

## **4.0 ASSESSMENT OF ALTERNATIVES**

An assessment of Project alternatives was carried out to fulfill the requirements of the ToR and EIS Guidelines.

The alternatives were selected through professional experience and consultation with Project stakeholders, including Regulatory Agencies, the public and Aboriginal communities (Chapter 7). The screening criteria considered potential environmental effects, social acceptability, engineering feasibility and cost. This EIS/EA Report includes but is not limited to the acceptable alternatives carried forward from the ToR. Alternatives further identified during the development of the Project are also assessed.

This chapter provides an overview of the alternatives assessment process, the alternatives assessed, and the set of preferred alternatives that are carried into this EIS/EA Report. Section 4.1 identifies the Alternatives to the Project; Section 4.2 addresses the alternatives assessment of Project constituents that are not associated with the disposal of mine wastes; and Section 4.3 addresses the assessment of alternatives for the disposal of mine wastes (e.g., waste rock, tailings). The preferred alternatives are described in detail in Chapter 5, and further assessed for physical, biological and socio-economic effects in Chapter 6.

The detailed alternatives assessment is presented in the Alternatives Assessment Report and the Mine Waste Disposal Alternatives Assessment Report, including a description of the potential impacts of each alternative considered.

As described in Chapter 2, the alternatives assessment considers two categories of alternatives:

- **Alternatives to the Project**, which are the functionally different ways to meet the Project need and achieve the Project purpose.
- **Alternative Means**, which are the various technically and economically feasible ways the Project can be implemented.

### **4.1 Alternatives to the Project**

As discussed in Chapter 1, the need for the Project derives from a strong global demand for gold, the opportunity presented by the Hammond Reef deposit and the need for local economic development. Historically high gold prices present an opportunity for OHRG to supply the gold found in the Hammond Reef deposit to world markets.

The assessment of alternatives to the Project compares the likely benefits of proceeding with the Project with the “Do Nothing” alternative where the decision would be made not to proceed with the Project.

#### **4.1.1 Proceeding with the Project**

Proceeding with the Project entails open pit mining and processing of gold ore and the production of gold by implementing the Project components described in Chapter 1. Mining, processing and overall conduct of the Project would use proven and effective technical methods of gold mining in Canada.

Proceeding with the Project would have both positive and negative effects on the biophysical and socio-economic environment. Most biophysical effects would be restricted to the Project Site, while socio-economic effects would likely extend to a regional level. The design of the Project and the

assessment of alternatives are focused on ensuring that all significant adverse effects of the Project can be reduced or avoided entirely through good design, mitigation measures or compensation.

#### **4.1.1.1 Advantages of the Project**

The Project would have substantial economic benefits to OHRG in generating economic activity and wealth through the development of the Hammond Reef gold deposit. Further, the Project would also have substantial benefits on the socio-economic environment at a local, provincial and national level.

Positive effects of the Project would occur in the community-at-large and on Aboriginal communities. These positive effects would be evident on individuals, including: job creation, increased household and individual incomes, improved purchasing power, improved education and training. The Project would be expected to make a substantial contribution to the development of new business opportunities and economic growth in the Town of Atikokan and neighbouring Aboriginal communities, through the development of business activities as a result of Project purchases of goods and services during all phases of the Project. Finally, the Project would encourage a level of general optimism and growth in communities facing significant development challenges.

The Project would also lead to infrastructure enhancements beneficial to the community including upgrades to the access road and construction of a new landfill. The upgraded access road (Hardtack/Sawbill) would remain a public road during and after the Project's life cycle. The upgraded access road (Hardtack/Sawbill) would improve travel time and access to recreational areas in the vicinity of the Project Site. Collaborating and sharing responsibilities and funding associated with constructing a landfill will foster a mutually beneficial partnership between the municipality and Osisko.

The Project's purchase of electricity would result in increased revenue for Hydro One (i.e., the electricity provider), during the Project's phases.

The Project would also help collect valuable environmental data on the Project Site and surrounding area through its monitoring programs. Monitoring before, during and after the Project development would contribute to a more focussed understanding of the environment and identify areas where protection or enhancement is needed.

#### **4.1.1.2 Disadvantages of the Project**

A major purpose of the environmental assessment is to ensure that the Project can proceed without the creation of significant adverse effects. The preliminary screening of the potential Project effects identified some adverse effects on the biophysical environment. These included loss of fish-frequented habitat (i.e., Mitta Lake waterbodies located in the TMF and WRMF footprints), the loss of bat habitat, changes in water quality due to discharge of treated water from Project operations, nuisance effects such as increased noise and vibration from blasting, permanent landscape alteration, soil erosion and soil compacting in the Project footprint, and loss of vegetation, wetlands and streams in the Project footprint. The consequences of these effects would be considerably reduced once mitigation measures are applied.

A detailed description of the potential effects of the Project on the biophysical environment is provided in Chapter 6. Appropriate mitigation measures to address these potential effects are identified in Chapter 6.

Potential socio-economic effects would include increased risk of vehicular accidents in the access road, loss of fish habitat and of recreational fishing areas, and challenge to existing community services and infrastructure due to increase in population (i.e., introduction of Project workers from outside of the Atikokan community).

A detailed description of the potential effects of the Project on the socio-economic environment is provided in Chapter 6, including mitigation measures. Similar to the biophysical environment, no significant adverse effects are likely from the Project with implementation of mitigation measures.

#### **4.1.2 “Do Nothing” Alternative**

The “Do Nothing” alternative means that the Project would not proceed. The decision of not proceeding with the Project is the benchmark against which the consequences of implementing the Project can be measured. Comparison of the advantages and disadvantages of proceeding with the Project with the “Do Nothing” alternative provides the basis for selecting the preferred alternative. This comparison ensures that a decision to proceed with the Project would not result in substantial negative effects that could negate the obvious positive effects of economic development.

#### **4.1.3 Selection of Preferred Alternative**

As noted, the selection of the preferred alternative involves the choice between proceeding or not proceeding with the Project. A decision not to proceed with the Project is identified as the “Do Nothing” alternative.

In the “Do Nothing” alternative none of the potential effects - positive or negative - of the Project would occur. No increase in economic activity would occur. The existing conditions of the biophysical and socio-economic environment would remain unchanged. Any adverse effects of the Project on the existing environment would be avoided. However, the gold resource would not be developed and the resulting socio-economic benefits to the local community, Ontario and Canada would not occur. The development of this resource by a private sector mining company provides opportunities for economic growth without public expense. A Canadian firm, OHRG, would not have the opportunity to grow and provide benefits to shareholders.

Specifically, the loss of socio-economic benefits arising from the Do Nothing alternative would result in a loss of employment, business and general economic activity for the Town of Atikokan and neighbouring communities. The scope of these benefits is identified in the socio-economic assessment in Chapter 6.

Proceeding with the Project is not expected to have significant negative effects on the biophysical and socio-economic environment due to the implementation of appropriate mitigation measures. The potential positive socio-economic effects of the Project make it an attractive opportunity for OHRG, the community of Atikokan, Aboriginal partners, neighbouring communities, the Province of Ontario and Canadians.

Based on the foregoing analysis, the preferred alternative is “Proceeding with the Project.” Subsequent sections of this chapter identify and evaluate alternative means of carrying out the Project so that the positive effects would be enhanced and negative effects reduced or eliminated entirely.

## **4.2 Alternative Means of Carrying out the Project**

The EIS Guidelines require the environmental assessment to identify and describe alternative means of carrying out the Project, and assess the environmental effects of any such means (CEA Agency 2011).

In the provincial environmental assessment context alternative means are referred to as “alternative methods”. Alternative means or methods can include consideration of alternative technologies, alternative methods of applying specific technologies, alternative sites for a proposed undertaking, alternative design methods, and alternative methods of operating any facilities associated with a proposed undertaking (MOE 2009).

It is neither practicable nor necessary to evaluate alternative means for every aspect of the Project. Accordingly, the identification, assessment and selection of alternative means focused on alternative means for those aspects of the Project that have the greatest potential for adverse environmental effects.

This section addresses the alternatives to all Project constituents with the exception of disposal of mine wastes. The assessment of alternatives for the disposal of mine wastes (e.g. waste rock and tailings) is addressed in Section 4.3.

### **4.2.1 Preliminary Screening**

A preliminary screening of alternative means of carrying out the Project was included in the Project’s ToR, approved by the Ontario Minister of the Environment (July 2012). Project aspects for which two or more feasible alternatives were identified in the ToR have been carried forward for assessment in this report.

The only substantive change to the Project, which is not reflected in the Project Description or the ToR, is the inclusion of an on-site accommodation camp for workers. This alternative was initially scoped out of the Project design, however as the Project planning advanced it was necessary to include it as an alternative to ensure the Project remained feasible. A fibre optic line and auxiliary power line were also added at the advanced planning stage, but are not considered substantive because they utilize existing rights-of-way or will utilize the same cable support structures as the proposed project transmission line resulting in no additional biophysical or socio-economic impacts.

The need to consider an on-site worker accommodation camp as an additional alternative method of carrying out the Project was determined based on detailed planning, consultation, and baseline studies. Detailed planning for the Project clarified the total anticipated workforce, length of the commute and duration of the Project. Consultation activities, including engagement with Aboriginal communities confirmed that employment is important and that many community members live two or more hours from the Project Site. Socio-economic baseline studies confirmed the demographics of the local population, including age distribution and education levels. The conclusion from the detailed planning, consultation and baseline studies was that an on-site worker accommodation camp would be required to ensure the Project remained feasible.

Upon reaching the decision to include an on-site worker accommodation camp as an alternative means of carrying out the Project, the government, public and Aboriginal stakeholders were informed of this change.

For some components of the Project, a single feasible approach was identified (i.e., preferred alternative). These preferred alternatives have become part of the Project design and were, therefore, not assessed further. The constituents with a single feasible alternative are summarized below and described in detail in Chapter 5:

- **Mine development:** The only feasible mine development option is open pit development, including the draining of Mitta Lake. Once Mitta Lake is drained, the ore body will be accessed through open pit methods including two open pits (i.e., east pit and west pit).
- **Explosive storage siting:** The supply of explosives will be carried out under a contractor-provided service for delivery of explosives to each blast hole. The contractor will maintain an explosives factory on-site and will supply all infrastructure and vehicles required to deliver the explosive product to the hole. The explosives contractor will be required to supply the magazine(s) for storage of initiation and detonation consumables and to maintain the supply for operations. All temporary storage facilities will be constructed to meet Natural Resources Canada's requirements under the *Explosives Act*. A graded area for the explosives contractor to locate the magazine(s) will be located on-site as per requirements of the explosives licence, and the contractor will be responsible for the installation of the initiation system and detonating devices at the blast site and firing. Handling of explosives is legislated and methods will be required to meet regulations.
- **Chemical and fuel storage siting:** The mining and processing operation will consume cyanide, reagent chemicals, liquids and fuels including diesel, gasoline, lubricating and waste oil, antifreeze/glycol and propane, as required for heavy equipment operation, heating, back-up power generation and small vehicles. Chemicals and fuels will be brought to site by trucks. There will be a number of storage areas in the Project Site. Separate storage sites for petroleum and other chemical and reagents will be required for the Project and will be constructed according to the Technical Standards and Safety Act (2000).
- **Office and support facilities siting:** The main site will include administration offices, the processing plant and truck shop. Ancillary structures including administration, warehousing and storage buildings will be constructed adjacent to the processing plant. Communication links to site will be by satellite and fibre optic technology, with on-site communications by cell phone and radio as required. These infrastructure locations are selected to minimize the footprint and to be located close to the pit/processing plant.
- **Auxiliary power line alignment:** An initial screening of alternatives for the auxiliary line route found that only one route is feasible. The selected route for the auxiliary power line follows an existing right of way. The purpose of the auxiliary line is to bring power from the existing provincial grid to the new substation, in order to allow the instrumentation within the substation to operate.
- **Fibre optic line alignment:** The fibre optic line was not contemplated at the time of the ToR and has since been added to the Project. A fibre optic line will be required to provide telephone and internet services to Project administration offices. Satellite technology has been proven to be somewhat ineffective for communication at the exploration-site. Although communication using cell phones and satellite technology will still be used to some extent, it has been determined that the bandwidth is not sufficient and a more reliable communication, such as a fibre optic line, needs to be in place during Project operations. The alignment will follow the auxiliary transmission line along Highway 622 to the proposed substation, and then use the same corridor and support structures as the selected alternative for the Project transmission line. As described in Section 4.2.8, the preferred project transmission line alignment will follow Hardtack/Sawbill Road and cross Sawbill Bay. By using the same cable support structures as the project transmission line, there are no additional biophysical or socio-economic impacts associated with the fibre optic line, and material and installation costs are minimized. Alternatives were therefore not considered. The total length of the fibre optic line is 29 km.

- **Hazardous waste management:** Hazardous waste will be stored on-site in sealed containers in lined, bermed areas for shipment off-site to licensed facilities. Hazardous waste storage facilities will comply with the MOE's Guidelines for Environmental Protection Measures at Chemical Waste Storage Facilities. Transporters of hazardous materials are required to be trained and registered according to the federal Transportation of Dangerous Goods Regulation.
- **Water sourcing:** Fresh water will be required for ore processing and domestic use. The processing plant will require an estimate of 34,000 m<sup>3</sup>/day of water. Fresh water requirements based on processing plant make-up needs are estimated to be 17,000 m<sup>3</sup>/day. Fresh water will also be needed for potable water uses, gland water and reagent make-up water. Upper Marmion Reservoir is adjacent to the Project and is technically and economically feasible as a water source.
- **Water recycling:** Recycled water will be used as much as possible. To the extent practicable, water required by the processing plant will be provided through recycling and re-use of process water, mine water and reclamation of tailings water. Use of fresh water will be required for certain applications in the processing plant, and this fresh water will be obtained from an intake from Upper Marmion Reservoir.
- **Tailings pipeline alignment:** Selection of pipeline alignment is directly linked to the selected TMF location as described in Appendix 4.I Mine Waste Disposal Alternatives Assessment of the Alternatives Assessment Report. Additionally, the pipeline alignment was designed as the shortest distance between the processing plant and the preferred TMF location without interfering with mine infrastructure, following the upgraded mine site road and avoiding fish habitat to the extent possible. The tailings pipeline will be constructed above ground with drainage points and spill containment areas located at topographical lows. The tailings pipeline will be protected on either side by berms that would direct any potential spillage to constructed containment areas.
- **Organic and solid waste management:** Non-hazardous waste will be generated at the worker accommodation camp and the Mine and will be disposed of in a regulated landfill. The results of the preliminary screening process described in the ToR identified off-site disposal as the only available alternative being considered for managing organic and solid waste. The current landfill servicing Atikokan will reach its maximum capacity in approximately 5 years. The Town is looking for an industry partner to assist with the construction of a new landfill. The process of obtaining permits for the landfill has already been initiated by the Town of Atikokan. Partnering with the Town of Atikokan to develop a new landfill is the most reasonable option to manage non-hazardous waste generated from the Project operations. This alternative is in the best interest for both the Town of Atikokan and OHRG. Collaborating and sharing responsibilities and funding associated with constructing a landfill fosters a mutually beneficial partnership between the municipality and corporation. The storage, handling, transportation and final disposal of waste are subject to Ontario Regulation 347 – General Waste Management.
- **Low-grade ore stockpile siting:** Stockpiling of ore is necessary to allow for constant feed rates to the Ore Processing Facility. The Ore Processing Facility for the Project will require a temporary crushed low-grade ore stockpile. The low-grade ore stockpile will be temporary in nature, as the economic ore will be processed before the Project is decommissioned. There were no alternative ore stockpile locations reflected in the ToR. The results of the preliminary screening process indicated that the location of the low-grade ore stockpile would be dictated by the final location of the Ore Processing Facility. In OHRG's April 2011 Project Description there were two low-grade ore stockpiles shown and described, the locations



of which were based on the processing plant and pit layout that was contemplated at that time. However, since then there have been revisions and modifications to the site layout. Given the final location of the Ore Processing Facility within the current site layout (Figure 3-1), there is only one available alternative for the location of the low-grade ore stockpile. The location chosen was based on the proximity to the open pits and processing plant to minimize haul distances, reduce fuel consumption, minimize effects on the environment and not interfere with other mine site infrastructure. Therefore, no additional alternative locations have been identified. The low-grade ore stockpile site is located approximately 715 m southwest of the east pit, and about 1.1 km southeast of the Ore Processing Facility. The storage capacity of this site over the life of mine is estimated at 21 Mt (million tonnes), with a footprint of 0.22 km<sup>2</sup>. This stockpile location does not affect any waterbodies, and it is in the most economical location with regard to transporting ore from the open pits to the stockpile, and from the stockpile to the Ore Processing Facility.

Potentially available alternatives considered for assessment included approaches carried forward from the ToR preliminary screening process along with additional alternatives identified through subsequent site and mine planning.

The alternatives carried forward into the environmental assessment process are shown in Table 4-1, which shows the Project components and alternative means assessed.

