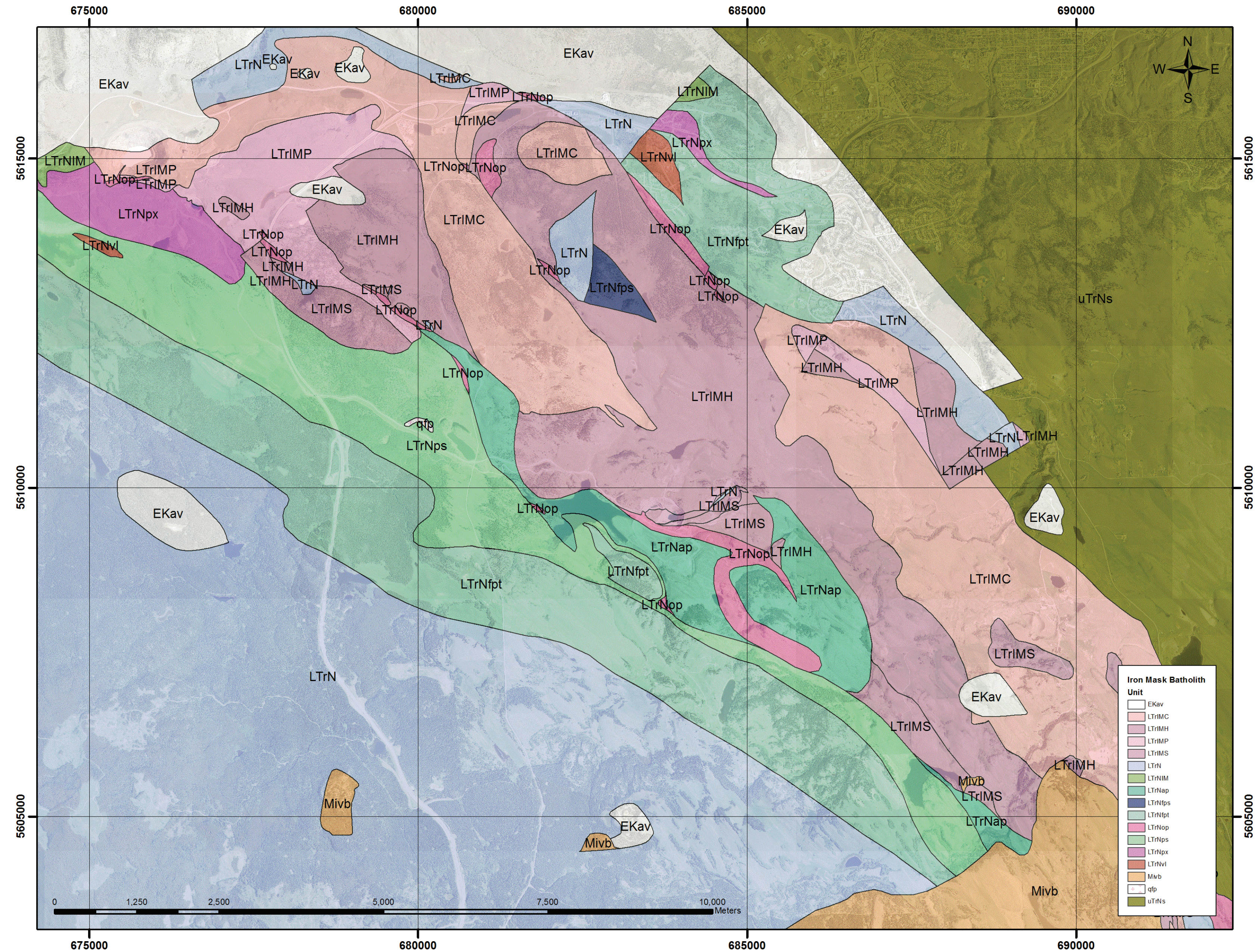
The regional geology of the Project area is dominated by the Upper Triassic Iron Mask batholith, which lies in the southern part of the Quesnel trough, also known as the Nicola belt (MINFILE 092INE012, 2007). The Iron Mask batholith is approximately 5 km wide and 20 km in length and trends northwest through the region (Figure 3.3-1). The Iron Mask batholith is classified as an alkaline porphyry, and is a multi-unit intrusive body composed of Pothook, Iron Mask Hybrid, Cherry Creek and Sugarloaf units. The rocks vary from fine-grained and porphyritic to coarse-grained and are silica poor, ranging from gabbro to syenite with diorite-monzodiorite-monzonite compositions predominating. Uranium – Lead (U-Pb) dating of the batholith has indicated an Upper Triassic age of 204±3 Ma (Mortensen, Ghosh and Ferri 1995).

Major systems of northwesterly and northeasterly-trending fractures or faults controlled the emplacement of the various units. A northwest-trending, northeast-dipping structure called the Leemac Fault has been recognized in the Rainbow Project area and is interpreted to extend into the Ajax Project area, becoming what is now termed the East Pit Fault. The Cherry Creek Fault is also northwest trending and is believed to be the contact between the Iron Mask batholith and Nicola Volcanic units. Numerous northeast-trending faults crosscut the Iron Mask batholith. Shallow faulting has been recognized in the Ajax and Pothook pits as well as in the Galaxy Project to the north of Ajax.

The Iron Mask batholith intruded a sequence of Nicola Group flows and volcaniclastic rocks of mafic and intermediate composition. This latter package consists of an extensive, thick sequence of subaerial and submarine mafic to intermediate flows, volcaniclastics and related sedimentary rocks. Adjacent to the Iron Mask batholith, the Nicola Group rocks are characterized by basaltic to andesitic composition clinopyroxene phyric flows and flow breccias, light green massive tuffs and bedded ash to lapilli tuffs.

Figure 3.3-1
Geology of the Iron Mask Batholith

ERM



Stratigraphically above the Nicola Group are a series of serpentinized picrite basalts that occur as wedges or slivers caught up in major fault-related northwest trending, northeast dipping structural corridors within the batholith. The most recent interpretation is that the picrite occurrences were emplaced along faults within the Nicola Group Volcanics. The picrite is occasionally crosscut by dykes of Sugarloaf diorite, and picrite xenoliths are occasionally found within the Sugarloaf diorite unit, indicating that the picrite pre-dated the Sugarloaf. Mineral chemistry indicates that these ultramafic rocks represent mantle-derived material which has undergone minimal differentiation or crustal contamination and, based primarily on regional geology and whole rock and mineral chemistry, they represent ultramafic magmatism in an island arc setting (Snyder and Russell 1993, 1995).

The youngest rocks in the region are a Tertiary sequence of tuffaceous sandstone, siltstone and shale with minor flows and agglomerates of basalt and andesite belonging to the Kamloops Group.

3.3.2 Local Geology

Outcrops are generally abundant in the Project area, in part due to the development of the West and East pits and haul roads. Historic surface mapping and geophysical survey data (induced polarization and magnetometer) have been supplemented by extensive diamond drilling in a number of areas on the property.

The Ajax property includes three areas: the Ajax West Pit, the Ajax East Pit (both pits were formerly mined in the 1980s and 1990s) and the Ajax East Extension (previously known as Monte Carlo). As many as twenty-two (22) rock types have been recognized in the Project area, but the major units can generally be combined into three main rock types: Iron Mask Hybrid, Sugarloaf diorite, and Nicola Volcanics. Geochemical characterization also groups geologic material that is presented in Section 3.4. The contact between the Sugarloaf diorite and the Iron Mask Hybrid trends northwesterly through West Ajax and changes to a southwesterly trend through East Ajax. The Sugarloaf-Iron Mask contact is truncated by a northwesterly striking fault at the north end of the East Project area. The contact between the Sugarloaf diorite and Nicola Group generally trends northwesterly through the Project area.

The Nicola Volcanics consist of picrite and various fine-grained and pyroxene porphyritic mafic volcanic rocks. The unit is dark green and non to weakly magnetic. The picrite unit is typically dark green to blue, fine-grained and strongly magnetic and may contain up to 10% ovoid 1-8mm relict olivine phenocrysts, now altered to serpentine and magnetite. The matrix generally consists of serpentine and tremolite-actinolite. These rocks are enriched in chromium and nickel. Chalcopyrite and pyrite may occur locally in these units, typically near the contacts with Sugarloaf diorite and Sugarloaf Volcanic Hybrid, but they are generally unmineralized.

The Iron Mask Hybrid is considered to be an assimilation of the Nicola Group into the intruding Pothook diorite. The Iron Mask Hybrid varies from fine to coarse-grained and is dioritic to gabbroic in composition. Weak propylitic alteration is common, with K-feldspar and albite alteration occurring locally. The Iron Mask Hybrid may contain up to 10% magnetite and locally chalcopyrite and pyrite are present.

Sugarloaf diorite is characteristically a fine to coarse-grained, light to medium gray porphyritic diorite containing euhedral hornblende phenocrysts. Unaltered Sugarloaf may contain up to 5%

fine-grained magnetite. Locally, the Sugarloaf diorite has assimilated rocks of the Nicola Group and is referred to as the Sugarloaf Hybrid. Albite and K-feldspar alteration is present in varying degrees. Strong albite alteration has commonly destroyed original textures locally. Sulphide mineralization is associated with albite alteration and consists predominantly of chalcopyrite and pyrite. Molybdenite, tetrahedrite, and bornite have been observed.

All units are cut by a variety of unmineralized late dykes including monzonite, latite and lamprophyre. The dykes are up to 5 m wide and steeply dipping, with variable azimuths, but are most commonly along similar orientations to regional faulting. The monzonite is typically pale, aphanitic to fine to medium grained and has small amounts of biotite, hornblende, pyroxene and magnetite. It is usually emplaced along northwest-trending faults. The latite is light brown to greenish gray, with irregular calcite and potassium feldspar phenocrysts in a fine-grained groundmass, and tends to follow northeast-trending faults. Occasionally quartz eyes are also visible. Rounded granite clasts up to a few centimetres are common, which can contain chalcopyrite and pyrite. The lamprophyre is a dark, fine-grained unit with phenocrysts of biotite and hornblende.

The youngest units seen at Ajax are the basalts. These fine-grained units have calcite filled amygdules and can contain xenoliths of diorite and mafic volcanics.

3.3.3 Mineralization

The Iron Mask batholith is host to more than 20 known mineral deposits and occurrences. Mineralization is commonly copper-gold, consisting primarily of fracture-controlled chalcopyrite and bornite associated with magnetite, while pyrite or pyrrhotite occur peripherally. Mineralization is hosted in all of the different phases of the batholith (Logan and Mihalynuk 2005). Mineralization is associated with regional fault zones that trend easterly or southeasterly through the area.

The mineralization in the Project area is associated with structural corridors of highly fractured sections of Sugarloaf and Sugarloaf Hybrid phases of the Iron Mask batholith. Chalcopyrite is the dominant copper mineral and occurs as veins, veinlets, fracture fillings, disseminations, and isolated blebs in the host rock. Concentrations of chalcopyrite rarely exceed 5%. Accessory sulphide minerals include pyrite and molybdenite. Bornite and tetrahedrite have also been observed in trace amounts.

High-grade copper mineralization (>1.0% Cu) is confined to chalcopyrite vein systems. Copper grades decrease away from the chalcopyrite veins. High-grade mineralization can extend several metres from the vein structure. Mineralization extends to depths exceeding 600 m and has a length exceeding 2,000 m.

It is common for gold concentrations to be directly correlated with copper concentrations. Gold mineralization increases slightly in areas where strong albite alteration occurs. The albite alteration is in part controlled by fault and vein structures. Minor palladium mineralization is associated with copper near the contacts of the Iron Mask Hybrid and Sugarloaf units. Minor amounts of silver have also been found.

3.3.4 Veining

Calcite and carbonate veining are common throughout all units on the Ajax property. Albite and potassium feldspar veins are typically observed in the Sugarloaf diorite and Sugarloaf Volcanic Hybrid units, but are occasionally noted in the Iron Mask Hybrid or Mafic Volcanic units as well, typically near the contacts with the Sugarloaf units. Chlorite, dolomite, epidote, hematite, magnetite and occasional quartz veining have been observed in all units. Talc and/or serpentinite veining has been noted in the Picrite unit. Gypsum and anhydrite veining have been observed at depth, typically beginning 100 to 200 m below the surface.

3.3.5 Structure

Regionally, the Iron Mask batholith is dominated by north to northwest-trending moderate to high angle faults which are considered to be deep seated, controlling deposition of volcanic and sedimentary rocks of the Nicola Group as well as emplacement of the various phases of the Iron Mask batholith. These structures were active as early as the mid-Triassic (Logan and Mihalynuk 2005).

Structural corridors, defined as zones of brittle deformation, are recognized as favourable zones for mineralization. Structural corridors have been interpreted from surface mapping and magnetic surveys and generally define the outer boundaries of the batholith.

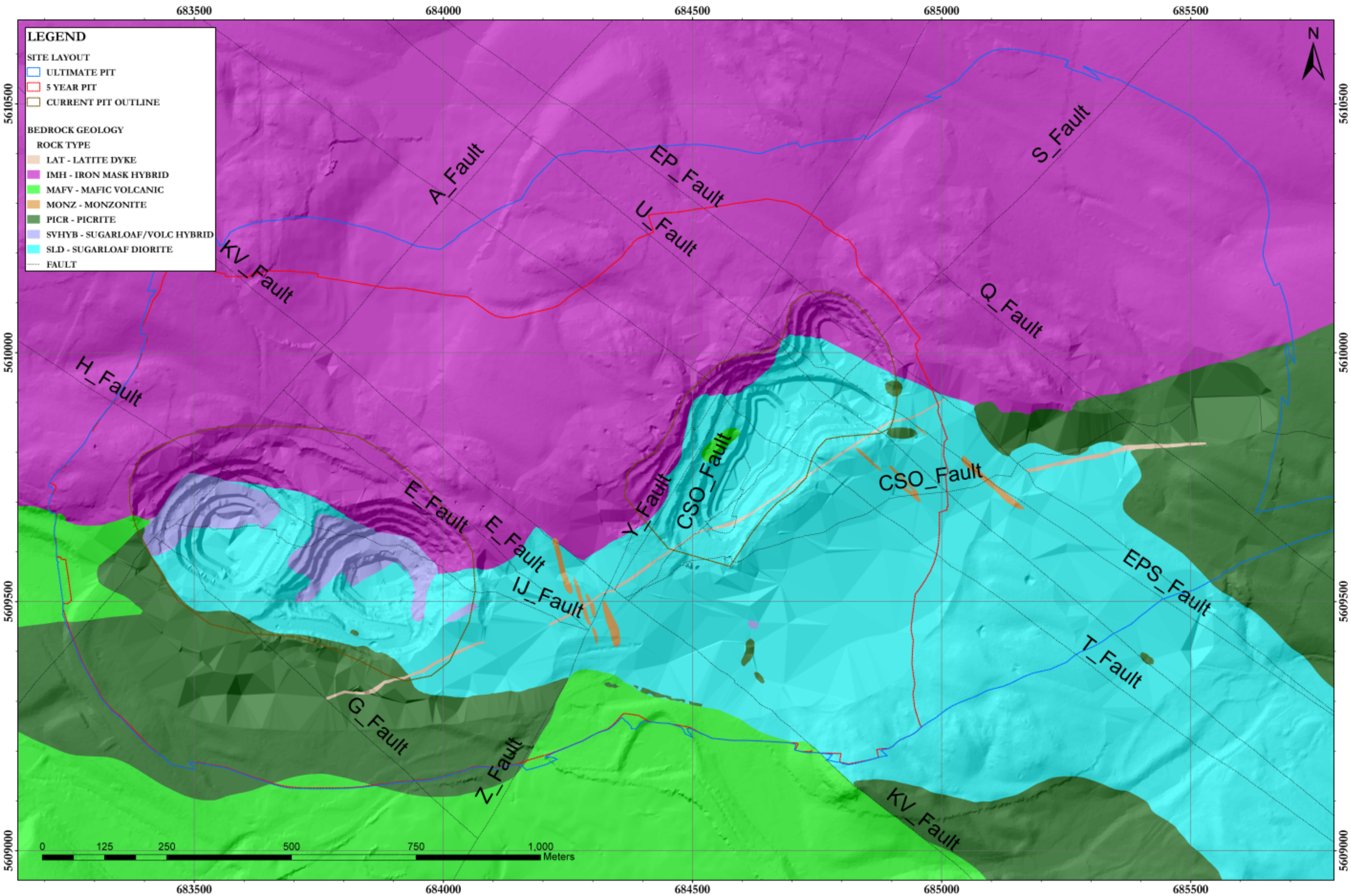
The northwest-trending Cherry Creek Fault, to the south of Jacko Lake, is the most prominent of these faults, but subparallel structures have been observed in the Ajax East and West Pit. The northwest-trending Leemac Fault is the other major fault in the area, extending from the nearby Rainbow showing and down toward the Project area, possibly becoming the East Pit Fault.

In the Project area, structures are dominated by several generations/orientations of steep faulting and a generation of flat thrust faults. Three main fault directions have been interpreted: northeast trending, northwest trending and west trending (Figure 3.3-2).

Two northeast trending, steeply- dipping faults (A and Z) are interpreted to be the youngest; terminating and offsetting other faults. The East Pit Fault (EPF) and the East Pit Splay (EPS) are two northwest trending, steeply dipping faults which are easily seen in the northernmost part of the Ajax East Pit. The EPF causes evident offset to both lithology and mineralization. Faults KV and T were interpreted from mapping and regional magnetic mapping, and are also northwest-trending and steeply dipping; these are interpreted to be the oldest faults in the area but may have been reactivated at a later date. It appears that both the northwest and northeast structures are offsetting the Sugarloaf diorite and the mineralization; however, the offset along the northwest structures is much more considerable. An east-trending fault (IJ), first interpreted by Ross (1993), cuts across the western half of the Ajax West area. Based on drill data and observations in the pit, there is no evidence that this fault is extensive, and it appears to terminate at faults A and Z. Two shallow-dipping, approximately east-trending faults (CSO) were interpreted based on observations of the pit walls and copper grade offsets in the drilling. The first is in the area of the East Pit and the second is in the area of the West Pit although it does not extend to surface. The timing and relationship of these flat lying faults to the other structures is unknown.

Figure 3.3-2

Interpreted Structural Faults of the Ajax Project



3.3.6 Surficial Geology

The surficial geology and geomorphology of the area is reflective of extensive glacial processes including the development of surface lineations and the deposition of till blanket (GSC 1995). The valleys in the Project area are characterized as morainal deposits consisting of drumlinized glacial till. Remnant glaciolacustrine deposits occur just north of the Afton pit and coarse colluvium deposits occur near Sugarloaf Hill (Knight Piesold 2011).

Overburden material encountered during drilling and trenching typically consists of clays, fine-grained silts and coarse sand and gravel. Overburden thickness in the Project area can vary widely, from 0 to 83 m.

Organic cover is present across the Project site in undisturbed areas and primarily consists of vegetative root mat, with silt, sand, and organic matter in varying proportions. Based on test pits and boreholes completed across the Property, the mean thickness is approximately 0.3 m and ranges between 0.0 and 1.0 m.

Glacial till materials are encountered across the Project site (Figure 3.3-3). The glacial till is generally encountered immediately below the organic cover. The till is described as sandy silt (with some clay and trace to some gravel) ranging to a silty, sandy gravel (with trace clay). The texture of the till near the ground surface has higher fines content at some test locations found within topographic lows. The relative density of the glacial till is found to be variable and is generally between compact to dense, increasing to very dense with depth in many areas of the site.

3.3.7 Mineral Resources

The mineral resources of the Ajax deposit were classified in accordance with Canadian Institute of Mining, Metallurgy and Petroleum definition standards and best practices referred to in NI 43-101 which have a reasonable expectation of economic extraction (Wardrop 2012).

The mineralization of the Project satisfies criteria to be classified into Measured, Indicated, and Inferred mineral resource categories. The Measured and Indicated resource stated in the 2012 Feasibility Study totals 512 Mt at an average grade of 0.31% Cu and 0.19 g/t Au, with an additional 73.7 Mt of Inferred at 0.27% Cu and 0.17 g/t Au. The total proven and probable mineral reserves are 503 Mt containing approximately 2,960 Mlbs of copper and 2,750 Koz of gold.

As previously noted, these resources are sufficient to economically support production of copper and gold for approximately 23 years at a nominal rate of 65,000 tonnes per day.

Figure 3.3-3

Soil Profile of the Ajax Project (BGC, 2011)

ERM

Soil profile from test pit

3.3.8 Geotechnical Investigations

A number of formal geotechnical studies have been completed for the Ajax Project. These studies have focused on key infrastructure items and are summarized below:

- Open Pit geotechnical and hydrogeological investigations and assessments (Appendix 3-C);
- hydrologic, geotechnical, and design investigations and assessments on the interaction of Jacko Lake and the Open Pit (Appendix 6.2-C and Appendix 6.6-A);
- Mine Rock Storage Facility geotechnical investigations and design assessments (Appendix 3-I);
- Tailing Storage Facility (TSF) material testing, hydrological and hydrogeologic investigation and assessments (Appendix 3-D);
- Road and Project infrastructure foundation geotechnical investigations and assessments (Appendix 3-I).

3.4 Site Geochemistry

3.4.1 Characterization and Screening

Based on static and laboratory and field based kinetic testwork, Calcium Neutralization Potential (CaNP) values and nonsulphate sulphur values are used to calculate the Calcium Net Potential Ratio (CaNPR) to screen the material as potentially acid generating (PAG) or not potentially acid generating (NPAG). A CaNPR criterion of 2.0 provides the basis for segregation of PAG and NPAG material and handling of mine rock, ore and tailings.

Mine rock will be characterized during the construction and operation phase, with results incorporated into updated mine production schedules and on-site tracking of material handling and transportation to ensure placement in the appropriate facility. In general, NPAG material will be used for construction over Project life and PAG material will be placed in Mine Rock Storage Facilities (MRSFs) and mixed with NPAG such that the resultant neutralization potential ratio (NPR) is 3.0 to further reduce potential for ML/ARD.

3.4.1.1 Mine Rock

Geochemical evaluation conducted in 2015 (Appendix 3-A) indicates that mined material will have relatively low sulphur content and high neutralizing potential (NP). Acid Base Accounting (ABA) tests show that the mine rock has low sulphide sulphur content, typically <0.02%, typically present in the sulphide mineral pyrite, with chalcopyrite and molybdenite occasionally observed.

Mine rock contains available carbonate neutralizing potential (NP) and non-carbonate NP, in the form of magnesium- and/or calcium-rich silicate minerals. The availability of silicate (non-carbonate) NP is observable in all mine rock types. Based on very conservative assumptions for CaNP and nonsulphate sulphur sulphur values, and a CaNPR of 2.0, approximately 88% of the mine rock is estimated to be NPAG.

Kinetic testing has been conducted for more than two years to estimate metal loadings from the mine rock materials. pH values range from 7.0 to 8.5 over this time indicating that under the enhanced weathering conditions, no ARD is indicated in any of the major mine rock types.

Metal leaching rates from the kinetic tests are relatively low and dissimilar between lithologies. Parameters of concern (POCs) include cadmium, copper, nickel, zincarsenic, molybdenum, selenium and vanadium Dissolved metal concentrations for POCs vary between mine rock types with values ranging typically below or very close to the BC Freshwater Aquatic Life Guidelines for some mine rock and exceeding guideline concentrations in others. Predictive water quality source terms (Appendix 3-B) incorporate consideration of these variable rates from different mine rock.

Of note is that field bins at the Ajax site have been in place since 2007 and the mine rock they contain has been exposed to natural weathering process for at least 15 years prior to field bin construction All of the field bins produced leachate with a pH averaging about 8, demonstrating that after at least 15 years of subaerial exposure, mine rock is not actively producing acidic drainage.

The management of mine rock at the Project will be conducted in concordance with the Metal Leaching and Acid Rock Drainage Management and Monitoring Plan (Section 11.5).

3.4.1.2 Ore

Ore samples have similar ML/ARD characteristics as mine rock from the same geologic unit with the exception of increased abundance of copper sulphide minerals in the ore samples. On average, ore samples also have increasing sulphide and carbonate content with increasing ore grade; however, total sulphur content is generally below 0.6%. Approximately 30% of the low and medium grade ore material temporarily stored in the ore stockpile was determined to be PAG using the conservative CaNPR screening criteria. This relatively low overall percentage, and the presence of carbonate mineral, suggests that net acid generation from the ore stockpile is not expected.

3.4.1.3 Tailings

Tailings are expected to have a low average sulphur content near 0.23 % and average CaNP values around 65 kg $CaCO_3$/t. Overall, the tailings are expected to be NPAG.

Tailings kinetic tests show a mean stable leachate pH of 8 and, as with the mine rock, the metal leaching rates are relatively low. Dissolved molybdenum, copper, selenium and vanadium show the highest release rates with selenium and sulphate exceeding BC water quality guidelines. Predictive water quality source terms (Appendix 3-B) incorporate consideration of these variable rates from the tailings.

3.4.1.4 Overburden

Overburden samples from within the proposed open pit boundary contain sulphur species primarily in sulphate minerals and acid insoluble sulphur phases with limited samples containing detectable sulphide sulphur. Also, a relatively large percentage of the total carbon content occurs in the form of organic carbon, however, there is sufficient carbon in carbonate minerals resulting in in CaNPR values higher than 20. No net acid generation is expected from the overburden unit after excavation.

Shaker flask extraction tests of the overburden material resulted in consistently neutral pH with only sulphate and selenium exceeding BC contaminated site guidelines in two of the twenty samples.

3.4.2 Source Terms and Predictive Modelling

Geochemical characterization studies are used to predict and evaluate the drainage quality of the MRSFs, ore stockpile, TSF and open pit walls. This predicted drainage quality is used to evaluate the potential impact of mine drainage as part of environmental assessment. Specifically, the predicted geochemical source terms from the MRSFs, the ore stockpile, the TSF and the pit walls are used as input into the project-scale water quality model to predict water chemistry at various locations across the Project and in the downstream environment. Long-term pit wall runoff quality predictions also feed into a numerical pit lake model to evaluate the evolution of water quality after mine closure. Geochemical source terms are presented in Appendix 3-B and the model results are discussed in the context of the environmental assessment within Chapter 6.

3.5 AJAX PIT DEVELOPMENT

A unique aspect of the Project is the location of Jacko Lake relative to the Ajax Pit. KAM has undertaken detailed investigations to understand current hydrogeological and geotechnical conditions between the lake and the open pit, and as detailed geotechnical monitoring plans are developed, they will be focused on effectively managing this risk. KAM recognizes the many environmental, social and cultural values associated with Jacko Lake, and is committed to developing, operating, and closing the Project in a manner that retains these values.

The pit will be developed in multiple phases. Total material movement from the pit is estimated at an annual average of approximately 90 Mt.

3.5.1 Open Pit Geotechnical Design

Ajax Pit slope design parameters were developed using a geotechnical drill hole database which was deemed to be of a Feasibility study level, as defined by Read and Stacey (2009). Table 3.5-1 outlines the major lithologies that make up the Ajax Pit rock mass. These lithologies also form the four geotechnical domains (see Appendix 3-C). Based on the current Ajax Pit design, the distribution of the major lithologies within the final pit walls is; the north pit wall will consist mainly of IMH, whilst the south pit wall will consist mainly of SLD and NVP.

Table 3.5-1. Summary of Major Geotechnical Domains

Geotechnical Domain	Lithology Description	Lithology Code(s)
Nicola Group Volcanics	Mafic volcanics and volcaniclastics	MAFV (NVV)
Picrite	Serpentinised picritic basalts	PICR (NVP)
Sugar Loaf Diorite	Diorite	SLD
Iron Mask Hybrid	Mixed volcanics and diorite (variable)	IMH

A summary of laboratory test and rock mass classification results are presented in Table 3.5-2. Based on the median RMR_{89} values presented, NVV and NVP are rated as 'fair rock', while SLD and IMH are considered 'good rock'.

Table 3.5-2. Summary of Mean Laboratory Test Results and Rock Mass Classification by Geotechnical Domain

	Laboratory Test Results					Rock Mass Classification	
Geotechnical Domain	Density (t/m³)	UCS[1] (MPa)	UTS[2] (MPa)	Young's Modulus E(GPa)	Poisson's Ratio (v)	RQD[3]	RMR_{89}[4]
MAFV (NVV)	2.90	181	13.3	70	0.24	70%	50
PICR (NVP)	2.86	106	13.2	22	0.15	48%	55
SLD	2.84	91	11.9	75	0.24	74%	67
IMH	3.20	84	10.5	102	0.26	70%	65

Notes:
[1] UCS = Unconfined Compressive Strength
[2] UTS = Ultimate Tensile Strength
[3] RQD = Rock Quality Designation (after Deere, 1964), median values
[4] RMR = Rock Mass Rating (after Bieniawski, 1989), median values

3.5.1.1 *Open Pit Slope Design Consideration*

The methods used to develop the open pit slope design parameters followed industry best practices, including 3D inelastic numerical modeling, and considered all available data within each geotechnical domain. As can be seen in summary Table 3.5-3, the inter-ramp angles (IRA) an overall slope angles (OSA) range from 44° to 50° and 45° to 53° respectively.

Table 3.5-3. Summary of Ajax Slope Design Parameters

Slope Material	Value	BFA[1] (°)	Bench (m)	IRA[2] (°)	Geotechnical Bench (m)	OSA[3] (°)
Rock (Pit)	max	75	18	50	25	53
	min	65	16	44	25	45
Overburden	max	30	16	20	NA	24
	min	27	8	19	NA	22

Notes:
[1] BFA = Bench Face Angle
[2] IRA = Inter-Ramp Angle
[3] OSA = Overall Slope Angle

3.5.1.2 *Hydrogeological Assessment*

Hydrogeological tests show that the hydraulic conductivity of the bedrock is generally similar from unit to unit. Drawdown observed during test pumping at monitoring wells installed adjacent to the contact of the MVP and SLD units suggest this contact zone is more permeable than the surrounding rocks. Test pumping results also indicate that the bedrock is heterogeneous and exhibits barrier boundary effects typical of limited recharge and fractured bedrock. Groundwater is generally located 100 m below the ground's surface. Pit wall depressurization will be managed through a combination of ex-pit dewatering wells and in-pit horizontal wall depressurisation drains. Based on hydrological studies, groundwater pushback of 125 m behind the pit wall will be achieved with the installation of horizontal drainholes averaging 300 m in length, with 100 m spacing.

3.5.1.3 Kinder Morgan Pipeline

The Kinder Morgan pipeline is currently routed along the western boundary of the ultimate open pit boundary through the northeast arm of Jacko Lake. For safety reasons, the Project design is based on the pipeline being routed west of Jacko Lake with the new alignment of the pipeline approximately 1.25 km from the western and northwestern edge of the open pit. This distance between the open pit and the pipeline minimizes, and possibly eliminates, the effect to the pit wall stability or pit dewatering due to the pipeline.

3.5.2 Pioneering Work

Initial preproduction pit development will be accomplished with front end loaders, dozers, percussion drill, and rear end dump trucks. Activities during this stage include removing overburden, developing mine access roads suitable for large mining equipment, and developing areas within the initial pit for the large shovel and mining equipment. Suitable organic material will be temporarily stockpiled for reclamation use.

3.5.3 Pit Development

The longest span of the pit is approximately 2.5 km in the east-west direction and approximately 1.4 km in the north-south direction. The highest crest elevation of the ultimate pit is 987 meters above sea level (masl) and the pit bottom elevation is approximately 410 masl prior to mine rock backfill. A description of the six phases for pit development to reach these ultimate boundaries is provided in the following:

3.5.3.1 Year -2 to Year 2

From Years -2 to -1 (Figures 3.5-1 to 3.5-4), open pit development is focussed on re-establishing access to the historic mine workings with dewatering and excavation and stripping of placed material. These activities are within or in close proximity to the existing footprint of the historic open pits.