**Table 4-1: Alternative Means of Carrying Out the Project Assessed for the Hammond Reef Gold Project**

<b>Project Component</b>	<b>Project Aspect</b>	<b>Alternative Means Assessed</b>
Ore Processing Facility	Ore Processing Method	Use of a cyanide destruction circuit
		Natural degradation of cyanide
Sewage Treatment Facility	Site Location	Single centrally-located facility
		Dedicated facilities for the camp and the mine site area
	Sewage Treatment Technology	Septic tank and tile field
		Pre-engineered and designed sewage treatment plant (Packaged plant)
Water Management	Water Discharge Location	Underwater pipeline with discharge to Lynxhead Bay Narrows
		Overland pipeline with discharge to Lynxhead Bay
		Overland pipeline to the northwest with discharge into the central portion of Sawbill Bay
		Overland pipeline to the south with discharge to the south end of Sawbill Bay
Access Road	Access Road Alignment	Hardtack/Sawbill Road
		Raft Lake Road

**Table 4-1: Alternative Means of Carrying Out the Project Assessed for the Hammond Reef Gold Project (Continued)**

<b>Project Component</b>	<b>Project Aspect</b>	<b>Alternative Means Assessed</b>
Power Supply	Transmission Line Alignment	Transmission line along Hardtack/Sawbill Road
		Transmission line along Raft Lake Road
		Transmission line along Hardtack/Sawbill Road and crossing Sawbill Bay
Office and Support Facilities	Worker Accommodation	On-site worker accommodation camp
		Off-site worker accommodation

### 4.2.2 Assessment Criteria

The available alternatives in Table 4-1 were initially screened against criteria adapted from Ontario Ministry of the Environment’s Code of Practice: Preparing and Reviewing Terms of Reference for Environmental Assessments in Ontario (MOE 2009). The screening assessment consisted of answering the following screening criteria:

- Does the alternative provide a viable solution to the problem or opportunity to be addressed?
- Does the alternative use proven technologies, and is it technically feasible?
- Is the alternative consistent with federal/provincial government priority initiatives?
- Can the alternative be carried out without significant effects to important environmental receptors?
- Is the alternative practical, financially realistic and economically viable?
- Is the alternative within OHRG’s ability to implement?
- Can the alternative be implemented within the Project Site?
- Is the alternative appropriate to the Proponent?
- Is the alternative able to meet the purpose of the *Canadian Environmental Assessment Act* (CEAA)/ *Environmental Assessment Act* (EAA)?

Each alternative was screened against the above criteria. The details of the screening are provided in the Alternatives Assessment Report. The result of the screening was either (1) the identification of one alternative (i.e., the preferred alternative), or (2) the identification of a number of alternatives that met the screening criteria. Each of the alternatives that met the screening criteria was advanced for a comparative evaluation using environmental and technical performance criteria. If only one alternative was considered feasible, it was identified as preferred alternative for that Project constituents and assessed as part of the Project.



The comparative evaluation of proposed alternatives was based on criteria and indicators developed for the assessment according to the following categories identified in Section 2.4, including:

### **Environmental Criteria**

The following sub-indicators were considered in the evaluation of potential environmental effects:

- **Water Quality:** Potential effects on surface water quality.
- **Terrestrial Ecology:** Potential loss of wetlands, forest cover and terrestrial habitat for species at risk, furbearers, upland breeding birds, moose and wild rice.
- **Aquatic Biology:** Potential loss of aquatic habitat in Upper Marmion Reservoir, Lizard Lake and other fish bearing water bodies. Species considered include Walleye, Smallmouth Bass, Northern Pike and small bodied forage fish.
- **Hydrology:** Potential changes in surface water flows and levels and effects on surface water navigability.
- **Hydrogeology:** Potential effects on groundwater levels and water quality.
- **Air quality:** Potential changes in ambient air quality due to emissions from stationary and mobile equipment and the ore processing facility.

### **Technical Criteria**

The technical evaluation considered constructability, operability, construction risk and closure.

### **Economic Criteria**

The economic evaluation considered total project costs including capital costs, operating cost and closure costs.

### **Social Criteria**

The social evaluation considered cultural heritage, services and infrastructure, land use, local resources and potential benefits to the local population and economy.

Selection of a preferred alternative was based on optimization of the defined criteria and indicators for each of the above categories. A description of specific criteria and indicators used in the evaluation of alternatives is provided for each alternative.

The alternative assessment process is depicted in Figure 4-1.

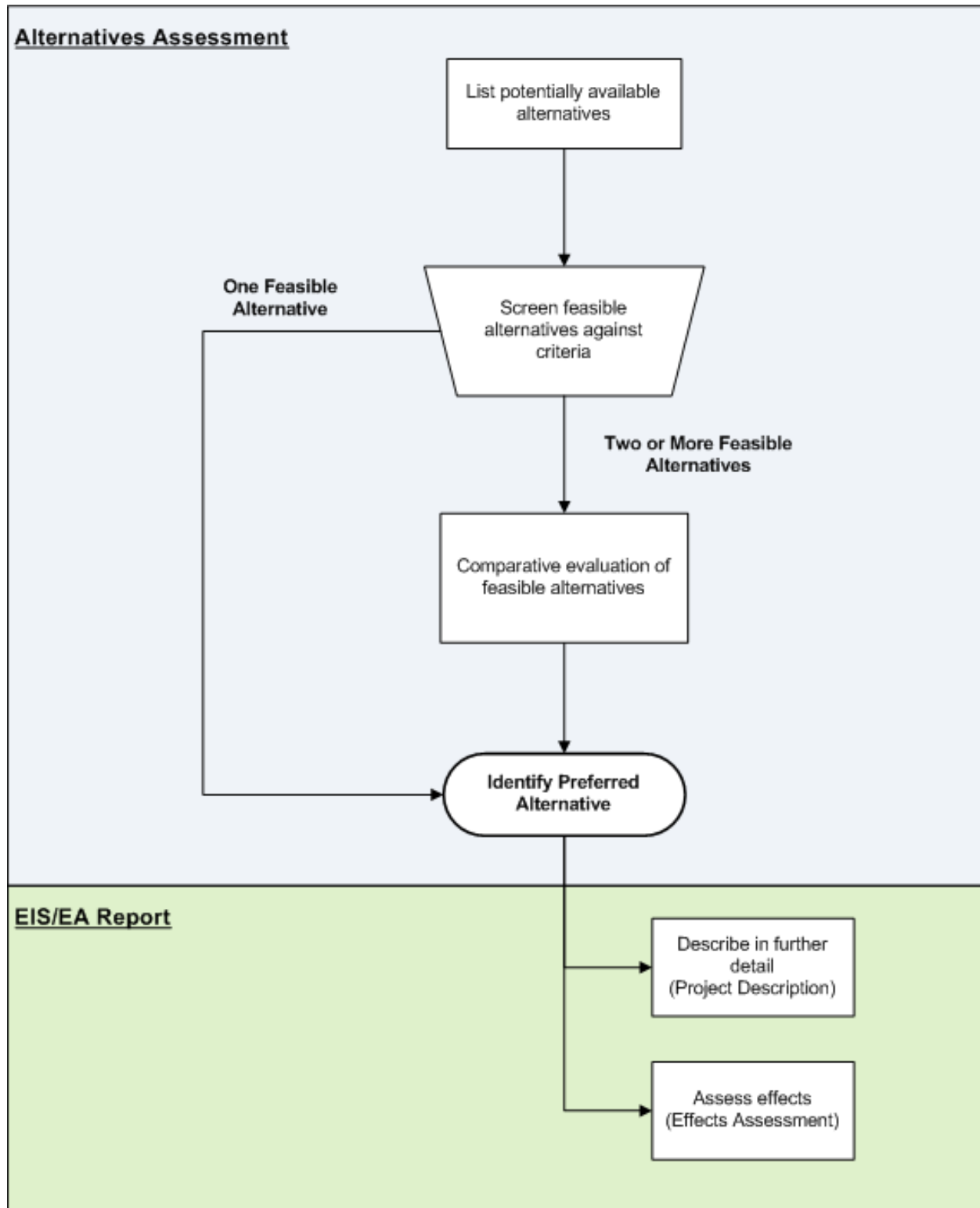


Figure 4-1: Assessment Approach for Alternative Means of Carrying Out the Project

The following sections describe the assessment of each of the alternatives identified for the aspects associated with each of the Project constituents in Table 4-1.

### **4.2.3 Ore Processing Method**

The Project includes mining and processing of ore containing gold. Processing will be required to extract the gold from the mineral matrices, and refine the gold into gold bars (doré). Ore processing follows a defined method including crushing, grinding, flotation, carbon-in-pulp gold recovery, gold elution, gold electro-winning, smelting using an induction furnace, and tailings production. Cyanide has been used to leach gold from ore since the 1890s, although with some ore bodies it is possible to use a different chemical or even a biological process.

Processing the ore at an off-site processing facility has been discounted as it would be uneconomical to transport low-grade ore to another processing facility. Further, Town of Atikokan and surrounding Aboriginal communities have strongly petitioned for the job opportunities associated with local processing.

Non-cyanide processing methods were considered in the ToR but excluded from the alternatives assessment because these technologies do not produce adequate concentration grades and recovery, given the nature of the gold at this location. Accordingly, the alternatives considered for the Ore Processing Facility are associated with the cyanide degradation or destruction technology used.

#### **4.2.3.1 Selection of Preferred Ore Processing Method**

The natural degradation alternative results in a much higher concentration of cyanide (14 ppm) in the tailings slurry and ultimately in the TMF compared to the cyanide destruction circuit alternative (5 ppm). The higher cyanide concentrations resulting from natural degradation will have an increased potential to adversely affect the environment and biological receptors. In addition, natural degradation requires a significantly larger reclaim pond area, and natural degradation is reduced significantly in the winter under ice cover. The larger reclaim pond area will require a greater capital investment to construct and will increase the project footprint and associated terrestrial impact. For these reasons, the natural degradation alternative is considered to clearly be a worse alternative compared to the use of a cyanide destruction circuit and has not been carried forward for further evaluation.

A cyanide destruction circuit provides a more consistent and predictable solution to managing the cyanide concentrations in the slurry and is selected as the preferred alternative. A cyanide destruction circuit reduces cyanide concentrations to levels much lower than any natural degradation process and significantly reduces the potential for negative impacts on ecosystems affected by cyanide compounds. The proactive destruction of cyanide and the resulting reduced concentrations in the tailings slurry and reclaim water flows will present much less risk to the biophysical environment, and therefore is expected to be more readily acceptable to local stakeholders.

### **4.2.4 Sewage Treatment Technology**

The worker accommodation camp and Mine site will generate sewage that must be treated on-site prior to discharge. The preliminary screening process in the ToR concluded that transporting sewage off-site to an established sewage treatment plant is not economically feasible and will not be considered for further evaluation. Two common technologies, a traditional septic tank and tile bed system and a package sewage treatment plant, are investigated as available alternatives for the Project.

The construction phase is selected as the bounding scenario for the assessment of sewage treatment technology alternatives because sewage generation is expected to be highest during the operations phase of the Project. During the operations, closure and post-closure phases, sewage generation is expected to be less and, therefore, the potential for environmental effect is considered to be reduced during these phases.

#### **4.2.4.1 Selection of Preferred Sewage Treatment Alternative**

Tile bed systems occupy a significant amount of land area and the site topography is such that significant grading would be required. Furthermore, the soil mantle in which the network of pipes would be embedded is considered to be inadequate. This type of system also poses greater environmental disturbance risks as a result of vegetation removal requirements and the potential for adverse ground and surface water impacts. Seepage to surface waters could result in organic enrichment and alter ecological conditions in adjacent waterbodies. Lastly, this method of sewage treatment would be much more onerous to remove and restore the affected land when the Project is decommissioned at closure. For these reasons, the septic tank and tile bed system is considered to be a worse alternative compared to a package sewage treatment plant and has not been carried forward for further evaluation.

The package sewage treatment plant alternative is selected as the preferred alternative for sewage treatment. A package sewage treatment plant is compact, easy to install, simple to operate and proven to be reliable. In a package plant, extended aeration processes are often better at handling organic loading and flow fluctuations as there is a greater detention time for the nutrients to be assimilated by microbes. The sewage treatment facility will be operated to attain regulated discharge limits; therefore there will be no adverse effect on water quality or on aquatic life.

#### **4.2.5 Sewage Treatment Facility Location**

Two alternatives are considered for siting the sewage treatment facility: one centrally-located facility and dedicated facilities at the worker accommodation camp and the Mine site areas. The operations phase is considered as the bounding scenario for the assessment of sewage treatment facility locations.

Alternative 1 involves a single treatment facility located near the worker accommodation camp that handles all sewage waste from the Project and discharges treated effluent directly south of the plant into Sawbill Bay. This alternative requires that domestic sewage from the process plant, truck shop administrative offices would be pumped via pipeline to the treatment facility.

Alternative 2 considers using multiple sewage treatment facilities distributed throughout the Project Site to accommodate specific areas. Four treatment facilities are proposed: a large facility located near the worker accommodation camp, and three smaller facilities designated for the process plant, truck shop, and emulsion plant respectively. The worker camp facility would discharge treated effluent directly south of the plant into Sawbill Bay, and the treated effluent from the three mine site systems would be discharged through the same discharge pipe as the effluent treatment plant which is to the south end of Sawbill Bay .

#### **4.2.5.1 Selection of Preferred Sewage Treatment Facility Location**

A single central facility requires an extensive system of pumps and pipelines to transport untreated sewage to the facility. A pump and pipeline system introduces operational complexity, increases both capital and operating costs and introduces the risk of releasing untreated sewage to the environment if a pipeline failure or operational

error were to occur. For these reasons, the single central facility alternative is considered to be a worse alternative compared to smaller localized facilities and has not been carried forward for further evaluation.

Construction and operation of multiple localized treatment facilities servicing the camp and the individual buildings at the Mine site has been selected as the preferred alternative for siting the sewage treatment facilities. Multiple smaller treatment facilities provide a simpler solution with lower operating costs and complexity, and reduced risk to the environment.

#### **4.2.6 Water Discharge**

Water is required for domestic use and ore processing. Water will be sourced from the Upper Marmion Reservoir and intermittently discharged back into the basin which consists of several bays and catchments. Process water, as well as recycled water from the TMF and site runoff water, will be collected in the Process Plant Collection Pond (PPCP) from where it will either be reused in the processing plant, or will be discharged to the environment. Potential discharge locations include Sawbill Bay and Lynxhead Bay, the major bays surrounding the Project Site.

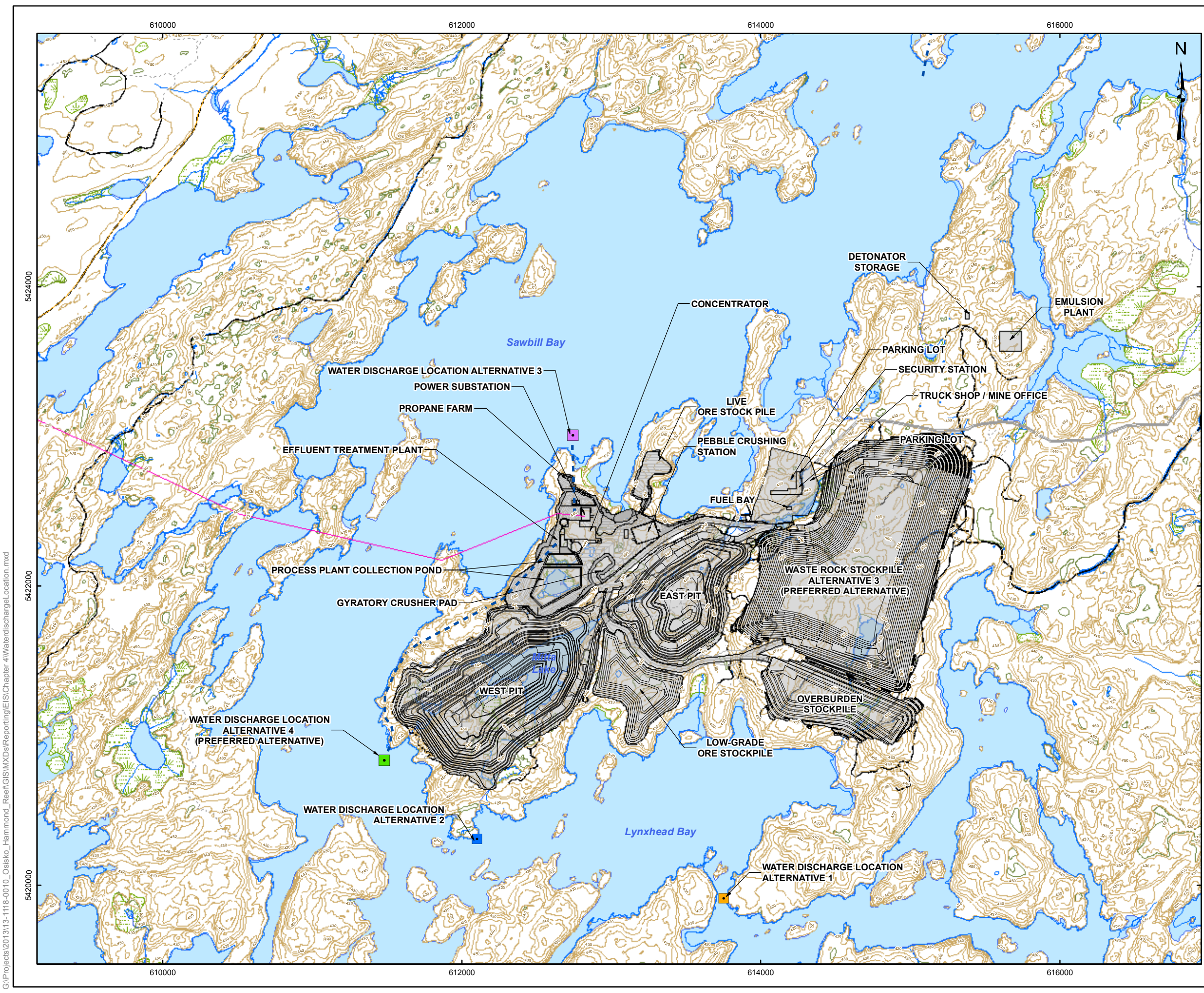
Sawbill Bay and the Sawbill Bay Watershed are located to the west – northwest of the Project Site. Sawbill Bay is somewhat isolated relative to the main flow paths through the Seine River system, and has a relatively small watershed. As such, this bay has a very low turnover rate (greater than 2 years). At some periods during the year the flow direction moves back into Sawbill Bay rather than away from the bay due to management of the reservoir for flood control and water power generation requirements at downstream hydro-electric facilities on the Seine River.

Lynxhead Bay and Lynxhead Narrows are located to the south – southeast of the Project Site, and are separated from the main infrastructure areas by topography and the open pits. While Lynxhead Bay and Lynxhead Narrows are small in surface area they are located in the main flow channel of the Seine River and, therefore, convey flow from upstream locations within the Upper Seine River watershed including the Lac des Milles watershed. As such, the turnover rate is high (less than 10 days), and a very large volume of water flows through this small zone. Consultation with Aboriginal groups, the public and the government review team has identified Lynxhead Narrows as a walleye spawning area. Four alternatives have been identified for potential discharge locations and pipeline alignment, as described below and shown in Figure 4-2.



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**LEGEND**

- Possible Route for Water Intake or Discharge Line
- Index Contour (5m interval)
- Ditch
- Marsh/Swamp
- River/Stream
- Road
- Trail
- Lake
- Wetland

**Water Discharge Location Alternatives**

- Alternative 1 - Underwater Pipeline with Discharge to Lynxhead Bay Narrows
- Alternative 2 - Overland Pipeline with Discharge to Lynxhead Bay
- Alternative 3 - Overland Pipeline to the Northwest with Discharge into the Central Portion of Sawbill Bay
- Alternative 4 - Overland Pipeline to the South with Discharge to the South End of Sawbill Bay (Preferred Alternative)

— Mine Site Road  
— Access Road  
— Project Transmission Line  
■ Project Facilities

**REFERENCE**

Base Data - Provided by OSISKO Hammond Reef Gold Project Ltd.  
 Base Data - MNR NRVIS, obtained 2004  
 Produced by Golder Associates Ltd under licence from Ontario Ministry of Natural Resources, © Queens Printer 2008  
 Projection: Transverse Mercator Datum: NAD 83 Coordinate System: UTM Zone 15N



<b>PROJECT</b>		HAMMOND REEF GOLD PROJECT ATIKOKAN, ONTARIO, CANADA	
<b>TITLE</b>		WATER DISCHARGE LOCATION ALTERNATIVES	
 Golder Associates Mississauga, Ontario	PROJECT NO. 13-1118-0010	SCALE AS SHOWN	VERSION 2
	DESIGN	CGE	14 Nov. 2008
	GIS	JO	2 Dec. 2013
	CHECK	SP	2 Dec. 2013
		REVIEW	SP
			FIGURE: 4-2

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#### **4.2.6.1 Selection of Water Discharge Alternative**

The Project is expected to require water discharge periodically throughout the year. The selected water discharge location alternative is the South end of Sawbill Bay (Alternative 4). The use of Sawbill Bay will allow for a shorter pipeline that will require a lower capital cost relative to the Lynxhead Narrows alternative. In addition, the use of the south end of Sawbill Bay provides favourable mixing conditions with a reduced potential to effect identified fish spawning habitat and decreased potential to effect the local fishing resource.

#### **Environmental Criteria**

Discharge water quality is estimated to meet MMER criteria for all parameters. Copper and cyanide concentrations may exceed CCME and PWQO criteria under certain hydrologic conditions, therefore, ambient mixing conditions in the receiving water at the discharge location is an important consideration to ensure sufficient mixing occurs and the potential effects on aquatic habitat is minimized.

Given the high turnover rate and high volume of water flowing through the Lynxhead Bay zone, the amount of mixing through this location is substantial and will result in lower overall receiving water concentrations (likely similar to the upstream water quality). Poor mixing conditions exist in Sawbill Bay due to low inflow volumes and back flooding of the bay from the main flow channel. It is possible that the concentrations of some parameters in this bay will increase to concentrations similar to the discharge (i.e., in the case of Alternative 3), however the concentrations downstream of the Project, at the Raft Lake Dam are expected to be similar to existing conditions.

In addition to flow and water quality, the potential effect on aquatic and terrestrial habitats was considered. Alternative 2 is an overland pipeline which could result in a small loss of terrestrial habitat. Alternatives 1, 3 and 4 have less overland piping and are not expected to result in any terrestrial habitat loss.

Aquatic habitat has the potential to be affected. Alternatives 1 and 2, located in Lynxhead Bay and Lynxhead Narrows are identified locations for walleye spawning habitat, which are important aquatic habitats. Alternatives 3 and 4 are not located near identified spawning habitat, therefore the potential to affect important aquatic habitat is less for these alternatives. However, because Alternative 3 does not offer adequate mixing, the discharge at this location could cause a change in water quality that may affect some sensitive species.

All four alternatives will result in a negligible increase in flows to Upper Marmion Reservoir and effects on groundwater quality or quantity are not expected.

#### **Technical Criteria**

The effluent treatment plant will be located northeast of the west pit and waste rock stockpile (as shown in Figure 3-1). The pipeline is planned to extend from the effluent treatment plant without interfering with mine operations or crossing over structures such as the open pits. Options for effluent conveyance include gravity-driven conveyance and pumping. The most reliable method is gravity-driven conveyance, which requires less operational maintenance and is simpler than a system that relies on pumping stations.

The length of pipeline must be considered as a shorter pipeline leads to less complicated construction and maintenance, and reduces the likelihood of pumping. Alternative 3 has the shortest pipeline and Alternative 1 has the longest pipeline. Underwater pipelines (Alternative 1) do not require freezing preventative measures, while overland pipelines do. Therefore, pipelines that are susceptible to freezing (Alternatives 2, 3 and 4) introduce operational and environmental risk if freezing and subsequent failure occurs.

## **Social Criteria**

No effects on cultural heritage, services and infrastructure or land use are anticipated from water discharge. The selection of a water discharge alternative has the potential to affect local resources.

Alternatives 1 and 2 have been identified as a fish spawning habitat location. Selection of these alternatives has the potential to affect local fishing resources. Alternative 3 is not located near identified fish spawning habitat, but has poor mixing characteristics which also has the potential to affect local fishing. Alternative 4 is considered the best alternative for the protection of local resources.

## **Economic Criteria**

Alternative 1 has the longest pipeline, incurring the greatest capital and maintenance costs, while Alternative 3 has the shortest pipeline, incurring the lowest capital and operating costs. Alternatives 2 and 4 are both feasible; however, they require freezing prevention measures and the risk of failure and the cost of maintenance are higher.

### **4.2.7 Access Road**

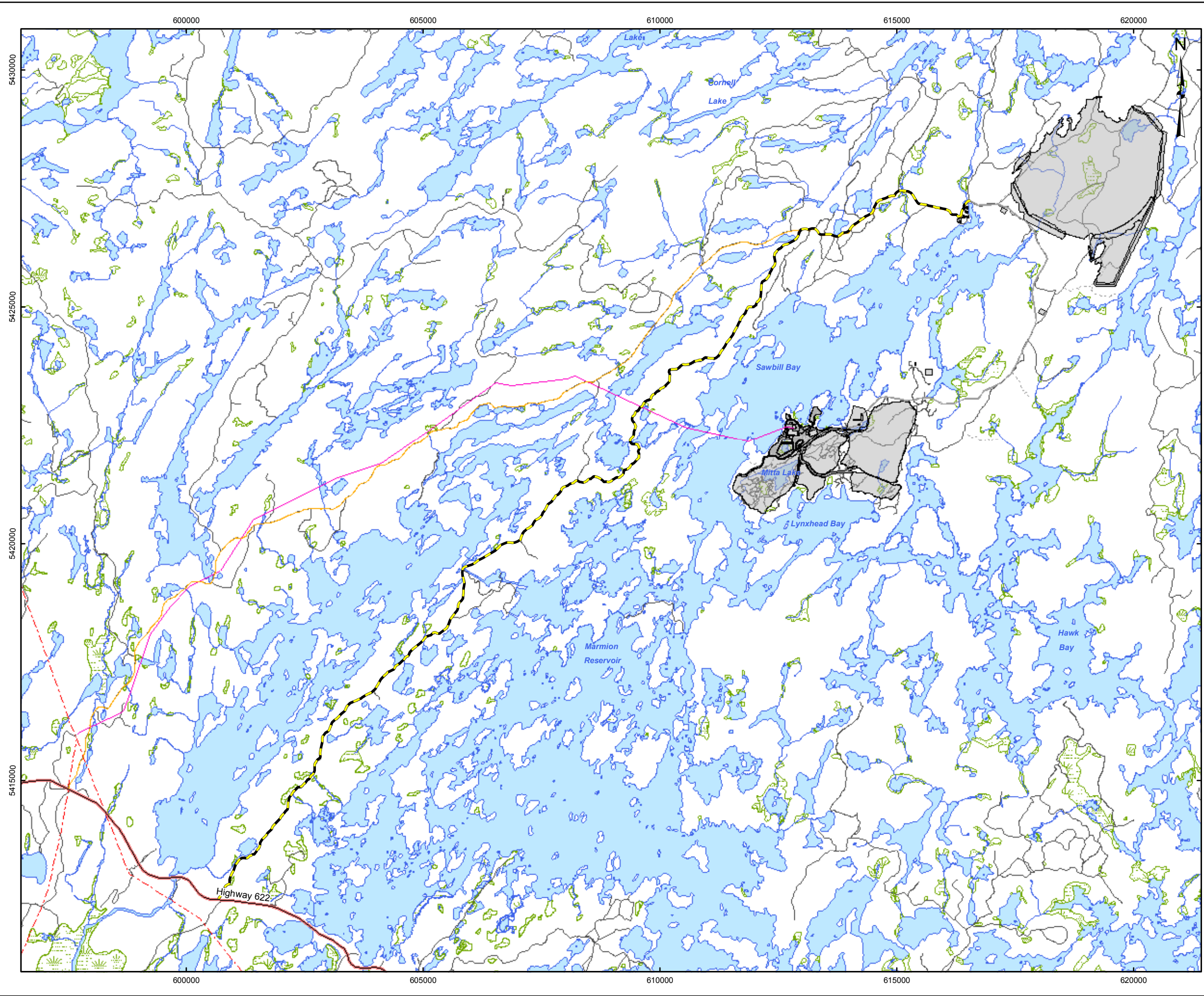
The Project will require the upgrading of an existing gravel road to facilitate transport of equipment and supplies to the mine site. On-site access roads are also necessary to provide access routes connecting the site infrastructure. The option of widening Premier Lake Road was screened out in the ToR as this route would require significant upgrades and the route is much longer, resulting in commute times for workers and supplies from Atikokan to increase by an hour.

Two alternatives are assessed for the main access road to the mine site; the Hardtack/Sawbill Road sequence (Alternative 1) and Raft Lake Road (Alternative 2). The two road alignments considered are shown in Figure 4-3.

Alternative 1 currently exists as a full length route that would require widening and upgrading to support heavy equipment and haul truck loads.

Alternative 2 would require construction of a new section of road of approximately 2 km in length north of the Raft Lake Cut, construction of bridging across the Cut and widening and upgrading to support heavy equipment and haul truckloads of the existing sections of road.

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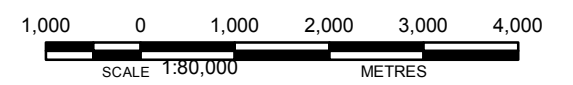


**LEGEND**

- Provincial Highway
  - Road
  - - - Trail
  - - - Power Transmission Line
  - River/Stream
  - Lake
  - Wetland
- Access Road Alternatives**
- Alternative 1 - Hardtack / Sawbill Road (Preferred Alternative)
  - Alternative 2 - Raft Lake Road
- Mine Site Road
  - Project Transmission Line
  - Project Facilities

**REFERENCE**

Base Data - Provided by OSISKO Hammond Reef Gold Project Ltd.  
 Base Data - MNR NRVIS, obtained 2004  
 Produced by Golder Associates Ltd under licence from  
 Ontario Ministry of Natural Resources, © Queens Printer 2008  
 Projection: Transverse Mercator Datum: NAD 83 Coordinate System: UTM Zone 15N



PROJECT		HAMMOND REEF GOLD PROJECT ATIKOKAN, ONTARIO, CANADA	
TITLE		ACCESS ROAD ALIGNMENT ALTERNATIVES	
 Golder Associates Mississauga, Ontario	PROJECT NO.	13-1118-0010	SCALE AS SHOWN
	DESIGN	CGE 14 Nov. 2008	VERSION 2
	GIS	JO 2 Dec. 2013	
	CHECK	SP 2 Dec. 2013	
	REVIEW	SP 2 Dec. 2013	

**FIGURE: 4-3**

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#### **4.2.7.1 Selection of Preferred Access Road Alignment**

Hardtack/Sawbill Road (Alternative 1) is the selected alternative and will be upgraded to accommodate the increased traffic volume and heavy vehicles. The road will remain public and it is anticipated that the majority of the road will continue to be functional once the Mine is decommissioned. The Raft Lake Road alignment is not considered a viable option due to the higher costs and loss of terrestrial and aquatic habitat associated with constructing a new roadway and bridge.

Several factors were considered when selecting the best access route for the Project. These factors include the number of water crossings, construction time, potential habitat loss, total length, overall cost and value to the community.

#### **Environmental Criteria**

Hardtack/Sawbill Road (Alternative 1) already exists and only requires upgrades and widening the road. Due to the already existing corridor, there will be little terrestrial habitat disturbance, and minor additional effects on water quality as stream crossings are already in place.

Raft Lake Road (Alternative 2) requires considerable upgrades including construction of new sections of roadway and new water crossings. Construction of the new road will result in some terrestrial habitat loss and new stream crossings will cause result in some loss of stream habitat. The construction of new stream crossings may also affect water quality by increasing levels of total suspended solids (TSS) during in-stream construction.

Both alternatives will result in temporary alteration to stream flows during in-stream works. No effects to groundwater quality, quantity or air quality are anticipated from access road construction.

#### **Technical Criteria**

Both alternatives are technically feasible. Hardtack/Sawbill Road is the best alternative in terms of technical criteria as it entails widening and upgrading an existing road, with no new water crossings or culverts. The Raft Lake Road alternative requires considerable upgrades including construction of new sections of roadway, including new water crossings and culverts and the potential need to construct a new bridge.

#### **Economic Criteria**

Hardtack/Sawbill Road would be a lower cost as it entails improvements to an existing roadway. Raft Lake Road would be a higher cost since it requires considerable upgrades including constructing new sections of roadway with the potential need for construction of a bridge.

#### **Social Criteria**

Neither road alternative is anticipated to effect cultural heritage. The change to services and infrastructure would be positive in both cases, as both an improved road and a new road would allow for improved access to recreational areas. Local resources could be affected, especially due to the selection of Alternative 2 and the construction of a new road. A new road could result in increased pressure on hunting and fishing resources that were previously not easily accessible.

Potential benefits to the local population and economy would be similar for both selected alternatives and could include use of local contractors for road construction. The plan is for the road to remain public throughout all

phases of the Project, including mine decommissioning. This would result in positive socio-economic effects of increased access for the public to local recreation areas.

#### **4.2.8 Power Supply**

The mine and processing plant will require approximately 100 MW of power. Power for the Project Site will be supplied via a new 230 kV project transmission line, feeding a main on-site substation. The line would connect to an existing 230 kV transmission line just off Highway 622.

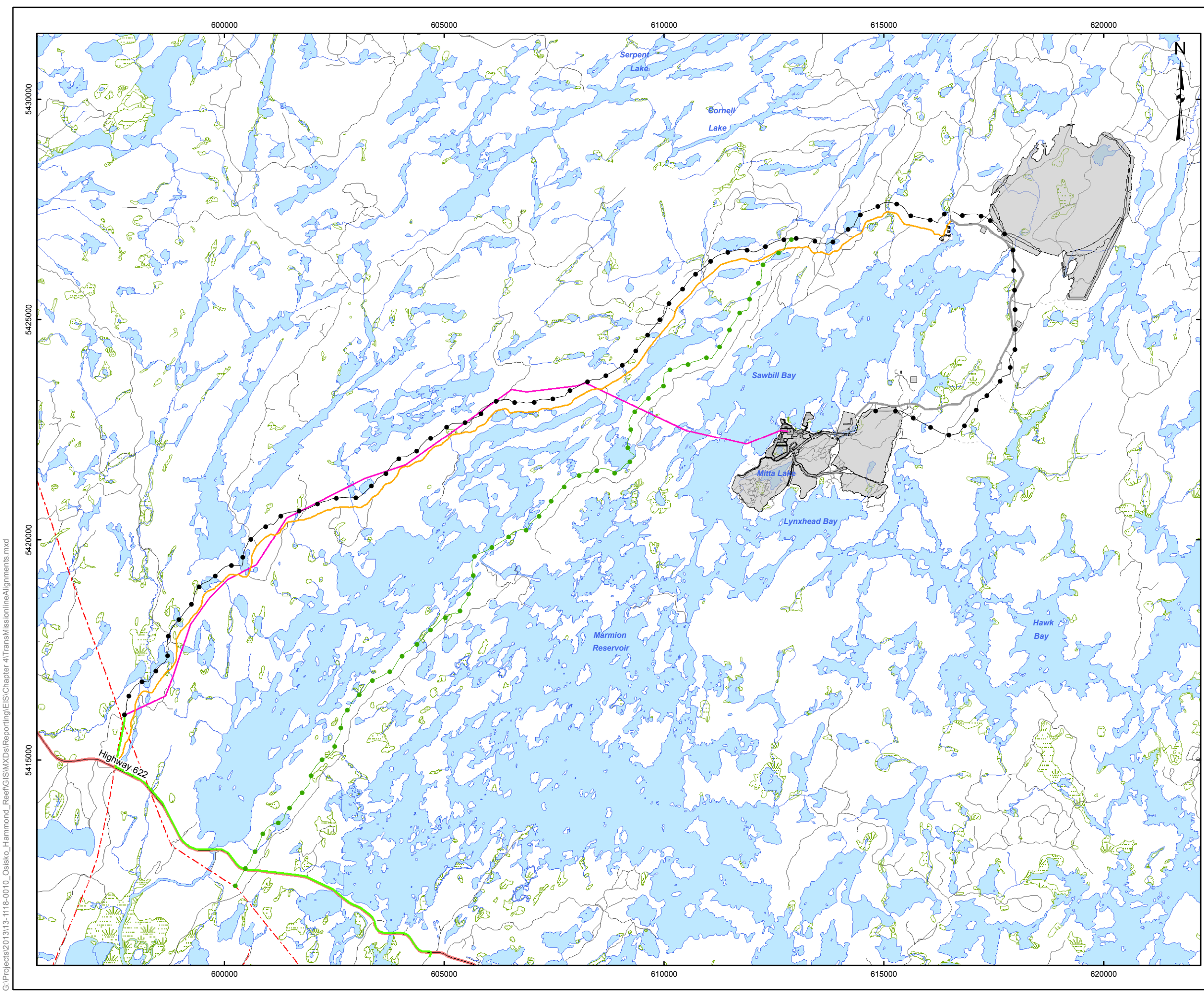
On-site diesel generators were considered in the Project ToR, but excluded due to the high carbon footprint from the use of non-renewable fossil fuels and because the option is not cost-effective. Diesel generation will be used for back-up power supply only. On-site renewable power generation was also considered in the ToR but not carried forward for further assessment as renewable energy cannot consistently and reliably provide power during mine operations.