- **Phase 1 –** This starter phase targets the area in the southwest of the final pit in the current area of the historic Ajax west pit. The pit bottom is currently planned to be accessed by a single ramp. This phase will be active for approximately two years with mining activities beginning in preproduction. Like all mining phases, this phase will occupy a topographic low and will require dewatering infrastructure (primarily horizontal drains) if groundwater is encountered at depth.

- **Phase 2 –** This phase targets deeper mineralization through an expansion of Phase 1 and extends the pit boundary along parts of the west and southwest wall. The pit bottom is currently planned to be accessed by a single ramp located along the northwest wall with an exit along the southeast boundary of the open pit. Phase 1 is within the boundaries of the Phase 2 footprint and extends the pit depth.
- **Phase 3 –** This phase is currently planned to be independent of the previous phases and as planned will be located east of Phase 2 in the area of the historic Ajax East Pit. Access to Phase 3 will be with a ramp exiting along the northern boundary of the pit. The bottom of Phase 3 will deepen the pit from the Phase 2 depth.

3.5.3.2 Up to Year 5

The open pit development by end of Year 5 (Figure 3.5-5) includes:

- **Phase 1 –** This phase is complete and the mining in this area continues as part of Phase 2.
- **Phase 2 –** This phase targets deeper mineralization with the pit bottom accessed by a ramp located along the northeast wall with an exit along the southeast boundary of the open pit. There will still be active mining in Phase 2 at the end of Year 5.
- **Phase 3 –** This phase remains independent of the previous phases with access via a counter-clockwise ramp exiting along the southeastern boundary of the pit. There will be active mining in Phase 3 at the end of Year 5.
- **Phase 4 –** This phase will extend the pit boundaries to the north and east of the previous phases. Phase 4 will be active for approximately six (6) years and is the initial phase to connect the previous phases into one pit. At the end of Year 5, Phase 4 will be established with active mining utilizing the Phase 3 exit and haul road.

3.5.3.3 Up to Year 10

The open pit development by end of Year 10 (Figure 3.5-6) includes:

- **Phase 2 –** This phase is complete and mining in this area continues as part of Phase 4.
- **Phase 3 –** This phase is complete and mining in this area continues as part of Phase 4.
- **Phase 4 –** This phase extends the pit deeper by the end of Year 10 with access via a haul road along the southeast area of the pit and the exit along the southeast pit boundary.
- **Phase 5 –** This phase takes the open pit boundary to its final ultimate boundary to the northeast and east of the previous phases. Phase 5 will continues to deepen the pit bottom by end of Year 10 with ramp access along the south area of the pit exiting the pit at the southeast boundary.

3.5.3.4 Up to Year 23

The open pit development by end of Year 23 (Figure 3.5-7) includes:

- **Phase 4 –** This phase is complete and mining in this area continues as part of Phases 5 and 6.

- **Phase 5 –** This phase is complete and the area is used for mine rock disposal as backfill material.
- **Phase 6 –** This phase continues mining deeper in the eastern area of the open pit with a pit bottom at the final elevation by end of Year 23. Access is via ramp located along the east and portions of the south pit wall exiting at the southern pit boundary.

3.5.4 Ore Quality Control

Distinguishing between the different ore mining areas and accurately predicting mine rock-ore contacts will be required over the course of the Project. The geology and mine planning group will be responsible for sampling, geological mapping of blast holes, merging assay data with blasthole coordinates, generating short-range-mine plans, performing ore and mine rock delineation, performing mine to process plant reconciliations, and quality control. Quality control personnel will assist mine operation with ore-mine rock decision-making. Ore control will rely on digital methods such as high precision GPS and virtual digital mapping. This approach will extend to mine rock characterization and the classification of material as PAG and NPAG and support ML/ARD management, as outlined in Sections 3.4 and 3.9.

3.5.5 Drilling and Blasting

Blasthole drilling will be performed with electric rotary production drills. Blast damage to the pit walls will be minimized to preserve strength along bedding planes defining the potential failure blocks. A wall control program will consist of pre-splitting and trim blasts which will be carried out along ultimate walls, including the intermediate pit phases if geotechnical conditions warrant. Trim pattern blast holes will be drilled with the production drill rig and the pre-splitting blast-holes will be drilled with a diesel percussion drill rig. Mine rock material will be blasted to produce a suitable particle size distribution for loading and hauling. Mineralized material will be blasted to comply with fragmentation requirements and a specified particle distribution.

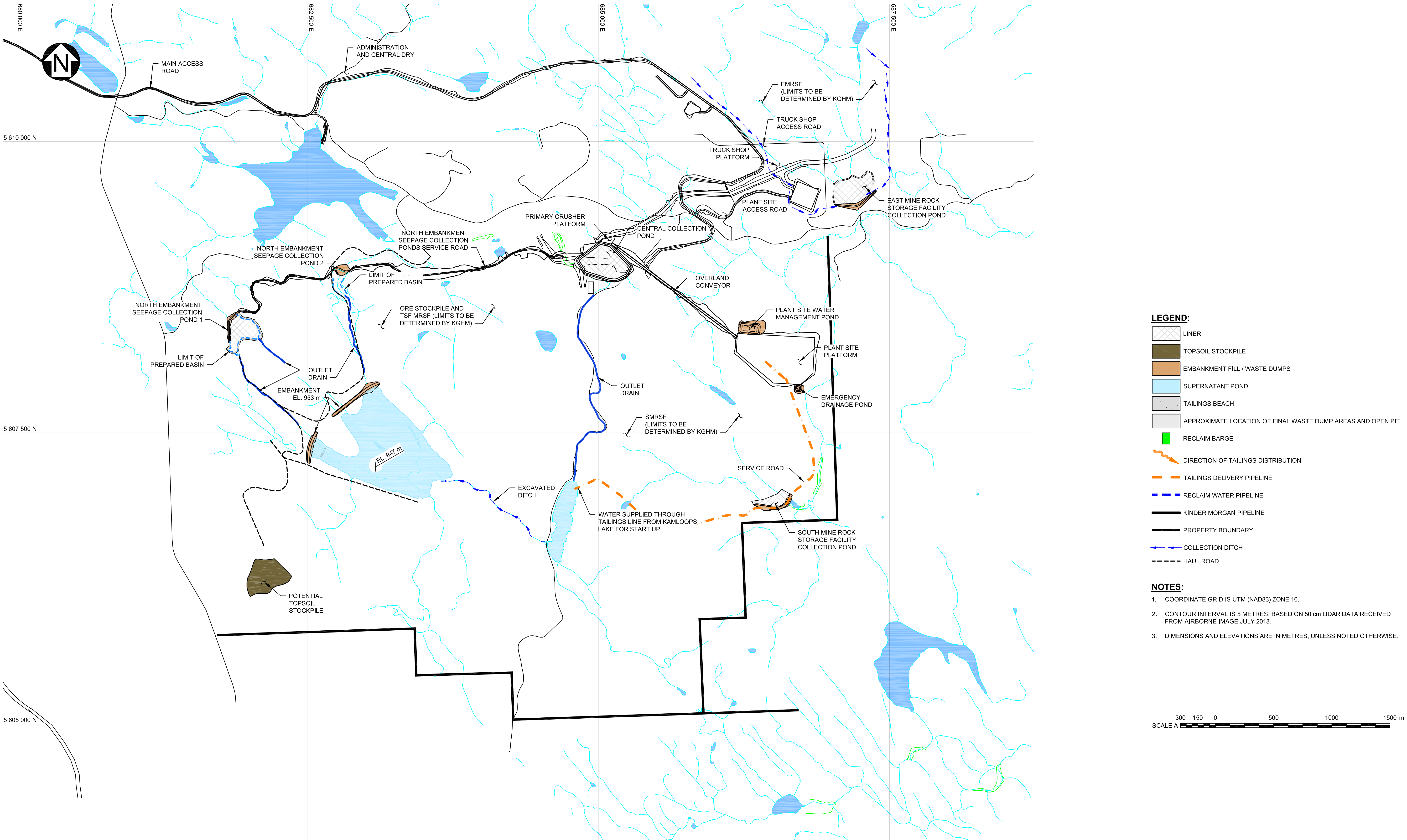
A mix of ammonium nitrate/fuel oil (ANFO) and emulsion explosives will be used for blasting.

Blast designs have been developed to eliminate the risk of structural damage and minimize annoyance effects from blast induced ground vibrations to nearby communities, residential homes, businesses, towers and other free standing structures. These detailed blast designs have also been developed to protect the health and safety of the public, mine employees and aquatic life in Jacko Lake. Finally blast designs have proposed procedures for blast notifications, warning signage blast clearance zones, communications, and post blast inspections. Additional detailed information on blasting procedures, including dust control, is contained in Appendix D of Appendix 10.5-A.

3.5.6 Loading and Hauling

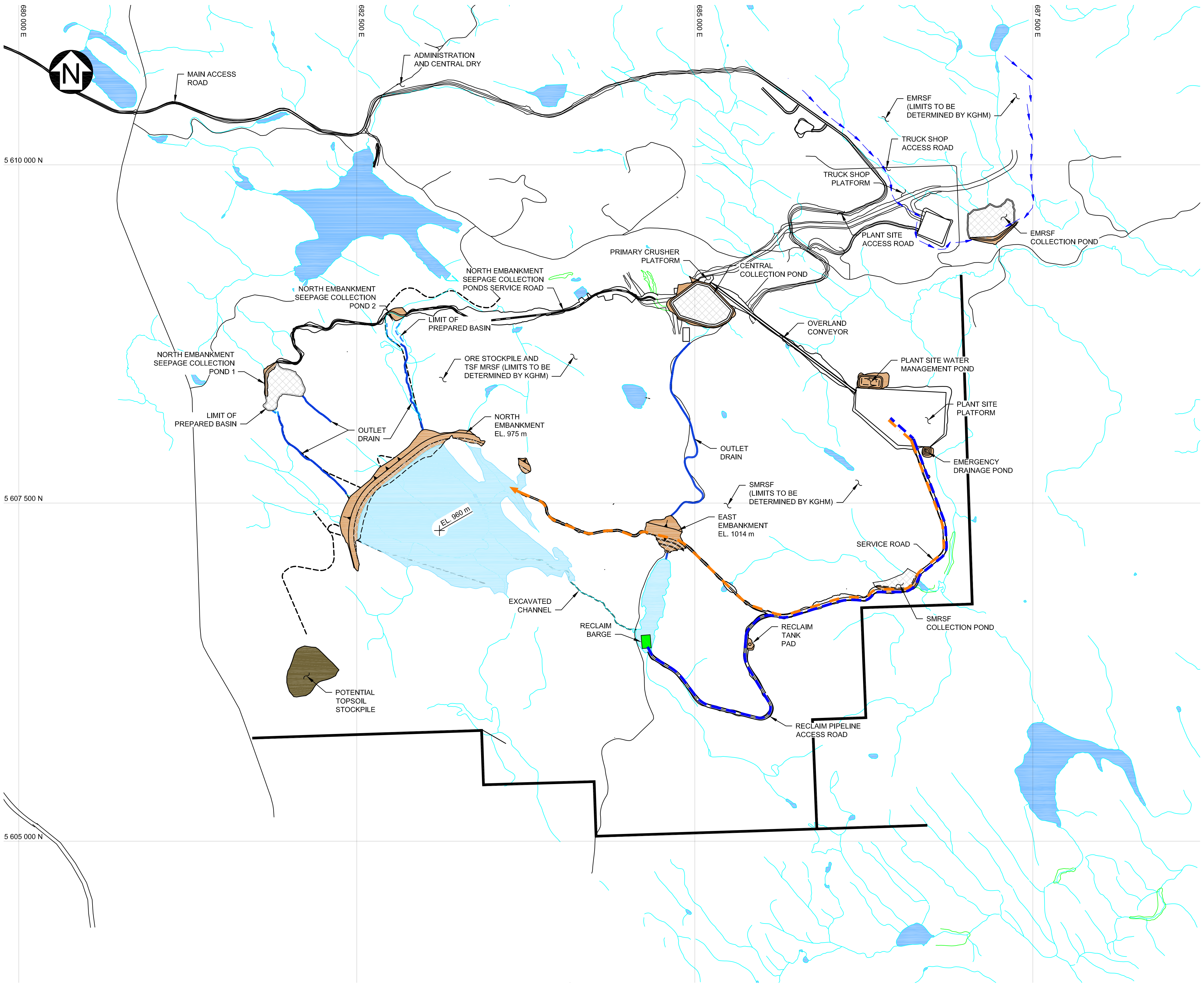
Traditional large scale trucks and shovels will load and transport material from full 15 m benches. Front end loaders will support the main production fleet by working on less productive faces, completing clean-up projects and serving as backup.

Figure 3.5-1
Conceptual General Arrangement Year -2



Source: Norwest (2015).

Figure 3.5-2
Conceptual General Arrangement Year -1



LEGEND:

- LINER
- TOPSOIL STOCKPILE
- EMBANKMENT FILL / WASTE DUMPS
- SUPERNATANT POND
- TAILINGS BEACH
- FINAL OPEN PIT
- RECLAIM BARGE
- DIRECTION OF TAILINGS DISTRIBUTION
- TAILINGS DELIVERY PIPELINE
- RECLAIM WATER PIPELINE
- KINDER MORGAN PIPELINE
- PROPERTY BOUNDARY
- COLLECTION DITCH
- HAUL ROAD

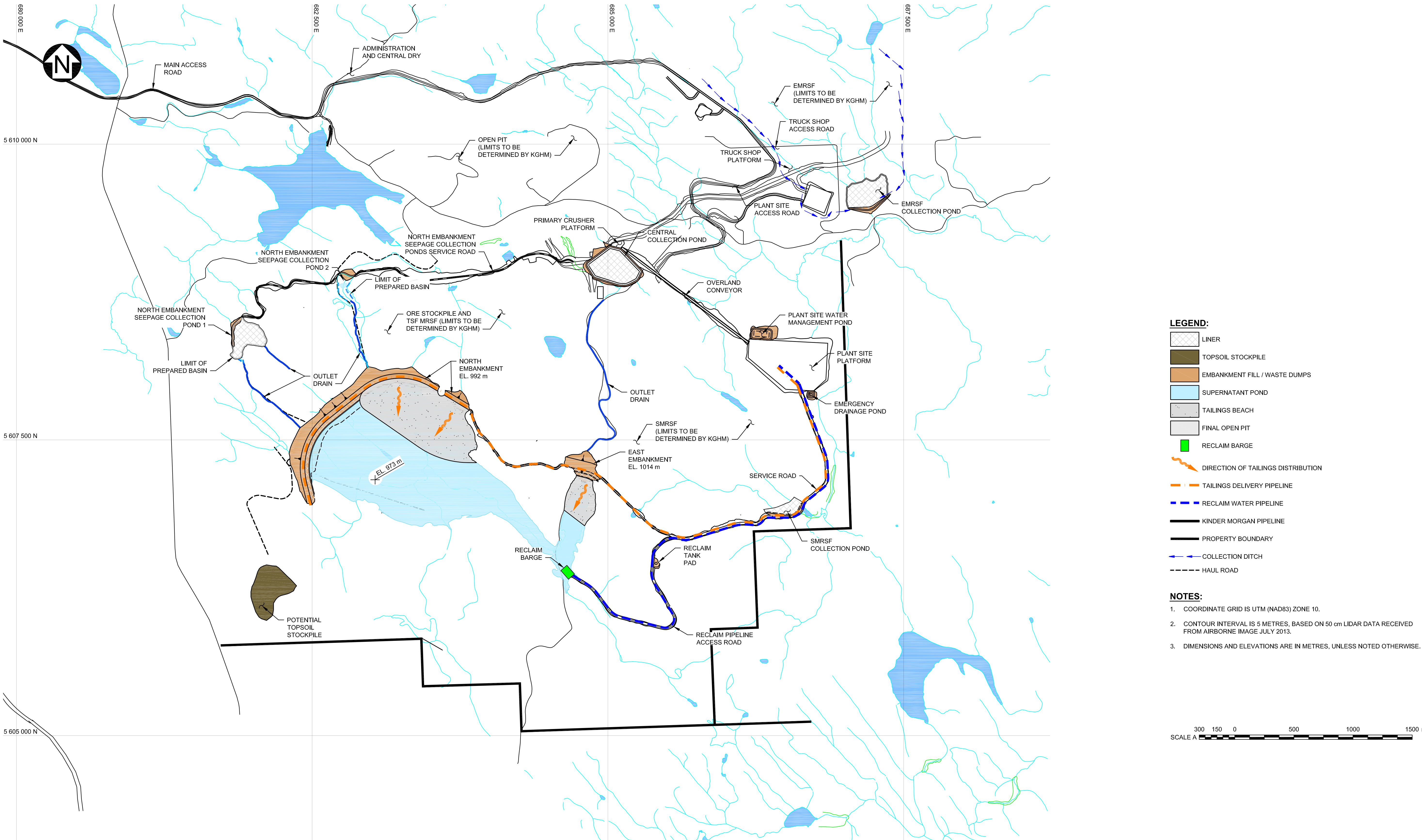
NOTES:

1. COORDINATE GRID IS UTM (NAD83) ZONE 10.
2. CONTOUR INTERVAL IS 5 METRES, BASED ON 50 cm LIDAR DATA RECEIVED FROM AIRBORNE IMAGE JULY 2013.
3. DIMENSIONS AND ELEVATIONS ARE IN METRES, UNLESS NOTED OTHERWISE.

SCALE A 300 150 0 500 1000 1500 m

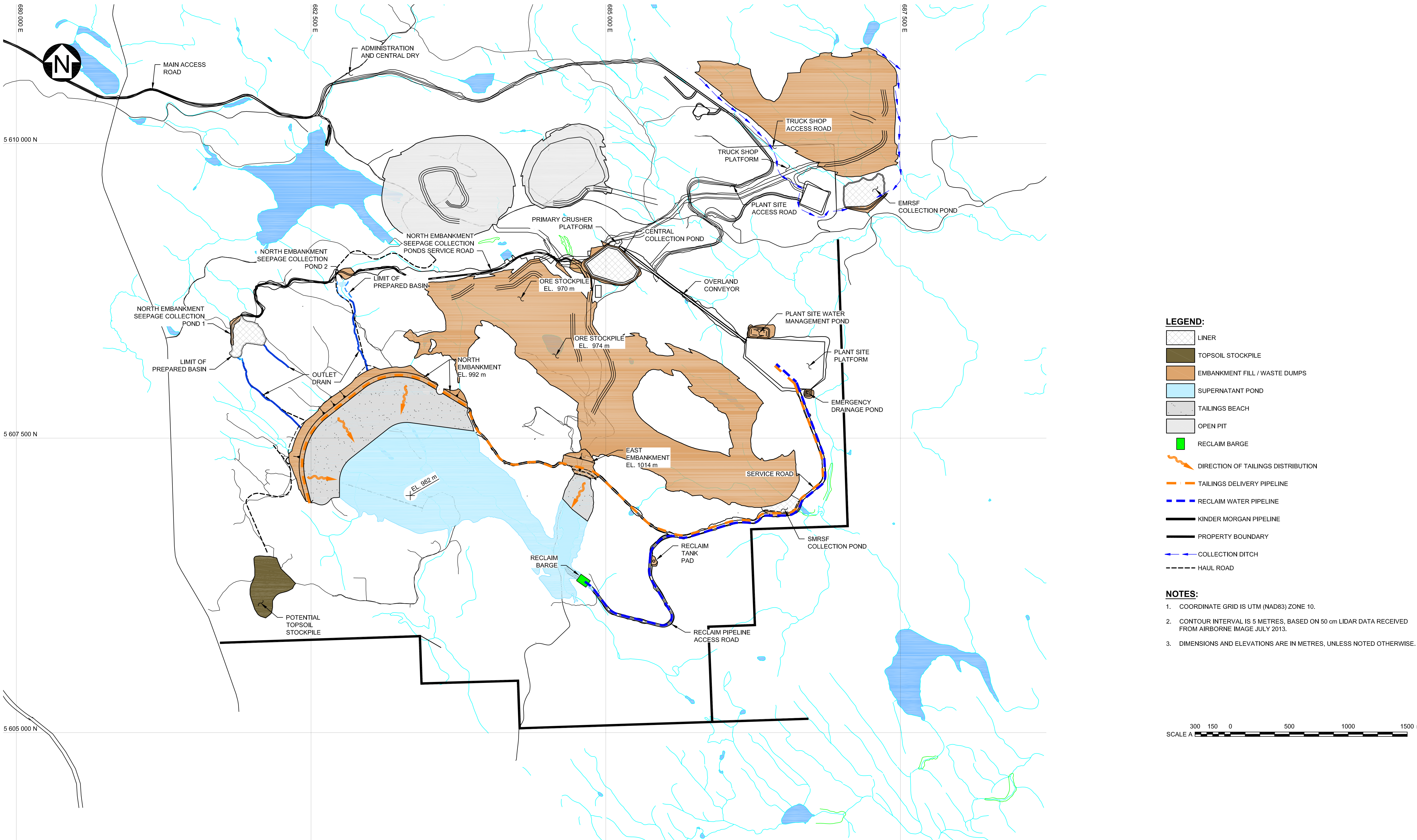
Source: Norwest (2015).

Figure 3.5-3
Conceptual General Arrangement Year 1



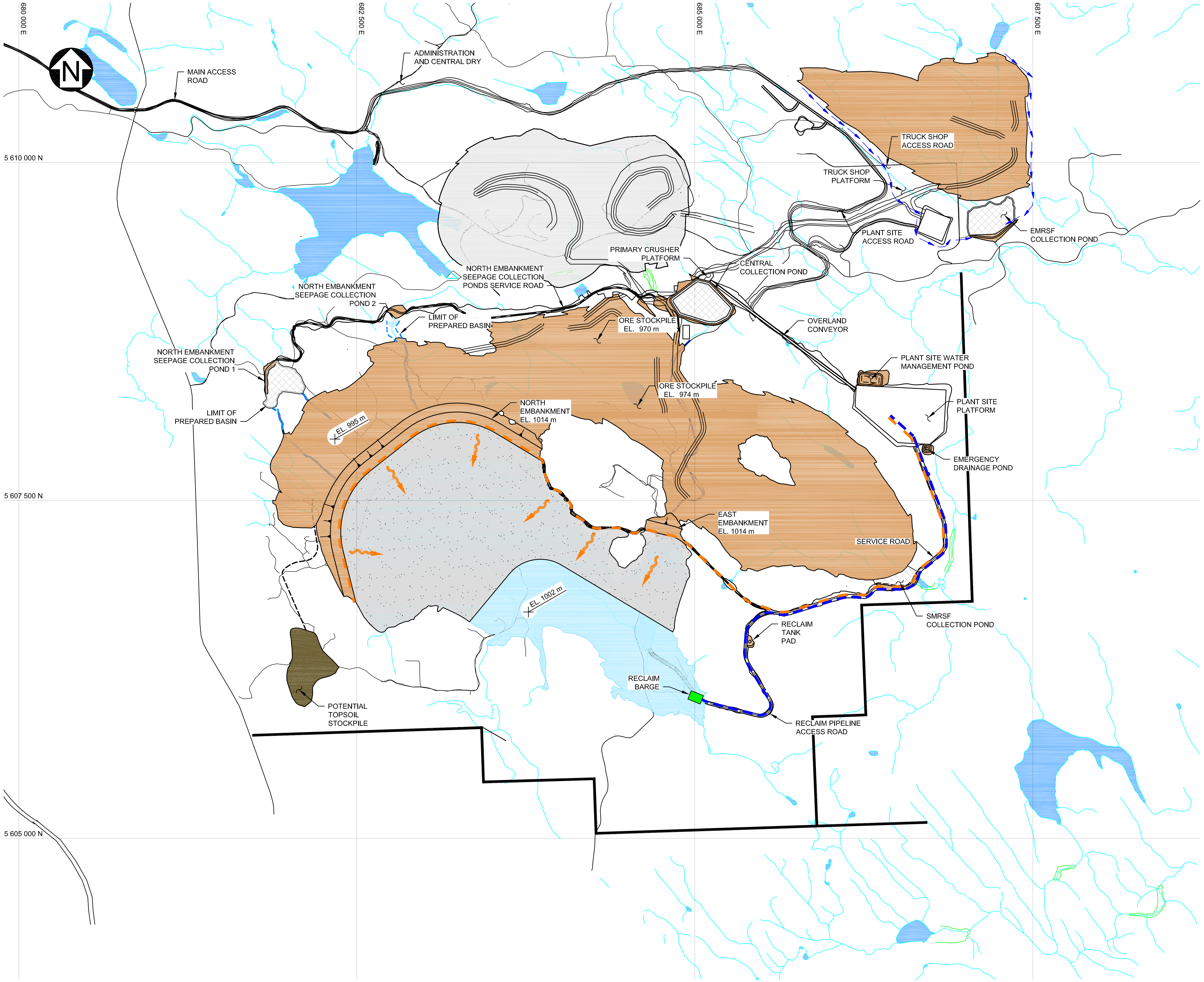
Source: Norwest (2015).

Figure 3.5-4
Conceptual General Arrangement Year 2



Source: Norwest (2015).

Figure 3.5-5
Conceptual General Arrangement Year 5



LEGEND:

- LINER
- TOPSOIL STOCKPILE
- EMBANKMENT FILL / WASTE DUMPS
- SUPERNATANT POND
- TAILINGS BEACH
- OPEN PIT
- RECLAIM BARGE
- DIRECTION OF TAILINGS DISTRIBUTION
- TAILINGS DELIVERY PIPELINE
- RECLAIM WATER PIPELINE
- KINDER MORGAN PIPELINE
- PROPERTY BOUNDARY
- COLLECTION DITCH
- HAUL ROAD

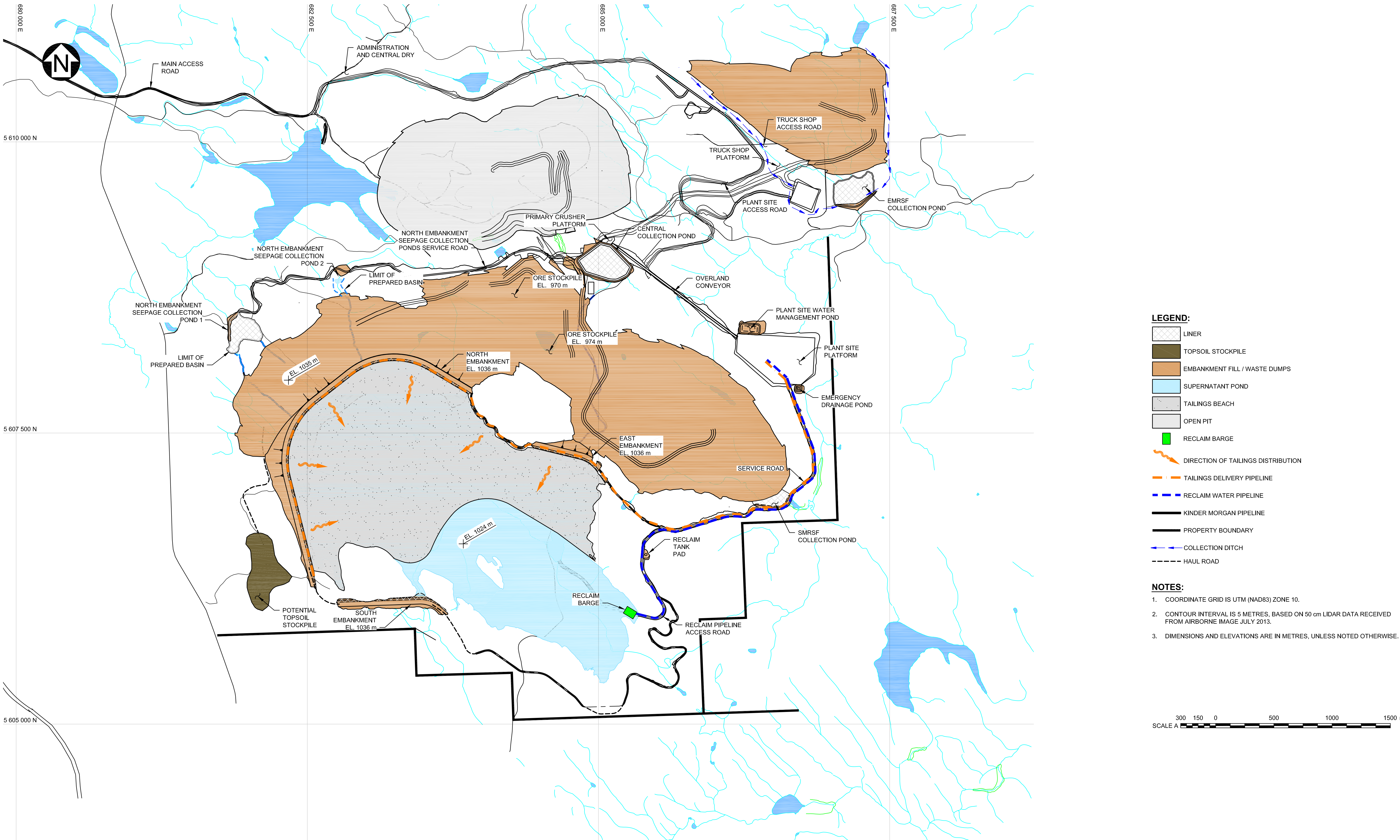
NOTES:

1. COORDINATE GRID IS UTM (NAD83) ZONE 10.
2. CONTOUR INTERVAL IS 5 METRES, BASED ON 50 cm LIDAR DATA RECEIVED FROM AIRBORNE IMAGE JULY 2013.
3. DIMENSIONS AND ELEVATIONS ARE IN METRES, UNLESS NOTED OTHERWISE.

SCALE A 300 150 0 500 1000 1500 m

Source: Norwest (2015).

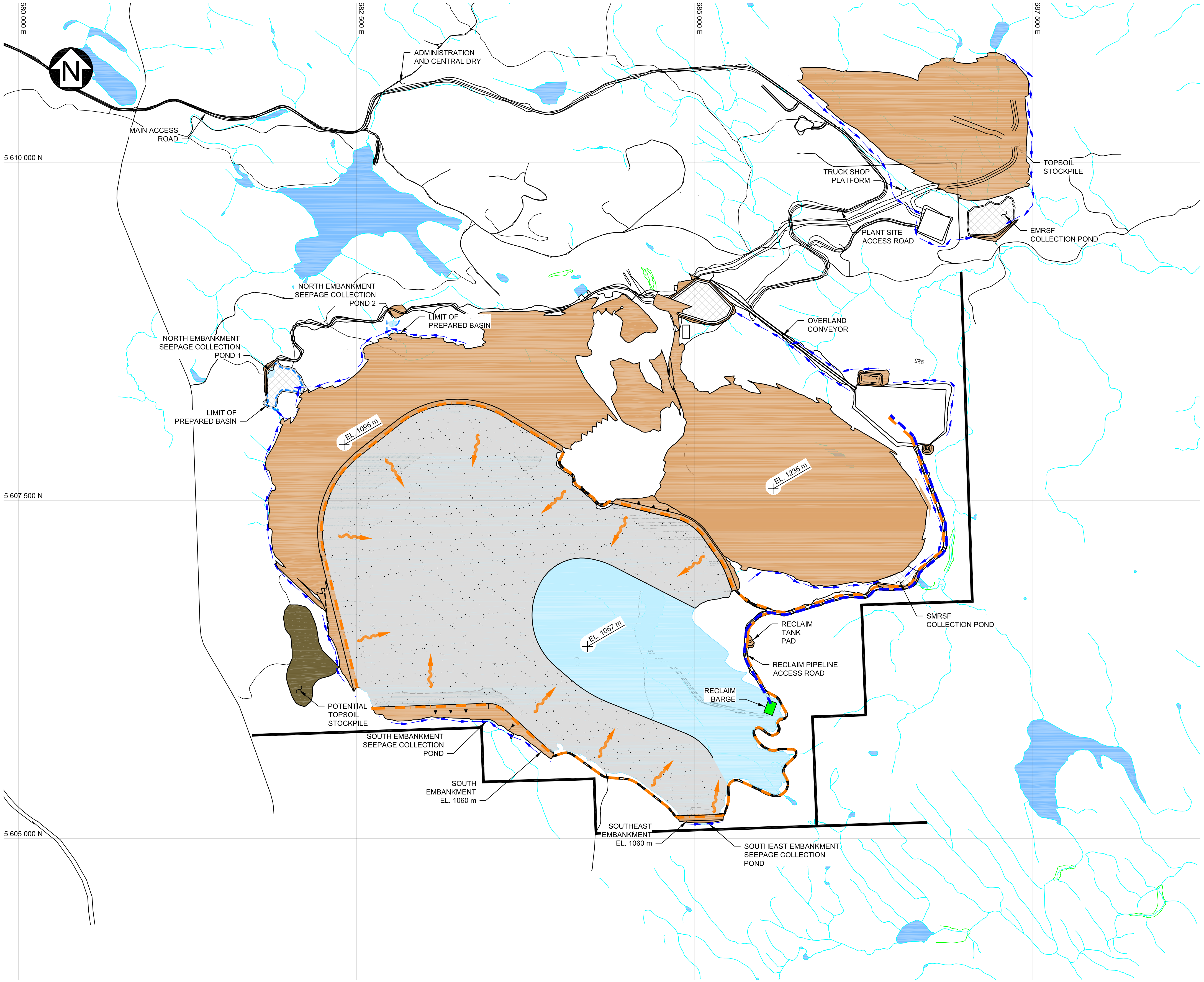
Figure 3.5-6
Conceptual General Arrangement Year 10



Source: Norwest (2015).