There are three transmission line alignment alternatives considered. Alternatives 1 and 2 were carried forward from the preliminary screening process described in the ToR. A third alternative (Alternative 3) was subsequently developed as a result of further consideration and conceptual design discussions with the electrical power utility. The alternative transmission line alignments are shown in Figure 4-4.

The selection between these three alternatives will not affect the potential effects during operations, but have the potential to affect terrestrial habitat during construction. Therefore, the construction phase has been selected as the bounding scenario for the selection of transmission line alignment.

A 10 km auxiliary transmission line will be constructed adjacent to Highway 622. The purpose of the auxiliary transmission line is to provide electricity required to operate the substation that connects the project transmission line to the provincial electricity grid. The new substation will be constructed near the intersection of Highway 622 and Hardtack Road.

There are no additional alternatives identified for the auxiliary power line. The only available alternative is to source the power from Atikokan Generating Station and align the power line with Highway 622. This alternative utilizes existing rights-of-way resulting in no additional biophysical or socio-economic impacts.



**LEGEND**

- Provincial Highway
- Road
- - - Trail
- - - Power Transmission Line
- Auxiliary Power Line
- River/Stream
- Lake
- Wetland

**Transmission Line Alternatives**

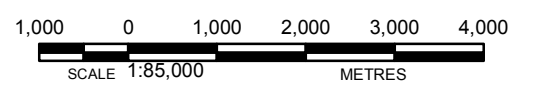
- Alternative 1 - Transmission Line Along Hardtack / Sawbill Road
- Alternative 2 - Transmission Line Along Raft Lake Road
- Alternative 3 - Transmission Line Along Hardtack / Sawbill Road and Crossing Sawbill Bay (Preferred Alternative)

— Access Road

■ Project Facilities

**REFERENCE**

Base Data - Provided by OSISKO Hammond Reef Gold Project Ltd.  
 Base Data - MNR NRVIS, obtained 2004  
 Produced by Golder Associates Ltd under licence from  
 Ontario Ministry of Natural Resources, © Queens Printer 2008  
 Projection: Transverse Mercator Datum: NAD 83 Coordinate System: UTM Zone 15N



<b>PROJECT</b>	<b>HAMMOND REEF GOLD PROJECT ATIKOKAN, ONTARIO, CANADA</b>		
<b>TITLE</b>	<b>TRANSMISSION LINE ALIGNMENT ALTERNATIVES</b>		
 Golder Associates Mississauga, Ontario	PROJECT NO. 13-1118-0010	SCALE AS SHOWN	VERSION 2
	DESIGN	CGE	14 Nov. 2008
	CHECK	SP	2 Dec. 2013
	REVIEW	SP	2 Dec. 2013
			FIGURE: 4-4

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#### **4.2.8.1 Selection of Preferred Power Supply Alternative**

The preferred project transmission line alignment is Alternative 3 – Hardtack/Sawbill Road across Sawbill Bay. The selected alignment for the access road to the mine site is via Hardtack Road and Sawbill Road, and as this alignment will already undergo road construction and upgrading it is advantageous that the Project transmission line be implemented along this corridor.

The option of the transmission line crossing Sawbill Bay significantly reduces the length of the line, and in turn, the overall cost of installing the transmission line. As the project transmission line will be strung across the bay, the potential effects to water quality and aquatic habitats will be minimized. The change to the visual landscape is expected to be a concern that will be addressed through ongoing work with the community. The changes to visual landscape will be fully reversible during mine closure because the infrastructure will be decommissioned.

All three proposed alignments are viable routes for implementing a transmission line. The proposed alignments follow existing roadways, however, each alignment involves varying degrees of environmental and socio-economic impacts, and encompass different technical and economic obligations.

#### **Environmental Criteria**

Three alternatives were compared against the environmental criteria, with a focus on terrestrial ecology. Terrestrial ecology would be the most potentially affected component of the environment due to transmission line construction. Any vegetation clearance required for construction would disturb and potentially destroy terrestrial habitat. The alignment along the Hardtack/Sawbill road and crossing Sawbill Bay is the shortest route and therefore requires the least vegetation clearance, and less habitat loss.

None of the three transmission line alignments are anticipated to affect water quality, air quality, stream flows, or groundwater quality and quantity. Aquatic life will also be unaffected as construction will avoid aquatic habitats.

#### **Technical Criteria**

In all three cases, construction of the transmission line is simplified due to the presence of an existing roadway. Vegetation clearing would be minimized as excavators and other equipment already have unobstructed access to install transmission lines and poles. Sections of Raft Lake Road (Alternative 2) require construction of new roadway, while Sawbill Road is continuous along the length of road. Sections of Alternative 3 are not along a roadway and would require clearing of new areas.

Alternative 3, in which the transmission line is strung across Sawbill Bay, presents the easiest option in terms of constructability. The total span across the water is short enough that placement of footings directly in the water can be avoided. Alternative 3 is the shortest route, minimizing overall construction time.

#### **Economic Criteria**

Alternative 2 is the longest route, and thus requires a larger budget for material and installation. Additionally, Raft Lake Road requires construction of new roadway which would have to be completed preceding transmission line installation. Since Raft Lake Road (Alternative 2) was not selected as the Access Road alternative, it makes less economic sense to select it as the transmission line alternative. Alternative 3 will incur the lowest costs as it is the shortest route.



## **Social Criteria**

The transmission line construction is not anticipated to affect cultural heritage or services and infrastructure.

Local resources could be affected through the change to the visual landscape. The local area is known as a wilderness destination, and the presence of a transmission line could affect this perception. Alternative 3 has the largest potential to affect the visual landscape, as it would be located over the water in an area that is frequented by tourists in boats and canoes.

### **4.2.9 Worker Accommodation**

An on-site worker accommodation camp alternative with a capacity of up to 1,200 persons was evaluated against off-site accommodations in the Town of Atikokan.

The environmental assessment process was used as a planning tool that enabled OHRG to make informed decisions, identify potential risks to the Project and choose alternative methods of carrying out the Project that would bring the greatest benefits and lowest potential effects. The issuance of a federal Project Description Document and provincial ToR were completed early in the planning process and minor changes to Project details have occurred throughout the planning process.

The only substantive change to the Project, which is not reflected in the Project Description Document or ToR, is the inclusion of an on-site worker accommodation camp. This alternative was initially scoped out of the Project design, however as the Project planning advanced it was evident that it should be included as an alternative to ensure the Project remained feasible.

An on-site worker accommodation camp was included in the detailed environmental assessment for the Project. The location for the on-site worker accommodation camp is within the Project Site and did not require additional baseline data collection.

The need to consider an onsite worker accommodation camp as an additional alternative method of carrying out the Project was determined based on detailed planning, consultation, and baseline studies. Detailed planning for the Project clarified the total anticipated workforce, length of the commute and duration of the Project. Consultation activities, including engagement with Aboriginal communities confirmed that employment is important and that many community members live two or more hours from the site making a daily commute from those communities impossible. An on-site worker accommodation camp offers the opportunity for Aboriginal community members to maintain a permanent resident in their community while being provided accommodation while on-shift at the on-site camp. Socio-economic baseline studies confirmed the demographics of the local population, including age distribution and education levels. The conclusion from the detailed planning, consultation and baseline studies was that an on-site worker accommodation camp would be required to ensure the Project remained feasible.

Upon reaching the decision to include an on-site worker accommodation camp as an alternative means of carrying out the Project, the government, public and Aboriginal stakeholders were informed of this change.



The following provides a summary of consultation activities that included information about the on-site worker accommodation camp:

- Presentation to Atikokan Mayor and Council July 30, 2012.
- Presentation to the Metis Nation of Ontario August 3, 2012.
- Community News Brief August 13, 2012.
- Consultation Update meeting with provincial and federal government leads August 14, 2012.
- Community Open House August 18, 2012.
- Presentation to Fort Frances Chiefs Secretariat September 17, 2012.
- Letter to the CEA Agency September 20, 2012.
- Letter to the MOE EAB September 20, 2012.
- Letter from CEA Agency to Aboriginal communities October 26, 2012.
- Alternatives Assessment Workshop (CEAA, DFO, EC, NRCan, and MNDM) November 20, 2012.

Both options of an on-site worker accommodation camp and off-site worker accommodation are being re-considered and evaluated. The alternatives are described below.

Alternative 1 consists of an on-site worker accommodation camp located near the north end of Sawbill Bay adjacent to the existing exploration camp. The location is shown in Figure 4-5. The camp will have a capacity of up to 1,200 persons and will be constructed and operated during the Project construction phase. The camp would remain in operation until the end of the closure phase of the Project, at which time all facilities would have been removed. The camp would have an approximate footprint area of 1.6 ha, including parking facilities and will be designed and constructed with appropriate buffer areas, in accordance with the Forest Fires Prevention Act.



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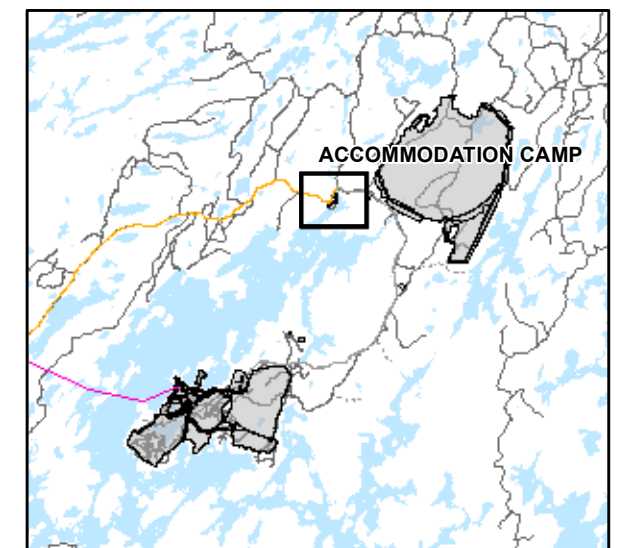
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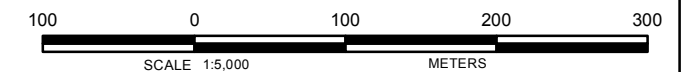
**LEGEND**

- Road
- - - Trail
- Index Contour (5m interval)
- River/Stream
- Lake
- - - Mine Site Road Centre Line
- Access Road
- Project Facilities



**REFERENCE**

Base Data - Provided by OSISKO Hammond Reef Gold Project Ltd  
 Base Data - MNR NRVIS, obtained 2004  
 Produced by Golder Associates Ltd under licence from  
 Ontario Ministry of Natural Resources, © Queens Printer 2008  
 Projection: Transverse Mercator Datum: NAD 83 Coordinate System: UTM Zone 15N



PROJECT		HAMMOND REEF GOLD PROJECT ATIKOKAN, ONTARIO, CANADA	
TITLE		ON-SITE ACCOMMODATION CAMP LOCATION	
 Mississauga, Ontario	PROJECT NO.	13-1118-0010	SCALE AS SHOWN
	DESIGN	CGE 14 Nov. 2008	VERSION 2
	CHECK	SP 2 Dec. 2013	
	REVIEW	SP 2 Dec. 2013	

**FIGURE: 4-5**



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Alternative 2 involves off-site worker accommodation in the Town of Atikokan and surrounding communities. Employees would commute to work for Alternative 2 via the mine access road. The socio-economic assessment considers the number and availability of housing in Atikokan.

Both alternative worker accommodation arrangements were screened against the criteria presented in Section 4.2.2, and both were considered viable alternatives and advanced for a comparative evaluation. The comparative evaluation considered the biophysical impacts of camp construction as well as the socio-economic issues associated with worker attraction, travel, and value to the community.

#### **4.2.9.1 Selection of Preferred Worker Accommodation Alternative**

Based on the comparative evaluation, specifically the technical challenges, Alternative 1, on-site worker accommodation camp, was selected as the preferred alternative. This alternative enhances the ability to attract and provide for skilled workers from areas beyond the LSA by offering flexible living arrangements, which is a key success factor for the Project.

Offering on-site worker accommodation is key to the successful recruitment of skilled workers. It will also improve worker safety by reducing the potential for traffic accidents involving OHRG staff through reducing the number of vehicle trips on the access road (Hardtack/Sawbill).

Some of the deciding factors included the fact that Aboriginal communities are interested in working on the Project, however the site is over 2 hours away from the closest First Nations community; the socio-economic baseline study has shown that the demographics of the Town can't supply the necessary workforce; Housing availability in Town is not able to accommodate an increased population of 1,200 workers, the 2006 occupancy rate for private dwellings in Atikokan was 92.4%, representing 108 unoccupied dwellings; Other regional mines provide a fly in/fly out option and Osisko needs to be competitive to attract the skilled workforce.

Although Osisko will construct an on-site camp, workers will still be encouraged to consider living in Town. Osisko is committed to providing incentives for workers to live in Town, the details of which will be further informed through the Atikokan/Osisko committee.

Importantly, the selection of Alternative 1 does not preclude the ability for individual workers to live in and commute from Atikokan. As part of OHRG's commitment to enhancing community benefits from the Project, we have committed to working with the Town to encourage workers to live in Town. Alternative 1 provides opportunities for both workers wishing to live in Town, commuting daily by bus or personal vehicle, and workers preferring a shift rotation, allowing them to reside in the RSA or elsewhere in Canada. Finally, carrying Alternative 1 forward into the effects assessment provides a conservative approach to evaluating the total effects of the project.

Several environmental, technical, economic and social criteria were considered when choosing the best alternative for worker accommodation for the Project. The key environmental considerations include loss of terrestrial habitat and potential changes to water quality. The key technical factor considerations include the availability of land near the Project Site, the ability to staff the Project. Key economic considerations include potential capital, operating and maintenance costs. Key socio-economic considerations include potential effects to cultural heritage, services and infrastructure, local resources and benefits to the local population and economy.

## **Environmental Criteria**

Project-environment interactions resulting from off-site worker accommodations are minimal. No interactions are anticipated with water quality, terrestrial ecology, aquatic ecology, hydrology or hydrogeology. Some potential interactions are possible with air quality, due to increased traffic on the access road from daily worker commuting. Negligible effects to the environment would occur as a result of off-site worker accommodations.

Some project-environment interactions are associated with the construction of a 1,200 person worker accommodation camp on-site. Domestic wastewater discharge volumes will increase, and an additional discharge point will be included in the Project design near the worker accommodation camp. The effects to water quality are anticipated to be negligible because wastewater will be treated prior to discharge. An on-site worker accommodation camp will result in wildlife disturbance due to the increased presence of humans, and minor habitat loss associated with an increased Project footprint. Effects to aquatic ecology are not anticipated since camp construction will include a buffer zone from the Marmion Reservoir and wastewater will be treated prior to discharge. There will be a potential for interaction with flow patterns and water levels due to water withdrawals for worker accommodation camp use, however the effects are anticipated to be negligible. No interaction with groundwater quality or quantity or air quality is anticipated.

## **Social Criteria**

Several Project interactions with the social environment are anticipated as a result of an off-site worker accommodation alternative. Throughout consultation activities, OHRG learned that the Town of Atikokan preferred an off-site worker accommodation alternative and perceived this alternative to be a direct source of benefits to the Town. The following discussion summarizes some of the key points OHRG learned throughout consultation with the Town.

An off-site worker accommodation alternative would result in an increased local population. Population decline has been a challenge to the Town of Atikokan due to loss of municipal tax base and the Town's ability to maintain services. Increased local population would result in a diversified economy, stimulation of local markets and increased local incomes.

Some concern has also been expressed with regards to the potential change in community character, increased traffic volumes, and the strain on municipal services and infrastructure that could result from rapid population growth. An off-site worker accommodation alternative is not anticipated to interact with cultural heritage or land and resource use.

The on-site worker worker accommodation alternative would also result in interactions with the social environment. Local population growth would not be as pronounced; therefore some economic benefits may also be less immediate. The municipal tax base may not increase as quickly as it would with an off-site worker accommodation alternative; however the strain on municipal services would also be less. The on-site worker accommodation alternative would limit the increase in traffic volumes in Town and on the Project access road.

No effect on cultural heritage is anticipated as the site has been surveyed for archaeological potential and identified as being low. A stronger interaction with land and resource use would result from the on-site worker accommodation alternative, since the camp would increase the Project footprint, and the potential for workers to take part in fishing and hunting would be increased.

The Town of Atikokan and surrounding communities favour off-site worker accommodation as the local economy benefits from increased population. The economy is enhanced by stimulating local markets and boosting incomes. On the other hand, commuting time may be considered a drawback to potential employees.

In the Town of Atikokan, housing availability currently may not meet demand once mine construction and operation commences, and construction of additional housing may be necessary. As the Project has continued to develop it has become apparent that a portion of the skilled workers hired may be recruited from various regions across Canada. Atikokan and neighbouring towns have small populations and therefore, a small pool of employee candidates to draw from. In addition, many of the skilled worker positions required to be filled are in very high demand as a result of the number of mines being developed in Northern Ontario. Offering the flexibility for workers to continue to live in their existing communities and commuting to the Mine will help attract local skilled workers. Lastly, paid food and accommodation is a benefit to young workers. Another advantage related to the on-site worker accommodation camp is reduced likelihood of traffic accidents involving Project staff due to the fact that the number of vehicle trips on the access road (Hardtack/Sawbill), particularly in the winter, will be decreased.

### **Technical Criteria**

An off-site worker accommodation alternative has several technical challenges. As discussed in the meetings held with the Town of Atikokan, government regulators and Aboriginal communities, the socio-economic baseline studies undertaken for the Project indicated that staffing the project from the Town was not possible due to the volume and education levels of the available labour force. Worker accommodation in Town would be a distance of approximately 40 km from the Mine representing a commute time of 30-60 minutes. Additionally, Aboriginal communities are located more than two hours away from the site, and daily commuting was determined to be impractical.

The on-site worker accommodation alternative has several technical requirements that were considered. The land base was identified as being available at the current location of the exploration camp, approximately 1 km from the mine site. Additional requirements include potable water and sewage treatment facilities which were deemed feasible at site.

### **Economic Criteria**

The capital and operating cost for an off-site worker accommodation option are lower for OHRG. The Town of Atikokan perceives that the economic benefits to them would be increased should an off-site worker accommodation alternative be selected, through the increased municipal tax base associated with population growth. An on-site worker accommodation alternative would have a higher cost to OHRG due to the construction of worker accommodation, potable water treatment and sewage treatment facility.

## **4.2.10 Tailings Deposition Technology**

The ore processing plant will generate tailings that must be deposited in the Tailings Management Facility (TMF). Two common tailings deposition technologies, conventional slurry tailings and thickened tailings, were investigated as available alternatives for the Project. Both alternatives are considered feasible and safe when managed in a responsible manner.

A comparative evaluation was carried out to determine whether surface disposal of conventional slurry tailings or thickened tailings is the preferred tailings deposition technology for the Project.



The operations phase is selected as the bounding scenario for the assessment of tailings deposition technology alternatives because tailings generation occurs during the operations phase of the Project.

#### **4.2.10.1 Selection of Preferred Tailings Deposition Alternative**

Based on the comparative evaluation, specifically the reduced reclaim water storage and pumping requirements, reduced dam height and volume, lower life of mine costs and reduced consequence of failure, Alternative 2, thickened tailings deposition was selected as the preferred alternative. Thickened tailings are less likely to segregate and form problematic areas of tailings slimes. In addition, thickened tailings disposal simplifies water management and reduces the overall risks typically associated with conventional slurry tailings disposal. Another key advantage of thickened tailings is that they are generally easier to rehabilitate for site closure.

Several environmental, technical, economic and social criteria were considered when choosing the best technology for tailings deposition. The key environmental considerations include TMF footprint, dusting, potential for water quality impacts, and consequence of failure. The key technical factors and considerations include tailings beach slope, containment dam height, dam volume, slope stability, dam design/construction and reclaim pond requirements. Key economic considerations include estimated capital, operating and maintenance costs. Key socio-economic considerations include risk of failure, community safety and aesthetics.

#### **Environmental Criteria**

Some project-environment interactions associated with tailings deposition include; loss of vegetation, impacts to air quality from dusting, and environmental risk associated with dam failure or poor performance of the tailings management facility.

Alternative 1, conventional slurry tailings requires higher dams and more impounded water resulting in an increased likelihood of dam failure. In the event of a tailings containment dam failure, the downstream environmental consequences could include significant loss of terrestrial and aquatic habitat. There is a higher potential for impacts to air quality from dusting with conventional tailings because the tailings will segregate resulting in areas with coarse-sized tailings particles that are more susceptible to wind erosion. Dust mitigation measures may be required on inactive beaches.

Flatter topography at OHRG makes stacked thickened tailings deposition more favourable because Alternative 2 requires lower dam heights. The thickened tailings alternative requires a smaller reclaim pond which would somewhat reduce the amount of clearing and grubbing. The smaller reclaim pond with thickened tailings would reduce the risk of failure and have a lower consequence of a facility breach. The potential for impacts to air quality from dusting are less with thickened tailings because the tailings are non-segregating and maintain a higher level of saturation. A tailings surface with well-graded particles (i.e., mixture of fine and coarse grained) is less susceptible to wind erosion. However, there is some potential for impacts to air quality from dusting of the desiccated thickened tailings surface until another layer of saturated tailings is deposited over top. Continual rotation of tailings discharge from the central deposition point will reduce the potential for dusting.

#### **Social Criteria**

Community safety and aesthetics are key concerns for stakeholders. With both tailings deposition technology alternatives, there is a risk of tailings dam failure. Conventional tailings, with a larger water pond and higher dams, would have a higher inherent risk and consequence of failure than thickened tailings, which would have a smaller water pond and lower dams.

Visually, lower dams associated with thickened tailings are less obtrusive than the higher dams of conventional tailings. Furthermore, the closed thickened tailings management facility will have less visual impact after the tailings are revegetated because the perimeter dams are smaller.

No effects on cultural heritage are anticipated from the tailings management facility for either tailings deposition alternative.

### **Technical Criteria**

A conventional slurry tailings management facility would require higher perimeter containment dams and would therefore have a higher likelihood of failure. Higher dams and dams that retain water have increased likelihood and consequence of failure. The conventional slurry tailings alternative would require higher dams and larger water retaining dams that are more expensive to construct. The conventional tailings alternative would have increased rates of tailings and reclaim water pumping between the process plant and TMF.

A thickened tailings management facility would require lower perimeter containment dam crest elevations (i.e., lower dam heights) and smaller dam volumes to provide the required tailings storage capacity. Lower dams would generally have a lower consequence of failure. Thickened tailings are non-segregating which would result in lower permeability tailings and reduced seepage from the TMF. With thickened tailings deposition, only the perimeter dams adjacent to the reclaim water pond would be water retaining. The thickened tailings alternative would require less pumping of reclaim water back to the process plant and would have a smaller reclaim water pond.

### **Economic Criteria**

The estimated capital and operating costs are lower for the thickened tailings alternative. Dam construction costs would be lower for the thickened tailings alternative. Pipeline and pump capital and operating costs are higher for the conventional tailings alternative. Operating costs are lower for the thickened tailings alternative because smaller tailings and reclaim water volumes would require less energy to pump. However, it should be noted that the dam construction and pipeline cost savings associated with the thickened tailings alternative would be offset by the capital and operating costs of a tailings thickener plant.

#### **4.2.11 Summary of Preferred Non Mine Waste Alternative Means of Carrying Out the Project**

A full range of non-mine waste alternative methods of carrying out the Project have been examined and assessed, as presented in the Alternatives Assessment Report and discussed herein. Alternatives that meet the Project objectives were identified in the ToR and an initial screening process was completed. The alternatives that were deemed reasonable were carried forward for further evaluation and were investigated in greater detail. Comparative summaries of the features of the alternatives, environmental and social impacts, cost requirements, and discussions of the degree to which the alternative fulfills the need identified were used to determine which option is best overall. A summary of the preferred alternative for each Project constituent is presented below in Table 4-2.

**Table 4-2: Summary of Preferred Alternative Means of Carrying out the Hammond Reef Gold Project**

<b>Project Component</b>	<b>Preferred Alternative</b>
Ore processing method	Processing using cyanide including a cyanide destruction circuit
Project transmission line	Transmission line along Hardtack/Sawbill Road and crossing Sawbill Bay
Sewage treatment facility location	Dedicated facilities for the camp and the Mine
Sewage treatment technology	Package sewage treatment plant
Water discharge location	Overland pipeline to the south with discharge to the south end of Sawbill Bay
Access road	Hardtack/Sawbill Road
Worker accommodation	On-site worker accommodation camp
Tailings Deposition	Thickened tailings

The above alternatives are carried into this EIS/EA Report and described in detail in Chapter 5 and further assessed for physical, biological and socio-economic effects in Chapter 6.

### 4.3 Mine Waste Disposal Alternatives

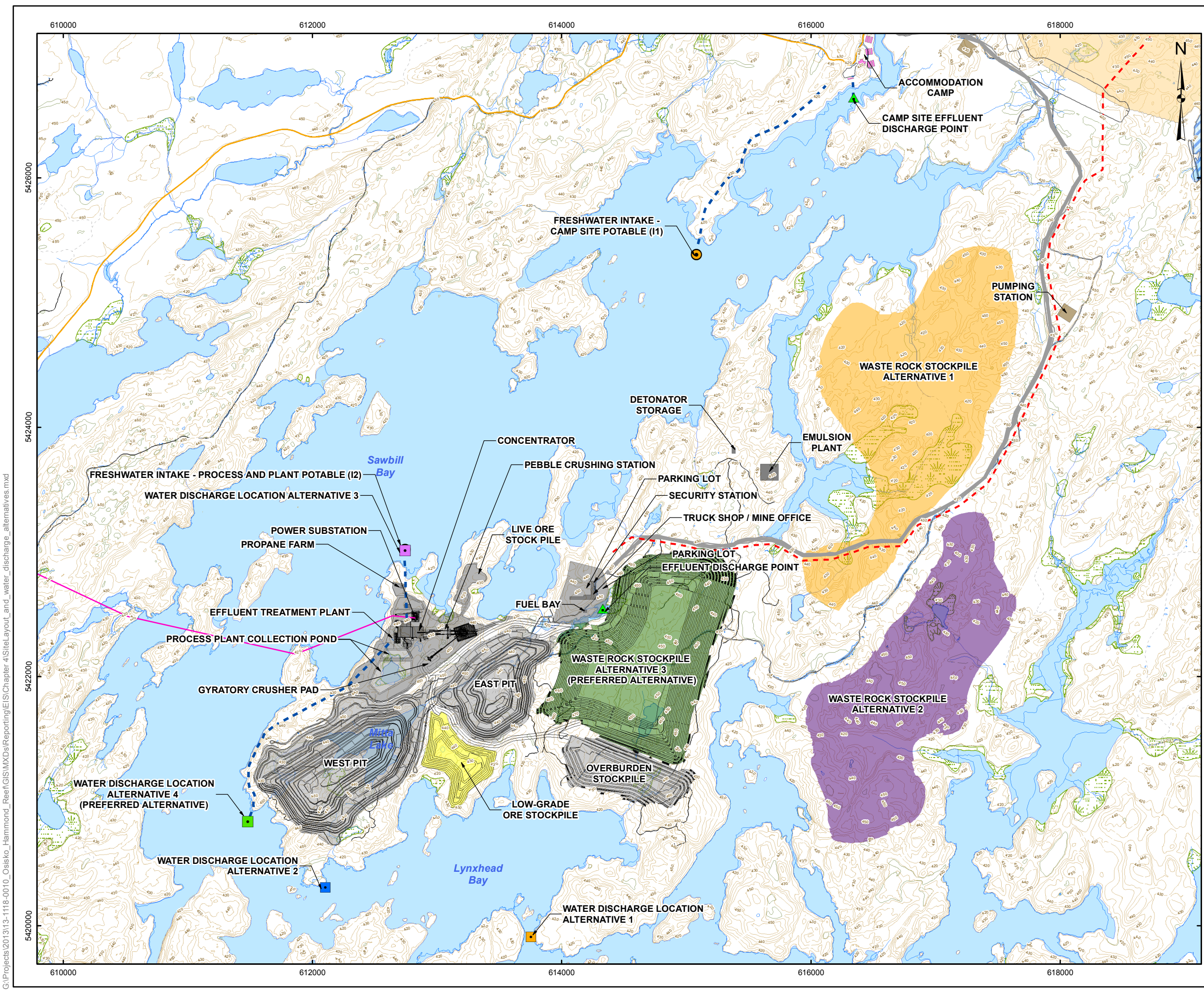
An assessment of mine waste disposal alternatives for the Osisko Hammond Reef Gold Project (the Project) is required under Environment Canada's Guidelines for the Assessment of Alternatives for Mine Waste Disposal (the Guidelines) (Environment Canada 2011). In order to appropriately meet the requirements of these guidelines as they relate to waste disposal, the structure of Section 4.3 differs from the Sections above. The Project, located in northern Ontario, will include a Tailings Management Facility (TMF) and a Waste Rock Management Facility (WRMF), both of which may impact natural water bodies frequented by fish and may need to be designated as Tailings Impoundment Areas (TIAs)<sup>1</sup> per Schedule 2 of the Metal Mining Effluent Regulations (MMER).

The objective of the mine waste alternatives assessment is to effectively evaluate and identify the most appropriate methods and locations for disposal of mine waste based on various environmental, technical, economic and socio-economic considerations. The preferred facility alternatives should result in minimal net effects on the environment and be technically sound and economical.

In accordance with the Guidelines, a Multiple Accounts Assessment (MAA), a decision matrix method of analysis, was used to evaluate TMF and WRMF alternatives and select the preferred facilities for the Project. This type of analysis allows for transparency in the decision making process. The mine waste disposal alternatives assessed in the Mine Waste Disposal Alternatives Assessment Report for the selection of the TMF site and the waste rock stockpile site are listed in Table 4-3 and shown on Figures 4-6 and 4-7, respectively. A description, characterization and qualitative/quantitative assessment of each alternative are summarized in the following sections and provided in detail in the Alternatives Assessment Report, and Appendix 4.I of the Alternatives Assessment Report - the Mine Waste Disposal Alternatives Assessment Report.

<sup>1</sup> The term Tailings Impoundment Area (TIA) refers to a natural water body frequented by fish into which tailings, waste rock, and any effluent that contains any concentration of the deleterious substances specified in the Metal Mining Effluents Regulations (MMER), and of any PH, are disposed (Environment Canada 2011).





**LEGEND**

- ▲ Effluent Discharge Point
- Freshwater Intake - Camp Site Potable
- Freshwater Intake - Process and Plant Potable
- Possible Route for Water Intake or Discharge Line
- Index Contour (5m interval)
- Ditch
- Marsh/Swamp
- River/Stream
- Road
- Trail
- Lake
- Wetland

**Water Discharge Location Alternatives**

- Alternative 1 - Underwater Pipeline with Discharge to Lynthead Bay Narrows
- Alternative 2 - Overland Pipeline with Discharge to Lynthead Bay
- Alternative 3 - Overland Pipeline to the Northwest with Discharge into the Central Portion of Sawbill Bay
- Alternative 4 - Overland Pipeline to the South with Discharge to the South End of Sawbill Bay (Preferred Alternative)

**Low-Grade Ore Stockpile**

- Only Alternative

**Waste Rock Stockpile Alternatives**

- Alternative 1
- Alternative 2
- Alternative 3 (Preferred Alternative)

- Mine Site Road
- Access Road
- Project Transmission Line
- Tailing Pipeline Alignment
- Project Facilities

**REFERENCE**

Base Data - Provided by OSISKO Hammond Reef Gold Project Ltd.  
 Base Data - MNR NRVIS, obtained 2004  
 Produced by Golder Associates Ltd under licence from Ontario Ministry of Natural Resources, © Queens Printer 2008  
 Projection: Transverse Mercator Datum: NAD 83 Coordinate System: UTM Zone 15N

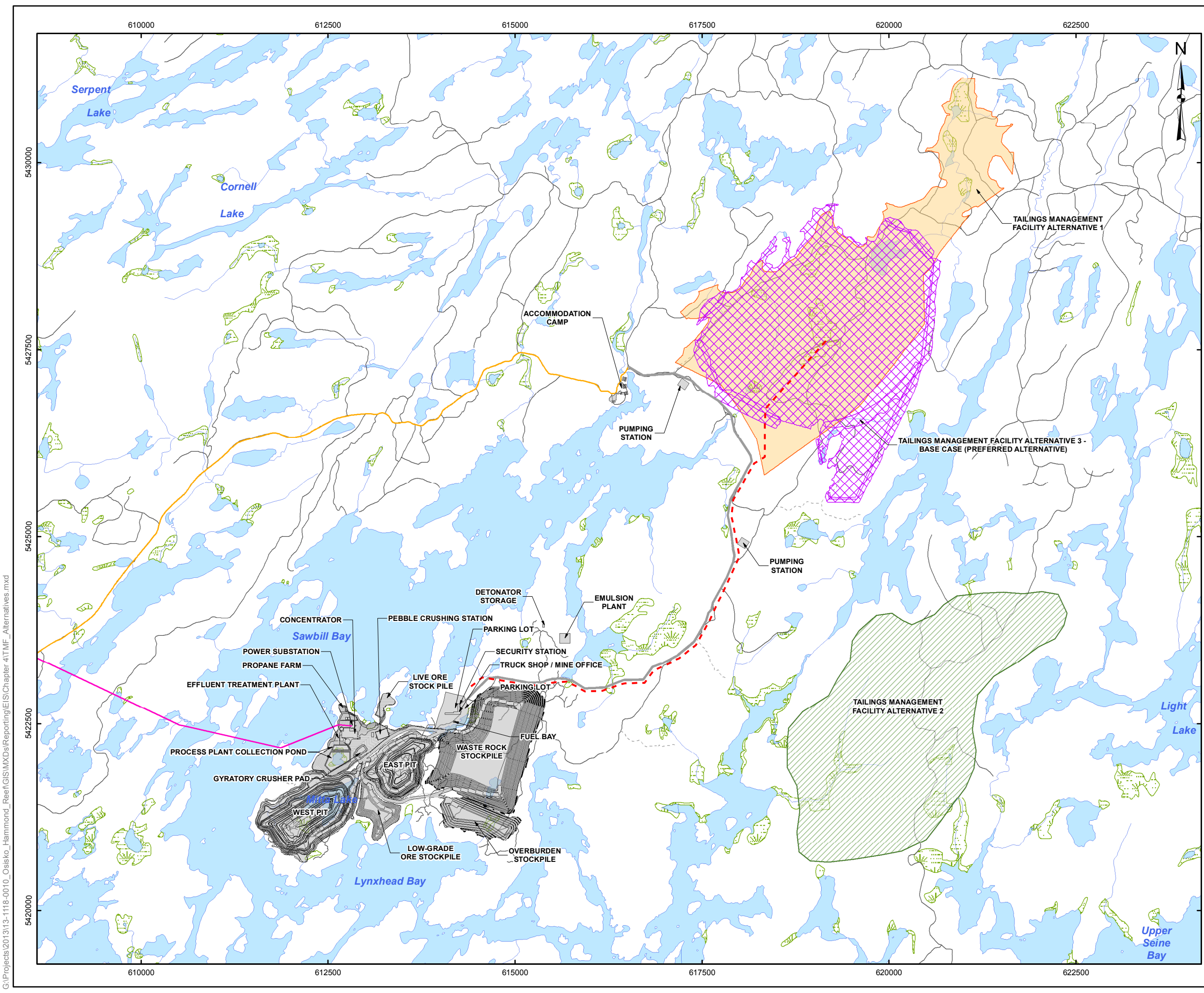


PROJECT		HAMMOND REEF GOLD PROJECT ATIKOKAN, ONTARIO, CANADA	
TITLE		WASTE ROCK MANAGEMENT FACILITY SITING ALTERNATIVES	
 Golder Associates Mississauga, Ontario	PROJECT NO.	13-1118-0010	SCALE AS SHOWN
	DESIGN	CGE 14 Nov. 2008	VERSION 2
	CHECK	SP 2 Dec. 2013	<b>FIGURE: 4-6</b>
	REVIEW	SP 2 Dec. 2013	