Figure 3.5-7
Conceptual General Arrangement Year 20

ERM



LEGEND:

- LINER
- TOPSOIL STOCKPILE
- ORE
- EMBANKMENT FILL / WASTE DUMPS
- SUPERNATANT POND
- TAILINGS BEACH
- OPEN PIT
- RECLAIM BARGE
- DIRECTION OF TAILINGS DISTRIBUTION
- TAILINGS DELIVERY PIPELINE
- RECLAIM WATER PIPELINE
- KINDER MORGAN PIPELINE
- PROPERTY BOUNDARY
- COLLECTION DITCH
- HAUL ROAD

NOTES:

1. COORDINATE GRID IS UTM (NAD83) ZONE 10.
2. CONTOUR INTERVAL IS 5 METRES, BASED ON 50 cm LIDAR DATA RECEIVED FROM AIRBORNE IMAGE JULY 2013.
3. DIMENSIONS AND ELEVATIONS ARE IN METRES, UNLESS NOTED OTHERWISE.

SCALE A 300 150 0 500 1000 1500 m

Source: Norwest (2015).

3.6 MINE PRODUCTION SCHEDULE

Mine production will begin with a one and a half year development and pre-stripping phase (during construction). This phase will focus on road development, TSF starter dam, mining phase preparation, and exposure of ore. Following this phase, a ramp-up period in mining rates will take place over the course of two years until peak mining rates are achieved. The ramp up period is designed to quickly gain access to higher grade ore for processing, while stockpiling lower grade for processing toward the end of the mine life. Approximately 90 Mt of material will be moved in any given year during operation.

Mining activities will begin with the expansion of the existing East and West open pits during the initial years of production. By Year 5, the two existing open pits will be merged into a single mining phase. Following this merger, the subsequent pushbacks will expand the pit limits to the east. Mining rates will gradually subside from their peaks levels beginning in the latter stage of the mine life. Development of the IPMRSF will begin at approximately Year 14.A summary of the overburden, mine rock and ore production from the open pit is presented in Table 3.6-1. The production schedule presented below is based on the current mine plan which extends to 17 years, however the estimates for additional ore have the potential to extend the mine life up to 23 years, which was used as the conservative value for assessments. Actual mine production rates during operation will be optimized based on a balance between mine fleet capacity and changes in commodity prices. Years 6 through 10 and 11 through 17 have been presented as annual averages.

Table 3.6-1. Summary of Estimated Mine Production from Ajax Open Pit

Year	Run Of Mine (ROM) Waste (Mt)	ROM Ore (Mt)	Re-handle from Ore Stockpiles (Mt)
-2	2	0	0
-1	26	4	0
1	46	29	1
2	71	27	3
3	74	26	5
4	87	27	2
5	80	21	5
6 to 10	73	21	2
11 to 17	48	21	3

3.7 PROCESS PLANT AND ORE PROCESSING

3.7.1 Overview

The process plant will consist of stage-wise crushing and grinding, followed by a flotation process to recover and upgrade copper from the feed material. A gravity circuit will be included within the flotation circuit to enhance gold recovery with a gravity gold concentrate being filtered and shipped or the gravity gold concentrate may be combined with the copper concentrate. The final flotation tailings will be disposed of using thickened slurry delivery to the TSF. A thickener bypass system will be in place which will be utilized during thickener maintenance and repair. Process water will be recycled from the TSF and freshwater will be used for pump gland seals, reagent preparation, gravity circuit fluidisation and initiation/make-up needs.

The process plant will be a steel structure with insulated steel roof deck and insulated wall cladding. Overhead cranes and major equipment will be supported on steel platforms complete with steel grating and handrails (e.g., cyclones, samplers, analyser, screens, etc.). These multi-level steel platforms will provide services for ongoing operation and maintenance needs. Several means of egress and staircases will also be provided. The building will house electrical rooms, control rooms, dry facilities and offices.

The process plant consists of the following unit operation (Figure 3.7-1):

- crushing circuits:
  - Run-of-Mine (ROM) ore receiving and primary crushing,
  - covered coarse ore stockpile,
  - coarse ore stockpile ore reclaim,
  - secondary cone crushing and screening circuit,
  - covered fine ore stockpile,
  - HPGR crushing and wet screening circuit;
- grinding and classification:
  - ball mill grinding circuit,
  - cyclones for classification;
- processing:
  - rougher flotation,
  - copper cleaner flotation,
  - concentrate regrinding stages,
  - gravity gold circuit,
  - copper concentrate thickening, filtration, and shipping; and
- thickened tailings disposal.

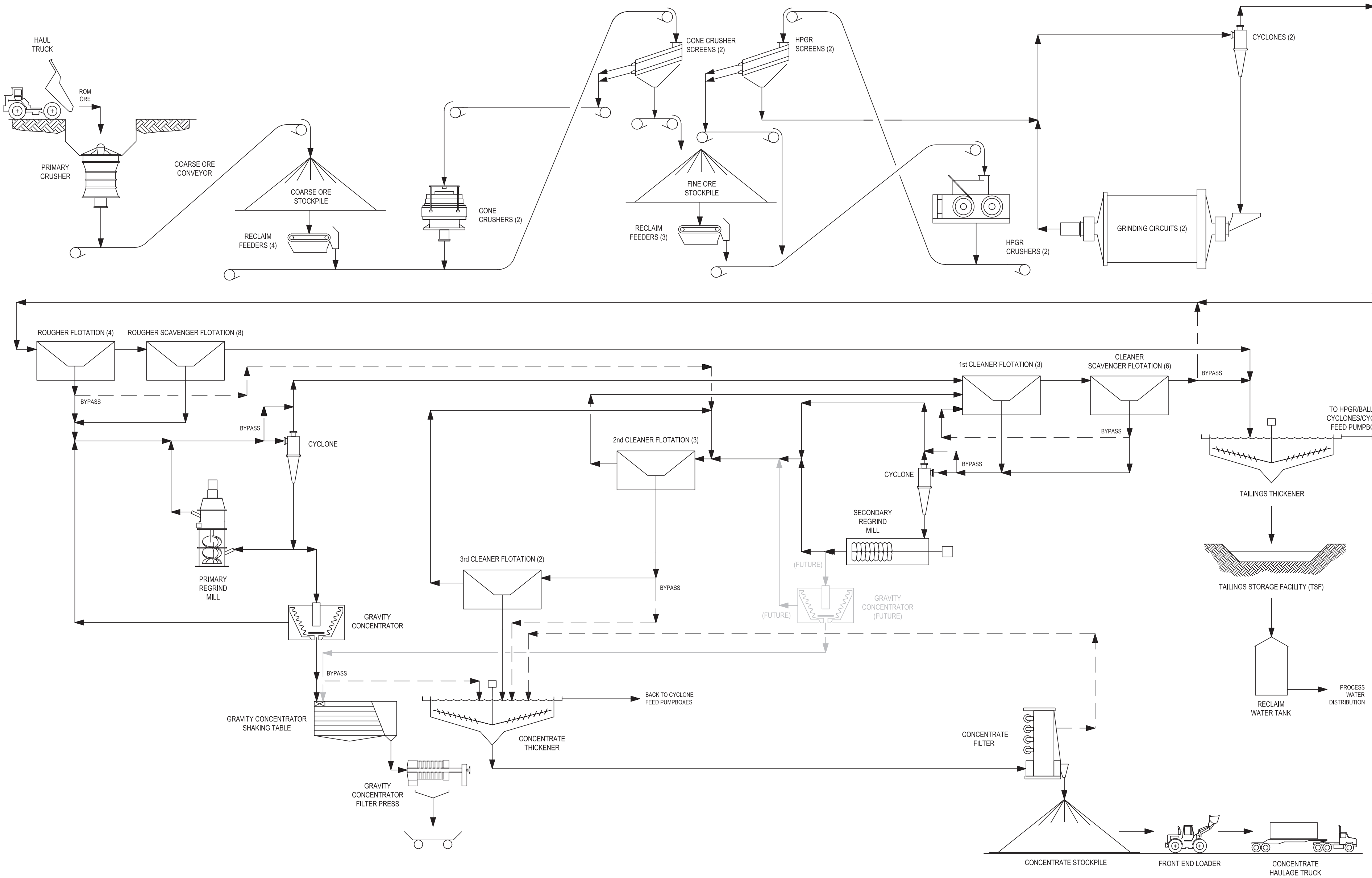
3.7.2 Primary Crushing and Conveying

A crushing and conveying system on the exit point of the ultimate pit design (ex-pit crusher) will reduce the ROM material to make it suitable to be transported by belt conveyors. The crushed rock is loaded onto conveyors for transport to the process plant.

The ex-pit primary crusher and conveying system consists of one fixed primary crusher and corresponding belt conveyors. Ore will be crushed to the size P80 of 150 mm which meets the process requirements. The crushed ore will be transferred to the coarse ore stockpile by a belt conveyor. The conveyor will be covered for dust control.

Figure 3.7-1

Simplified Process Overview



3.7.3 Rougher Flotation

Cyclone overflow from each ball mill circuit flows into the flotation circuit. Each ball mill line will feed its own rougher flotation train consisting of six tank flotation cells. Flotation reagents and the cyclone overflow will be added to the feed box at the beginning of each line. During the rougher flotation process, the majority of copper minerals will be floated into a rougher concentrate which will be further processed in the primary regrind and cleaner flotation circuits. The remaining slurry (tailings) from the rougher flotation circuit consists of mostly gangue material and flows by gravity to the tailings pumpbox.

3.7.4 Primary Regrind

In order to produce the desired concentrate grind size, rougher concentrate is fed to the primary regrind cyclone feed pumpbox and then pumped to the primary regrind cyclone. The majority of the cyclone underflow will report back to the primary regrind cyclone feed pumpbox. A portion of the cyclone underflow will be diverted for gravity concentration of gold. Cyclone overflow will be advanced to the first cleaner flotation circuit.

3.7.5 Cleaner Flotation & Secondary Regrind

Cleaning of the rougher copper concentrate is accomplished in a three stage cleaner flotation circuit with the concentrate advancing through the circuits and the tailings being returned through the circuit counter-current to the concentrate.

First cleaner flotation will utilize a single row of nine flotation cells. First cleaner concentrate can be pumped to a secondary regrind cyclone cluster which will feed a horizontal stirred secondary regrind mill. The cyclone overflow will flow to the secondary cleaner flotation circuit. The secondary cleaner flotation circuit will consist of three tank flotation cells. Concentrate from the secondary cleaner flotation circuit is fed to the third cleaner flotation cells if further refinement is needed, or can be pumped directly to the concentrate thickeners. The third cleaner flotation circuit will include two tank flotation cells.

3.7.6 Reagent Handling and Storage

Various reagents will be added to the process slurry streams to facilitate the recovery of copper and gold during the flotation process. Table 3.7-1 summarizes the estimated quantity of reagents needed.

Various reagents will be added to the process slurry streams to facilitate the recovery of copper during the flotation process. The preparation of the various reagents will require:

- bulk handling system;
- mix and holding tanks;
- metering pumps;
- flocculant preparation facility; and
- lime slaking and distribution facility;

Table 3.7-1. Summary of Annual Reagents for Ajax Project Process Plant

Reagents	Nominal Annual Total Consumption (t)	Reagent Use
Collector – PAX	400	Promotes adherence of minerals to flotation bubbles
MIBC/Dowfroth	450	Generates froth for flotation
Depressant – Royal Chemical Depress HG Tipo A	1,800	Inhibits adherence of minerals to flotation bubbles
Gold promoter MX900	300	A type of collector
Lime	13,000	Adjusting pH
Flocculant	7	Promotes agglomeration of particles for sedimentation and filtration

Reagents will be added to the grinding and flotation circuit to modify the mineral particle surfaces and enhance the floatability of the valuable mineral particles into the copper-gold concentrate. Fresh water will be used to make up or dilute the various reagents that will be supplied in powder or solid form, or which require dilution prior to the addition to the slurry. Solutions will be added to the addition points of the various flotation circuits and streams using metering pumps.

The PAX collector reagent will arrive at the plant in bulk bags and will be dumped into hoppers for withdrawal of pre-determined quantities for mixing with water to the required solution strength. The reagent will be made up in a mixing tank, and then transferred to the holding tank, from where the solution will be pumped to the addition points in the circuit. The frother reagent, MIBC, will be pumped directly from bulk containers using metering pumps. The promoter will be delivered in liquid form and pumped into its respective storage tank.

Flocculant will be prepared as a dilute solution and will be further diluted in the thickener feed well.

Lime, as quick-lime, will be delivered in bulk and will be off-loaded pneumatically into a silo. A concentrated lime slurry will then be prepared in a lime slaking system. This lime slurry will be pumped to the points of addition using a closed loop system. The valves will be controlled by pH monitors to manage the amount of lime added.

The following measures will be implemented to ensure spill containment:

- Reagent preparation and storage facility will be located within a containment area designed to accommodate 110% of the content of the largest tank if exposed to meteoric waters. If the reagent storage area is within a building the containment capacity will be equal to the capacity of the largest tank in the containment;
- Each reagent will be prepared in its own contained area in order to limit spillage and facilitate its return to its respective mixing tank; and
- Storage tanks will be equipped with level indicators and instrumentation to ensure that spills do not occur during normal operation.

Each reagent line and addition point will be labelled in accordance with Workplace Hazardous Materials Information Systems (WHMIS) standards. All operational personnel will receive WHMIS training, along with additional training for the safe handling and use of the reagents. Appropriate ventilation, fire and safety protection, and Material Safety Data Sheet (MSDS) stations will be provided at the facility.

3.7.7 Laboratory Services

Laboratory services will be available on-site tailored to meet Project requirements to support grade control and process plant control. The assay laboratory will be equipped with the necessary analytical instruments to provide all routine assays for the mine, process plant and exploration. The metallurgical laboratory will undertake all necessary test work to monitor metallurgical performance and, more importantly, to improve process flowsheet unit operation and efficiencies. Environmental analyses (such as water quality testing) will be performed by third-party laboratories offsite.

3.8 Tailings Storage Facility and Tailings Management

The TSF will store tailings solids, process water, and contact runoff water from the Project. It will be constructed in stages over the life of the mine, with the crest elevation of the four embankments raised over time to meet the volumetric retention requirements of the operation. The design for the TSF is presented in more detail in Appendix 3-D.

3.8.1 Site Selection

A tailings alternatives assessment has been completed taking into consideration an area spanning a 10 km radius from the process plant. The preferred location is south of the open pit and west of the process plant (see Section 17.4.8).

3.8.2 Design and Operating Objectives

The principal objectives for the design of the TSF are to: provide containment for tailings solids and supernatant water during the operation phase, optimize supernatant management for reuse in the process plant, and tailings solids containment in the long term (post-closure) to achieve effective reclamation at mine closure.

The following factors have been considered in the design of the TSF:

- application of Best Available Technology (BAT) and Best Available Practices (BAP) for tailings containment to ensure permanent, secure, and total containment of all tailings materials;
- control of seepage through the basin and embankments and removal of free-draining liquids from the TSF during the operation phase for recycling as process water;
- no surface water discharge to the environment during the operation phase of the Project.
- physical and chemical characteristics of the tailings material, including ML/ARD potential, as well as the potential for liquefaction;

- hydrology and hydrogeology, including local climatic conditions and extreme weather events (including projections of increased extreme weather events as a result of global climate change);
- foundation geology and geotechnical considerations, as well as seismic data and earthquake risk;
- availability and characteristics of construction materials; and
- topography of the tailings management facility and adjacent areas.

3.8.3 Thickened Tailings Strategy

The Project is planning to incorporate a strategy to thicken the tailings by mechanically dewatering to create a slurry with 60% solids. One of the main advantages of thickened tailings is the recovery of water during the thickening process that can be reused in the processing plant facility resulting in a smaller volume of stored supernatant within the TSF. In addition, the higher solids content improves the physical stability of the tailings deposited within the TSF.

3.8.4 General Description of TSF and Distribution System

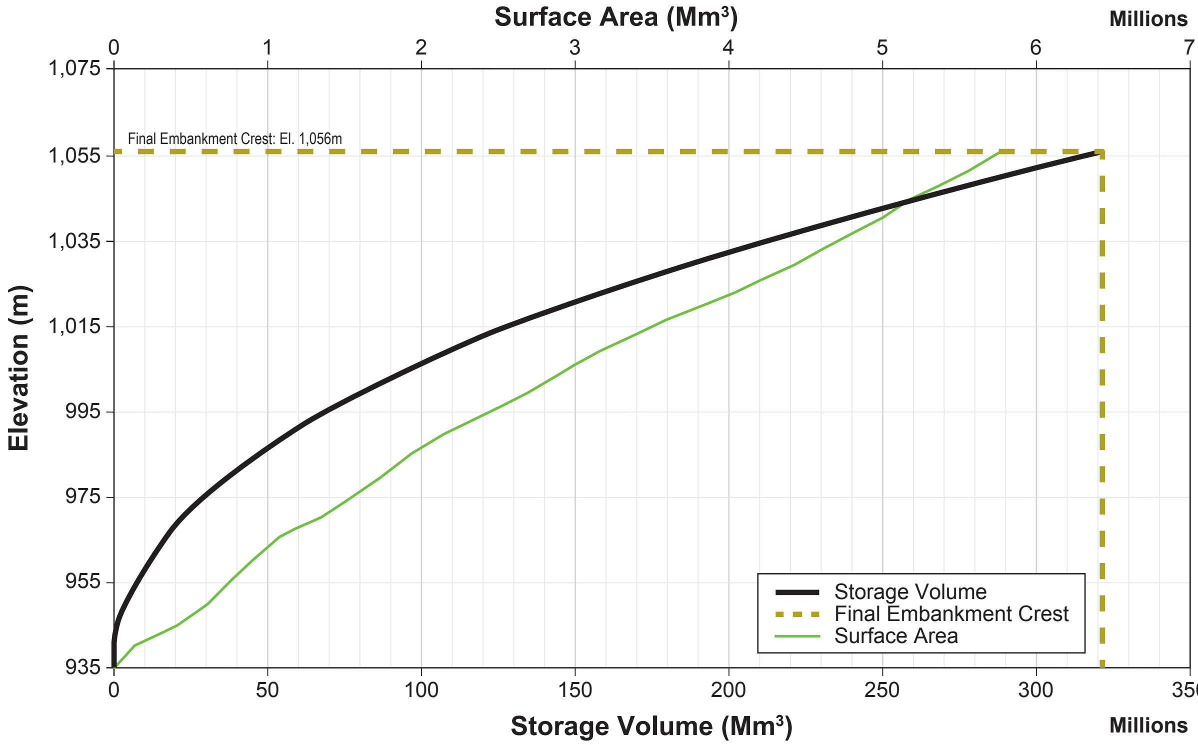
The TSF is situated to the southwest of the plant site area, and is designed to contain approximately 440 Mt (275 Mm^3) of tailings within an area bounded by natural topography and four embankments constructed using a 'downstream' method. The embankments will be constructed over six stages over project life (Figure 3.8-1) to the following approximate dimensions:

- the North Embankment, approximately 3,650 m long by 122 m high embankment wraps around from the north and to the west, toward Lac Le Jeune Road;
- the South Embankment, approximately 1,550 m long by 42 m high embankment wraps around from the south and to the southeast;
- the Southeast Embankment, approximately 550 m long by 14 m high embankment is at the most southerly area of the TSF; and
- the East Embankment, approximately 1,450 m long by 108 m high embankment is along the northeastern boundary of the TSF in the current Goose Lake area.

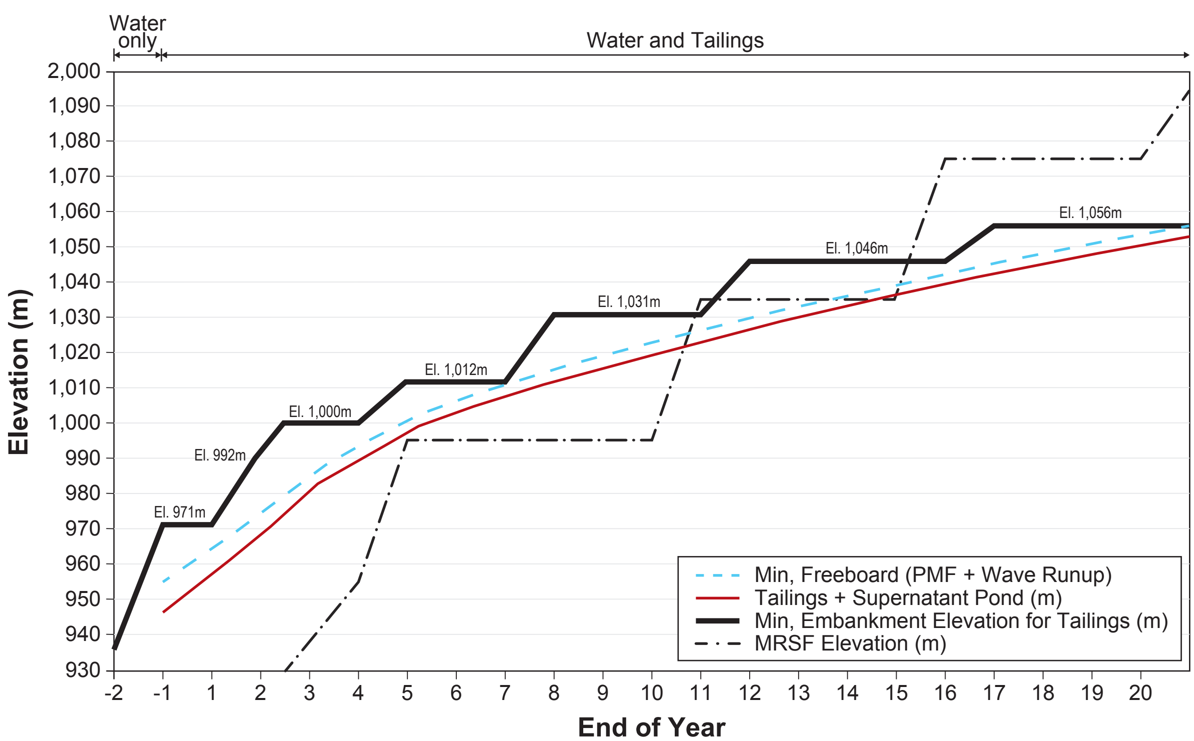
The embankments will be designed and constructed to meet Canadian Dam Association's (CDA) "Dam Safety Guidelines" criteria as independent structures to contain tailings and supernatant water. Integral to the embankment design will be the use of a mine rock buttress and/or mine rock storage facilities immediately downstream of the TSF, which are incorporated in the embankment designs to buttress these structures. The WMRSF will buttress the north embankment while the SMRF will buttress the east embankment. Inclusion of these design buttressing components as part of the dam design from start-up and throughout all stages of the north and east embankment construction increases the Factor of Safety (FOS) against a breach several times higher than the minimum design requirement.

Figure 3.8-1
Ajax Tailings Storage Facility Storage Capacity and Filling Schedule

a) TSF Depth Area Capacity Curve



b) TSF FIlling Schedule



Source: Norwest (2015).

Conceptual development of the TSF is presented in Figure 3.8-2. In general the components of the TSF can be described as:

- **TSF base**: The in-situ material of the basin of the TSF will be compacted as needed to provide additional controls on TSF drainage and seepage.
- **TSF Embankments** will comprise of the following zones:
  - Till Blanket (Liner System) - will be constructed from low-permeability glacial till material from nearby sources to reduce pore pressures in the embankment and minimize any seepage through the embankment. Prior to placement of this seepage control zone on the upstream face of the TSF, the foundation surface will include moisture conditioning and smoothing before installing a non-woven geotextile.
  - Compacted Mine Rock: will be constructed from NPAG mine rock material from open pit operations. The material placement and compaction requirements for the embankment zone will be to minimize any settlement or structural issues that may impact the upstream seepage control zone (ie. Liner system).
- **Mine Rock Buttress**: will be constructed from mine rock materials from open pit operation. The material placement and compaction requirements for the buttress will be to minimize settlement and structural issues that may impact the TSF embankment.
- **Mine Rock Storage Facility**: will be constructed from NPAG and PAG mine rock materials from open pit operation. This material will be placed in layers to meet ML/ARD CaNPR of 3 within the MRSF. More details on the MRSFs can be found in Section 3.9.1.

The tailings will be pumped from the process plant to the TSF via an overland pipeline within a bermed corridor located along the access road to the North, East and Southeast embankments. Tailings will be discharged from the delivery pipeline into the TSF from spigots optimizing beach development and supernatant management within the TSF. Reclaim water will be pumped from the TSF using a floating barge positioned in the southeastern area of the TSF. A dedicated pipeline will be installed in the same corridor with the delivery pipeline. Reclaim water will be pumped to a storage tank located on the topographic divide between the TSF and the process plant.

3.8.5 Runoff and Seepage Control

Seepage through the embankments will be limited by the installation of a liner system in the embankment. Seepage from the facility is anticipated and included in water balance estimates (Chapter 6.4) to determine potential leakage flow rates during the operation phase.

The water management facilities in TSF area will include water collection ponds and collection ditches. The four seepage collection ponds will include the following locations with all collected seepage directed to the Central Pond:

- Natural surface runoff and seepage from the North Embankment and WMRSF will collect in seepage collection ponds 1 and 2 to the northwest of the North Embankment. The eastern portion of the embankment, WMRSF, and ore stockpile will go to the Central Collection Pond;

- Natural surface runoff and seepage from the East Embankment and eastern area of the SMRSF will collect in the Central Collection Pond;
- Natural surface runoff and seepage from the south area of the SMRSF will collect in the seepage collection ponds adjacent to the processing plant; and
- Natural surface runoff and seepage from the South and Southeast Embankments will be toward the TSF area because of the local topography.

3.8.6 Monitoring and Reporting

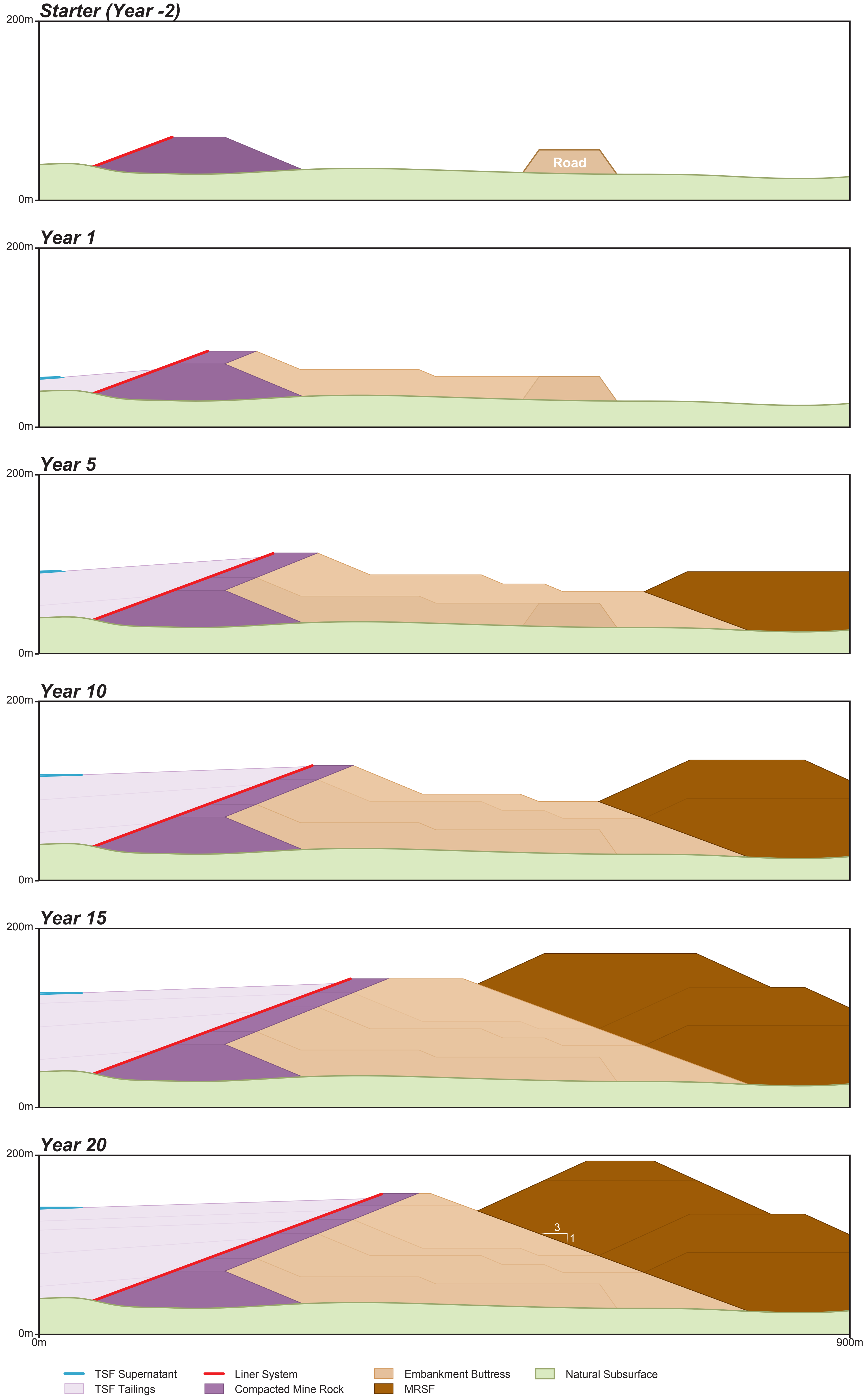
The TSF will be monitored using a formalized procedure incorporated into the Project Environmental Management System (EMS) and in compliance with the BC Dam Safety Guidelines (Appendix 3-D, Section 8). Geotechnical instrumentation will be installed in the embankments and foundation during construction and over the life of the Project. The instrumentation will be used to monitor and assess embankment performance and to identify any conditions different to those assumed during design and analysis. Amendments to the ongoing designs and/or remediation work can be implemented to respond to the changed conditions, should the need arise. Key control and monitoring subject areas should include:

- inspections of the TSF with regard to performance monitoring, instability indicators, stability monitoring, tailings deposition, water management and control;
- construction controls, including the use of a construction quality assurance program;
- procedures for dust control; and
- quality assurance and quality control measures for operation, monitoring and inspections.