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**LEGEND**

- Road
- River/Stream
- Lake
- Wetland

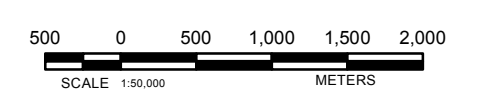
**Tailings Management Facility Alternatives**

- Alternative 1
- Alternative 2
- Alternative 3 - Base Case (Preferred Alternative)

- Tailings Pipeline Alignment
- Mine Site Road
- Access Road
- Project Transmission Line
- Project Facilities

**REFERENCE**

Base Data - Provided by OSISKO Hammond Reef Gold Project Ltd.  
 Base Data - MNR NRVIS, obtained 2004  
 Produced by Golder Associates Ltd under licence from Ontario Ministry of Natural Resources, © Queens Printer 2008  
 Projection: Transverse Mercator Datum: NAD 83 Coordinate System: UTM Zone 15N



PROJECT		HAMMOND REEF GOLD PROJECT ATIKOKAN, ONTARIO, CANADA	
TITLE		TAILINGS MANAGEMENT FACILITY SITING ALTERNATIVES	
 Mississauga, Ontario	PROJECT NO. 13-1118-0010	SCALE AS SHOWN	VERSION 2
	DESIGN	CGE	14 Nov. 2008
	GIS	JO	2 Dec. 2013
	CHECK	SP	2 Dec. 2013
	REVIEW	SP	2 Dec. 2013

**FIGURE: 4-7**

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The assessment procedure follows Environment Canada's (2011) guidelines which describe a seven-step approach, as follows:

- Step 1: Identify candidate alternatives.
- Step 2: Pre-screening assessment.
- Step 3: Alternative characterization.
- Step 4: Multiple Accounts Ledger.
- Step 5: Value-based decision process.
- Step 6: Sensitivity analysis.
- Step 7: Document results.

The candidate alternatives and pre-screening (Steps 1 and 2) are described in this section, below. Section 4.3.1 and 4.3.2 describe the approach to the alternative characterization (Step 3) and multiple accounts Ledger (Step 4), while Section 4.3.3 provides additional detail on how stakeholders were engaged in order to evaluate the various options. Each of the waste facilities are then evaluated with respect to the Value-based decision process (Step 5), a sensitivity analysis (Step 6), as documented in Section 4.3.4 (Waste Rock) and 4.3.5 (Tailings) respectively (Step 7).

Steps 1 and 2 of the assessment of the Project's mine waste disposal alternatives were completed during the ToR development and approval process. An additional alternative waste rock stockpile location was subsequently identified during the advancement of site layout and mine planning work. Finally, during the comment period for the draft EIS/EA report, Environment Canada proposed another alternative WRMF because it was perceived to have limited impact to aquatic habitat. The results of the alternatives identification and pre-screening process are the alternatives shown in Table 4-3.

**Table 4-3: Mine Waste Disposal Alternatives Assessed for the Hammond Reef Gold Project**

<b>Project Aspect</b>	<b>Alternatives to Be Assessed</b>
Tailings Management Facility siting	Tailings Management Facility Alternative 1
	Tailings Management Facility Alternative 2
	Optimized Base Case (TMF Alternative 3)
Waste Rock Stockpile Siting	Waste rock stockpile 1
	Waste rock stockpile 2
	Waste rock stockpile 3
	Waste rock stockpile 4 (suggested by EC)

The Environment Canada (2011) guidelines suggest that at least one of the alternatives for each project constituent should be "dry land" alternative, which is one that does not impact a natural water body that is frequented by fish. The physical size requirements of both the TMF and the waste rock stockpile combined with the abundant and frequent fish-bearing water bodies that exist throughout the regional setting within a reasonable distance of the Project Site made it impossible to identify a dry land alternative of sufficient size

without incurring significant costs that would undermine the Project's feasibility. Care was taken, however, to identify alternatives that would minimize the impact on natural water bodies frequented by fish. The degree of impact of each alternative was evaluated in the assessment, as required.

### 4.3.1 Alternative Characterization

To transition towards the next steps of the evaluation process, it is necessary to characterize the mine waste disposal alternatives. Characterization criteria for the Project alternatives are categorized into the four broad groups or "accounts" identified below. Accounts are then sub-divided into more focused components that are described in the following sections.

- *Environmental* – This account focuses on characterizing the environment surrounding the alternatives including considerations such as hydrology, hydrogeology, water quality, air quality and potential impacts to aquatic, terrestrial and bird life.
- *Technical* – This account focuses on engineering considerations such as foundations conditions, dam size and volume, water management requirements, pipeline and haul road routes and lengths and closure design.
- *Economic* – This account focuses on potential costs including capital and operational costs, and costs for fish habitat compensation and closure.
- *Socio-economic* – This account focuses on influences to local and regional land users including considerations such as aesthetics, the presence of archaeological sites, land claims and effects to land uses such as hunting, fishing and tourism.

### 4.3.2 Multiple Accounts Assessment

A multiple accounts assessment (MAA) is used to compare the waste disposal facility alternatives. The MAA employs a multi-level assessment approach beginning with broad generalized characterization *accounts* (as described in Section 4.3.1, Step 3 – Alternative Characterization). Accounts are further broken down into specific *sub-accounts*, and measurable *indicators*. The MAA decision making tool is used to identify elements that differentiate alternatives and provide a basis for quantifying assessment considerations through a weighting and scoring system.

Sub-accounts are used to assess a specific consideration within the broader account. An example of a sub-account is the *Aquatic Habitat* within the *Environmental* account. Sub-accounts should be differentiating, meaning they demonstrate distinction amongst the alternatives.

In order to assess and compare the sub-accounts, measurable attributes, called *indicators*, are assigned to each sub-account. Indicators allow for the qualitative or quantitative measurement of factors associated with the sub-accounts. Indicators are focused, specific components that represent their respective parent sub-account. An example of an indicator is the *Permanent Streams Impacted* within the *Aquatic Habitat* sub-account.

### **4.3.3 Public, Aboriginal and Government Consultation**

Public, Aboriginal and government groups were engaged on the subject of alternatives assessment and selection, including mine waste alternatives on an ongoing basis. Chapter 7 details Project Public Consultation and Aboriginal Engagement and provides a full summary of activities, including meeting notes and information materials.

A summary of the meetings and discussions regarding Alternatives that took place with Public, Government and Aboriginal groups is provided below.

#### **4.3.3.1 Public**

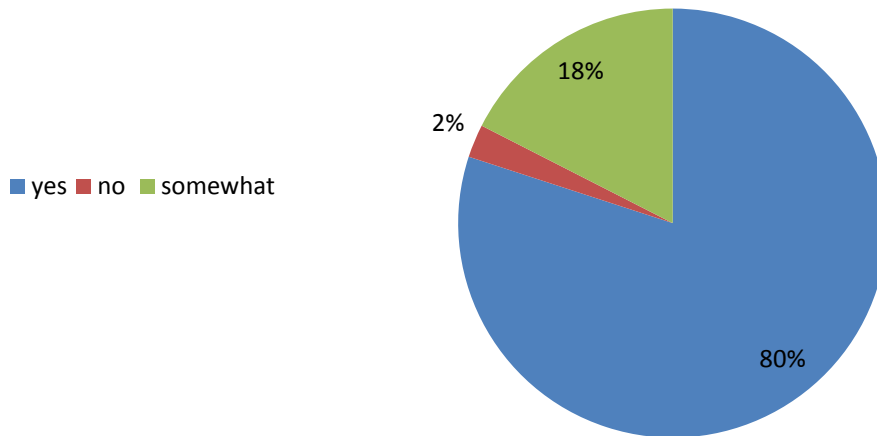
A Community News Brief has been published on a biweekly basis since November 2010. Examples of publication titles which touched on the topic of Project alternatives and the results of the assessment include:

- Project Phases and Schedule
- Working out the Project Details
- Waste Rock
- Tailings Management and Reclamation
- Sharing the Results of the Environmental Assessment
  - Hydrogeology
  - Hydrology
  - Terrestrial Biology
  - Aquatic Biology
  - Water Quality
  - Atmospheric
- Environmental Assessment – Considering Comments and Finalizing the Report

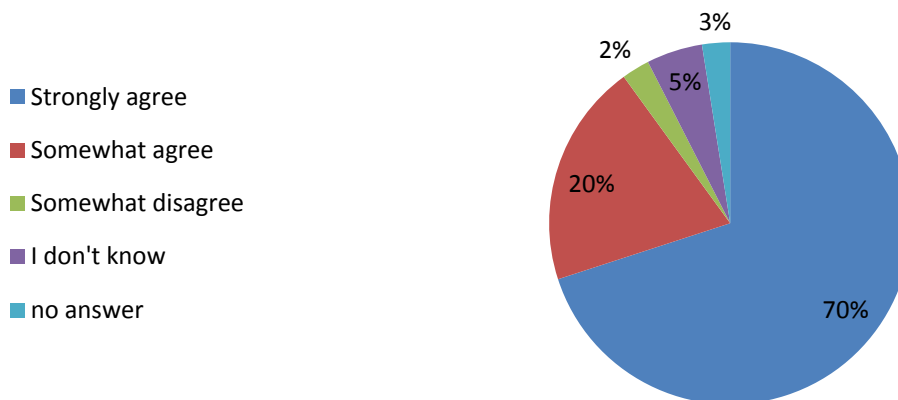
Five Community Open Houses have been held from February 2011 to April 2013. The Community Open Houses include sharing information about the Project description, alternatives and the results of the assessment. Project details were also shared with a variety of community groups, including high school students, seniors, tourist outfitters and the local fishing and hunting club.

The most recent feedback received from public comment forms indicate a strong understanding of the Project details, and support for the Project moving forward. The pie charts below show the responses provided by members of the Public who attended the Open House on April 3, 2013 in Atikokan. Eighty percent of the 40 people who completed a comment form feel up to date on the status of the Hammond Reef Project and 90 percent feel confident in Osisko's environmental management plans.

### I feel up to date on the status of the Hammond Reef Gold Project



### I am confident that Osisko's plan will minimize environmental impacts from the Project



OHRG is committed to ongoing consultation with the Public as detailed in Chapter 8, should the Project go forward, a Town Committee will be formed to ensure ongoing information sharing and community involvement in the Project.



### 4.3.3.2 Government

Several hundred written comments were received from the Government Review Team following the publication of the Draft EIS/EA Report.

Approximately 35 of these comments included questions on alternatives, mostly requesting further detail and requesting a stronger link to the regulatory requirements. Comments on the alternatives assessment were provided by the following regulatory agencies:

- Ministry of Environment, EAB
- Canadian Environmental Assessment Agency
- Ministry of Natural Resources
- Environment Canada

Written responses to all comments were provided in draft form to agencies for discussion at scheduled meetings. Formal written responses will be provided to agencies and published as part of the Final EIS/EA Report.

Mine waste alternatives were a specific area of concern for Environment Canada. OHRG travelled to Gatineau to meet with Environment Canada regarding this topic on July 23, 2013. Subsequent correspondence to the meeting outlined Environment Canada's specific requests for report revisions.

Environment Canada requested that OHRG undertake a more detailed mine waste alternatives assessment by including additional sub-accounts and indicators in the multiple accounts analysis. Environment Canada provided a detailed list of suggested sub-accounts and indicators for Environment, Economic and Socio-Economic accounts. OHRG incorporated all these revisions to the report as summarized in Table 4-4 below.

**Table 4-4: Indicators Added to the Assessment based on Consultation with the Government Review Team**

Account or Sub-Account	Suggested Indicator	Added to Assessment?
Terrestrial Habitat	Impact on terrestrial flora and fauna	Yes
	Potential effects on wildlife	Yes
	Potential effects on bird habitat	Yes
Aquatic Habitat	Permanent streams impacted	Yes
	Ephemeral streams impacted	Yes
	Indirect impacts such as downstream flow reductions	Yes (indirectly through impacts to streams and fish-bearing lakes)
	Number of fish-bearing lakes affected	Yes
	Area of fish-bearing lakes affected	Yes
Economic	Capital and operating costs provided in dollars	Yes

**Table 4-4: Indicators Added to the Assessment based on Consultation with the Government Review Team (Continued)**

Account or Sub-Account	Suggested Indicator	Added to Assessment?
Socio-Economic	Aboriginal and Public Perception/Opinion	Considered on an ongoing basis without including in accounting format. Detailed in Chapter 7 of the EIS/EA Report and Section 2.5 of this report.
	Effects on land use such as hunting, fishing and tourism	Yes
Technical	Seismic risks	Considered to be non-distinguishing

### 4.3.3.3 *Aboriginal*

The Community News Brief has been published in the Wawatay Times on a biweekly basis since spring 2012 and hard copies have been sent to the First Nations band offices.

During the period from February 2011 to April 2013, OHRG has given presentations to the FFCS (10 meetings), LDMLFN (8 meetings) and MNO Region 1 Consultation Committee (7 meetings).

OHRG visited each First Nations community and shared the Project details, alternatives and conclusions presented in the EIS/EA Report. Community feasts were held with the 4 Metis communities to share project details. Feedback received from Aboriginal communities regarding alternatives and mine waste tailings alternatives were considered in the assessment. Information provided by Aboriginal groups that informed Project design and alternative selection included:

- Identification of fish habitat
- Identification of sacred sites
- Avoidance of siting tailings in important lake on trap line = Lizard Lake
- Agreement with trap line holder

Throughout communications and engagement events OHRG has heard many concerns about potential long term effects of the Project on the environment. Although the focus of these comments is often expressed through the importance of the whole and interconnected environment, the following specific environmental concerns have been stated in writing by identified Aboriginal communities.

These concerns are identified in Table 4-5 which also shows the corresponding MAA account/sub-account that addresses the concern.

**Table 4-5: Aboriginal Community Concern Concordance Table with MAA account/sub-account**

Community	Concern	Corresponding MAA (Account/Sub-account)
Seine River First Nation	Water Quality	Environment/Water Resources
	Aquatic biology	Environment/Aquatic Habitat

**Table 4-5: Aboriginal Community Concern Concordance Table with MAA account/sub-account  
(Continued)**

<b>Community</b>	<b>Concern</b>	<b>Corresponding MAA (Account/Sub-account)</b>
Seine River First Nation (Continued)	Terrestrial Biology	Environment/Terrestrial Habitat
	Hydrology	Environment/Water Resources
	Closure Planning	Technical/Closure
Naicatchewenin First Nation	Tailings and water management	Technical/Water Management & Technical/Complexity of Design and Construction
	Water quality	Environment/Water Resources
Mitaanjigamiing First Nation	Ground water	Environment/Water Resources
	Mitta Lake	Environment/Aquatic Habitat
	Air Quality	Environment/Air Quality
Lac des Mille Lacs First Nation	Mitta Lake	Environment/Aquatic Habitat
	Water management	Technical/Water Management
	Ore processing	Not included in Mine Waste Disposal Assessment – Considered in Alternative Means for the Project in Chapter 4
	Tailings management	Technical/Complexity of Design and Construction
Metis Nation of Ontario	Mitta Lake	Environment/Aquatic Habitat
	Aquatic biology	Environment/Aquatic Habitat
	Terrestrial biology	Environment/Terrestrial Habitat
	Socio-economics	Socio-economics/Effects on Land Use
	Traditional Use Study	Socio-economics/Archaeology & Socio- economics/Effects on Land Use
	Closure planning	Technical/Closure
	Project Alternatives	
	Transmission line	Not included in Mine Waste Disposal Assessment – Considered in Alternative Means for the Project in Chapter 4
	Workers camp	Not included in Mine Waste Disposal Assessment – Considered in Alternative Means for the Project in Chapter 4
	Ore Processing	Not included in Mine Waste Disposal Assessment – Considered in Alternative Means for the Project in Chapter 4
	Tailings management	Technical/Complexity of Design and Construction
	Harvesting access	Socio-economics/Effects on Land Use
	Community consultation	Not included in Mine Waste Disposal Assessment – Considered in Chapter 7
EA Methods	Not included in Mine Waste Disposal Assessment – Considered in Chapter 2	

OHRG is committed to ongoing consultation with Aboriginal groups as detailed in Chapter 8. OHRG has formed four Resource Sharing Committees with the First Nations who are signatories to the Resource Sharing Agreement. Technical working groups will also be formed with the Metis Nation of Ontario should the Project proceed and move on towards construction. Ongoing engagement with Aboriginal communities will ensure they are involved in the Project planning process as it moves forward.