Procedures related to the environmental management of the TSF will be clearly documented, together with the roles and responsibilities of relevant staff. This documentation will be revised as needed to ensure that it is up to date and accurate, and it will be maintained throughout the mine operation and closure phases.

KAM will align with the Mining Association of Canada *Toward Sustainable Mining* program Tailing Management Protocol and adopt the guidelines entitled *Developing an Operation, Maintenance and Surveillance Manual for Tailings and Water Management Facilities* (2005), which provides useful guidance in documenting staff roles and management procedures, including:

- roles and responsibilities of personnel assigned to the tailings management facility;
- procedures and processes for managing change;
- the key components of the tailings management facility;
- procedures required to operate, monitor the performance of, and maintain the facility to ensure that it functions in accordance with its design, meets regulatory and corporate policy obligations, and links to emergency planning and response; and
- requirements for analysis and documentation of the performance of the facility.


Starter (Year -2)
200m
0m
Road
Year 1
200m
0m
Year 5
200m
0m
Year 10
200m
0m
Year 15
200m
0m
Year 20
200m
0m
3
1
0m
900m
TSF Supernatant
TSF Tailings
Liner System
Compacted Mine Rock
Embankment Buttress
MRSF
Natural Subsurface

3.9 MINE ROCK STORAGE AND ORE STOCKPILES

3.9.1 Mine Rock Storage Facilities

The four MRSFs—SMRSF, EMRSF, WMRSF, and IPMRSF—will be built in an incremental methodology based on guidance from the BC Mine Waste Rock Research Committee Interim Guidelines and site geotechnical and seismic information. Table 3.9-1 summarizes the maximum storage capacity of these MRSFs. During mine life, MRSF construction will be optimized according to the mine production schedule, operational needs, adaptive management, progressive reclamation and meeting closure objectives. Thus, the mine rock within these areas may be less than the maximum capacity shown; as outlined in the relevant assessment.

Table 3.9-1. Maximum Mine Rock Storage Facility Capacity

Facility	Acronym	Storage Capacity (Mt)	Footprint (ha)	Approx. Height (m)
South Mine Rock Storage Facility	SMRSF	550	210	270
East Mine Rock Storage Facility	EMRSF	150	100	85
West Mine Rock Storage Facility	WMRSF	200	155	140
In-Pit Mine Rock Storage Facility	IPMRSF	200	Within open pit	Within open pit

A key feature of the design of the MRSFs is their use to buttress the TSF embankments, providing additional long-term stability to the TSF. The TSF embankments and SMRSF and WMRSF will be constructed as two separate, but adjoining, facilities utilizing two slightly different methods. The outermost portion of the downstream slope of the TSF embankment will be constructed by placing the mine rock in 2 m lifts and compacting the material to meet the design specifications. It is anticipated that trucks will be utilized to haul the mine rock that will be spread with a dozer at the desired lift height.

The MRSFs will be constructed in lifts approximately 20 m high with the mine rock hauled to the active lift and dumped on the end of the lift. A dozer will be utilized to push material over the edge, maintain the desired elevation and alignment of the lift and maintain adequate safety berm heights. The MRSF lifts will be constructed parallel to the TSF embankment lifts with controls in place to prevent the mine rock storage facility from encroaching into the area required for construction of the TSF embankment lifts. Mine rock will be characterized throughout Project life and classified as NPAG or PAG (see Section 11.5). These results will be incorporated into updated mine production schedules and on-site tracking of material handling and transportation will ensure placement in the appropriate facility. NPAG mine rock will be stored in all the facilities and PAG mine rock will be limited to the WMRSF, SMRSF, and IPMRSF. In general NPAG material will be used for construction over life of mine and PAG material will be placed in MRSFs and mixed with NPAG such that the resultant NPR is non-acid generating, to further reduce potential for ML/ARD. The quantity of PAG to each facility will be monitored and managed to ensure that the average facility NP/AP ratio does not exceed a ratio that will potentially produce acidic drainage. Within each lift, PAG will be distributed as evenly as possible to avoid accumulation of PAG in any one area. This will include placement of PAG truck loads followed by placement of NPAG allowing for mixing of NPAG and PAG material.

A description of the MRSF development is provided in the following sections. With ongoing Project design and planning, the operational development will be revised as needed.

3.9.1.1 Year -2 to Year 2

The MRSF development to end of Year 2 (Figure 3.5-1 to Figure 3.5-4) is focussed on establishing the footprint of the MRSFs.

The first lift of the SMRSF will be established at an elevation of approximately 925 masl with subsequent lifts to be built in 20 m heights. At the end of Year 2, it will hold approximately 10 to 15% capacity of NPAG and PAG/Unclassified (UNCL) mine rock.

The first lift of the EMRSF will be built to approximately 900 masl elevation with subsequent lifts to be built in 20 m heights. Development of this mine rock storage facility will start in Year -1 and by end of Year 2 will be at approximately 80 to 85% capacity of NPAG mine rock.

The development of the WMRSF starts in construction phase and by Year 2 holds approximately 10% of its total capacity.

3.9.1.2 Year 5

By the end of Year 5 (Figure 3.5-5), the SMRF will hold approximately 35% of its total capacity of NPAG and UNCL mine rock and the EMRSF will be at approximately 95% capacity of NPAG mine rock. The WMRSF will have approximately 30% of its total capacity containing both NPAG and UNCL mine rock.

3.9.1.3 Year 10

By the end of Year 10 (Figure 3.5-6), the SMRSF continues to be used and will be at 95% of its capacity with 346.5 Mt of material at an elevation of 1,175 m. By the end of Year 8, the WMRSF will have approximately 134.2 Mt, or approximately 60% of its total capacity, with an elevation of 1,035 m.

3.9.1.4 Year 20

By the end of Year 13, the SMRSF and WMRSF capacity will be reached and progressive reclamation can start on this MRSF during Years 14 and 15. After approximately Year 14, the IPMRSF is the only available MRSF and by the end of Year 23 (Figure 3.5-7), its capacity will be reached representing approximately 1/6 of the open pit volume. Mine rock in the IPMRSF is placed within the western area of the open pit Year 13 to 18, with the lower part of the IPMRSF built from the bottom of the pit and the upper part built by accessing from near the top of the open pit and dumping back onto the IPMRSF.

3.9.2 Ore Stockpiles

Two stockpiles will be available for approximately 45 Mt ore storage: low-grade stockpile and medium grade stockpile. The stockpiles will be constructed in lifts based on guidance for the BC Mine Waste Rock Pile Research Committee Interim Guidelines and active throughout the mine life. The low-grade and medium grade stockpiles will store lower grade ore until the end of mine life or to supplement ROM ore. Once the pit reserves are exhausted, all ore stockpiles will be mined with production equipment in a top-down sequence and delivered to the mill for processing. The stockpiles will be constructed on a platform to provide a flat working area for mining equipment.

Stockpiles will be designed following the same principles/ level of design required for the MRSFs. The BC Mine Waste Rock Pile Research Committee Interim Guidelines will be followed.

3.10 OVERBURDEN AND TOPSOIL STOCKPILES

The topsoil and overburden will be stockpiled primarily on top of the EMRSF. Additional Reclamation Stockpiles are located within the site layout as potential topsoil and/or overburden storage areas available throughout mine life as the TSF increases its footprint.

During the construction period, topsoil and overburden present in the foundation areas along the toe of the MRSFs will need to be removed to ensure geotechnical stability. These materials will be excavated and replaced with coarse and durable ROM mine rock and the topsoil and overburden will be placed in designated storage areas for use during reclamation and closure.

Soil and overburden stockpiles, and all other disturbances, will be re-vegetated as part of placement to prevent loss of soil from surface erosion and to inhibit weed establishment. Re-vegetation also promotes seed stock for progressive use of the stockpiles and ensures that the stockpiled soil remains viable throughout operation and closure. These stockpile areas will also incorporate development of drainage, erosion prevention and sediment control structures.

Activities during operation will primarily involve the sequential grubbing, stripping, stockpiling and management of overburden and topsoil from the open pit, TSF and MRSF footprints in accordance with the site plan and production schedule. Management plans are developed that outline:

- soil stripping, handling and storage (Chapter 11.3);
- erosion prevention and sediment control (Chapter 11.2); and
- invasive plant control (Chapter 11.17).

3.11 EQUIPMENT

3.11.1 Construction and Reclamation Equipment

Table 3.11–1 presents a preliminary list of the number of pieces of equipment for construction. This list will evolve as planning and operational needs are further defined. Equipment may also change over mine life due to changes in technology.

Table 3.11-1. Estimated Equipment for Construction and Decommissioning and Closure Phases

Equipment Type	Number of Units	Engine Type	Equipment Type	Number of Units	Engine Type
Major Mobile Equipment			**Mobile Support Equipment**		
Excavators	9 to 12	Diesel	Ambulance	1	Diesel
Articulated Trucks	15 to 30	Diesel	Fire Truck	1	Diesel
Tandem Dump trucks	15	Diesel	Rescue	1	Diesel
Grader	6	Diesel	Water Truck	6	Diesel
Front end loaders	6 to 9	Diesel	Fuel/Lube Truck	3	Diesel
Forklifts	6	Diesel	Pickups	40 to 60	Diesel and Gasoline
Cranes	6 to 9	Diesel	Service trucks	4	Diesel
Track dozers	6	Diesel	Crew Bus (within mine site use)	15	Diesel
Compactors	6	Diesel	Mobile Lighting Units	Multiple	Diesel
Telehandlers	6	Diesel	**Stationary Processing Equipment**		
Manlifts	Multiple	Diesel	*Power Generators*		
			1.5 MW Generator	Multiple	Natural Gas or Diesel

Due to the short time period for construction, the equipment presented will not require replacement during the construction phase.

3.11.2 Mining Equipment

Table 3.11–2 lists the preliminary fleet needed each year during the operation phase; this list will also evolve with further refinement of operational needs and technology changes over mine life, but is considered reasonably conservative for the purposes of environmental assessment (e.g., dust generation, noise, fuel use, etc.).

3.11.3 Surface Equipment

A significant fleet of surface equipment will be needed to move people and freight about the site, maintain roads and remove snow. This equipment will also be used to maintain and build access roads, and to meet various site facility requirements (including stockpile maintenance, and further exploration development). All stationary processing equipment is installed inside buildings. With the exception of the overland conveyor (which is covered), all conveyors are covered.

Light vehicles such as half- to one- tonne trucks, school buses, and mechanical service trucks will be utilized to transport personnel and carry out surface maintenance and logistical work. An ambulance and fire truck will be maintained at the process plant for emergency response.

Table 3.11-2. Estimated Equipment for Operation Phase

Equipment Type	Number of Units	Engine Type	Equipment Type	Number of Units	Engine Type
Major Mobile Equipment			**Mobile Support Equipment** (*cont'd*)		
Electric Shovel	3	Electric	Tire Handler	1	Diesel
Large FEL	1	Diesel	Skid Steer loader	2	Diesel
Medium FEL	1	Diesel	Drill Water truck	3	Diesel
Haul Truck	25	Diesel	Flat deck truck	1	Diesel
Grader	2	Diesel	Plant Loader	1	Diesel
Clean-up FEL	2	Diesel	Sanding/Plow Truck	2	Diesel
Track Dozer	5	Diesel	Service Truck	3	Diesel
Large Backhoe	1	Diesel	Service backhoe	1	Diesel
Backhoe	1	Diesel	Steam truck	1	Diesel
Refuse Haul truck	2	Diesel	Welding Truck	2	Diesel
Blasthole Drill	4	Electric	Zoom Boom	3	Diesel
Mobile Support Equipment			Pickup trucks	50	Gasoline
Ambulance	1	Diesel	Passenger Vans	7	Gasoline
Fire Truck	1	Diesel	**Stationary Processing Equipment**		
Mine Rescue	1	Diesel	Crusher	1	Electric
Water Truck	4	Diesel	Conveyors	1	Electric
Tow truck	1	Diesel	Screens	Multiple	Electric
Fuel/lube Truck	3	Diesel	Centrifuges	Multiple	Electric
Manlift	1	Diesel	Pumps	Multiple	Electric
Crane	1	Diesel	Motors	Multiple	Electric
Crew Bus	3	Diesel	Agitators	Multiple	Electric
Mobile Lighting Units	12	Diesel	Air Compressors	Multiple	Electric
Cable reeler	2	Diesel	**Power Generators (Backup)**		
Stemming Loader	2	Diesel	1.5 MW Generator	Multiple	Natural Gas or Diesel
Scraper	1	Diesel			

3.12 EXPLOSIVES

3.12.1 Explosives Manufacturing and Storage

The Project will include a combined facility for explosives manufacturing and for explosives storage (explosives magazine). Two potential locations have been included in the general arrangement (Figure 2.2-1), a preferred location between the open pit and EMRSF, and an alternate location north of the access road connecting Inks Lake Interchange and Highway 5. Both locations have been carried forward for purposes of the environmental assessment; however only a single facility will ultimately be constructed and operated, with the final location determined through advanced engineering and permitting.

A blend of ANFO and emulsion explosives will be used for mine development. Design Criteria for all manufacturing and storage facilities for explosives at the Project will conform with the requirements of the Explosives Act, the Ammonium Nitrate Storage Facilities Regulations, Transportation of Dangerous Goods (TDG) Regulations, Bulk Guidelines published by the Explosives Regulatory Division of NRCan (NRCAN 2014), and the Health, Safety and Reclamation Code for Mines in British Columbia (BC MEMPR 2008) to ensure worker and public safety.

Separation distances were considered in the selection of the Explosives Manufacturing Facility. The Quantity Distances Principle Manual-1995 published by ERD-NRCan details the required separations distances, based on the type of explosives, nature of the receptor and the net explosives quantity (NEQ) of explosives to be stored.

The Explosives Manufacturing Facility and Explosives Magazine will serve for the entire life of the mine and will be installed during the construction phase of the project. Both facilities will be licensed by the explosives contractor in accordance with the Explosives Act (1985a) and criteria established by NRCan's Explosives Regulatory Division.

The approximate distance from the explosive storage location between the pit and EMRSF and: Peterson Creek is 0.9 km; Jacko Lake is 3.0 km; the south point of the Aberdeen community is 2.4 km. The approximate distance from the explosive storage location near the north access road and: Inks Lake is 1.3 km; Highway 5 is 1.4 km.

Ammonium nitrate will be transported to the Project by truck and stored within a designated area near the explosives facility. Parking and a truck wash facility and other ancillary facilities (e.g. warehouses, and offices) will be located at the explosives facilities. Local site management would include containment of contact water from the facility, and associated fuel storage, and transporting for inclusion in the Project water management system. Detonators will be stored in a separate area to the ammonium nitrate and diesel fuel storage.

The explosives manufacturing facility has been designed so that there will be no process effluent from the facility.

On a daily average basis, approximately 50 tonnes of ammonium nitrate (AN) in prill form and 38 tonnes of emulsion stored within silos at the explosives facility. The storage would include 3 to 20 tonne silos for prill and 2 to 20 tonne silos for emulsion. Fuel will also be stored at the explosives facility as described in Section 3.13.4. The annual explosive requirements are presented in Table 3.12-1.

3.12.2 Transportation of Explosives to Work Sites

Diesel and AN will be either be transported to the blasthole on a designated vehicle as separate components and mixed just prior to loading into the blasthole or manufactured at the explosives manufacturing facility and transported on a designated vehicle to the blasthole. An explosives contractor will transport the materials to the work site and supply the explosives products. Explosives will be placed down the hole with the use of blend (if needed) and pumping trucks on an as-needed basis.

Table 3.12-1. Estimated Annual ANFO Explosive Use

Year	ANFO (AN) (tonnes)	Emulsion (tonnes)
-2	65	600
-1	740	6,500
1	2,100	19,000
2	3,000	26,500
3	3,000	26,500
4	2,500	25,000
5	2,500	22,500
6 to 23	3,000	30,000

3.12.3 Blast Pattern and Management

Production blasting will occur an average of once a day to meet mine operation requirements; if two to three blasts occur in one day, they will be preceded or followed by days without blasting. Blasting will only occur during the day with notification provided, as outlined in the Explosives Management Plan or Noise Management Plan (Chapter 11.11 or 11.22). Blasting design will be adjusted in the area approaching Jacko Lake to reduce the adverse effects from vibration and increased air pressure; however, timing and notification will remain the same as outlined in the Explosives and Blast Management Plan.

3.13 ANCILLARY INFRASTRUCTURE

Ancillary infrastructure to be constructed in the vicinity of the open pit will include the truck maintenance facility and associated mine dry along with the fuel storage facilities. The laboratories, warehouse and laydown will be in the area of the process plant. The first aid facility, water treatment plant, and administrative offices will be centralized in the administration building in the area of the processing plant to reduce the overall Project footprint. (The electrical substation, which will also be in the vicinity, is described in Section 3.15).

The development will also include pad areas for the above infrastructure. Earthworks include use of cut-and-fill construction methods, and some rock blasting, to create the pads. The cut material is used locally as part of the pad fill construction in addition to fill material provided from open pit pre-stripping activities. Material used in construction will be classified as NPAG.

3.13.1 Truck Maintenance Facility, Warehouse, and Mine Dry Facilities

The truck maintenance facility will be a stand-alone steel building with an insulated roof and walls to be located near the EMRSF, fuel tank farm, and haul road to provide easy access for haul truck maintenance and refuelling. The truck maintenance facility is located a sufficient distance beyond the ultimate pit to assure worker safety during a blast within the pit. Dedicated areas in the truck maintenance facility include a lube room and lube pumping area, air compressor room, electrical and instrumentation room repairs, mechanical room, tool crib, maintenance and warehouse offices and shovel and drill repair area.

The building will also accommodate a high-storage rack warehouse and a dry changing facility. The dry changing facility will accommodate up to 355 people with individual lockers, hanging baskets, and showers; as well as offices, training room, conference room and a lunch room. Sumps and trenches will be constructed to collect liquid from maintenance facilities and activities.

A hazardous waste storage building will also be located in truck maintenance facility area.

3.13.2 Administration Building and Emergency Services

The administration building will house the administrative, engineering, environmental and geology staff. The administration building will include offices, meeting rooms, lunch room, training rooms, files archive, accounting offices, environmental laboratory, washroom facilities, and a boots cleaning station. The administration building will also house fire and medical emergency services, and provide parking for a fire truck and an ambulance.

3.13.3 Cold Storage Warehouse

The cold storage warehouse will be a light, un-insulated structure.

3.13.4 Reagents Storage Building

The reagents storage building will be located to the South West of the main process building flotation area and will house reagents that are stored in segregated areas. The building will also have a reserve space for other miscellaneous reagents and ceramic grinding media.

3.13.5 Concentrate Storage

A filter within the process plant will be used to reduce the moisture content of the concentrate to about 8 to 10%. It will be conveyed into the concentrate storage facility until loaded onto sealed trucks for transport to the Port of Vancouver. The storage facility in the process plant will have capacity to store over 10 days' worth of concentrate, which is considered sufficient to address routine shipping interruptions. No additional storage is proposed.

The concentrate storage area will have a concrete floor with a sump. Material collected in the sump from wash downs will be returned to the concentrate thickener underflow. A wheel wash will be incorporated in the loading area for the concentrate trucks prior to departure.

3.13.6 Fuel Supply and Storage

Fuel handing, transportation, and storage facilities and activities will be consistent with the Health, Safety and Reclamation Code (BC MEMPR 2008) and the Ministry of Water, Land and Air Protection's (BC MWLAP's 2002) publication, *A Field Guide to Fuel Handling, Transportation and Storage*. The transportation, storage and handling of fuels required for the Project at the construction, operation, closure, and Post-Closure stages will be addressed by the Hazardous Materials Management Plan (Chapter 11.10), which will be modified as required over the life of the Project.

Heavy and light vehicle fuelling will be arranged in a convenient location for operation. The fuelling of light vehicles will be situated strategically near the heavy vehicle truck maintenance facility and within a practical distance of roads and haul roads. The heavy vehicle fuelling facility will be located near the primary crushing station.

Diesel fuel consumption over the life of the mine is estimated to be an average of approximately 30 M litres per year with a peak annual diesel use of up to 45 M litres. Lighter vehicles used on site will use gasoline and diesel with an average annual consumption of 1.5 M litres per year. Refuelling stations for mobile equipment will be located adjacent to the haul road accessing the open pit and adjacent to the truck maintenance facility.

The on-site fuel distribution will be a vendor-provided package including a complete self-contained station with pumps, piping, metering, controls, structural steel skid, and complete mechanical and electrical assembly. Fire protection facilities including fire extinguishers, smoke and heat detectors, and exterior manual pull stations will be provided as part of fuelling facility package.

Fuel storage and associated refuelling stations will be at two locations for the Project: light vehicle fuel storage with three (3) double-walled tanks (14,000 L, 14,000 L and 50,000 L), and haul truck fuel storage with five (5) double walled tanks (100,000 L each). A third location is at the explosives manufacturing/storage facility with one double-walled tank.

Each fuel storage area will be designed to have bermed spill containment with a capacity of 110% of the volume of the largest tank in the containment area. The lining within the bermed area will be an impervious HDPE liner membrane. The design of these facilities will be based on industry standards for installation, jointing, etc., of the membrane to ensure its integrity. Water collected within the secondary containment will be pumped through oil/water separators and released to the TSF or contained and disposed offsite in an approved facility. Fuel storage areas and vehicles will be equipped with spill kits for emergency response. Each spill kit contains the appropriate type, size and quantity of equipment for the volume/type of product present in the storage.

Refuelling stations will also have a containment area to contain minor spills or leaks during refuelling. Fuel transfer will be done by pumps.

Smoking will be prohibited in the vicinity of the fuel storage/refuelling areas and measures will be implemented to prevent sparks that could ignite fuel or fumes. Fire extinguishers and other firefighting equipment will be strategically located adjacent to the fuel storage/refuelling areas.

Fuel levels in tanks will be measured and records of deliveries and dispensing compared as part of a regular capacity audit.

3.13.7 Wastewater (Sewage, Greywater)

3.13.7.1 Sanitary Sewage

Sewage management for the Project will be consistent with the requirements of the *Environmental Management Act* and its Municipal Wastewater Regulation.

Domestic sewage and greywater will be produced by toilets, showers, laundry facilities, and janitorial services. During construction sewage and greywater will be collected in tanks and disposed of in an approved facility offsite as the pre-packaged sewage system is constructed. Once available it will be used during construction and into, and throughout, the operation phase.

The pre-packaged system for sewage collection and treatment plant will be installed at the process plant and truck maintenance areas. The main gate and crusher area will maintain sewage collection in tanks and a truck will transfer sewage from the holding tank to the sewage treatment facility or septic systems will be installed.

Effluent from the sewage treatment facility will be treated to be of appropriate quality for direct discharge to the nearest water management ponds and pumped to either the process water system or the TSF. Sewage sludge generated at the Project sewage treatment plant will be transported offsite for disposal at a licensed facility.

3.13.7.2 Truck Wash

Water will be used in the heavy equipment and truck washing facilities installed at the truck maintenance facility. An oily water treatment system will also be installed to treat the collected wash water and to the extent possible, treated oily water will be recycled for reuse. Upset conditions are anticipated to occur which will require occasional discharge of excess collected wash water to the East Mine Rock Water Management Pond.

3.13.7.3 Landfarm

Hydrocarbon contaminated soil, snow and ice will be treated within a designed landfarm. Siting and design criteria for the land treatment facility will meet requirements of MOE as set forth by Protocol 15 for Contaminated Sites – Soil Treatment Facility Design and Operation for Bioremediation of Hydrocarbon Contaminated Soil (BCMOE 2012).

The landfarm will be constructed for the progressive treatment and remediation of hydrocarbon contaminated soils, as and when required. The facility will be located adjacent to the southwest area of the EMRSF and will consist of multiple cells. If soil permeability in the facility is greater than 10^{-6} cm/s, a geo-membrane or other suitable liner will be installed and covered with fine-grained gravel or soil to temporarily store and land farm contaminated soil. The area will be leveled, sloped and bermed such that surface runoff from the area can be contained and, depending on quality and quantity, either reused, or disposed in the TSF through the on-site water management system, or disposed offsite at an approved facility.

3.13.8 Solid Waste

3.13.8.1 Waste Types

A material is considered to be a waste when it can no longer be used for its original intended purpose. The types of waste anticipated to be generated by the main components of the Project can be classified into combustible, non-hazardous waste; non-combustible, non-hazardous waste; recyclable waste; treated sewage; hazardous waste; and other waste.

Typical combustible non-hazardous wastes include discarded materials in a solid, liquid, or semi-solid form that do not pose a risk to human or environmental health. The types of waste generated within this category include: domestic food wastes; lumber scraps; domestic refuse; damaged bulk containers; concrete and other construction debris such as steel, wire, roofing and asphalt**.** These wastes will be generated over the life of the Project, however, no open burning or incineration onsite is proposed. These waste streams will be managed and disposed offsite or onsite as outlined in section 3.13.9 as part of the overall Waste Management Plan.

Recyclable materials comprise discarded items that can be refurbished and reused. The typical types of waste generated within this category include: cardboard and paper; beverage containers (plastic, aluminum, glass, tetra packs); tires; electronics and electrical wastes; and dry cell batteries for domestic use (e.g., AAA to D cells, 6 and 9 volt batteries).

Hazardous materials are covered by the *Transportation of Dangerous Goods Act* (1992) under Classes 2 through 6, and 8 through 9, that are no longer used for its original purpose and are intended for storage, treatment, recycling, or disposal. Used batteries, oil, and solvents and empty petroleum and reagent drums, carboys and pails will be stored in a secure location and transported off site to an approved disposal facility by an approved hazardous waste transporter. Lead acid batteries greater than 1 kg and rechargeable batteries are considered a hazardous material and will be safely stored until they can be transported to a commercial recycler or registered hazardous waste receiver.

In addition wastes identified above, KAM has identified additional materials to be managed. The other categories include:

- medical waste – waste generated in the first aid or health room will require special handling. Medical waste products will be put in single use medical waste containers. Both the containers and medical wastes will be disposed at an appropriate facility offsite.
- used oil and fuels – used oil and fuels will be stored and disposed offsite.

Waste types and quantities produced will fluctuate throughout mine life. Estimates provided here are a rough order of magnitude based on similar projects, available statistics, and professional judgement:

- Hydrocarbon contaminated soils: 110 m^3 (annual) 10 m^3 monthly;
- biomedical waste: 1 drum annually (208 L/drum);
- used batteries: 635 kg (annual) 50 kg (monthly);
- hydrocarbon contaminated absorbent: 55 drums (208L/drum) annually 5 drums monthly;
- Solvents: 1,200L (annually) 100L monthly;
- tires (light vehicles and heavy equipment): 290 (annual) 25 (monthly);
- electronic equipment: 860 kg (annual) 72 kg (monthly);

- florescent lamps: 15 drums (208L/drum) annually 1.5 drum monthly;
- used oil and grease: 3,000L annual 250L monthly;
- waste cupels containing lead: 5,000 kg annually 415 kg monthly;
- putrescible food waste: 22,000 kg annually 1,800 kg monthly; and
- laboratory chemical waste: 5 drums annually (208L/drum) 0.5 drum monthly.

3.13.9 Waste Management

Solid waste management is outlined in Chapter 11.9 to address handling, storage and disposal of the other waste streams identified.

The waste management infrastructure for the Project will be established at the onset of the site preparation and construction activities and consists of: a waste sorting facility (temporary and permanent); secure hazardous waste storage area; and a permanent disposal location within the MRSFs.Recyclable non-hazardous, combustible and non-combustible waste will be stored in dedicated waste storage facilities located at the Project. Specific waste storage locations have not been identified at this time. Material will be safely stored until it is transported to an appropriate recycling or disposal facility. The Project will have both indoor and outdoor storage, and waste will be segregated according to its susceptibility to exposure to the elements.

Hazardous waste will be temporarily stored on-site in designated storage areas, within lined Seacans, or buildings, and appropriate containers for trucking. All hazardous materials will be packaged for shipment to certified waste management facilities for subsequent treatment, recycling and/or disposal. All hazardous waste will be packaged, labelled and stored in appropriate containers in accordance with Canadian and provincial regulations. Used motor oil, transmission fluid and other petroleum fluids will be transferred to UN certified containers and transported off site and disposed at an approved facility

Waste management within the MRSFs will be used during construction and early operation for permanent disposal of non-hazardous wastes (except for domestic waste). Domestic waste from the operation phase will be stored on-site and disposed of at an approved disposal facility offsite each week. Industrial wastes, such as used oil, contaminated soil, and other hazardous wastes, will be reduced and reused as much as possible. The disposal of hazardous wastes will be contracted to a service provider.

Scrap metal from the process plant and truck maintenance facility will be collected in bins and recycled by a qualified local contractor.

Solid waste materials will be sorted at the source with material reused, recycled as much as possible, and the remaining material disposed of in an approved facility offsite.

3.13.10 Emergency Services

Emergency response services will be housed in the administration building. Emergency services will work with Thompson Nicola Regional District, City of Kamloops and New Gold Mining to provide a cooperative emergency response plan. KAM will have on-site security (described in Section 3.13.8) to ensure that public access is restricted and to assist off-site emergency.

3.13.11 Fire Response and Protection

Fire response services will be coordinated within the administration building. Fire protection measures will be in place at the process plant, where inert gas suppression, complete with fire alarms and fire detection, will be equipped within the electrical room, control room, and tool room of the process plant. Ventilation in these rooms will be equipped with dual action (fusible link and mechanical actuation) dampers that will close and isolate the room in the event of a fire. A fresh/fire water tank will be equipped with a standpipe which will ensure that the tank is always holding at least 40 m^3 of water, equivalent to a two hour supply of fire water.

Fire extinguishers for fire suppression, fire alarms and fire detection will be equipped in the process plant and other infrastructure (e.g., the Administration Complex, Truck Maintenance Building and Dry Facilities) on site. All vehicles will be equipped with fire extinguishers.

3.13.12 Project Security and Public Access to Site and Roads

KAM will have on-site security to ensure that public access is restricted and to assist off-site emergency. The Project will also be secure with the installation of a fence surrounding the Project, including the installation of gates at current existing road networks. This security will direct all traffic to enter/leave the Project through the main entrance. Secondary gated entrances will be available for emergency use only.

Due to safety consideration, all site road networks within the Ajax Project will be restricted to KAM's use. Suppliers, contractors and visitors to the site will be required to register their presence at the main entrance and report to the administration centre. KAM's community communication will emphasize this requirement to the public.

3.13.13 Communications

Site-wide communications, including the Project site and associated road and utility corridors, will be installed early in the construction period and designed to incorporate proven, reliable, and state-of-the-art systems to ensure that personnel have adequate voice, data, and other communication channels available. A number of integrated systems will be provided for on- and off-site communication at the Project and a site LAN will be provided to consolidate services into a single network infrastructure.

Computers, cameras, telephones, and any Internet Protocol (IP) devices requiring connection to the corporate network will utilize the LAN. Further to the hardwired portion of the LAN, wireless access points will be placed in common areas such as the administration area and construction office.

The communication systems will include a voice over internet protocol (VoIP) telephone system over a plant-wide fibre optic network. A trunked radio system consisting of hand-held, mobile, and base radios will provide wide area coverage for on-site communication. The trunked radio system will be interfaced to the on-site VoIP telephone system.

Internet connectivity and external telephone service to the Project will be provided by a local telephone company or internet service provider.

3.14 SITE WATER MANAGEMENT

The preliminary water management plan covers the Project mine life from construction through to long-term closure. The objectives of the plan are to manage mine site runoff in a manner that provides sufficient water to support ore processing, while avoiding adverse effects to downstream water quality, minimizing the potential for storm flows to cause damage to mine structures, and maximizing water recycling.

3.14.1 Goose Lake, Peterson Creek, and Jacko Lake

Goose Lake is within the footprint of the TSF and initially will be the area for water recycling to the process plant. During operation, this lake will be covered with tailings as the TSF is filled and permanently lost. Baseline studies have been conducted at Goose Lake, and results are reported in Chapters 6 through 10 of the Application/EIS (and associated appendices). Goose Lake is a small, shallow waterbody with naturally poor water quality, as it is a closed basin with high evaporative concentration. The lake is not considered navigable, and not fish bearing.

The discharges of Peterson Creek downstream of Jacko Lake are currently subject to variations in creek flow through annual increases during spring freshet, followed by a gradual reduction in stream discharge in the summer months. To supply downstream water licence holders, summer flows are augmented by the opening of an existing manual control gate located at the outlet of Jacko Lake. At the start of Project construction, Jacko Lake will also have a new dyke that will be installed in the northeast arm to accommodate relocation of the Kinder Morgan pipeline and contain the anticipated PMP during an extreme storm event.

The water management plan for Jacko Lake and Peterson Creek for the Ajax Project includes engineered dams on Jacko Lake, a diversion system and a new pond within Peterson Creek to address the following key objectives:

- upgrade existing Jacko Lake facilities and provide design flood storage during mine operation;
- divert water from Jacko Lake and around the open pit area discharging downstream into Peterson Creek during operation; and
- supply water to downstream water license holders during operation.

Engineered dams will be required around the periphery of Jacko Lake to provide a reasonable offset from the open pit to avoid flooding the workings and to preserve fisheries within Jacko Lake. The dams are:

- **JLD 1** – in Peterson Creek, downstream of the existing water level control dam;

- **JLD 2** – in the northest arm of Jacko Lake, incorporating the dyke installed to relocate the Kinder Morgan pipeline providing a buffer between Jacko Lake and the open pit;
- **JLD 3** – in the northwest are of Jacko Lake; and
- **JLD 4** – in the southwest area of the open pit to provide another buffer area between the pit boundary and Jacko Lake.

To maintain supply of downstream water licence holders, any surplus water from Jacko Lake and allocated irrigation water will be transferred to a new discharge point on Petersen Creek, effectively diverting a short portion of Peterson Creek. The Peterson Creek diversion system will include redundancy (e.g., backup pumps and generator) to ensure consistent operability. The system is designed to ensure that water supply to existing water licence holders downstream on Peterson Creek is maintained. Jacko Lake excess water and allocated irrigation water will be mechanically pumped through a pipeline following the main site road around the north side of the open pit and discharged near Peterson Creek, east of the primary crusher. A new impoundment (Peterson Creek Downstream Pond) will be constructed. The embankment will include a new control structure that will be operated by the Water Bailiff and directed by the Water Stewardship Branch of MOE based on water licence requirements of downstream users and water levels in Jacko Lake. These structures will be required during construction and operation phases; closure considerations are addressed in the Reclamation and Closure Plan (Section 3.17).

The Supporting Topic - Jacko Lake (Section 8.7) serves to aggregate summaries for all VCs that have potential pathways of effect from the Project on Jacko Lake. The intent of the section's summaries is to provide a snapshot of residual effects, mitigations and the determination of significance for each of the relevant VCs.

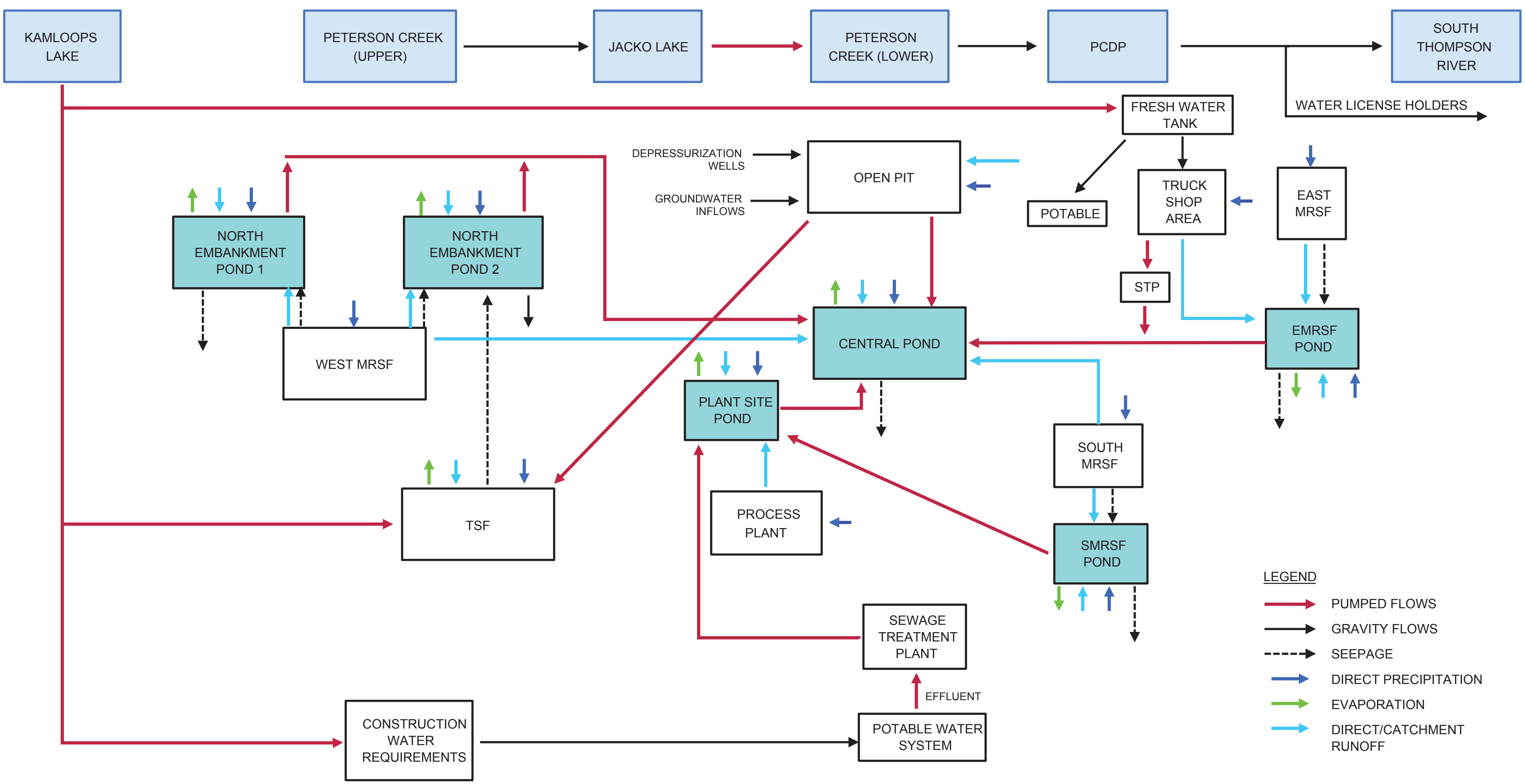
3.14.2 Water Management during Construction

The conceptual water management strategy for the Project during construction is presented in Figure 3.14-1. During construction water will be initially supplied from ponded water within the historic open pit which contains approximately 500,000 m^3 of water. This water will be treated, as required, and used for construction water management activities including dust control, aggregate production (screening and crushing), and initial earthworks. Once the construction of the freshwater water intake, pipeline and pumping system required for the operation is complete, freshwater requirements for the Project will be drawn from Kamloops Lake and supplied to a fresh/fire water storage tanks. Water consumption for the operation phase is discussed in Section 3.14.3.

Approximately 1,500 m^3/h water is considered the peak freshwater demand for the Project, however, water balance estimates indicate the average annual freshwater requirement will be approximately 1,000 m^3/h.

Figure 3.14-1

Conceptual Water Management for Ajax Project - Construction



Source: BGC (2015).

Freshwater for construction and operation will be supplied from Kamloops Lake, a section of the Thompson River. The Project's water supply system will consist of an upgraded intake and pumping station at Kamloops Lake, a new booster station along the existing pipeline, the existing New Afton water pipeline between Kamloops Lake and the New Afton Mine, approximately 16 km of new pipeline from a tie point at New Afton to the Ajax processing plant and new booster stations along the new pipeline. Access roads and power supply will also be constructed within the pipeline corridor to accommodate regular maintenance and inspection. The discussions with New Afton have been initiated to update and share these facilities and are on-going.

Currently, an intake system and steel pipeline is operated by New Gold Inc. to supply water to the New Afton Mine (located approximately 10 km northwest of the Project). The intake is sized to accommodate the water supply needs for New Gold; however, the pipeline is designed for a capacity larger than New Gold's requirements. Immediately south of the New Gold intake, there exists water intake infrastructure previously operated by Teck for the historic Afton Mine. This infrastructure is not currently in use and includes an intake in Kamloops Lake and a wet well and pump house on shore.

KAM is intending to restore this closed water intake infrastructure to provide freshwater for the Ajax Project, however, upgrades to this existing intake and pump house will be required to provide the necessary water requirements to the Project. These improvements, include modifications and replacement of the existing pumps, piping and electrical systems, will not result in an increased footprint within Kamloops Lake or on shore.

Freshwater will be pumped from Kamloops Lake using the upgraded system into the existing pipeline currently in use by New Gold. The combined freshwater supply (New Gold and KAM) will be pumped within the existing pipeline from the pumphouse on the shore of Kamloops Lake to the New Gold – New Afton storage pond. From the New Afton storage, a new pipeline and associated booster stations will be installed and pump water to the Ajax Project.

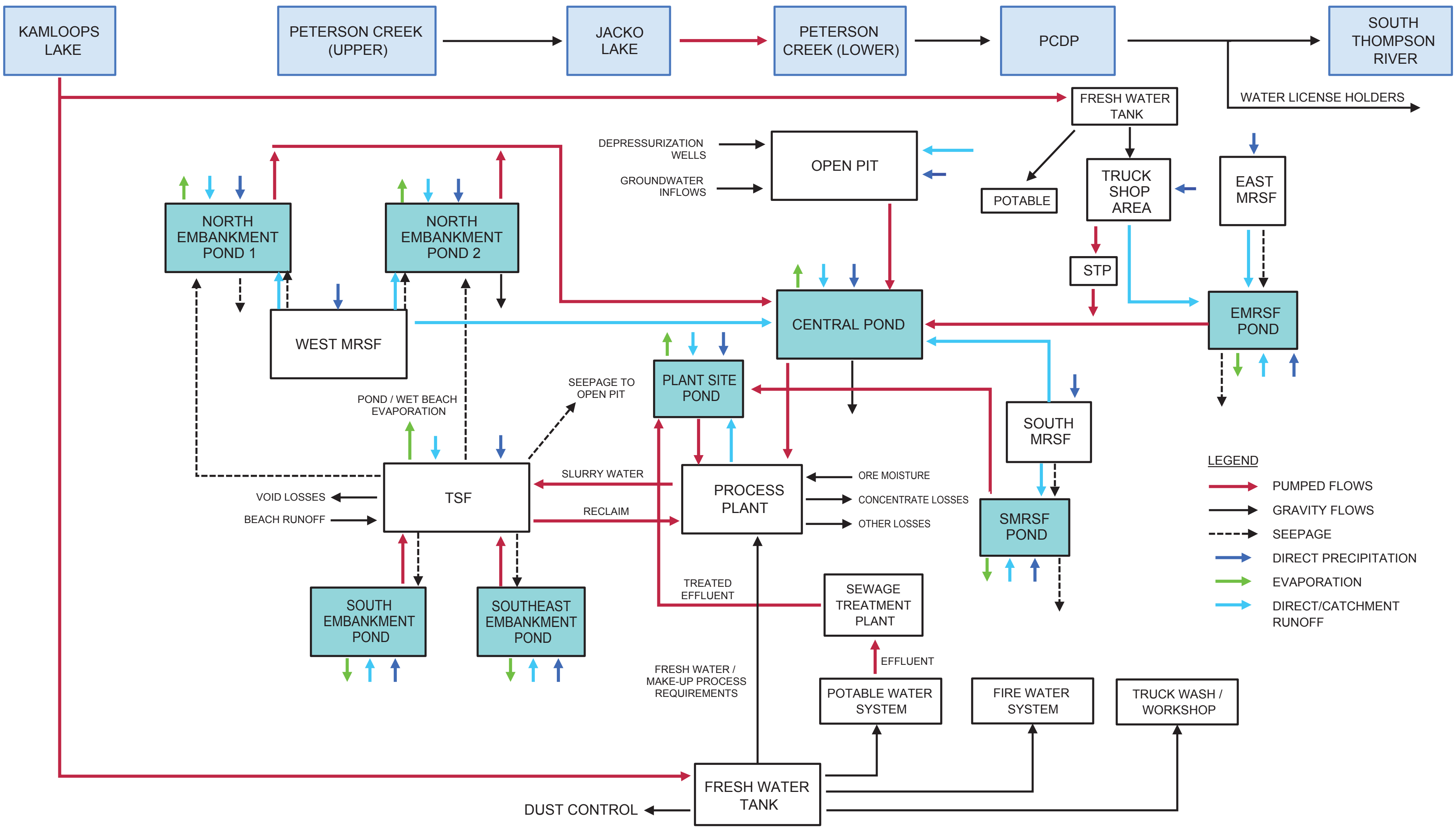
Within the Ajax Project, the freshwater pipeline will supply water to the explosives facility, primary crusher, truck shop, plant site and other buildings and facilities as required. A portion of the water will be treated for potable use during all Project phases and stored in a dedicated potable water storage tank prior to delivery to various service points. Other water uses during construction include diamond drilling activities and use within maintenance/vehicle facilities. KAM will continue exploration and development drilling during the construction and operation phases with water management as per current best management practices.

3.14.3 Water Management during Operation

The conceptual water management strategy for the Project during operation is presented in Figure 3.14-2.

Figure 3.14-2

Conceptual Water Management for Ajax Project - Operations



Source: BGC (2015).

Site Water Balance

During operation, there will be no surface discharge to the receiving environment. However, the process plant will require a circulating water load. Most of this water will be recycled water from the TSF, but some make-up water will be required due to the losses of water in the consolidated tailings, evaporation losses, and ice formation within the TSF during the winter months. This make-up water supply will be obtained from runoff when available (e.g., runoff from MRSFs, dewatering of the open pit diverted to the TSF during the summer months) and from Kamloops Lake. The preliminary water management plan and the thickened tailings strategy (described in Section 3.8) will minimize the requirement for make-up water.

Refer to Appendix 6.4-C for additional details on the water balance.

Water Supply

Fresh (non-contact) water will be required for dust control, reagent preparation, gland seal water, potable, process water make up and for firefighting purpose. Fresh water will be pumped from Kamloops Lake and stored in a fresh/fire water tank prior to use. Optimization of water use will be based on reducing the need for freshwater as much as possible and maximizing use of collected contact water from across the Project

Fresh and contact water will be available in varying quantities from the following sources:

- reclaim water from TSF pumped directly to the process water tank;
- reclaim water from plant site concentrate thickener pumped directly to the process water tank;
- fresh water via a pipeline from the Kamloops Lake pump station.
- surface contact runoff, and tailings seepage water collected in the seepage ponds and Central Collection Pond; and
- open pit groundwater and surface runoff that is collected within the open pit and pumped to the Central Collection Pond.

The potential to recycle treated effluent from the City of Kamloops for use as process water is also being investigated. Both of these options would reduce the requirement for freshwater supply; however they are future opportunities, and are not incorporated as part of the Project and the effects assessment at this time.

Diversion/Collection Systems (Contact water)

The site will be positively drained at all times with existing drainage courses preserved as much as possible and separate from the collection network to intercept contact water.

Runoff from site facilities will be directed to one of the seepage/collection ponds as follows:

- North Embankment Pond 1 and 2 – collect seepage from the TSF and runoff from a portion of the West MRSF,

- South and Southeast Embankment Ponds – collect seepage from the TSF and runoff from the TSF embankment along with undisturbed areas located upgradient,
- SMRSF Pond – collects seepage and surface runoff from the southeast portion of the South MRSF,
- EMRSF Pond – collects seepage and surface runoff from the East MRSF,
- the Plant Site Pond – collects runoff from the plant site,
- Central Pond – all of the above ponds are pumped to the Central Pond, which also receives runoff from a portion of the West MRSF and South MRSF. Groundwater inflows and surface runoff to the open pit are also collected and pumped to the Central Pond.

Drainage that comes in contact with the site and mine operation, particularly open pit or from ore stockpiles and MRSFs, has the potential to contain dissolved metals and other constituents (e.g., blast residues) and is therefore directed to the Central Collection Pond. Other surface contact water with elevated sediment loads will be collected and directed to the Central Collection Pond.

3.14.4 Water Management during Closure

The conceptual water management strategy for the Project at closure is presented in Figure 3.14-3 and Figure 3.14-4 and is discussed further in the Reclamation and Closure Plan (Section 3.17).

3.15 POWER SUPPLY

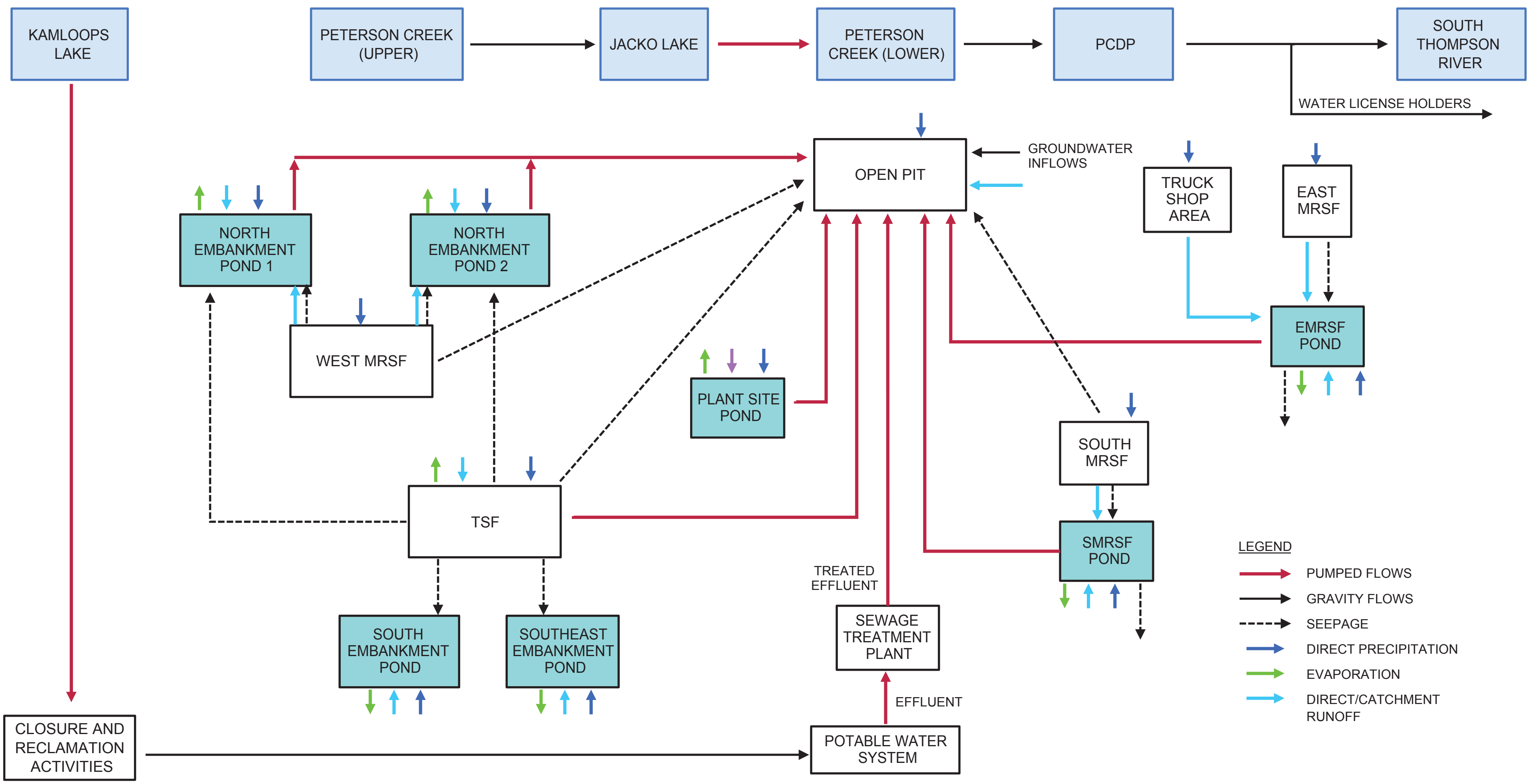
For construction, a 25kV overhead power line will be constructed from the BC Hydro transmission line along Lac Le Jeune Road to the west of the Project and follow the access and existing haul road alignments. For operation, the average power demand of the Project is approximately 90 MW which will be accessed from the BC Hydro grid to the east of the Project. A 9 km, 230 kV overhead power line will be constructed from the BC Hydro transmission line 2L265 to the east of the Project area near Knutsford.

The line will be constructed within a corridor approximately 10 m wide from the tie-in location to the process plant along the eastern boundary of the Project. This power line will be constructed using single wooden poles, although some H-frame structures will be required. No permanent road access is needed within this corridor over Project life and no in-water works or minimal vegetation clearing is needed; DFO authorization is not anticipated at this time, however, self-assessment (as provided by DFO guidance) will be conducted as needed. Scheduling will be based on optimization of access to minimize footprint and environment effects and meeting construction milestones. Staging areas are currently unknown at this time, however, they will be either on KAM land holdings or under agreement with the private land owner. Progressive reclamation activities will include the power supply corridor as needed over project life to meet the closure objectives.

At the Project's main substation located adjacent to the process plant, power supply will be stepped down to 25 kV for distribution to Project infrastructure such as the open pit, TSF, administration offices, mine rock and ore handling areas, and the water management.

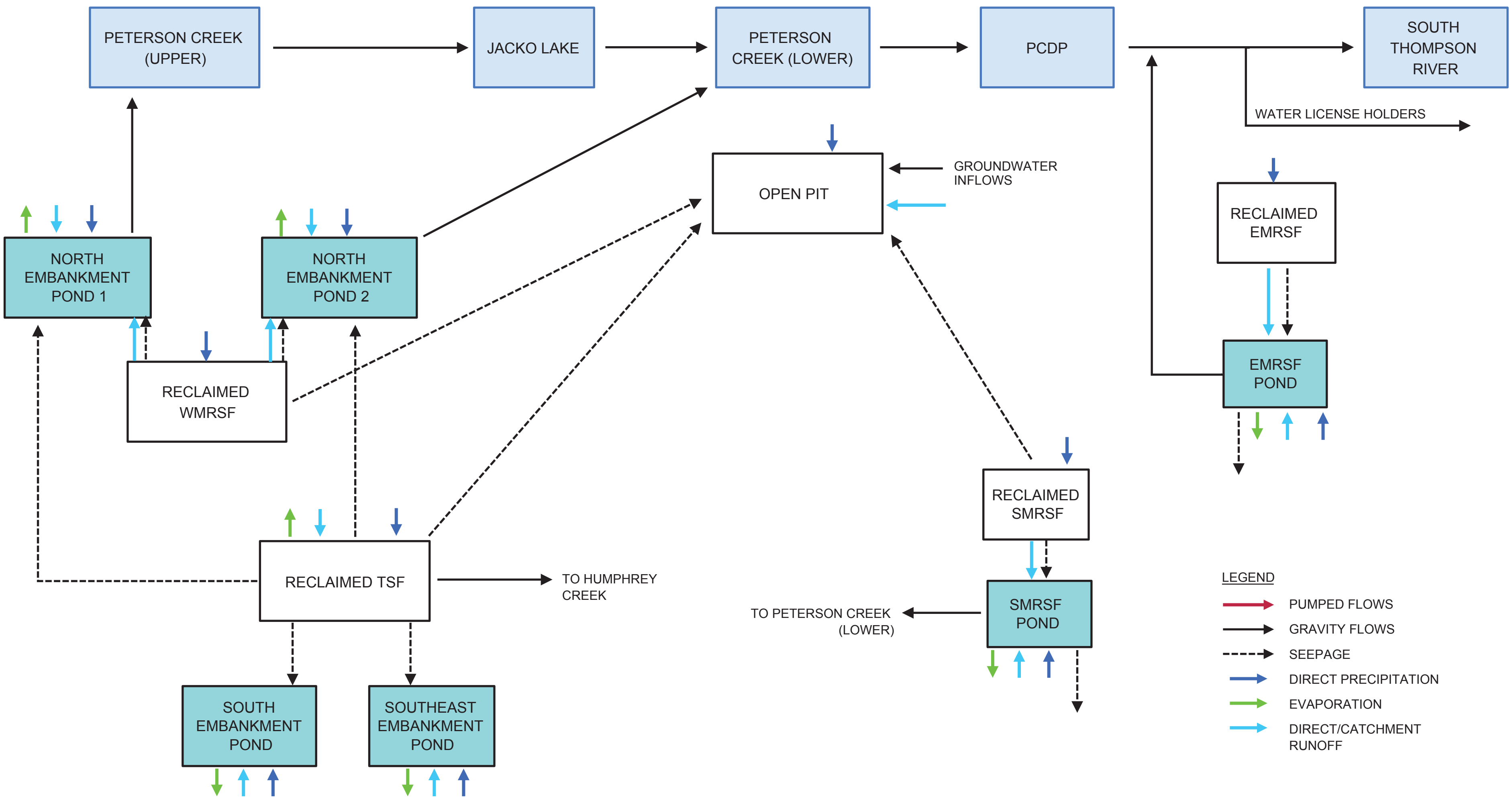
Figure 3.14-3

Conceptual Water Management for Ajax Project - Decommissioning and Closure



Source: BGC (2015).

Figure 3.14-4
Conceptual Water Management for Ajax Project - Post-Closure



Source: BGC (2015).

Backup power will be provided by diesel or natural gas generators. To reduce air emissions, the preferred approach is to use natural gas fuelled backup generators. The connection to the Fortis natural gas pipeline to the east of the Project will be via a buried pipeline that follows the power line corridor. To further reduce air emissions, the connection to the Fortis pipeline will allow heating of the process plant and the truck maintenance facility using natural gas.

3.16 TRAFFIC AND PROJECT ACCESS

3.16.1 Project Traffic

3.16.1.1 Construction Phase Traffic Estimate

During the construction phase, the Project will require a workforce consisting of employees, contractors and suppliers. Workforce requirements will vary depending on activities with an estimated peak of 1,800 during the construction period. Traffic patterns for the Project workforce is an important consideration in the assessment to provide a safe commute for personnel and meet operational needs. KAM is committed to implementing a number of contractually supported travel demand mitigation strategies during construction as necessary to reduce or eliminate significant adverse effects on the Kamloops traffic network, including company bus transportation, carpooling car incentives and staggered shifts to reduce employee traffic during rush hours.

According to the 2011 National Household Survey, approximately eighty percent (80%) of the employed population primarily drives personal vehicles to/from their place of work while the remaining 20% rides as a passenger, buses, cycles, walks, or takes another mode of transportation. Of this, 7% of all transportation is as a passenger in car, truck or van (Statistics Canada 2011). KAM has assumed the percent of the Project workforce that utilizes carpooling can be raised from 7% to 15% through the use of employee incentives.

To mitigate the effect of peak traffic volume during the construction phase, bus transportation will be provided for approximately 1,500 personnel (during the peak of construction workforce requirements). The remaining 300 personnel are anticipated to drive to and from the site with approximately two-thirds on-site at any one time. There will be parking provided on site for these personnel. To further mitigate the effect of the Project generated traffic during the peak periods, Project related traffic will be spread out over longer periods by staggering shift start and end times over two hour periods during the day. There may be a limited night-shift work during construction.

Heavy vehicle traffic during the construction phase will consist of equipment and supply deliveries as well as workforce buses, freight, materials and supplies. The majority of construction equipment will be mobilized and remain on site until construction ends.

Construction traffic will peak in Year -1 with the predicted daily average traffic, with the mitigation measures described above, summarized in Table 3.16-1. Additional traffic estimates and assumptions used to estimate the number of trips associated with the Project is described in the Traffic Impact Assessment (Appendix 8.1-A).

Table 3.16-1. Daily Average Traffic Volume to Project during Construction and Operation

Trip Type	Total Trips Construction	Total Trips Operation
Personal Staff vehicles	506	330
Buses	55	0
Heavy Vehicles	10	16
Total	**571**	**346**

3.16.1.2 Operational Phase Traffic Estimates

KAM estimates approximately 500 personnel will be employed during any typical operation phase year. As this estimate, represents an average over Project life, the total personnel may be adjusted within each assessment as warranted to provide a conservative basis to determine the impacts. Where warranted, the assumed total personnel is included in the relevant Chapter.

There are four groups of staff:

- Staff that will be non-shift workers who will work Monday to Friday;
- Staff including:
  - Mine shift-staff who will work 10 to 12 hour shifts per day, seven days per week;
  - Process shift-staff who will work 10 to 12 hour shifts per day, seven days per week; and,
  - Maintenance shift-staff who will work 10 to 12 hour shifts per day, seven days per week.

On any given day, 2/3 of the total employees will be scheduled to work while the other third will be on their time off.

Heavy vehicle traffic during the operation phase will consist of concentrate trucks and supply trucks. Concentrate trucks will deliver the raw output material from the Project to Vancouver for shipping. Output capacity of the Project will vary from day to day; hence, the number of concentrate trucks leaving and entering the site will also vary. Supply trucks will deliver fuel (diesel and gasoline), bulk materials, reagents, small-sized mining equipment, general mine supplies and waste management services (sewage sludge, garbage and recycling transfer). Heavy vehicle traffic will typically consist of B-Trains that can move a maximum payload of 35 metric tonnes.

On occasion, oversize loads will be required for delivery of special equipment. This rare occurrence and management of this type of vehicle and trip would comply with Ministry of Transportation and Infrastructure (MOTI) oversize loads permitting.

To address the impacts on the network arising from the addition of Project traffic, a mitigation strategy has been developed to reduce the passenger vehicle trips and hence impacts on the Kamloops area traffic network that includes:

- carpooling incentives; and
- staggered shift start and end times so that some Project traffic is shifted outside of peak traffic during morning and evening rush hours.

For the Traffic Impact Assessment, the predicted peak daily average traffic during operation with mitigation measures is summarized in Table 3.16-1. Additional traffic estimates and assumptions used to estimate the number of trips associated with the Projects is described in the Traffic Impact Assessment (Appendix 8.1-A).

3.16.2 Project Access

The Project site is currently accessed by an existing network of paved and gravel roads. Major highways that provide access to the Project include Highway 5 (Coquihalla Highway) and Highway 1 (Trans-Canada to Southern Yellowhead Highway). Highway 1 is part of the BC section of the Trans-Canada Highway. East of Cache Creek, Highways 1 and 97 proceed on a common alignment for 72 km passing through Savona en route to Kamloops. Highway 5 merges onto the Trans-Canada from the south at this point. The merged Highways 1/97/5 proceed east for 12 km through the western part of Kamloops to where Highway 5 diverges north. Highways 1 and 97 leave Kamloops 7 km (4 mi) east of the city. Highway 5 is a 524 km long north-south route in southern BC and connects Highway 1 with Highway 16, the northern Yellowhead route. Combined this system provides the shortest land connection between Vancouver and Edmonton. A portion of Highway 5 south of Kamloops is also known as the Coquihalla Highway; the northern portion is known as the Southern Yellowhead Highway.

A Traffic Management Plan that describes Project access details is presented in Chapter 11.20 and a summary of Project access is presented here.