The active and ongoing participation of the Aboriginal, public and government in the project planning process is a key aspect of the EA Process. OHRG's commitment towards ongoing engagement with Aboriginal communities and the public through information sharing and formation of committees is directly tied to the environmental assessment process, and our commitments are outlined in Chapter 8 Social Management and Chapter 9 Commitments Table of the EIS/EA Report.

#### **4.3.4 Waste Rock Management Facility Siting**

The Project is expected to generate approximately 260 million tonnes of waste rock during the life of mine. Waste rock from the east and west pits is estimated to be approximately 132 million cubic metres. About 16.1 million tonnes of waste rock will be deposited in the west pit during the later stages of mining. During operations, waste rock will either be used for construction or placed in a WRMF.

The WRMF will be designed with conservative side slopes (about 2.5H:1V) with bench configurations and stockpile heights that are stable, while providing the required storage volume.

The selection of candidate locations was based on consideration of terrain, available space and the distance of the site to the mine pits. A 7 km radius from the centroid of the mine pits was considered as a spatial boundary for identifying candidate alternatives and locations not directly accessible by haul truck (i.e., across Marmion Reservoir) were not considered viable. Beyond the spatial boundary of 7 km, it was considered that the costs required to haul waste rock from the mine pits to the WRMF would render the project uneconomical.

The results of the preliminary screening process described in the ToR identified two WRMF alternatives (i.e., Alternatives 1 and 2), as shown on Figure 4-6. As a result of advancement of the Site Layout and mine planning work, an additional alternative (Alternative 3) for the WRMF was identified. As the proposed overburden stockpile abuts the Alternative 3 WRMF, the footprint of the WRMF includes the overburden stockpile area. Finally, during the comment period for the draft EIS/EA report, Environment Canada proposed another alternative WRMF because it was perceived to have limited impact to aquatic habitat.

The WRMF alternatives have been characterized with respect to the environmental, technical, economic and social accounts described in Section 4.3.1 to 4.3.3. A multiple accounts ledger was generated in which the sub-accounts and indicators have been used as a framework for characterizing the alternatives. The alternative characterization considers the entire Project life cycle from construction through closure.

The multiple accounts ledger (Step 4) was developed for each alternative in which each account was further broken down into sub-accounts that reflect the material impact (i.e., benefit or loss) associated with the alternative being evaluated. The sub-accounts were measured through indicators. The multiple accounts ledger sought to identify those elements that differentiated alternatives and provided the basis for scoring and weighing the alternatives in Step 5 of the assessment, known as the value-based decision process.



The multiple accounts ledger for the WRMF alternatives is provided in Tables 4-6 to 4-9 below. The indicator quantities for each alternative and the qualitative value scales that determined the indicator quantities are provided in the Alternatives Assessment Report.

#### 4.3.4.1 Environmental Account

The environmental account encompasses a range of issues pertaining to the direct and indirect effects to the environment as a result of developing the WRMF alternatives. The environmental account, sub-accounts, indicators, and metrics for each indicator are summarized in Table 4-6.

**Table 4-6: Environmental MAA**

Account	Sub-Account	Indicator	Metric	Unit
Environmental	Terrestrial Habitat	Impact on flora and fauna due to WRMF infrastructure	Haul road footprint length	m
		Impact on flora and fauna due to WRMF footprint	WRMF footprint area	km <sup>2</sup>
		Effects on wildlife	Distance from mine pits	km
		Effects on bird habitat	Qualitative Rank	-
	Water Resources	Impact on surface water	Number of watersheds affected	#
		Ability to limit impact on Sawbill Bay and Lynxhead Bay	Qualitative Rank	-
		Impact to groundwater	Number of collection ponds required	#
	Aquatic Habitat	Number of stream crossings by haul road	Value	#
		Permanent streams impacted	Length of stream impacted	M
		Ephemeral Streams Impacted	Length of stream impacted	M
		Number of fish-bearing lakes affected	Value	#
		Area of fish-bearing lakes affected	Area	Ha
	Air Quality	Potential for dust generation	Life of Mine Dust Emissions	M-Kg
		Potential for greenhouse gas emission	Life of Mine CO <sub>2</sub> Emissions	tonnes
	Noise	Haul road distance	Length of haul roads	M

#### 4.3.4.2 Technical Account

The technical account assesses the technical merits of the alternatives. The account considers the full life cycle of the Project life (construction, operation, and closure). The technical sub-accounts, indicators, and metrics for each indicator are summarized in Table 4-7.

**Table 4-7: Technical MAA**

Account	Sub-Account	Indicator	Metric	Unit
Technical	Complexity of Design and Construction	Foundation conditions	Qualitative Rank	-
		Topography containment	Qualitative Rank	-
		Maximum height	Maximum height of stockpile	m
		Potential impact to other infrastructure	Qualitative Rank	#
	Water Management	Number of potential collection ponds required	Value	#
		Seepage collection ditches	Length of seepage collection ditches	km
	Closure	Complexity of closure	Slope Area	#

#### 4.3.4.3 Economics Account

The economics account considers issues pertaining to the direct and indirect costs associated with the development of the alternatives. The economic sub-accounts, indicators, and metrics for each indicator are summarized in Table 4-8.

**Table 4-8: Economics MAA**

Account	Sub-Account	Indicator	Metric	Unit
Economics	Capital Cost	Total estimated capital cost	Dollar value	\$
	Operating Cost	Total estimated operational costs per year	Dollar value per year	\$/year
	Closure Cost	Total estimated closure cost	Dollar value	\$
	Fish Habitat Compensation	Total estimated fish habitat compensation cost	Dollar value	\$

#### 4.3.4.4 Socio-Economics Account

The socio-economic account addresses the social and cultural impacts of each WRMF siting alternative. The socio-economic sub-accounts, indicators, and metrics for each indicator are summarized in Table 4-9.

**Table 4-9: Socio-economics MAA**

Account	Sub-Account	Indicator	Metric	Unit
Socio-Economics	Archaeology	Effects on cultural heritage sites	Number of areas with archaeological potential	#
	Visual Impacts	Maximum height of stockpile	Height	M
		Minimum Distance from Marmion Reservoir	Length	M
	Land Claims	Number of known claims	Value	#
	Effects on Land Use	Effects on hunting	Number of trap lines, trapper cabins and/or bear baiting stations	#
		Effects on fishing	Number of fish bearing lakes and/or permanent streams	#

#### 4.3.4.5 Non-differentiating Indicators

The following indicators were considered to be non-differentiating between alternatives, thereby providing no value or merit if included in the MAA. This section demonstrates that these indicators were considered, assessed and ultimately omitted from the in-depth MAA.

##### 4.3.4.5.1 Potential for Acid Rock Drainage

Geochemical testing has shown that the waste rock produced is non-acid generating with excess neutralizing potential and that sulphide concentrations are generally very low. The potential for acid rock drainage is independent of WRMF site selection and has been considered to be a non-distinguishing characteristic for WRMF site selection and is not included in the MAA.

##### 4.3.4.5.2 Potential for Metal Leaching

Geochemical testing has shown that the waste rock produced will have limited potential for metal leaching. The potential for metal leaching is independent of WRMF site selection and has been considered to be a non-distinguishing characteristic for WRMF site selection and is not included in the MAA.

##### 4.3.4.5.3 Seismic Risks

The geotechnical properties pertaining to seismic risk do not vary from one alternative WRMF site to another. The inherent risk of seismic activity within the Hammond Reef mine site area is very low according to the Global Seismic Hazard Map produced by the Global Seismic Hazard Assessment Program. Therefore, seismic hazards are not anticipated for any of the evaluated alternatives and are not considered in the MAA.

##### 4.3.4.5.4 Impacts on Protected Areas and Conservation Lands

The EIS Guidelines indicate that protected areas and conservation lands are areas that are designated by federal, provincial or municipal jurisdictions as ecologically or historically important. These designated areas include wilderness areas, parks, and sites of historical or ecological significance, nature reserves, and federal

migratory bird sanctuaries. There are neither lands designated as protected areas nor conservation lands within any of the alternative WRMF footprints.

A value-based decision process (Step 5) was applied using quantitative analyses to determine the relative merit ratings and final ranking of each alternative. Each alternative was evaluated and assigned a score under each indicator. Weighting factors were then introduced to weight the relative importance of each account, sub-account and indicator. The scoring and weighting systems are detailed in the Mine Waste Disposal Alternatives Assessment. A sensitivity analysis was carried out to eliminate potential bias and subjectivity that is inherent in the evaluation and weighting process. The sensitivity analysis evaluates the influence of the selected account, sub-account and indicator weighting on the alternative ranking results by varying the assigned weightings.

The sensitivity analysis considered the following scenarios:

- 1) **Base Case:** Account weightings were selected based on the recommendations of the Guidelines (environmental account weighted 6, technical account weighted 3, economic account weighted 1.5 and socio-economic account weighted 3). Sub-account and indicator weighting was selected based on input from technical and environmental experts.
- 2) **Sensitivity Case 1:** Same as the base case but with the economics account removed (i.e., economics account weighting equal to zero).
- 3) **Sensitivity Case 2:** Same as the base case but only the environmental and socio-economic accounts considered (i.e., economics and technical account weightings are equal to zero).
- 4) **Sensitivity Case 3:** Same indicators and sub-account weighting as the base case and all accounts weighted equally.
- 5) **Sensitivity Case 4:** All weighting factors (i.e., accounts, sub-accounts, indicators) weighted equally

The detailed assessment results for all cases are provided in the Mine Waste Disposal Alternatives Assessment Report. The final results and rankings of the base case and sensitivity cases are presented in Table 4-10.

**Table 4-10: Base Case and Sensitivity Analysis Results**

Sensitivity Case		WRMF 1	WRMF 2	WRMF 3	WRMF 4
Base Case	Guideline recommended account weighting	3.1	3.9	4.2	3.6
Sensitivity Case 1	Economics removed	3.2	4.0	4.2	3.8
Sensitivity Case 2	Only environmental and socio-economic accounts considered	3.0	4.2	4.3	3.7
Sensitivity Case 3	All accounts weighted equally	3.2	3.8	4.2	3.5
Sensitivity Case 4	All weighting factors (i.e., accounts, sub-accounts, indicators) weighted equally	3.3	3.8	4.1	3.9



Based on the results of the analyses, the waste rock stockpile alternative with the highest ranking is WRMF 3, and is therefore regarded as the preferred alternative. The factors that contributed to WRMF 3 attaining the highest score are its smaller footprint and hence least biophysical impacts, proximity to the open pits, and lowest life of mine costs.

#### **4.3.5 Tailings Management Facility Siting**

The tailings management facility (TMF) is a facility to store waste produced by processing the ore. The project is expected to generate approximately 165 million cubic metres of tailings over the life of the project. Thickened tailings will be hydraulically transported from the processing facility to the TMF where the tailings will be contained through natural (topographic) containment, constructed perimeter dams or a combination of both.

The perimeter containment dams will be designed to comply with the Canadian Dam Association (CDA) Dam Safety Guidelines (CDA 2007). The containment dams will be designed to have sufficient freeboard above the elevations of adjacent tailings beaches to contain extreme precipitation events and the TMF will be equipped with an Emergency Spillway to prevent the overtopping of the perimeter containment dams.

The perimeter containment dams will be constructed of rockfill and designed with transition/filter zones to prevent piping or internal erosion (e.g., migration of tailings particles). In the case of low-permeability starter dams, seepage will be reduced using a geomembrane liner. An external seepage collection system with pump stations will collect and return any seepage back into the TMF.

At closure, exposed tailings beaches will be revegetated and erosion protection will be placed in drainage ditches will be upgraded where required. Runoff from the revegetated tailings surface is expected to eventually be suitable for discharge without treatment. After the water quality of the runoff from revegetated surface meets discharge criteria, the TMF reclaim pond will be lowered by reducing the spillway invert and flows will be released to the environment.

The identification of candidate TMF siting alternatives was carried out and documented in January 2012 as an Appendix to the Hammond Reef Terms of Reference (ToR). Five on-site locations (i.e., located within the Osisko mining claims) as well as one off-site location were considered as possible locations for the TMF. The candidate locations were selected based on considerations such as the presence of suitable topography and the distance of the site from the processing plant. A 25 km radius from the processing plant was considered as a spatial boundary for identifying candidate alternatives. Beyond this distance, it was considered that the maintenance and operational costs required to pump the tailings from the plant to the TMF would render the project uneconomical.

The Hogarth Pit alternative was originally considered as an opportunity to make use of an already disturbed area, and the possible remediation of ongoing environmental liabilities. However, due to the distance of the Hogarth Pit from the Project Site, the length of pipeline required (approximately 30 km), the extensive site characterization that would be required, and the long term liabilities and security issues involved, this alternative was excluded from further consideration. Implementation of the Hogarth Pit alternative for tailings storage would make the Project unfeasible.

Three TMF alternatives were considered to be viable alternatives through the pre-screening assessment and have been carried forward for assessment using the MAA and value based decision making process. The base case as presented in the ToR has been subsequently revised to take further advantage of the natural

topography in the area and minimize dam volumes, capital costs, and improve protection of the environment by increasing setbacks from Lizard Lake. However, the revised footprint impacts a small unnamed waterbody (identified as API #2) which is a fish-bearing water body thereby increasing the compensation requirements for the Project. The Tailings Management Facility Siting Alternatives carried forward for assessment in the MAA are shown on Figure 4-7.

The TMF alternatives have been characterized with respect to the environmental, technical, economic and social accounts described in Section 4.3.1. A multiple accounts ledger was generated in which the sub-accounts and indicators have been used as a framework for characterizing the alternatives. The alternative characterization considers the entire Project life cycle from construction through closure.

A multiple accounts ledger (Step 4) was developed for each alternative in which each account was further broken down into sub accounts that reflect the material impact (i.e., benefit or loss) associated with the alternative being evaluated. The sub accounts were measured through indicators. The multiple accounts ledger sought to identify those elements that differentiated alternatives and provided the basis for scoring and weighing the alternatives in Step 5 of the assessment, known as the value based decision process.

The multiple accounts ledger for the TMF alternatives is provided in Tables 4-11 to 4-14 below. The indicator quantities for each alternative and the qualitative value scales that determined the indicator quantities are provided in the Mine Waste Disposal Alternatives Assessment Report.

### 4.3.5.1 Environmental Account

The environmental account encompasses a range of issues pertaining to the direct and indirect effects to the environment as a result of developing the TMF alternatives. The environmental sub-accounts, indicators, and metrics for each indicator are summarized in Table 4-11.

**Table 4-11: Environmental MAA**

Account	Sub-Account	Indicator	Metric	Unit
Environmental	Terrestrial Habitat	Impact on flora and fauna due to TMF infrastructure	Length of tailings pipeline	km
		Impact on flora and fauna due to TMF footprint	TMF footprint area	ha
		Percentage of pipeline following existing road	Percent	%
		Effects on wildlife	Qualitative Rank	-
		Effects on birds	Qualitative Rank	-
	Aquatic Habitat	Number of stream crossings by tailings pipeline	Value	#
		Permanent streams impacted	Length of stream impacted	m
		Ephemeral streams impacted	Length of stream impacted	m
		Number of fish-bearing lakes affected	Value	#
		Area of fish-bearing lakes affected	Area	ha
	Water Resources	Impact on surface water	Number of watersheds affected	#
		Ability to limit impact to water quality in surrounding water bodies	Qualitative Rank	-
		Impact to groundwater	Number of collection ponds required	#
	Air Quality	Potential for dust generation	Tailings surface area	ha
Potential for greenhouse gas emission due to construction		Distance from waste rock stockpile	km	

### 4.3.5.2 Technical Account

The technical account assesses the technical merits of the alternatives. The account considers the full life cycle of the Project life (construction, operation, and closure). The technical sub-accounts, indicators, and metrics for each indicator are summarized in Table 4-12.

**Table 4-12: Technical MAA**

Account	Sub-Account	Indicator	Metric	Unit
Technical	Complexity of Design and Construction	Foundation conditions	Qualitative Rank	-
		Topography containment	Dam fill volume	-
		Pumping requirements	Tailings pipeline length	m
		Percentage of pipeline following existing road	Percent	%
		Tailings pipeline length	Length	m
		Geotechnical Risk	Maximum height of dams	m
		Dam hazard classification	Dam Class based on CDA Dam Safety Guidelines	-
	Water Management	Net run-off from tailings area	Area of tailings	ha
		Number of collection ponds required	Value	#
		Seepage collection ditches	Length of seepage collection ditches	km
Closure	Complexity of closure	Qualitative Rank	-	

### 4.3.5.3 Economics Account

The economics account considers issues pertaining to the direct and indirect costs associated with the development of the alternatives. The economic sub-accounts, indicators, and metrics for each indicator are summarized in Table 4-13.

**Table 4-13: Economics MAA**

Account	Sub-Account	Indicator	Metric	Unit
Economics	Capital Cost	Total estimated capital cost	Dollar value	\$
	Operating Cost	Total estimated annual operating cost	Dollar value per year	\$/year
	Closure Cost	Total estimated closure cost	Dollar value	\$
	Fish Habitat Compensation	Total estimated fish habitat compensation cost	Dollar value	\$



#### 4.3.5.4 Socio-Economics Account

The socio-economic account addresses the social and cultural impacts of the TMF siting alternatives. The socio-economic sub-accounts, indicators, and metrics for each indicator are summarized in Table 4-14.

**Table 4-14: Socio-economics MAA**

Account	Sub-Account	Indicator	Metric	Unit
Socio-Economics	Archaeology	Effects on cultural heritage sites	Number of areas with archaeological potential	#
	Visual Impacts	Maximum height of TMF	Height	m
		Distance from Marmion Reservoir	Distance	m
	Land Claims	Number of known claims	Value	#
	Effects on Land Use	Effects on hunting	Number of trap lines, trapper cabins and/or bear baiting stations	#
		Effects on fishing	Number of fish bearing lakes and/or permanent streams	#
		Effects on tourism and recreation	Number of tourism establishments and/or known camping areas	#

#### 4.3.5.5 Non-differentiating Indicators

The following indicators were considered to be non-differentiating between alternatives, thereby providing no value or merit if included in the MAA. This section demonstrates that these indicators were considered, assessed and ultimately omitted from the in-depth MAA.