The approximate driving distance from the nearest exit (Inks Lake exit 355) to the Project site from Highway 5 is approximately 4 km. The Highway 1/97/5 junction is located approximately 10 km from site. During operation, a portion of the existing historic mine haul road will be used as primary access to the site. This road is locally known as the "haul road" and was constructed to provide a route for hauling ore from the historic Ajax Mine to the processing facility at the Afton Mine. Under current conditions the haul road includes an overpass of Lac Le Jeune Road and an underpass of Highway 5. For the purposes of this assessment, the "haul road" is referred to as the Ajax Mine Access Road (AMAR).

The AMAR crosses Lac Le Jeune Road at Inks Lake approximately 2.6 km west of Highway 5 and approximately 8.3 km south of the intersection of Lac Le Jeune and Copperhead Drive, west of Kamloops. The AMAR to the Project will be gated along the AMAR in the area north of Jacko Lake. Upgrades to the AMAR will include asphalt paving, design curves, design super elevations, drainage improvements, signage and other works as required at the intersection with Lac Le Jeune Road to meet TAC standards as required by MOTI for public roads.

In addition to access road upgrades, the existing Inks Lake Interchange on Highway 5 (exit 355) will be redesigned to utilize the existing access road and underpass infrastructure. The Inks Lake Interchange was designed and constructed in 1987 and does not meet current TAC standards. Interchange upgrades will include design to meet current TAC standards, safe on and off access to Highway 5 and direct public traffic to Highway 5 from Lac Le Jeune Road. The upgraded interchange and improvements to the existing AMAR will provide the most direct access from the Project site to Highway 5 and prevent traffic impacts on Lac Le Jeune Road between the AMAR intersection and the Copperhead Interchange. The upgraded Inks Lake Interchange will provide a direct connection of the AMAR and Highway 5. Therefore the portion of the AMAR between the Project gate and Highway 5 will be converted from private road to public road as per MOTI Controlled Access Highway requirements.

The Project is also currently accessed by small private roads off Goose Lake Road to the south of the Project area. Goose Lake Road intersects Lac Le Jeune Road approximately 7 km south of the existing AMAR at Inks Lake. Goose Lake Road traverses the southern part of the Project toward the northeast where it intersects Long Lake Road in the Knutsford area approximately 0.5 km south of Princeton-Kamloops Highway 5A. During construction a portion of Goose Lake Road approximately 6 km in length will be closed and decommissioned at the southern and northern limits of the proposed TSF. An assessment of the potential effects of the proposed closure of Goose Lake Road on property access and land use (grazing leases), as well traffic network function are provided in the Traffic Impact Assessment (Appendix 8.1-A). This assessment concluded that the effect of closing a 6km section of the Goose Lake Road will be negligible to access, land use and overall traffic network connectivity and use therefore an alternative route is not required.

3.16.2.1 Temporary Access Plan

During the first six months of construction access to the Project will be via a Temporary Access Plan until the Inks Lake Interchange upgrades are complete. The Temporary Access Plan will enable personnel access from the north for vehicles and transit buses/vans along Lac Le Jeune Road from Highway 1 to the Project's main access gate . Prior to completion of the new interchange, Project related traffic will be contractually required to use the Temporary Access Plan so that traffic and road condition impacts from heavy vehicles on Lac Le Jeune Road are minimized and temporary. From the south, Project traffic will exit Highway 5 at the Walloper Lake Interchange and travel north on Lac Le Jeune Road to the AMAR intersection. These routes will be used until the new interchange is constructed to connect the AMAR and Highway 5. Heavy equipment access during construction will be via the Lac Le Jeune Road from the south via Highway 5 at the Walloper Lake Interchange (Exit 336) regardless of heavy vehicle origin.

Transit options for personnel during construction include limited personal vehicles and company provided buses to reduce Project related traffic volume on the Kamloops area traffic network. Approximately 85% of employees during construction will be contractually obligated to use company provided transportation via bus. Parking and transit facilities will be provided within designated areas. Parking lots, and transit facilities locations and criteria will be determined during the permitting stage, however preliminary locations have been identified and are part of ongoing discussions with the land owners and MOTI.

3.16.2.2 Primary Access Plan

During operation, all traffic including staff, concentrate trucks, and supply trucks will access the Project via the Primary Access Plan that will utilize the new Inks Lake Interchange off Highway 5 and the upgraded AMAR. As part of the Primary Access Plan, Project traffic will utilize Highway 5 and exit at Inks Lake Interchange for direct connection to the AMAR. The AMAR crosses Lac Le Jeune Road via an overpass to ensure safe access and egress.

A gate and associated security post located at the main access gate will restrict access to the Project during operation. Haul and access roads will also be constructed to connect the various on-site buildings and along new pipeline and power corridors.

Haul roads will be constructed for traffic within the pit and between the pit and ore crusher, MRSF, overburden stockpiles, construction areas, and truck maintenance facility. The roads are designed as excavated ramps inside the ultimate pit limit and as mainly-fill roads outside the ultimate pit limits. Large rear end dump haul trucks (300 tonne class) will be used for hauling both ore and mine rock to their destinations.

The access road network will provide for transportation of concentrate from the processing plant via truck to the Port of Vancouver (Kinder Morgan Port, North Vancouver) for shipping outside Canada for further smelting and refining. Loaded concentrate trucks will leave the Project via the main access road and access southbound Highway 5 by the Inks Lake Interchange, for travel south to Vancouver.

3.17 CLOSURE AND RECLAMATION

3.17.1 Introduction

This section provides a conceptual closure and reclamation plan (MCRP) for the Project, consistent with the Application Information Requirements (AIR) / EIS Guidelines, jointly issued by the BC Environmental Assessment Office and the CEA Agency. The AIR / EIS Guidelines (BC EAO 2014) require the MCRP describe how the Proponent intends to meet the statutory requirements for mine closure and reclamation of the Project. The MCRP addresses these requirements but is not intended to meet all the requirements for a permit approving the closure and reclamation program, pursuant to the *Mines Act* (1996a). The AIR / EIS Guidelines include:

- An overview of the proposed conceptual closure and reclamation plan;
- A description of the regulatory framework and requirements and government agreements that are needed with respect to the closure and reclamation phase of the Project;
- An outline of the end land use objectives, taking into consideration the recommendation of Ministry of Energy and Mines (MEM) that the reclamation program be aimed at ecological restoration of naturally occurring grassland communities, as well as information on re-vegetation species (including the possibility of cultivation of native grass seed for reclamation purposes), proposed reclamation methods and expected capability of the reclaimed area for vegetation and wildlife, especially wildlife and plant species identified as valued components;
- A description of the measures to be implemented through the mine site reclamation plan to mitigate long-term adverse effects of the Project;
- An Invasive Plant (Noxious Weed) Prevention and Control plan for all phases of the Project, including an inventory of, and control plan for, existing infestations as well as prevention activities and contingency plans for potential introductions;
- A description of the proposed development site at closure and after reclamation;

- A list of operational, decommissioning and closure, and reclamation components and activities intended to stabilize surface materials with a vegetation cover as quickly as possible; and
- A plan for temporary closure (including a description of the conditions under which temporary closure will occur).

3.17.2 Overview of Mine Closure and Reclamation Plan

Closure and reclamation planning contributes to the success of progressive reclamation during mining and closure at the end of mine life. Minimizing surficial disturbance to the extent possible will reduce the risk for potential environmental effects resulting from the Project. Progressively stabilizing and rehabilitating disturbed surfaces will limit degradation of the soil resource. Environmental monitoring plans will be developed as an important element of the environmental management system and to support progressive reclamation and closure.

The MCRP provides in the following sections:

- Section 3.17.3 – a description of the regulatory framework for mine closure in BC;
- Section 3.17.4 – closure and reclamation objectives including end land use objectives;
- Section 3.17.5 – an assessment of site soils, salvage and stockpiling methods and a preliminary material balance;
- Section 3.17.6 – a discussion of the treatment units used for reclamation planning, the selection of reclamation species and target habitat characteristics as well as re-vegetation monitoring and plans for invasive plant control;
- Section 3.17.7 –the closure and reclamation plan for specific mine infrastructure;
- Section 3.17.8 – temporary closure (care and maintenance) measures;
- Section 3.17.9 – monitoring plans for the closure period;
- Section 3.17.10 – closure and reclamation cost estimates.

3.17.3 Regulatory Framework

3.17.3.1 BC Mines Act *and Health, Safety and Reclamation Code*

The BC *Mines Act* (1996a) and Health, Safety and Reclamation Code for Mines in British Columbia (BC MEMPR 2008) require mining operations to carry out a program of environmental protection and reclamation to return, where practical, land, watercourses, and cultural heritage resources to a safe and environmentally sound state and to an acceptable end land use upon termination of mining.

The *Mines Act* and the Code are administered by the MEM. The Chief Inspector of Mines has authority for all permits and approvals under the *Mines Act* and the Code. Proponents of mining projects are required to obtain a permit from the MEM prior to commencing any work on a mine site, in accordance with Section 10 of the *Mines Act*. Section 10 of the *Mines Act* requires that a permit application must include “a plan outlining the details of the proposed work and a program for the conservation of cultural heritage resources and for the protection and reclamation of the land, watercourses and cultural heritage resources affected by the mine, including the information, particulars and maps established by the regulations or the code" (Section 10.1). As a condition of issuing a permit, the Chief Inspector requires a financial security for mine's reclamation, and to provide for protection of, and mitigation of damage to, watercourses and cultural heritage resources affected by the mine (Section 10.4).

A financial security is required as a condition of all *Mines Act* permits (Sections 10.4 and 10.5) for all, or part of, outstanding costs associated with mine reclamation and the protection of land, watercourses, and cultural resources, including post-closure commitments. The security held under the *Mines Act* (1996a) can also be used to cover the requirements of legislation, permits, and approvals of other provincial agencies.

The objective of BC's reclamation security policy is to provide reasonable assurance that the Provincial Government will not have to contribute to the costs of reclamation and environmental protection if a mining company defaults on its obligations. In the case of a company default, the security amount should be sufficient to allow Government to successfully manage the environmental issues at the mine site, complete any outstanding reclamation requirements, and continue to monitor and maintain the site for as long as is required (BC MEMPR 2008). Typically, MEM reviews the reclamation security at a mine site every five years, or whenever significant changes occur at the mine. The security obligation may increase or decrease depending upon assessed liability at the time and financial factors such as real return bond yields. The costing developed for the Application/EIS is a high-level cost estimate developed for full closure of the mine at the end of the planned mine life. During the permitting stage, more detailed costs estimates will be developed, including a detailed estimated for the first 5 years of operation.

3.17.3.2 Metal Mining Effluent Regulations

The Project will operate as a zero discharge facility with all contact water directed to the TSF and therefore Metal Mining Effluent Regulations (MMER) will not apply during Operation. At closure, the remaining water in the TSF will be pumped to the open pit. Water accumulating in water management ponds will be transferred to the open pit or TSF until suitable for release to the environment. In the Post-Closure phase, proposed discharge is to Humphrey Creek, which would require a permit that may potentially trigger MMER. The requirements for managing discharge during the Post-Closure phase will be evaluated based on need and the prevailing regulations at that time.

3.17.3.3 Environmental Management Act *and* Canadian Environmental Protection Act

The BC *Environmental Management Act* (2003) prohibits the discharge of waste to the environment unless specifically authorized. While there are different types of authorizations under the *Act,* most mining operation require air emissions, solid refuse, and effluent discharge permits. The *Canadian Environmental Protection Act* (1999) regulates the release of toxic substances into the environment, which includes potential contamination of soil by mining activities (Part 9 of the *Act*). Project closure will be carried out to meet the requirements of the BC *Environmental Management Act* and *Canadian Environmental Protection Act.*

3.17.3.4 Water Act

In British Columbia, ownership of water is vested in the Crown as stated in the BC *Water Act* (1996b). The *Act* is the principal law for managing the diversion and use of Provincial water resources. Under the *Act,* approvals are required for making changes in and about a stream, to authorize construction of works, and the diversion and use of water and water withdrawals. Water management systems will be closed in a manner to be compliant with the *Water Act*.

3.17.4 Closure and Reclamation Objectives

Standards for mine closure and reclamation are stated in Part 10 of the Code:

- Land Use (Section 10.7.4) - "The land surface shall be reclaimed to an end land use approved by the chief inspector that considers previous and potential uses."
- Land Capability (Section 10.7.5) - "Excluding lands that are not to be reclaimed, the average land capability to be achieved on the remaining lands shall not be less than the average that existed prior to mining, unless the land capability is not consistent with the approved end land use."
- Long-Term Stability (Section 10.7.6) - "Land, watercourses and access roads shall be left in a manner that ensures long-term stability."

Closure and Reclamation objectives for the Project include:

- Re-establish land capability such that the targeted end land use of seasonal cattle grazing and valuable wildlife habitat are met;
- Return land to the Agricultural Land Reserve (ALR);
- Maximize progressive reclamation of MRSFs and TSF embankments during operation;
- Re-establish the Peterson Creek flow path from Jacko Lake;
- Establish vegetative covers that meet the targeted end land use and provide long-term stability and minimize seepage through MRSFs and TSF; and
- Establish a pit lake, which will be a sink for management of water that cannot be immediately released to the receiving environment.

Closure and Reclamation planning has guided Project design with the end land use objective of returning the site to the ALR to support the same land uses in place today. Land previously used for the historic Afton Mine has successfully been returned to the ALR. A key factor in the Project's design is consideration of the physical and chemical stability of the reclaimed structures in the long term and preserving, where possible, or restoring mine-affected waterways. The MCRP is currently developed at a conceptual level and will be used to initiate planning discussions with stakeholders, including regulators and the SSN, to confirm that end land use and final reclamation configurations are addressing stakeholder interests and concerns.

Land use and capability objectives have been informed by pre-mining land use, which, for the Project, includes agriculture, wildlife, cultural and recreational values. Although the post-mining landscape will not be identical to the pre-mining landscape, the reclamation plan aims to replicate pre-mining ecosystems by re-establishing the original ecological diversity of landforms (slope, aspect and elevation), soil thickness / moisture regimes and vegetation communities. Most of the Project footprint is located within the ALR. Operation of the Project will require a temporary ALR exemption for non-farm use. KAM intends to return the reclaimed mine site to the ALR so it can continue operation as a viable ranching operation (Sugarloaf Ranch). Reclamation strategies will focus on providing equivalent grazing capacity compared to pre-mining conditions.

Planning for ecological diversity will enhance wildlife habitat. The MCRP includes the provision of habitat types such as Douglas fir and Ponderosa pine forests; aspen groves with associated shrubs and herbaceous communities; grasslands with shrubs; streamside riparian ecosystems, wetlands and pastures. For more detailed descriptions of target habitat types, please see Chapter 11.28 (Conceptual Restoration Plan). Figure 3.17-1 shows the conceptual plan for post-mining land-use. North-facing lower slopes of the MRSFs are targeted for forest with higher elevations targeted for herbaceous / grassland species. Grassland is planned for the southern slopes of the MRSFs and the TSF where drier conditions will prevail. Flatter areas such as the reclaimed process plant site and low-grade ore stockpile will be used for hay and pasture. Water management ponds will include shrub / herb wetlands. Roads and other linear infrastructure areas will largely be reclaimed as grassland.

Pre-mining and proposed post-mining hectares are shown in Table 3.17-1. The post-mining pit will comprise approximately 18% of the footprint area (1,705 ha) compared to about 4% for the existing Afton pits. The post-mining landscape will have approximately 125 ha less grassland and 200 ha less forested area compared to pre-mining footprint. Post-mining water feature areas will decrease from 21 ha to approximately 6 ha; the post-mining area calculation does not include the area of the final pit lake or the re-established Peterson Creek as both are not expected to comprise useful habitat. The re-established Peterson Creek may require a liner to limit surface water losses and potentially poor quality groundwater inflow to limit interaction with local groundwater regime. The shrub/herb wetland areas will target the water management ponds and do not include potential wetland areas that may be developed in the lower reaches of Humphreys Creek or the outlet of the TSF. The cultivated field area will increase slightly consistent with the post-mining ranching operation.

Table 3.17-1. Pre-Mining and Proposed Post-Mining Land Use

Category	Description	Pre-Mine Area (ha)	Pre-Mine Area (%)	Post-Mine Area (ha)	Post-Mine Area (%)
Pit	Open pit/mine disturbances and rock outcrop	76	4.5 %	299	18%
Grassland	Grassland including disturbed existing grasslands	1,129	66 %	1,004	59%
Grassland/Herbaceous	Herbaceous /sagebrush grassland	26	1.5%	179	10%
Cultivated Field	Hay and pasture	62	3.6%	74	4.3%
Shrub/Herb Wetland	Shrubby forest and wetlands	64	3.8%	20	1.1%
Forest	Sapling, young and mature forest	327	19%	123	7.2%
Water features	Lakes, ponds and creeks	21	1.2%	6	0.4%
Total		**1,705**	**100%**	**1,705**	**100%**

3.17.4.1 Long-Term Stability

Physical and chemical stability of mine infrastructure will be facilitated by closure designs that incorporate appropriate slopes, soil covers and re-vegetation to protect against erosion and sedimentation (Table 3.17-2). Soils will be carefully salvaged and stockpiled to minimize erosion and retain viability for reclamation (Chapter 11.3). Progressive reclamation of the MRSF and TSF embankments during operation will increase long-term stability and erosion control. The MRSF slopes and TSF embankments will have a minimum slope of 2.4 m (horizontal) to 1 m (vertical) slopes to allow for placement and stability of the reclamation cover (Section 3.17.7.2). The soil cover will include a compacted basal till layer to limit seepage into waste deposits and a growing layer comprised of overburden and topsoil to facilitate vegetative cover. A 'dry' closure planned for the TSF is designed to provide long-term stability of the surface. The open pit walls will naturally weather and the slopes unravel into the pit lake. The in-pit disposal of mine rock on the west side of the open pit will minimize slope unravelling along the section of the final open pit that is proximal to Jacko Lake and provide long-term stability.

Waterways will be diverted where they cannot be preserved or re-established after operation wherever feasible. Water diversion and contact water management infrastructure will be removed when it is no longer required. Re-establishment of Peterson Creek will be carried out to restore the pre-mining flow paths soon after cessation of mining operation whereas the water management ponds will be decommissioned and reclaimed as wetland areas.

Geochemical (static) test work from 856 mine rock samples show that from 78% to 95% of mine rock is classified as NPAG, depending on whether the conservative CaNPR < 2, or bulk NP criteria, are used in the derivation of NPR (Appendix 3-A). The mine rock samples generally have low sulphide content, typically below 0.2%, and have alkaline paste pH indicating that mine rock will initially contain available neutralizing potential (NP) to buffer acid.

Carbonate NP depletion calculations indicate that carbonate minerals could be consumed from up to 18% of the mine rock within the first 85 – 108 years after exposure in the MRSF. Following depletion of carbonate, kinetic results indicate that reactive silicate minerals will continue to provide buffering capacity. Of the five major rock units, the Iron Mask Hybrid (IMH) has the lowest sulphide content and produced dissolved metal concentration below or close to the BC WQG. Kinetic test data indicate the IMH has the lowest risk for neutral leaching relative to the other major rock types. Although this material has the potential for the release of Se and As above BC WQG, it is the most suitable material for construction of cover layers and outer layers of the MRSF.

Tailings kinetic tests show a mean sable pH of 8 with low rates of metal leaching. Dissolved Mo, Cu, Se and V showed the highest release rates with Se and SO4 the only constituents exceeding BC WQG (in field bin drainage).

Figure 3.17-1
Post Mining Land Use

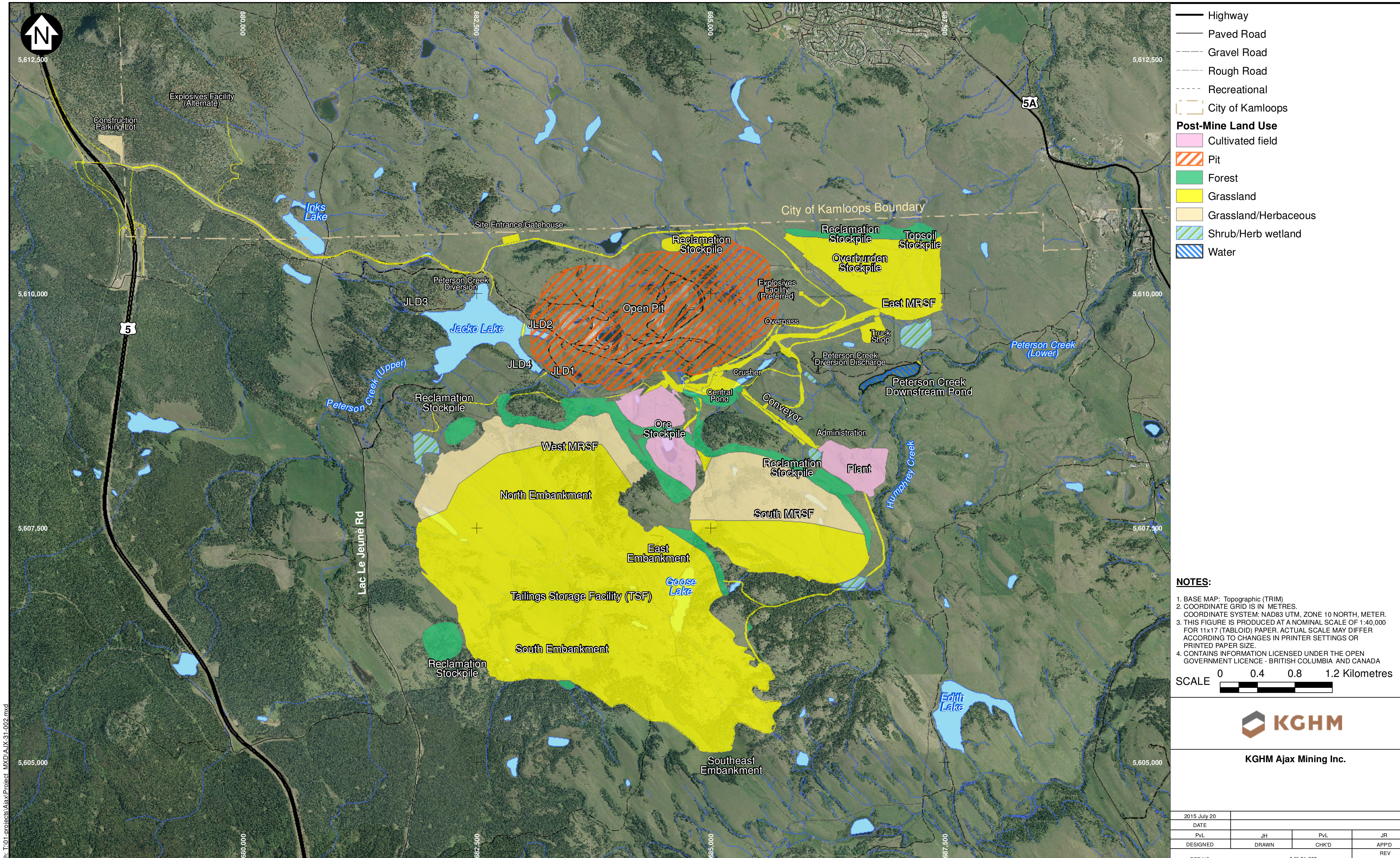


Table 3.17-2 Summary of Closure and Reclamation Activities

Project Component/ Concern	Phase	Proposed Activity
Mine Rock Storage Facilities		
Physical Stability	Construction	Minimize stripping footprint to prevent erosion and control invasive species establishment
Physical Stability	Construction/Operations	Re-vegetation with interim seed mix to prevent establishment of Invasive Species
Physical Stability	All Phases	Slope of 2.4:1 (maximum slope of 23 degrees)
Physical Stability	All Phases	On-going Geotechnical Monitoring
Physical Stability	Operations	Progressive reclamation of slopes to prevent erosion and invasive species establishment
Physical Stability	Operations/Closure	Recontour and revegetation of surface for prevention of erosion
Physical Stability	Closure/Reclamation	Soil and overburden placement for establishment of agronomic and native species
Chemical Stability	All Phases	Control of contact water
Chemical Stability	All Phases	On-going monitoring and development of action triggers
Chemical Stability	Closure	Capping of MRSF with 60 cm of compacted overburden to reduce water infiltration
Chemical Stability	Reclamation	Soil and overburden placement for establishment of agronomic and native species
Chemical Stability	All Phases	On-going geochemical monitoring
Tailings Storage Facility		
Physical Stability	Construction	Minimize stripping footprint to prevent erosion and control invasive species establishment
Physical Stability	All Phases	Slope of 2.4:1 (maximum slope of 23 degrees)
Chemical Stability	All Phases	Control of contact water
Chemical Stability	All Phases	On-going monitoring and development of action triggers
Physical Stability	Operations	Progressive reclamation of embankment slopes to prevent erosion and invasive species establishment
Chemical Stability	Closure	Capping of tailings surface with up to 1m of till to prevent infiltration
Chemical Stability	Closure	Transfer tailings water to pit to establish dry surface for closure
Physical Stability	Closure	Establishment of spillway to Humphrey Creek
Physical Stability	Closure/Reclamation	Soil and overburden placement for establishment of agronomic and native species

Project Component/ Concern	Phase	Proposed Activity
Pit		
Physical Stability	All Phases	On-going geotechnical monitoring
Physical Stability	All Phases	Pit design
Chemical Stability	All Phases	Control of contact water
Physical Stability	Operations/Closure	Backfill west edge of pit with MR in final stages of Operations
Physical Stability	Closure	Fencing and berm to protect human and animal safety
Peterson Creek Diversion and Downstream Pond		
Chemical Stability	All Phases	On-going monitoring and development of action triggers
Physical Stability	Closure/Reclamation	Reestablishment of Peterson Creek channel
Physical Stability	Closure/Reclamation	Reestablishment of vegetation and aquatic habitat
Reclamation Stockpiles (Includes Soil and Overburden)		
Physical Stability	Construction/Operations	Re-vegetation with interim seed mix to prevent erosion and invasive species establishment
Physical Stability	All Phases	Prescribed slope angles for soil and overburden stockpiles
Chemical Stability	All Phases	Soil management and stockpiling to avoid add-mix of materials
Chemical Stability	All Phases	On-going monitoring to ensure required nutrient levels within stockpiled materials
Water Management Ponds		
Physical Stability	Construction/Operation	Progressive reclamation of slopes to prevent erosion and establishment of Invasive Species
Chemical Stability	Operations	Lined facilities to prevent infiltration
Chemical Stability	All Phases	On-going monitoring and development of action triggers
Chemical Stability	All Phases	Control of contact water
Chemical Stability	Closure/Reclamation	Establishment of wetlands
Ancillary Facilities/Roads		
Physical Stability	Closure/Reclamation	Removal of all structures and foundations
Physical Stability	Closure/Reclamation	Cover and recontour all facility footprints
Physical Stability	Closure/Reclamation	Soil and overburden placement for establishment of agronomic and native species

3.17.5 Soil Management

Appropriate soil management is critical to reclamation success as it optimizes recovery of topsoil, conserves soil against loss and degradation during handling and manages soil through the life of the Project including strategies that regularly introduce seed stock and reduces soil storage times so that soil quality is maintained. The term 'topsoil' is used herein to describe the A and B soil horizons, which generally comprise the soil resource. The C horizon is generally unsuitable as reclamation material as it can contain elevated salt and/or carbonate concentrations that are detrimental to plant growth. The term 'overburden' is used herein to describe the C horizon (Plate 3.17-1).

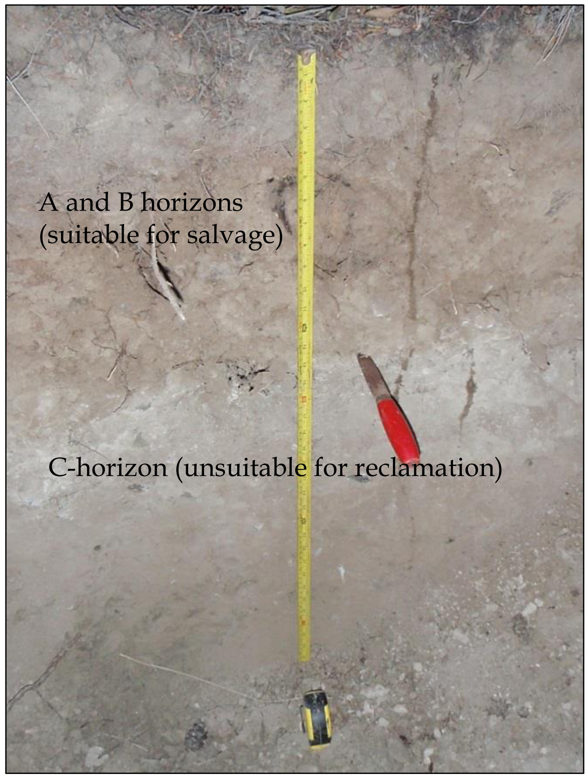


Plate 3.17-1. Soil profile showing A/B horizon and calcareous (pale) C horizon.

3.17.5.1 Soil Assessment

Soil inspections were conducted at 526 sites over approximately 1,705 ha (a survey intensity level of on average of one inspection per 4.4 ha, sufficient for baseline soil mapping at 1:5000 scale) between July 2012 and June 2015 (Appendix 3-E). The soils were classified and described according to the Canadian System of Soil Classification, which includes depth and thickness of soil horizons, soil colour, texture, structure and consistency. Soils identified include Chernozems (developed mainly on grasslands), Brunisols (developed mainly in forested areas) and Regosols. The soils have developed on colluvium, fluvial and glaciofluvial materials, till, eolian sediments and weathered bedrock. The soil data and surficial geological information was used to classify seven (7) soil management units (SMUs) including areas disturbed by previous Afton Mine operation within the Project footprint. Soils depths are highly variable with thinner soil present on steeper, drier sites and deeper soil in wetter, flat areas. The average topsoil depth (A and B horizons) is approximately 36 cm and the B horizon generally has more coarse fragment than the A horizon. In wetter areas soil profiles are much deeper, with topsoil horizons occasionally exceeding 1.5 metres in depth. The C horizon contains variable carbonate content and is generally unsuitable for reclamation except where it will be used as overburden for landscaping and to create separation between the mine rock or tailings and topsoil.

The suitability of soils for reclamation purposes was assessed utilizing criteria consistent with the BC *Mines Act* permitting requirements. The reclamation suitability criteria require consideration of several soil chemical properties (pH, electrical conductivity, and sodicity and saturation percentage) and physical properties (texture, moist consistency, and volumetric stone content). The soil management units (SMUs) have been identified (Figure 3-17.2) and their reclamation suitability rated as Good, Fair, Poor or Unsuitable (Table 3.17-3). The A and B horizons for all SMUs except SMU 3k (because of elevated carbonate content) are suitable for reclamation. Previous disturbed areas from the former Afton Mine have resulted in admixed soils with moderate to high carbonate contents making these materials (SMU 6) unsuitable for reclamation. The saline soil beneath water bodies and wetlands (22.6 ha) is unsuitable for reclamation.

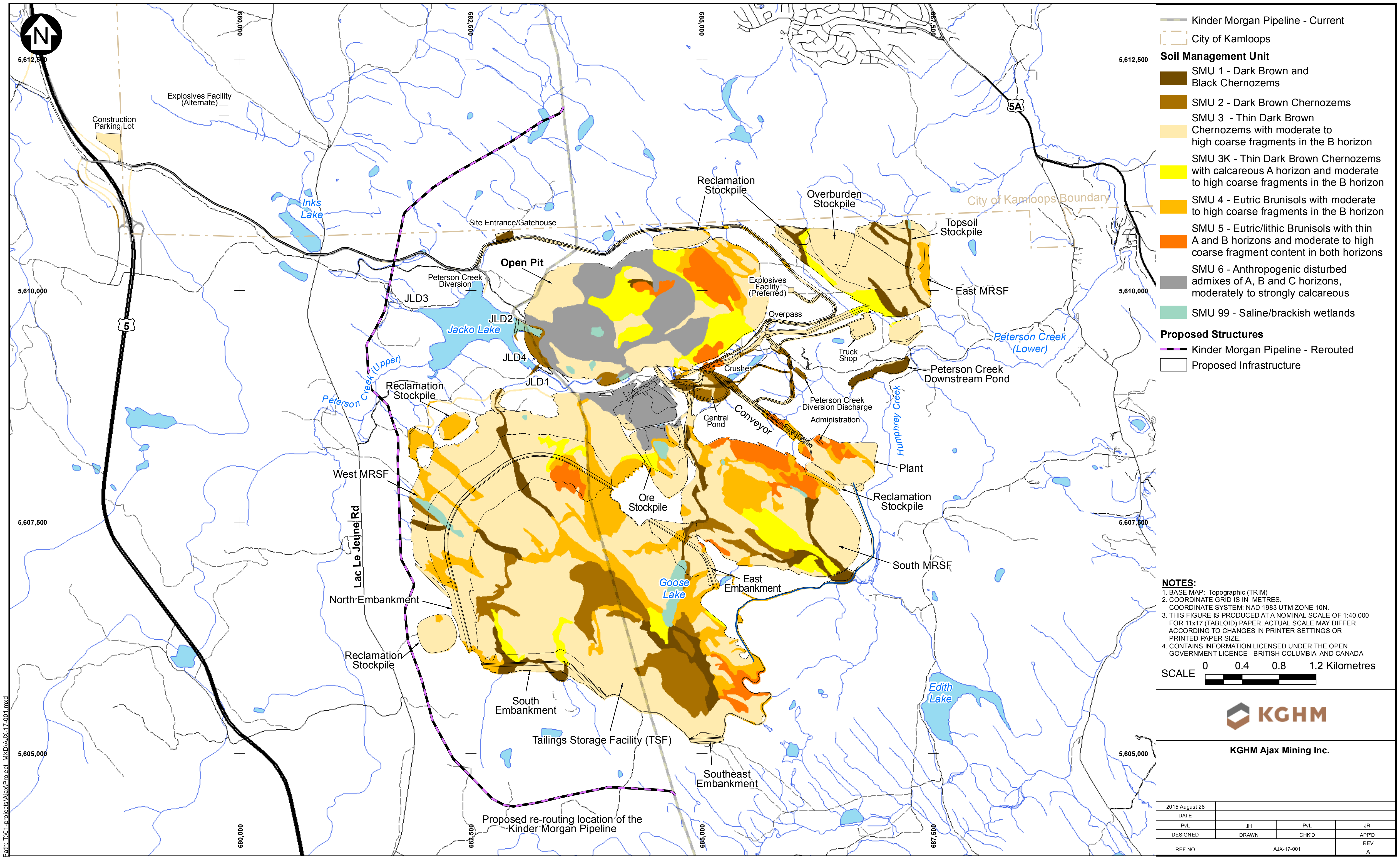
Table 3.17-3. Soil Management Units and Reclamation Suitability

SMU*	Description	Reclamation Suitability	Average Topsoil Thickness (cm)	Area (ha)
1	Dark Brown and Black Chernozem Soils - Deep silt to silt loam soils formed in edaphically wetter locations. Generally with favourable C horizon material suitable for reclamation purposes.	Good	A/B horizon - 37 cm (A up to 1.5 m)	82.0
2	Dark Brown Chernozems formed on glaciofluvial deposits. Silt loam with moderate coarse fragment content	Good	A/B horizon – 42 cm	114.6
3	Thin Dark Brown Chernozems with moderate to high coarse fragments in the B horizon	Good – Fair	A/B horizons – 37 cm	930.5
3k	Thin Dark Brown Chernozems with calcareous A horizons and moderate to high coarse fragments in the B horizon	Poor	A/B horizons – 37 cm	110.7
4	Fragile Eutric Brunisols developed on calcareous glacial till under forest vegetation. Sandy to silty loam.	Fair	A/B horizons – 31 cm	208.3
5	Fragile Eutric/Lithic Brunisols developed on shallow glacial till overlying colluvium / bedrock. Sandy to silty loam	Fair – Good	A/B horizons – 35 cm	80.3
6	Anthropogenic Disturbances – admixed A, B and C horizons, moderately to strongly calcareous and variable coarse fragment content	Poor - Unsuitable	Not determined	156.0
99	Saline wetlands	Unsuitable	Not determined	22.6
Total Area (ha)				**1,705**

** SUM = Soil Management Unit*

Although occupying a relatively small area in swales and valley bottoms, highly suitable soils are found in SMU 1 and SMU 2 as they comprise deep soils formed under moist conditions with favourable C horizon (SMU 1) and thick B horizon (SMU 2). SMU 3 covers the largest area and is considered fair to good for reclamation even though it has high coarse fragment content in the B horizon. SMUs 4 and 5 are considered fair to good for reclamation but have high coarse fragment content in the B horizon for SMU 4 and are thinly developed over bedrock in the case of SMU 5.

Figure 3.17-2
Ajax Project - Soil Management Units



3.17.5.2 Materials Balance

The average topsoil thicknesses and areas indicated in Table 3.17-2 have been used to prepare a reclamation material balance. Approximately 4,366,000 m^3 of topsoil will be required for reclamation of mine-disturbed areas using an average topsoil replacement depth of 35 cm (Table 3.17-4). Average topsoil replacement thickness is based on average topsoil thickness in the SMUs. The total volume of salvageable topsoil (A and B horizons) within the facility footprints is estimated at approximately 4,796,000 m^3 implying a soil surplus of approximately 430,000 m^3 (Appendix 3G).

The volume of overburden required for a 60 cm cover on the MRSFs and 50 cm cover on the TSF surface and embankments, ore stockpile footprint and building footprints is approximately 6,952,000 m^3. The cover thicknesses are based on rooting depths for most vegetation, and in the case of the MRSF, from unsaturated flow modelling that indicates infiltration is minimized for such a cover (Appendix 6.4-C). Most of this material will be sourced from the open pit footprint and will be stored in separate storage areas on the East MRSF during operation.

3.17.5.3 Soil Quality

Laboratory analysis was completed on topsoil samples collected from 53 sites representing a cross-section of all seven SMUs, primarily to establish baseline metal concentrations (Appendix 3-E). The results were compared against the Canadian Council of Ministers of the Environment (CCME) Guideline Limits for industrial and agricultural criteria. The sample results indicate boron, chromium, copper, nickel and vanadium concentrations exceed the industrial and agricultural criteria in all the SMUs. Copper concentrations exceeded agricultural land use guidelines at 22 sites and exceeded industrial land use guidelines an additional 20 sites. Nickel and vanadium concentrations exceeded agricultural and industrial land use guidelines at 25 and 22 sampling sites respectively. A majority of the samples analyzed had boron concentrations that exceeded CCME guidelines for agricultural land use, but all samples were below average crustal abundances. The exceedances are generally no more than twice the guideline concentrations and illustrate the naturally elevated background metal concentrations associated with the local geology.

The quality of stockpiled topsoil will be tested before use in reclamation to confirm its suitability.

3.17.5.4 Soil Salvage

All topsoil in disturbed areas will be salvaged unless determined unsuitable for reclamation by a qualified Reclamation Specialist with expertise in soil science. Soil will be salvaged from the footprints of the open pit; the MRSFs; the TSF (including embankments); roads; buildings and water management structures. Soil will not be salvaged from the ore stockpile footprint as these areas comprise former Afton MRSFs.

Soil will only be stripped when required. To the extent possible, stripped soils will be used as soon as possible for reclamation (e.g., direct placement). Soil will not be salvaged when they are excessively wet or dry, as these conditions can degrade soil quality. Where feasible, soil salvage should immediately follow vegetation clearing to avoid exposure to the elements. Vegetation removed prior to soil stripping may be chipped and used as mulch or removed from site. Timber will be salvaged and vegetation debris will be chipped or burnt as conditions warrant.

Table 3.17-4. Estimate of Topsoil and Overburden Volumes for Reclamation

Facility	Final Surface Area (m²)	Salvageable Topsoil Volume (m³)	Average Replacement Depth (m)	Topsoil Required based on Surface Area (m³)	Surplus (Deficit) of Topsoil (m³)	Overburden - Baseline Placement Depth (m)	Overburden Required based on Surface Area (m³)
East MRSF	1,008,885	393,918	0.35	353,110	40,808	0.6	605,331
South MRSF**	2,407,534	759,956	0.35	842,637	(82,681)	0.6	1,444,520
West MRSF**	2,429,126	496,014	0.35	850,194	(354,180)	0.6	1,457,476
North Embankment	307,224	incl. in TSF	0.35	107,528	(107,528)	0.5	153,612
East Embankment	113,530	incl. in TSF	0.35	39,736	(39,736)	0.5	56,765
Southeast Embankment	17,874	incl. in TSF	0.35	6,256	(6,526)	0.5	8,937
South Embankment	141,100	incl. in TSF	0.35	49,385	(49,385)	0.5	70,550
TSF	5,494,400	2,670,218	0.35	1,923,040	747,178	0.5	2,747,200
Open Pit	3,125,000	475,625	0	0	475,625	0	0
MG Ore Stockpile	222,886	Former Afton waste dump	0.35	78,010	(78,010)	0.5	111,443
LG Ore stockpiles	331,613	Former Afton waste dump	0.35	116,065	(116,065)	0.5	165,807
Buildings & Infrastructure	260,000	windrowed*	windrowed*	0	0	0.5	130,000
Total	**15,859,172**	**4,795,731**	**-**	**4,365,960**	**429,771**	**-**	**6,951,641**

** Water management structures, roads, buildings and infrastructure windrowed on-site during construction; stripped volume with equal replaced volume so there will be no surplus or deficit.*

*** Final surface areas are underestimated for WMRF and SMRF; maximum extent areas are slightly larger but will ultimately be reduced from use of mine rock for TSF reclamation.*

Careful separation of the topsoil (A and B horizons) from the underlying "overburden" is required to maintain the high quality of the topsoil. Combining the topsoil with overburden typically diminishes the soils capability to support plant growth; consequently, A and B horizons will be stripped and stored separately from overburden. In some cases, however, where the C horizon has a favourable texture and does not contain significant quantities of coarse fragments, salts, or carbonates, it can be amended with nutrients, blended with topsoil, and actively managed to provide a growing medium of an acceptable quality. Details of soil removal and handling are provided in the Soil Salvage and Handling Plan (Chapter 11.1).

3.17.5.5 Soil Stockpiling

Dedicated reclamation stockpile areas are shown in Figure 2.2-1 (see Chapter 2, Project Overview) in the following locations:

- west adjacent to the TSF,
- north adjacent to the West MRSF;
- north adjacent to the open pit; and
- on the East MRSF.

The stockpiles adjacent to mine infrastructure are targeted for use in progressive reclamation of MRSF slopes and TSF embankments whereas the stockpiles on the East MRSF will be used for reclamation of the TSF surface at the end of operation. Topsoil salvaged from linear features (e.g., roads and diversion ditches), building sites, parking and laydown/storage areas, and water management ponds will be windrowed adjacent to these features and are not shown in the figure. Overburden stockpiles will be stabilized by seeding with a legume /grass mixture and topsoil stockpiles with agronomic / grassland species to mitigate erosion and invasive plant management.

Stockpiled soils are vulnerable to erosion, compaction, loss of microbial function and destruction of soil structure. For these reasons the salvage and stockpiling of topsoil, wherever feasible, will occur sequentially as the footprint of the mine facilities expand, reducing the initial volumes and storage times of topsoil and overburden that need to be stockpiled. Details of soil stockpile management, including weed control, access management, erosion and sediment control, dust control and stockpile pad design are provided in the Soil Salvage and Handling Plan (Chapter 11.3).

3.17.5.6 Soil Placement

The general prescription for reclamation of mine facilities is placement of 50 cm of overburden, followed by placement of 35 cm of topsoil; however, this may vary slightly based on the number of lifts and degree of compaction specified. There are sufficient volumes of overburden and topsoil to construct the reclamation covers. The objective of the soil cover is to store and release precipitation and limit infiltration. Additional information regarding reclamation covers for the TSF and MRSFs are described in Section 3.17.7.

Stockpiled soil will be assessed for nutrients status and, where required, fertilizer will be applied during seeding. Overburden will be deposited by haul trucks and dozed in two lifts with varying degrees of compaction of each lift. Topsoil will be placed and dozed to form an uncompact layer prior to seeding. Soil compaction will be minimized by limiting driving over the placed topsoil. To retain the quality of the topsoil during placement, a 'rough and loose' replacement technique will be used to minimize compaction and increase microsite variability. Alternatively, compaction may be mitigated by ripping or other means to encourage deeper rooting. Monitoring of covers and contingency planning is discussed in section 3.17.7, and costs for closure of the MRSFs and TSF are discussed in section 3.17.10.

3.17.6 Re-vegetation

The main objective of the re-vegetation program will be to support the equivalent grazing capacity of the grasslands and provide wildlife habitat comparable to the pre-disturbance condition. Other objectives include providing long-term stability of disturbed areas, preventing invasive species, reducing erosion and dust emission, and providing diverse habitats for self-sustaining ecological communities. Baseline vegetation characterization included the collection of data to determine pre-disturbance vegetation community characteristics including species composition (grasses, forbs and woody species), biomass production and metals concentrations in order to provide information for comparison to future data collected from reclaimed areas of the mine as per annual mine reclamation reporting requirements (Appendix 3-H).

Planning diverse habitats for self-sustaining ecological communities will be based on target habitat types that identify areas based on elevation, slope and aspect (solar radiation). The habitat types provide a framework for developing treatment regimens that focus on the specific ecological factors that are limiting to the establishment of target plant communities including grasses, forbs, trees, and shrubs. Predominant habitat types include Douglas fir forests, Ponderosa pine forests, aspen copses and grasslands.

Native vegetation is a major component of the existing landscape within the Project footprint. Traditional plants identified within the Local Study Area (LSA) numbered 114 out of 125 potentially occurring (a comprehensive listing is provided in Table 12.2-3 of Chapter 12, Background and Aboriginal Group Settings). Traditional plants confirmed within the LSA, having multiple traditional uses and recorded as an indicator species in field surveys include: yarrow; saskatoons; kinnick; big sagebrush; sedges; red-osier dogwood; Scouler's hawkweed; rock mountain juniper; lemonweed; large-fruited desert-parsley (Qweowile); ponderosa pine; Douglas fir; willows; soapberries and cattail. Other species also important to the SSN include but are not necessarily limited to blue-bunch wheatgrass and rough fescue; shrubs such as rabbit-brush, rose and snowberry; and aspen.

Grassland reclamation will include both native and agronomic forage species. Fall rye and annual rye grass (agronomic species) will be included to provide quick establishment and ground cover for erosion control, soil stabilization and weed control. Local experience indicates success using a dryland forage mix ("Stump" mix by Purity Feed Co. Ltd.) of crested wheatgrass, annual ryegrass, intermediate wheatgrass, smooth bromegrass, alfalfa and creeping red fescue. Pasture will be established using alfalfa, wheatgrass, fescue and ryegrass. Use of a slow release fertilizer (NPKS: 18-18-18-2) is recommended for soil that has been stockpiled for long periods. Further details on seed mixes are provided in the Landscape Design and Restoration Plan (Chapter 11.28).

Monitoring and maintenance of re-vegetated areas will continue until self-sustaining vegetation has established and will likely be required into the Post-Closure phase. Monitoring includes presence / absence inspections, mapping of areas identified as containing invasive plants that have been treated with herbicide or physically removed and maintenance of the data base of the *Invasive and Alien Plant Program* (administered by the Southern Interior Weed Management Committee). Maintenance includes weed control and re-vegetation.

Invasive plant management is described in detail in the Invasive Plant Management Plan (Chapter 11.17). The term "invasive plant," used within the Invasive Plant Management Plan, includes plants referred to as invasive plants, invasive alien plants, and noxious weeds. Invasive plants can aggressively compete with and displace native vegetation when introduced into natural settings (Haber 1997). As such, they pose a serious threat to biodiversity.

Invasive plant management and control measures will be implemented throughout mine operation so that soil stockpiles and other disturbed areas remain, to the extent possible, free of invasive plants and weeds. Allowing weeds to establish on the soil stockpiles will impede reclamation efforts. To protect soil stockpiles from weed infestations, the following activities will be carried out:

- Seeding of soil stockpiles to minimize invasive species infestation and control erosion;
- Using herbicides where invasive species infestations are identified in areas intended for soil salvage prior to stripping to avoid contaminating the topsoil storage area;
- Controlling access to soil stockpiles and vehicle travel on reclaimed surfaces; and
- Regular monitoring to identify and remove invasive species.

Invasive plant prevention and control measures will be continued throughout the Decommissioning and Closure and Post-Closure phases. Annual monitoring will be conducted during the Decommissioning and Closure phase (5 years) with frequency reducing during Post-Closure based on monitoring results. Monitoring will continue until re-vegetated areas meet end land use objectives. The monitoring program will be subject to adjustment for specific areas as required, and will be reviewed annually in an annual reclamation report submitted to the MEM.

3.17.6.1 Progressive Reclamation

Progressive reclamation is reclamation completed during the construction and operation phases of a project that meet closure objectives. Progressive reclamation typically reduces the final closure costs as well as the duration of closure and reclamation activities. Progressive reclamation can increase efficiencies by utilizing available mining resources to conduct reclamation activities during the revenue-generating phase of the Project. Progressive reclamation measures will be considered successful if monitoring confirms that the completed work is physically and chemically stable (e.g., there are no signs of significant erosion or settlement, water quality in seepage ponds indicate that metal concentrations meet water quality criteria).

Progressive reclamation efforts will focus on final earthworks opportunities that present themselves, including:

- reclamation of soil and overburden stockpile footprints;
- re-contouring and reclamation of MRSF slopes and TSF Embankments;
- dismantling of unutilized buildings or infrastructure; and
- remediation of hydrocarbon contaminated soil that may result during construction and operation activities at a suitable facility.

Figure 3.17-3 shows mine footprint areas that can be progressively reclaimed during operation. The truck shop will be used during decommissioning and reclamation and will only be reclaimed in the Post-Closure phase. Progressive reclamation on temporary stockpiles, the TSF Embankments and MRSFs will provide opportunities to test and optimize reclamation techniques. Research may include soil amendments to develop an organically enriched surface layer, salvage and propagation of locally adapted native grass, forb and shrub species. Re-vegetation of mine rock storage areas from the Afton Mine indicates success with grassland establishment (Plate 3.17-2). Potential opportunities for closure research are provided in the Reclamation and Closure Plan (Chapter 11.28).

Plate 3.17-2. Re-vegetation on Afton Mine rock storage facility (looking south from Afton pit)

The following sections describe closure and reclamation plans for specific components of the Project.

3.17.7 Mine Closure and Reclamation Components

Table 3.17-5 provides approximate areas of the components described below.

Figure 3.17-3

Project Footprint Indicating Progressive, Decommissioning and Closure, and Post-Closure Reclamation Areas

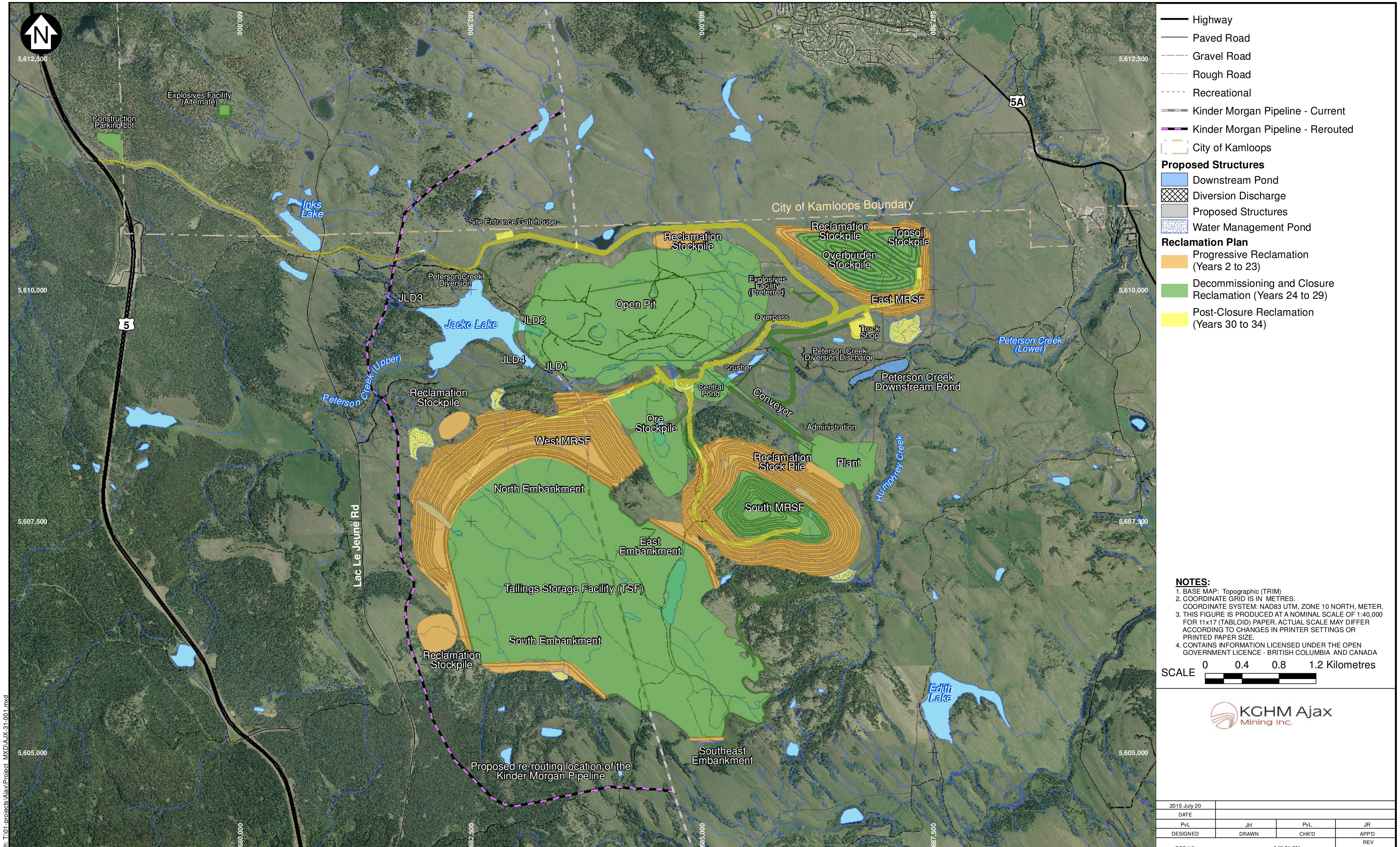


Table 3.17-5. Approximate Areas of Mine Components

Mine Component	Maximum Area (ha)
Tailings storage facility surface	544
Tailings storage facility embankments	60
Mine rock storage facilities	594
Low-grade ore stockpile footprint	55
Soil and overburden stockpile footprint	79
Plant, buildings and truck shop footprints	29
Roads	36
Water management ponds	27

3.17.7.1 Tailings Storage Facility

At closure, the TSF surface will comprise an area of approximately 544 ha and approximately 60 ha of embankments built of mine rock that will be progressively reclaimed during operation. Analyses of tailings samples indicate that the tailings will be net neutralizing and will not require special placement constraints to maintain pH-neutral drainage (Appendix 3-A).

The TSF surface will be reclaimed with a cover system designed to 'store and release' water, limit infiltration to underlying materials and provide a medium for establishing sustainable vegetation cover consistent with the final land use. There will be no ultimate closure pond and excess water will shed to the environment (Humphrey Creek) via an engineered spillway channel when storage is exceeded in the growth medium layer.

Design criteria to meet the closure objectives for the TSF include:

- The TSF embankments will have a maximum slope of approximately 23° (2.4 H: 1V) and TSF surface approximately 1% – 2% easterly slope;
- Placement of mine rock to compact fine tailings and provide a trafficable surface for reclamation vehicles;
- A cover design incorporating variable layers to isolate tailings from reclamation materials and allow gravity drainage to the environment. The final surface is to be reclaimed with topsoil and overburden thickness of approximately 85 cm total;
- Establish agronomic and native species to enhance agricultural value and wildlife habitat.

At the end of mining the TSF supernatant pond will be located at the southeast corner of the facility. Through the course of the Decommissioning and Closure phase the water in the TSF will be pumped to the open pit. Mine rock will be hauled from the South and West MRSF and deposited on the TSF surface to accelerate tailings compaction and to provide a trafficable surface for reclamation equipment. A layer of mine rock at least 1 m thick will be installed in the tailings beach areas, with greater thicknesses possible in the pond area due to requirements for additional materials because of the moisture associated with this remaining footprint. Tailings pore water produced from compaction of the tailings will be pumped to the open pit on an ongoing basis during the Decommissioning and Closure of the TSF.

There will be no ultimate closure pond and after reclamation, excess water will shed via a channel connecting the TSF to Humphrey Creek (in the Post-Closure phase); during the closure period the water will be pumped to the open pit. Water collecting in the TSF water management ponds down gradient of the embankments will either be pumped back to the TSF, pumped to the open pit or gravity drain to the open pit in the Decommissioning and Closure phase (Figure 3.14-3). In the Post-Closure phase, the water management ponds are expected to operate as evaporation ponds with any flood flow released to the environment (Figure 3.14-4).

The TSF cover system includes a low permeability layer and overlying growth medium layer including:

- a till (silty clay) layer approximately 25 cm-thick;
- an overburden layer, approximately 25 cm-thick; and
- a topsoil layer approximately 35 cm-thick.

Prior to application, topsoil will be tested to assess fertilizer requirement. The surface will be seeded with an agronomic and native grassland seed mixture to provide a soil stabilizing ground cover and forage consistent with end land use objectives. The TSF surface is mostly targeted for grassland species that will attract terrestrial invertebrates and birds; however, trees and shrubs will be planted in areas having suitable characteristics such as the toe of the West MRSF and swales where wetter conditions are expected. This approach is consistent with KAM's objective of returning the land to its pre-mining land capability and reverting to the ALR.

The TSF embankments will be progressively reclaimed during the Operation phase. This will provide opportunities to test the cover design and re-vegetation prescriptions. Trees will not be planted on the upper slopes of the TSF embankments to protect the integrity of the structure but will be targeted for the lower slopes where moister soil conditions are likely.

Closure and reclamation of the TSF can be summarized as follows:

- During operation, tailings will be consolidating, and forcing water either down (via seepage) or up to the surface. This process will continue into Post-Closure, with fully unsaturated conditions requiring several hundred years to achieve (Appendix 6.4-C).
- Drain-down that is forced to the surface will be actively pumped to the Pit during decommissioning and closure, until such time as the surface materials are trafficable to allow construction of the closure cover.
- Seepage from the TSF will be captured in the water management ponds downslope of the embankments. During Post-Closure, these will operate as evaporation ponds with only flood flow released to downstream creeks.
- The closure cover on the TSF is intended to 'store and release' water, limit infiltration to underlying waste materials and provide a medium for establishing sustainable vegetation cover consistent with the final land use. There will be no ultimate closure pond and excess water will shed to the environment (Humphrey Creek) when storage is exceeded in the growth medium layer.

3.17.7.2 Mine Rock Storage Facilities

Geochemical characterization indicates that, although there may be PAG rock disturbed during operation, the geologic materials are typically low sulphide and contain an excess of neutralization potential (Appendix 3-A). These types of materials are suitable for blending of PAG and NPAG. All PAG mine rock will be blended with NPAG mine rock to provide a NPRN of at least 3.

Design criteria to meet the closure objectives include:

- The MRSFs are to have a maximum 23° slope (2.4:1) at closure;
- Reclaim the final surface with a minimum cover thickness of 95 cm, which may incorporate variable layers (including soil) to meet specific land use objectives and operational requirements; and
- Agronomic and native species will be used to establish agricultural and wildlife habitat.

The closure objective for the MRSFs is to ensure stability of the reclaimed surface with a self-sustaining mix of agronomic and native grass species. The reclaimed MRSFs will be sloped to maximum of 23° (2.4 H: 1V). Three MRSF have the following maximum surface areas:

- SMRSF – 254 ha;
- EMRSF – 101 ha; and
- West Mine Rock Storage Facility - 239 ha.

Actual surface areas are expected to be less because of use of mine rock for TSF reclamation and reduction of the overburden / soil stockpiles on the East MRSF during the Decommissioning and Closure phase.

Following re-contouring of the slopes to ensure physical stability, reclamation materials (overburden and soil) will be applied, followed by fertilization and seeding.

The general soil placement prescription (Section 3.17.5.6) will be applied in areas where the seepage flow path is toward the open pit. In areas of the MRSFs where seepage pathways are towards the receiving environment, water balance and water quality predictions show that an enhanced cover design can reduce infiltration through the facility (Appendix 6.4-C and Appendix 6.3-C;). In these areas, a minimum thickness of 60 cm of till will be placed to reduce infiltration followed by approximately 35 cm of topsoil. The till will be compacted to provide an infiltration barrier. Modelling indicates that annual infiltration can be reduced from 44 mm to 8 mm when a 0.3 m thick, compacted low permeability till cover is placed between the mine rock and topsoil compared to a nominal reclamation cover (Appendix 6-4-C). The cover is expected to perform better on flatter slopes compared to slopes where there may be challenges achieving adequate compaction and where drier conditions could increase basal layer permeability.

In addition, a non-compacted overburden layer is required for root penetration of reclamation species. The topsoil will be loosely placed to prevent compaction and allow for better seed and moisture retention. The MRSFs will be seeded with a dry land mix of agronomic and native species.

Grass, forb and shrub/tree species will be established utilizing elevation, slope, aspect and soil moisture regime to determine site-specific treatments. It is anticipated that the MRSF reclamation treatments will include both native and agronomic grassland species. Mine rock, coarse woody debris and variable topsoil/overburden placement depths can be used to develop specific landscape/habitat features that are consistent with the surrounding natural landscape.

Progressive reclamation of the lower slopes of the MRSFs will be undertaken as sufficient area becomes available. Reclamation materials in temporary stockpiles or direct placement from areas undergoing soil salvage will be used wherever possible. The upper slopes and tops of the MRSFs will be reclaimed during decommissioning and closure. Overburden and soil will be sourced from the stockpiles on the East MRSF to complete the reclamation.

During decommissioning and closure, runoff and seepage from MRSFs collecting in the water management ponds will be diverted to the open pit by gravity flow (SMRSF) or pumping (WMRSF and EMRSF). Once the MRSFs are reclaimed, the water management ponds will be operated as evaporation facilities with flood flow released to the environment.

Monitoring of the cover systems and revegetation success will be conducted annually in the Closure phase and less frequently, as required, in the Post-Closure phase. Maintenance is likely to include repairing the cover in eroded areas and revegetating. Contingency plans may include changes to the soil cover prescription based on monitoring of the performance of the soil cover in areas that are progressively reclaimed. In the Post-Closure phase, monitoring for a 5 year period has been assumed, after with the land is expected to revert to the ALR.

3.17.7.3 Stockpiles

<u>Ore Stockpiles</u>

The ore stockpiles will be developed on the former Afton Mine waste rock dump that will be leveled using mine rock to create an area for storing low to medium grade ore for processing near the end of mine life. During decommissioning and closure, the ore stockpile pad will be reclaimed by placing and contouring a 50 cm layer of overburden followed by a 35 cm layer of topsoil. Sampling of the stockpile footprint will be carried out to ensure that ore material has been removed prior to reclamation. It is anticipated that reclamation treatments will focus on creation of agronomic grassland (spring and fall pasture) and important native species for encouragement of wildlife use in association with grazing.

<u>Soil and Overburden Stockpiles</u>

Most of the salvaged topsoil and overburden will be stored on the East MRSF. Other temporary reclamation material stockpiles will be located closer to the TSF and other MRSFs and used to progressively reclaim the slopes of these facilities during operation. The footprints of these temporary stockpiles will be reclaimed on an ongoing basis. Once final stockpile volumes and contours are achieved on the East MRSF, the stockpiles will be immediately seeded with a grassland seed mix in order to provide a soil stabilizing ground cover that will also serve as a potential seed source when the soil materials are subsequently placed on mine facilities during reclamation. Material remaining on the East MRSF will be contoured and re-vegetated.

3.17.7.4 Open Pit

Approximately 1,470 Mt of material will be excavated to create an open pit measuring around 2.5 km x 1 km. Up to 200 Mt of mine rock will be backfilled in the pit toward the end of the mine life. The open pit will be partially filled during decommissioning and closure by approximately 16.3 Mm^3 of dense saline water from the TSF pond (or 13% of the total volume introduced over 200 years) and thereafter fill with groundwater and precipitation (Appendix I). Pit lake filling simulations predict that 1,000 years after closure the water level in the pit will reach a relatively stable water level (680 masl) which is approximately 220 m below the pit perimeter (Appendix 6.4-C). Pit lake water will therefore never discharge to the environment.

The TSF pond water has a major influence on the physical stratification of the lake and water chemistry in the lower portion of the lake (Appendix 3-G). After 200 years, the pit lake is predicted to comprise an upper 130 m thick layer of mixed, more oxygenated, less dense and cooler (epilimnion) water separated (by a pycnocline) from an underlying anoxic zone (hypoliminion) with virtually no seasonal variability. The development of anoxic conditions in the lower water column is beneficial for water quality as it is a factor contributing toward the formation of a permanent sink for metals in sediments that form in the base of the pit lake.

The pH of the pit lake is predicted to remain neutral to slightly alkaline; however, the water quality model indicates concentration increases of some parameters over the simulated 200 year period due to lake evaporation, pit wall runoff and seepage from the TSF. The water quality model indicates exceedance of the BC water quality guidelines for wildlife for molybdenum, selenium and arsenic (Appendix 3-G). The pit lake model potentially over-estimates water quality as it does not account for attenuation mechanisms common in natural lakes that have a high rate of biological activity. Biological productivity can be enhanced by organic additions and fertilization and potentially reduce metal concentrations in surface waters.

Closure measures will focus on preventing access to the perimeter of the open pit and the pit lake. A rock barrier (approximately 2.5 m high with 1.4H: 1V slope), or game fencing will be constructed around the pit to keep out farm and wild animals. Warning signs will be posted at regular intervals to prevent accidental entry into the area. A gate will be provided to allow access to the pit lake for sampling.

3.17.7.5 Infrastructure and Equipment

Infrastructure to be removed includes the processing plant, administration and truck shop, associated fueling stations, mine site substation, power lines and poles, water pipelines and water management ponds, and explosives storage and magazine. All buildings not required for closure activities will be demolished using typical mechanical methods such as shears, grapples and hydraulic hammers mounted on track equipment. Above ground concrete will be broken up and reduced to ground level. Building rubble will be buried in-situ or deposited in the open pit. Where soil contamination is suspected, soil testing will be carried out to determine the nature and extent of contamination. Material exceeding regulatory standards will either be remediated by removing to an offsite facility or treated at the Project's land farm.

Salvageable materials from all buildings will be removed as practicable prior to demolition. Steel and other metal will be recovered for sale or recycling. All unused chemicals and explosives will either be returned to the supplier or disposed of in a suitable off-site facility. Potentially hazardous materials will be removed for off-site disposal at a licensed facility.

All equipment (including machinery) will be removed from site for salvage or disposal at an approved facility. Lubricants and oils will be drained from all equipment and packaged for disposal at a designated off-site facility. Conveyors will be dismantled and the metal components removed off site for sale or recycling. The conveyor belts will be cut up and disposed off-site. To the extent practicable, all wiring will be removed off site and taken to a designated facility for recycling.

The re-contoured areas will be covered with growth medium, and vegetated with appropriate plant species in accordance with end land use objectives. The rock used to construct a level surface (pad) for the site buildings will be reclaimed by capping the surface with overburden and topsoil. The re-contoured pads will be re-vegetated to conform to the land use objectives. The edges of the rock pads will be contoured to blend with the surrounding landscape. Plant water management ponds will be infilled with rock and reclaimed.

3.17.7.6 Roads

Roads associated with the Project include the Ajax Main Access Road (AMAR), mine service roads and haul roads as well as a number of existing exploration roads/ trails. The AMAR from the highway to the near the mine entrance will remain in place as it will be a public road providing access to Lac Le Jeune Road and Jacko Lake. Most mine service roads will be deactivated and reclaimed although some will remain post-closure for monitoring and post-mining land use. All haul roads will be deactivated and reclaimed. The estimated area occupied by all roads excluding haul road areas on the MRSFs is approximately 38 ha including approximately 2 ha of exploration roads. Exploration roads and drill pads may be reclaimed during the Operation phase.

Some of the mine service roads and haul roads will be required during the Decommissioning and Closure phase for reclamation activities. The haul roads from the East MRSF, West MRSF and South MRSF will be required during the closure phase to transport reclamation materials from stockpiles to the reclamation site. When the haul roads are no longer required they will be decommissioned and closed. The truck shop access road will be maintained to service reclamation vehicles and deactivated once reclamation on the MRSFs and TSF is complete. The plant access road will be deactivated during decommissioning and closure.

Roads required for ongoing site maintenance and monitoring may be semi-permanently deactivated during decommissioning and closure, and fully deactivated in the Post-Closure phase. Semi-permanent deactivation will allow the road to remain in place and be useable but environmentally stable. Semi-permanent deactivation measures may include:

- removal of culverts and replacement with cross ditches; installation of ditch blocks at cross ditch locations if required;
- installation of waterbars across the road to direct road surface water off the road;
- removal or breaching of windrows along the road edge; outsloping/insloping of the road surface as appropriate; and
- re-vegetation of exposed soil surfaces for erosion and weed establishment control.

Deactivation and closure of roads requires that cut slopes are re-established to match the surrounding topography. Running surfaces will be ripped and prepared surfaces will be top-dressed with soil salvaged prior to site development and windrowed adjacent to the road. The reclaimed surface will be fertilized and seeded to pre-disturbance vegetation. To control erosion and weed ingress, appropriate control measures will be implemented to prevent vehicle travel on reclaimed surfaces and to ensure geotechnical and hydraulic stability. Some mine roads may be repurposed to allow access to land parcels and to support ranching activities after mine closure.

3.17.7.7 Pipelines and Power

Pipelines

The Kamloops Lake water supply pipeline and pumping infrastructure will be decommissioned and removed once no longer required. Closure of the Peterson Creek diversion and TSF delivery and reclaim pipelines are described in Section 3.17.7.9. The pipeline corridors will be ripped, fertilized and seeded as required once the pipelines have been removed. The pipe will be removed from site and recycled or disposed of in a licensed facility.

A buried natural gas pipeline will deliver gas to the processing plant for heating and to fuel emergency generators. The pipeline will be accommodated within the same right-of-way as the power line. The gas line will be decommissioned during decommissioning and closure, with the pipeline ends sealed and the pipe left in-situ.

Power

The main power line from the BC Hydro transmission line to the processing plant will be constructed using single wooden poles although some H-frame structures will be required. The line will be constructed within a 10 m wide corridor over a distance of approximately 9 km. From the transformer near the plant, power lines will extend to various areas within the plant area, ex-pit crusher, truck shop, water management ponds, site entrance, Peterson Creek diversion and tailings discharge locations.

The power line will be decommissioned once it is no longer required for mine operation and reclamation activities. The cable and poles will be removed and recycled. The power line corridor will be ripped, fertilized and seeded where required.

3.17.7.8 Solid Waste Management Facilities

Solid waste management facilities include temporary waste storage areas and sewage holding ponds. Storage areas include a temporary storage (sorting) facility and a hazardous waste storage area. Non-reactive construction waste will be disposed of in the South MRSF during the Construction and Operation phases. Specific closure and reclamation measures are not required since the debris will be buried under mine rock and progressively reclaimed during the Operation phase.

Contaminated Soil Management

A land farm will operate during mine operation to treat hydrocarbon contaminated soil in an approximate 2 ha facility. Treated soil will be used for site reclamation. The facility may not operate in the Decommissioning and Closure phase in which case all hydrocarbon contaminated soils will be transported off site for treatment at a licensed facility.

Temporary Waste Storage Facilities

Hazardous waste will be temporarily stored on site in designated storage areas, placed in modified sea cans until transfer and appropriate containers for shipping. All hazardous materials including waste oil, solvents and batteries, will be packaged and labelled for shipment to certified waste management facilities for subsequent treatment, recycling and/or disposal. If sub-surface contamination is suspected, a sub-surface investigation will be carried out prior to reclamation. Reclamation of waste storage facilities will include application of overburden/soil and seeding.

Non-hazardous materials will be temporarily stored on site in separate designated storage areas from hazardous material. Storage areas will be constructed to store different types of recyclable materials. Most items will be stored in outdoor laydown yards including tires, scrap metal and electrical materials. Scrap metal from the processing plant will be collected in bins and recycled by a qualified local contractor. The locations of the facilities will be at the processing plant and truck shop and the footprints are expected to be small. Domestic waste will be stored on site and routinely disposed at a nearby off-site disposal facility. Reclamation of non-hazardous waste storage facilities will include application of overburden/soil and seeding.

3.17.7.9 Water Management Systems

During Decommissioning and Closure, the contact water management system will be re-configured to pump water stored on the TSF to the open pit. The freshwater requirement from Kamloops Lake will reduce, and Peterson Creek will be re-established in the corridor between the open pit and the West MRSF.

Mine Contact Water

During Decommissioning and Closure, active management of surface runoff and seepage from the TSF and MRSF's will be required including pumping the water management ponds to the TSF and open pit. Water management systems will remain in place at the TSF until monitoring indicates that the water quality is suitable for discharge to the environment. The water management ponds are expected to operate as evaporation facilities Post-Closure and the Central Collection Pond reclaimed as part of the re-established section of Petersen Creek.

All tailings pipelines will be decommissioned and removed from site and the pipeline corridors re-vegetated as required. Water in the TSF supernatant pond will be diverted to the open pit using the reclaim delivery system. When the TSF surface has been reclaimed, runoff is expected to be suitable for release to the environment; however, facilities for continued diversion to the open pit will remain until a steady state of water quality has been established and water quality guidelines are met for any potential discharge due to excessive runoff from the reclaimed facility.

Reclamation of the water management ponds will include removing the pump back systems, and breaching the pond dykes. Smaller seasonal ponds and wetlands are anticipated in the former water management pond areas. Exposed liner will be removed and re-vegetation of the pond footprint completed. The Central Collection Pond will be reclaimed early in Decommissioning and Closure phase to allow restoration of Peterson Creek whereas other seepage ponds may remain into the Post-Closure phase (>5 years after end of operation) should water quality be unsuitable for release to the environment. Flow diagrams illustrating the Decommissioning and Closure and Post-Closure water management plans are provided in Figures 3.14-3 and 3.14-4.

Truck Wash Settling Pond

A small lined settling pond will be constructed adjacent to the truck maintenance shop to retain collected water for several weeks before being pumped to the TSF. An oily water treatment system will be installed to treat the collected wash water. After decommissioning of the truck shop, the area will be assessed for potential soil and groundwater contamination. Reclamation will include infilling with rock, capping with overburden and topsoil and seeding the area.

Sewage Pond

Sewage will be treated using a pre-packaged (rotating biological contact) system located near the Administration building. A small pond adjacent to the sewage treatment plant will retain off-spec sewage. This pond will be deactivated once no longer required by dozing down construction berms to fill the pond and reclaiming with overburden, topsoil and seeding.

Jacko Lake Dams

The Jacko Lake dams will be retained at closure. The Southeast Dam will be modified to incorporate a broad-crested overflow spillway to pass design flood flows to a re-established Peterson Creek channel. Excess flows over the 892.0m normal water level will flow to Peterson Creek (similar to pre-mining conditions). A low level decant system will be established to enable flow control capability at Jacko Lake by the BC Water Steward. Flow over the weir and from the decant system will discharge into an engineered open channel, constructed to re-establish the existing Peterson Creek waterway (Appendix 3-F).

The long-term stability of Jacko Lake is an important aspect of the closure arrangement of the Ajax site. The ultimate open pit crest is adjacent to the east side of Jacko Lake and current plans are to backfill a portion of the west pit toward the end of mining. The pit backfill will be configured to provide for long-term stability (Appendix 3-F).

Peterson Creek Diversion

The Peterson Creek diversion pipeline will be removed when the Peterson Creek waterway is re-established. The waterway will be restored as an engineered channel between the open pit and West MRSF (Appendix 3-F). A conceptual channel alignment is shown in Figure 3.17-4. The ultimate channel alignment and design will be determined by further studies and will be developed in accordance with appropriate design criteria. The channel would serve primarily as a conveyance channel and potentially include a liner, if required, to limit seepage losses from the channel and potentially poor quality seepage from entering the channel. Similarly, the existing Peterson Creek channel, immediately downstream of Jacko Lake was lined with glacial till to limit seepage losses.

The Central Collection Pond, through which the restored channel will be established, will be removed entirely to accommodate the channel and reclaimed as a combination of grassland, forest and wetland (Figure 3.17-1).

Peterson Creek Downstream Pond

The Peterson Downstream Pond will remain in place to provide the BC Water Steward with a captured water source and flow control capability. Inflow to the pond will include flow from the re-established upstream portion of Peterson Creek and flow from Humphrey Creek.

No structural changes will be made to the pond and dam structures. Design of the overflow spillway during operation incorporates the closure catchment area and no adjustments to the overflow spillway would be required (Appendix 3-F).

Fish Habitat Offsetting

A potential offsetting plan for loss of fish habitat is to increase the size and depth of Inks Lake by constructing a water retaining dam and filling the basin using water from Kamloops Lake. Inks Lake is unable to support fish without enhancement due to its shallow depth, lack of inflow, and unsuitable water quality.

At mine closure, reliance on a passive system that does not rely on pumping freshwater from Kamloops Lake is the preferred approach to maintaining a positive water balance. A potential water supply could be from Jacko Lake using a gravity fed pipeline. The FLNRO has suggested that its water allocation volume for Jacko Lake could be diverted to Inks Lake for this purpose. Other potential water supply options are being considered.

3.17.8 Temporary and Final Mine Closure

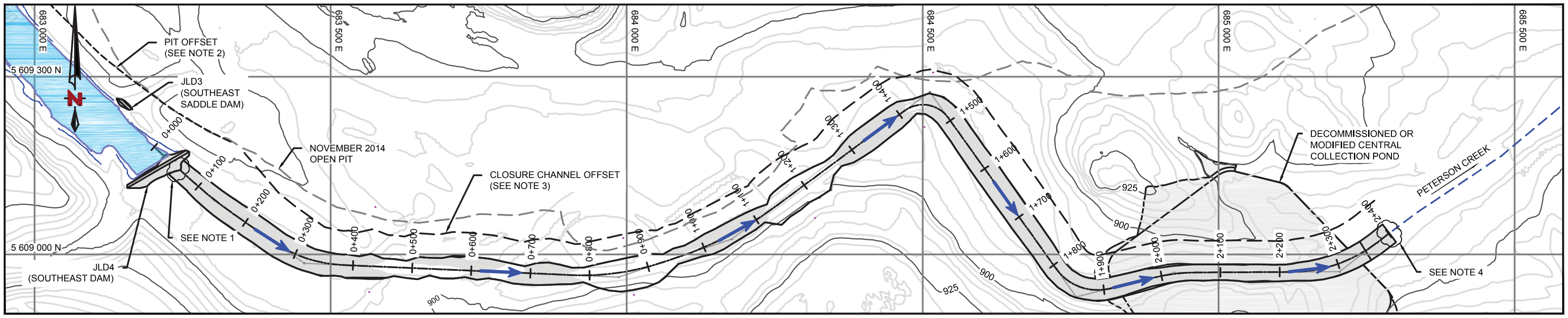
3.17.8.1 Temporary Mine Closure

Temporary closure may be required for a number of reasons including economic factors (e.g., severely depressed metal prices or a major mechanical failure,), environmental factors (e.g., investigation following safety or environmental incident) or social factors (e.g., labour conflict). Temporary closure could last for several weeks or as long as several years depending on the nature of the event and contributing factors.

Figure 3.17-4

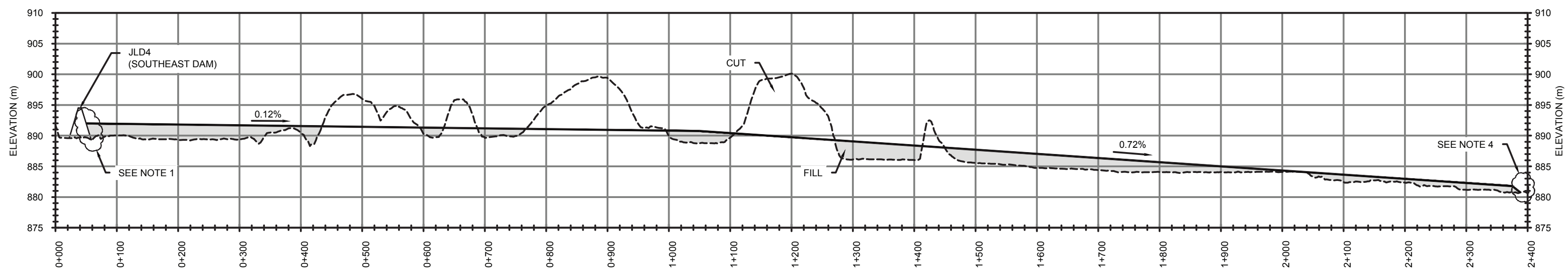
Peterson Creek - Conceptual Closure Channel

ERM



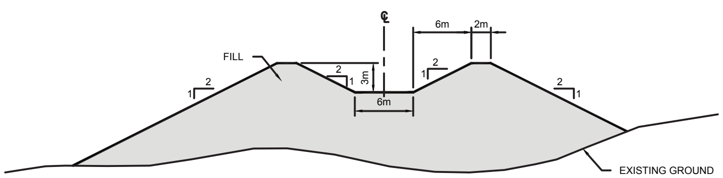
PLAN VIEW

SCALE 1:7500



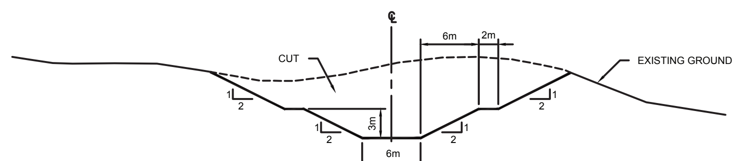
PROFILE

HORIZONTAL SCALE 1:7500
VERTICAL SCALE 1:750



CLOSURE CHANNEL
TYPICAL CROSS SECTION IN FILL

SCALE 1:500



CLOSURE CHANNEL
TYPICAL CROSS SECTION IN CUT

SCALE 1:500

CUT FILL REPORT	
CUT (m^3)	FILL (m^3)
70100	165500

LEGEND:

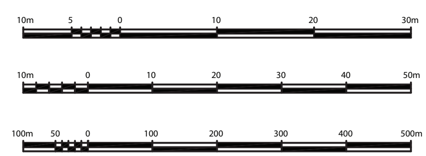
- - - - EXISTING GROUND
ENGINEERED FILL
—— SPILLWAY INVERT
→ CLOSURE CHANNEL FLOW DIRECTION

NOTES:

1. SPILLWAY AND TIE-IN DETAILS WITH JLD4 (SOUTHEAST DAM) TO BE DETERMINED DURING DETAILED DESIGN PHASE.
2. PIT OFFSET GUIDELINES PRESENTED IN TECHNICAL MEMORANDUM C135-KA39-RPT-00-01.
3. BASED ON 40 m OFFSET FROM CLOSURE CHANNEL CREST, OFFSET TO BE CONFIRMED DURING DETAILED DESIGN PHASE.
4. TIE-IN TO PETERSON CREEK TO BE DETERMINED DURING DETAILED DESIGN PHASE.

REFERENCES:

1. ALL DESIGN COORDINATES PROVIDED ARE IN METRES.
2. TOPOGRAPHY DATA BASED ON APRIL 2013 LIDAR PROVIDED BY KGHM.
3. BATHYMETRY SURVEY BASED ON DATA PROVIDED BY KGHM ON JANUARY 13, 2015.
4. OPEN PIT OUTLINE BASED ON NOVEMBER 2014 MINE PLAN PROVIDED BY KGHM ON FEBRUARY 20, 2015.



Source: Norwest (2015).

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Temporary closure could lead to permanent closure without resumption of mining, although this unlikely event would be triggered by a commercial decision by KAM not to continue operating. This decision would require a final MCRP to be filed with the regulators, or a notification to the regulators that the company intends to execute the latest MCRP as its final MCRP. Following all required regulatory approval, the final closure and reclamation measures would be executed.

During temporary closure, management is focused on the care and maintenance activities that are required during the cessation of a mining operation. The objective of care and maintenance activities is that the Project facilities are kept in a manner that is safe for humans, livestock, wildlife and the environment. The success of the temporary closure provisions will be monitored by conducting routine inspections.

Temporary closure activities will be managed by a core team of KAM site personnel, who will maintain a presence on-site. Site caretakers will be responsible for maintaining site security throughout the period of temporary closure. The site caretakers will report to KAM management or the mine manager (as appropriate).

Temporary Closure Activities

The following temporary closure activities will be implemented immediately following the stoppage of operation:

- Access to the site, all buildings and facilities will be secured and restricted to authorized personnel only. Security and administration buildings will be operated and maintained;
- Mechanical, hydraulic and electrical systems will be locked out and maintained in a secure state (i.e., in a no-load condition) if they are not required to operate through the temporary closure period;
- Mobile heavy equipment that is not required during temporary closure will be stored in appropriate areas in a no-load condition. Fluid levels in all fuel tanks will be recorded and routinely inspected for leaks or potential hazards;
- Explosives will be secured, disposed of or removed from site;
- The hazardous materials inventory will be updated (process chemicals, reagents and petroleum products) and these materials will be secured on-site or removed from site; and
- Warning signs will be posted around open pit. The haul road will be barricaded.

Monitoring, Maintenance, and Reporting

Inspections and monitoring programs will be conducted to assess the physical and chemical stability of mine components. Inspections will be conducted at appropriate frequency to confirm that infrastructure, including: embankments, berms, dykes and access roads, ditches and water management ponds are all performing as designed. MRSFs and ore stockpiles will be maintained such that they are physically stable. TSF water levels will be monitored as there may be an accumulation of water if it is not being reclaimed for processing. If temporary closure is prolonged (i.e., more than a year) then it may be necessary to decant the tailings supernatant to the open pit to maintain safe water levels. Access roads will be maintained, including plowing snow from roads, repairing culverts, employing erosion and sediment control measures. Environmental monitoring as prescribed in applicable approvals (e.g., surface water quality) will be continued to ensure that regulatory requirements are being met.

The inspections will be formally recorded and include details on the inspection results. A brief summary following each inspection will be provided to KAM management in order to identify any concerns or maintenance measures; any major issues will be reported immediately. Monthly and annual monitoring reports will be prepared to present the findings of the inspections in accordance with permit requirements. Recommendations for maintenance and any suggested modifications to the monitoring program will be included in the reports. Physical and chemical monitoring and the associated maintenance activities will be conducted until such time as the Project changes status by either resuming operation or advancing to final closure.

3.17.8.2 Final Mine Closure

Final mine closure will occur when either all mineable and economic mineral reserves have been exhausted or if a commercial decision is made by KAM management to permanently cease operation. An important consideration of final closure is the effect of mine closure on employees, contractors and suppliers and the public. It is KAM's aim to plan for closure so that adequate notice (if possible, in the order of a year or more) can be given to employees and the public.

Decommissioning and Closure activities are expected to take up to five (5) years. Most buildings and associated infrastructure may be closed in a shorter time frame, however, closure and reclamation of the TSF is expected to take longer than a couple of years. In the Decommissioning and Closure phase, the TSF and MRSFs will be reclaimed and infrastructure not required in the Post-Closure period will be decommissioned, demolished or removed from site. A five (5) year Post-Closure phase is assumed for the purpose of the MCRP during which monitoring and maintenance will be ongoing. Reclamation will not be considered complete until a site reclamation report stating that it successfully meets applicable standards has been signed off by qualified professionals and by government agencies.

Monitoring and maintenance of all closed facilities and structures will continue through the Decommissioning and Closure and Post-Closure phases to confirm proper function and mitigation of environmental effects. Post-Closure monitoring will begin after closure and decommissioning activities are completed, as determined by the on-site plans and regulatory requirements. The length of required Post-Closure monitoring will be based on monitoring results, and the requirements of relevant government agencies.

3.17.9 Monitoring

Monitoring during the Closure phase is required under section 10.7.30 of the Code and the Environmental Code of Practice for Metal Mines (Environment Canada 2009) to demonstrate that reclamation and environmental protection objectives are being achieved. Monitoring activities will be carried out by qualified technicians and the results provided in annual reclamation and environmental monitoring reports (per section 10.1.5 of the Code; BC MEMPR 2008). Site-specific monitoring requirements will be indicated in permits issued for effluent discharges should they be required (e.g., water discharge in terms of the *Environmental Management Act* (2003) and the Metal Mines Effluent Regulation (SOR/2002-222).

The Operational ML/ARD Monitoring Plan is outlined in Section 11.5.5. Operation monitoring for ML/ARD includes direct sampling of mine rock and tailings as well as seepage monitoring. Post-Closure monitoring will focus on monitoring seepage and runoff from the major mine facilities. The concepts for post-closure monitoring are presented in Section 3.17.9.

Site-specific environmental monitoring plans will be developed, implemented and updated throughout the mine life. Site-specific monitoring plans that measure the environmental effects of the mine operation will be used to verify endpoints that were predicted in the environmental assessment. Adaptive management measures may be required based on monitoring results (Environment Canada 2009). At the end of mine operation, the environmental monitoring plans will be evaluated and revised to ensure they remain appropriate for the changing conditions of mine closure.

Dams will be visually inspected by a qualified geotechnical person on a scheduled basis according to provincial requirements, to monitor for any uncontrolled seepage exiting on downstream areas and to check the overall performance and stability of the structure and its related facilities. An operation, maintenance and surveillance (OMS) manual will be developed by KAM, which will detail long-term monitoring and record-keeping procedures for the structure. Monitoring procedures will be developed in line with Provincial and CDA Guidelines.

The frequency of monitoring during the Decommissioning and Closure phase is expected to decrease in the Post-Closure phase. The level of monitoring effort in the Post-Closure phase will be determined by the success of reclamation activities and the results of data collected during the Closure phase. Monitoring activities will include:

- reclamation monitoring (vegetation composition and (range) productivity; trace element uptake in vegetation);
- geotechnical monitoring (in accordance with dam safety regulations);
- surface water quality and flow monitoring (e.g., water management ponds, Jacko Lake and Peterson Creek Downstream Pond, Pit lake, Humphrey Creek);
- aquatic effects monitoring at determined locations down gradient of Project and reference site(s); and
- groundwater quality monitoring – in select monitoring wells down gradient of MRSFs and TSF.

3.17.9.1 Reclamation Monitoring and Maintenance

Reclaimed areas will be monitored annually for up to five (5) years following reclamation and then in the order of one every two years or until the vegetation is well established. Monitoring details are provided in the conceptual restoration plan (Chapter 11.19). Bare areas may indicate that the soils are compacted. Treatment may include roughening the surface to reduce surface compaction before reseeding. Slope instability or erosion may require re-grading and re-vegetation. A maintenance allowance has been made in the closure cost estimate for replanting up to 15% of the reclaimed areas.

3.17.10 Mine Closure Cost Estimate

This section provides a preliminary estimate of closure and reclamation costs based on the current mine plan and the approach to closure and reclamation described in the MCRP. The estimate indicates expected costs at the end of mine life in 2015 dollars but does not factor progressive reclamation during mining operation that will reduce costs during closure and decommissioning. More detailed closure and reclamation costs will be developed as required by the *Mines Act* for project permitting. Contractor rates (BC Road Builders and Heavy Constructing Association; 2014 – 2015 Blue Book) have been used in developing the costs and no allowance for offsetting against salvage value has been made. The cost estimates are presented under closure, Reclamation and Monitoring/Indirect costs.

3.17.10.1 Closure Costs

Closure cost estimates are provided for decommissioning of the following infrastructure:

- Demolition of the process plant, truck shop, crusher and conveyors, administrative and other buildings.
- Decommissioning of the Peterson Creek diversion, tailings lines and water management ponds.
- Removal of freshwater pipeline from Kamloops Lake and the power transmission line; and
- Removal of any solid waste remaining at closure.

The closure cost estimate is **$7.2 million**.

3.17.10.2 Reclamation Costs

Reclamation costs are based on restoring the landscape and reclaiming the surface on mine closure. Reclamation includes site preparation, hauling and spreading of reclamation materials and re-vegetation. Cost estimates for reclamation of the following areas are provided:

- Safety measures around the open pit;
- Reclamation of the MRSF and TSF embankments and surface;
- Reclamation of the ore stockpile footprint areas and the plant and truck shop footprint areas;
- Re-establishment of Peterson Creek, reclamation of contact water ponds and tailings pipeline corridors; and
- Reclamation of water and transmission line corridors and roads.

The largest cost item is to establish the closure cover system for the TSF ($105 million). The total reclamation cost estimate is **$178 million**.

3.17.10.3 Monitoring and Indirect Costs

For initial planning purposes, monitoring costs for ten (10) years with decreased frequency after five (5) years have been provided for geotechnical, water quality, aquatic effects and reclamation monitoring and maintenance. Indirect costs include engineering design, construction management, road maintenance, security and administration.

Monitoring and indirect costs are estimated at **$10 million.**

Total closure costs are estimated at approximately $195 million.

3.17.10.4 Closure and Reclamation Plan Updating

The MRCP will be revised every five (5) years during operation to coincide with mine plan renewals (BC MEMPR 2008). The plan will describe the results from areas successfully reclaimed and those still to be reclaimed in the following five years, including vegetation species used, soil conditions and land use objectives. The information will be summarized in tabular form with mapping provided.

Closure plans will be reviewed and revised as necessary throughout the mine life cycle (Environment Canada 2009). Annual reporting on progressive reclamation as well as plans for the coming year will be provided. The plans may become more detailed, incorporating to a greater degree all activities related to the mine and taking into greater consideration site conditions and monitoring results. Closure plans may also be revised in response to:

- the results of progressive reclamation activities;
- the results of tests to assess specific aspects of the closure plan;
- public response to a proposed closure plan;
- changes in mine operation, such as production rate or ore type;
- changes in regulatory requirements;
- changes in economic conditions, such as input costs and other economics related to mine closure; and
- unexpected or adverse conditions encountered during the construction and operation phases of the mine life cycle.

Reclamation cost estimates will be reviewed and revised annually to reflect completed closure expenditures and outstanding liabilities.

3.18 HUMAN RESOURCES

3.18.1 Construction Workforce

With employees, contractors and suppliers, personnel on site during the construction phase could be as high as 1,800.

3.18.2 Operation Workforce

It is estimated that approximately 500 personnel will be employed during any typical year during the Operation phase. Approximately 20% of this workforce is expected to work 8:00 am to 5:00 pm weekday shifts; the remaining staff will comprise four crews working on rotating 12-hour shifts, starting at either 7:00 am or 7:00 pm.

3.18.3 Closure Workforce

The estimated workforce needed to implement decommissioning, reclamation and closure activities will be drawn from the existing Operation workforce and will be significantly less than the employment levels of construction and operation. It is anticipated that the workforce would reduce over the five year decommissioning and closure period, to intermittent personnel needed onsite post closure.

3.19 REFERENCES

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