##### 4.3.5.5.1 Potential for Acid Rock Drainage

Geochemical testing has shown that the ore to be mined and the tailings produced are non-acid generating with excess neutralizing potential and that sulphide concentrations are generally very low. The potential for acid rock drainage is independent of TMF site selection and has been considered to be a non-distinguishing characteristic for TMF site selection and is not included in the MAA.

##### 4.3.5.5.2 Potential for Metal Leaching

Geochemical testing has shown that the ore to be mined and the tailings produced have limited potential for metal leaching. The potential for metal leaching is independent of TMF site selection and has been considered to be a non-distinguishing characteristic for TMF site selection and is not included in the MAA.

##### 4.3.5.5.3 Seismic Risks

The geotechnical properties pertaining to seismic risk do not vary from one alternative TMF site to another. The inherent risk of seismic activity within the Hammond Reef mine site area is very low according to the Global Seismic Hazard Map produced by the Global Seismic Hazard Assessment Program. Therefore, seismic hazards are not anticipated for any of the evaluated alternatives and are not considered in the MAA.

##### 4.3.5.5.4 Impacts on Protected Areas and Conservation Lands

The EIS Guidelines indicate that protected areas and conservation lands are areas that are designated by federal, provincial or municipal jurisdictions as ecologically or historically important. These designated areas include wilderness areas, parks, and sites of historical or ecological significance, nature reserves, and federal

migratory bird sanctuaries. There are neither lands designated as protected areas nor conservation lands within any of the alternative TMF footprints.

#### **4.3.5.6 Results and Sensitivity Analysis**

A value-based decision process (Step 5) was applied using quantitative analyses to determine the relative merit ratings and final ranking of each alternative. Each alternative was evaluated and assigned a score under each indicator. Weighting factors were then introduced to weight the relative importance of each account, sub-account and indicator. The scoring and weighting systems are detailed in the Mine Waste Disposal Alternatives Assessment. A sensitivity analysis was carried out to eliminate potential bias and subjectivity that is inherent in the evaluation and weighting process. The sensitivity analysis evaluates the influence of the selected account, sub-account and indicator weighting on the alternative ranking results by varying the assigned weightings.

The sensitivity analysis considered the following scenarios:

- 1) **Base Case:** Account weightings were selected based on the recommendations of the Guidelines (environmental account weighted 6, technical account weighted 3, economic account weighted 1.5 and socio-economic account weighted 3). Sub-account and indicator weighting was selected based on input from technical and environmental experts.
- 2) **Sensitivity Case 1:** Same as the base case but with the economics account removed (i.e., economics account weighting equal to zero).
- 3) **Sensitivity Case 2:** Same as the base case but only the environmental and socio-economic accounts considered (i.e., economics and technical account weightings are equal to zero).
- 4) **Sensitivity Case 3:** Same indicators and sub-account weighting as the base case and all accounts weighted equally.
- 5) **Sensitivity Case 4:** All weighting factors (i.e., accounts, sub-accounts, indicators) weighted equally

The detailed assessment results for all cases are provided in the Mine Waste Disposal Alternatives Assessment Report. The final results and rankings of the base case and sensitivity cases are presented in Table 4-15.

**Table 4-15: Base Case and Sensitivity Analysis Results**

<b>Sensitivity Case</b>		<b>TMF 1</b>	<b>TMF 2</b>	<b>TMF 3</b>
Base Case	Guideline recommended account weighting	3.1	3.2	<b>3.9</b>
Sensitivity Case 1	Economics removed	3.2	3.3	<b>3.9</b>
Sensitivity Case 2	Only environmental and socio-economic accounts considered	3.2	3.4	<b>4.0</b>
Sensitivity Case 3	All accounts weighted equally	3.2	3.1	<b>3.9</b>
Sensitivity Case 4	All weighting factors (i.e., accounts, sub-accounts, indicators) weighted equally	3.3	3.5	<b>4.1</b>

Based on the results of the analyses, the tailings management facility alternative with the highest ranking is TMF 3, and is therefore regarded as the preferred alternative. The factors that contributed to TMF 3 attaining the highest score are the lowest life of mine costs, absence of impacts to areas of cultural heritage and less obtrusive visual impacts during operation and post-closure.

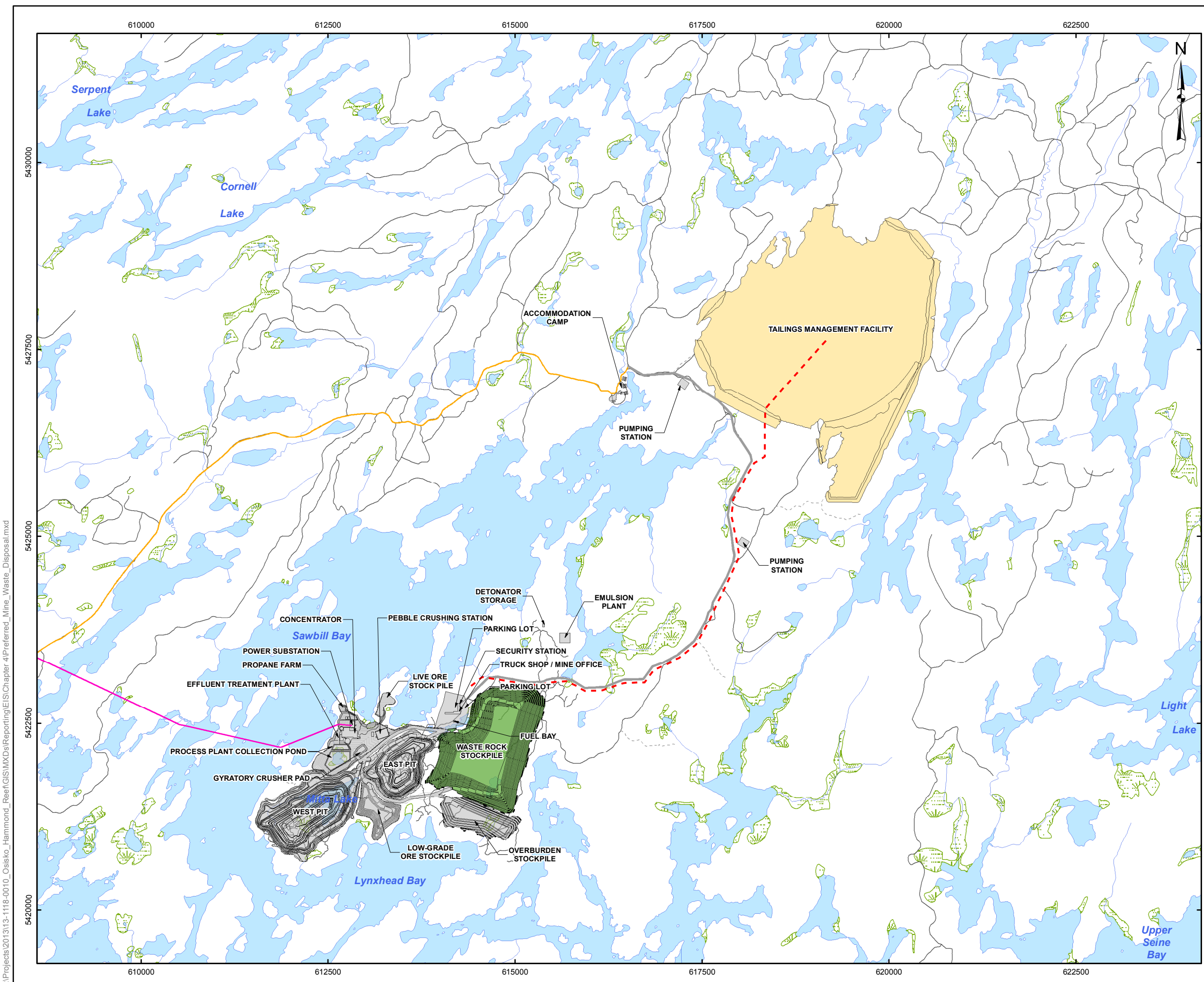
#### **4.3.6 Summary of Preferred Mine Waste Disposal Alternatives**

A full range of mine waste disposal alternatives have been examined and assessed, as presented in the Mine Waste Disposal Alternatives Assessment Report and discussed herein. Alternatives that met the Project objectives were identified in the ToR and an initial screening process was completed. The alternatives that were deemed reasonable were carried forward for further evaluation and were investigated in greater detail. A summary of the potential impacts associated with all mine waste disposal alternatives are presented in Appendix 4.I. A multiple accounts analysis including a qualitative/quantitative assessment and value-based decision process was applied to each alternative in accordance with Environment Canada's *Guidelines for the Assessment of Alternatives for Mine Waste Disposal* (Environment Canada 2011), leading to the selection of the best overall option. Figure 4-8 shows the preferred sites of all mine waste disposal facilities.



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**LEGEND**

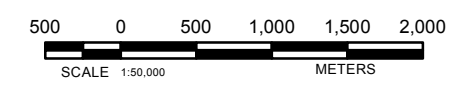
- Road
- River/Stream
- Lake
- Wetland

**Preferred Mine Waste Disposal Alternatives**

- - - Tailings Pipeline Alignment
- Waste Rock Stockpile
- Tailings Management Facility
- Mine Site Road
- Access Road
- Project Transmission Line
- Project Facilities

**REFERENCE**

Base Data - Provided by OSISKO Hammond Reef Gold Project Ltd.  
 Base Data - MNR NRVIS, obtained 2004  
 Produced by Golder Associates Ltd under licence from  
 Ontario Ministry of Natural Resources, © Queens Printer 2008  
 Projection: Transverse Mercator Datum: NAD 83 Coordinate System: UTM Zone 15N



PROJECT		HAMMOND REEF GOLD PROJECT ATIKOKAN, ONTARIO, CANADA	
TITLE		PREFERRED MINE WASTE DISPOSAL ALTERNATIVES	
PROJECT NO. 13-1118-0010		SCALE AS SHOWN	VERSION 2
DESIGN	CGE	14 Nov. 2008	
GIS	JO	2 Dec. 2013	
CHECK	SP	2 Dec. 2013	
REVIEW	SP	2 Dec. 2013	

**FIGURE: 4-8**

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A summary of the preferred alternative for each mine waste disposal constituent is as follows:

- Waste Rock Management Facility – WRMF 3, located immediately east of the open pit and mine processing plant.
- Tailings Management Facility – TMF 3, Optimized “Base Case,” located approximately 9 km northeast of the processing plant.

## 4.4 Preferred Project Alternatives

The evaluated alternatives for the project transmission line, water discharge location, access road, tailings management facility and waste rock management facility are presented together in Figure 4-9. The preferred Alternative Means of Carrying out the Project and the preferred Mine Waste Disposal Alternatives are summarized in Table 4-16.

**Table 4-16: Summary of Preferred Alternative Means of Carrying out the Hammond Reef Gold Project**

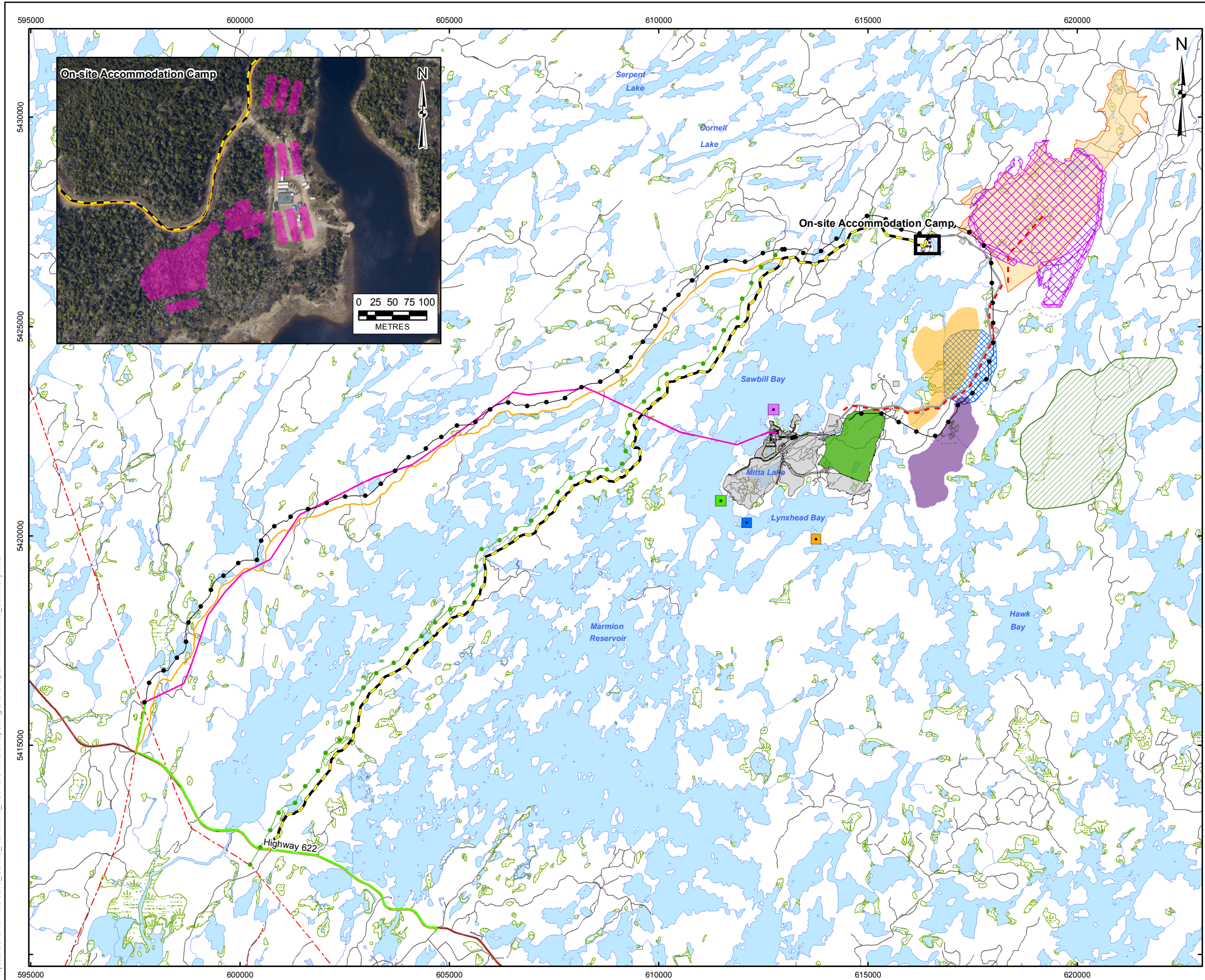
<b>Project Component</b>	<b>Preferred Alternative</b>
Ore processing method	Processing using cyanide including a cyanide destruction circuit
Project transmission line	Transmission line along Hardtack/Sawbill Road and crossing Sawbill Bay
Sewage treatment facility location	Dedicated facilities for the camp and the Mine
Sewage treatment technology	Package sewage treatment plant
Water discharge location	Overland pipeline to the south with discharge to the south end of Sawbill Bay
Access road	Hardtack/Sawbill Road
Worker accommodation	On-site worker accommodation camp
Tailings Deposition	Thickened tailings
Tailings management facility	“Optimized “Base Case”, located approximately 9 km northeast of the processing plant (TMF 3)
Waste rock management facility	Located immediately east of the open pit and mine processing plant (WRMF 3)

These alternatives comprise the proposed Project and are described in detail in Chapter 5. The physical, biological and socio-economic effects of the Project, including these alternatives, are assessed in Chapter 6.



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**LEGEND**

- Provincial Highway
- Road
- Trail
- Power Transmission Line
- Auxiliary Power Line
- River/Stream
- Lake
- Wetland

- - - Tailings Pipeline Alignment  
— Mine Site Road  
 Project Facilities  
 On-site Accommodation Camp

**Water Discharge Location Alternatives**

- Alternative 1 - Underwater Pipeline with Discharge to Lynhead Bay Narrows
- Alternative 2 - Overland Pipeline with Discharge to Lynhead Bay
- Alternative 3 - Overland Pipeline to the Northwest with Discharge into the Central Portion of Sawbill Bay
- Alternative 4 - Overland Pipeline to the South with Discharge to the South End of Sawbill Bay (Preferred Alternative)

**Access Road Alternatives**

- Alternative 1 - Hardtack / Sawbill Road (Preferred Alternative)
- Alternative 2 - Raft Lake Road

**Transmission Line Alternatives**

- Alternative 1 - Transmission Line Along Hardtack / Sawbill Road
- Alternative 2 - Transmission Line Along Raft Lake Road
- Alternative 3 - Transmission Line Along Hardtack / Sawbill Road and Crossing Sawbill Bay (Preferred Alternative)

**Waste Rock Stockpile Alternatives**

- Alternative 1
- Alternative 2
- Alternative 3 (Preferred Alternative)

**Tailings Management Facility Alternatives**

- Alternative 1
- Alternative 2
- Alternative 3 - Base Case (Preferred Alternative)
- Alternative 4

**REFERENCE**

Base Data - Provided by OSISKO Hammond Reef Gold Project Ltd.  
 Base Data - MNR NRVIS, obtained 2004  
 Produced by Golder Associates Ltd under licence from Ontario Ministry of Natural Resources, © Queens Printer 2008  
 Projection: Transverse Mercator Datum: NAD 83 Coordinate System: UTM Zone 15N

1,000 0 1,000 2,000 3,000 4,000  
 SCALE 1:90,000 METRES

<b>PROJECT</b>	HAMMOND REEF GOLD PROJECT ATIKOKAN, ONTARIO, CANADA		
<b>TITLE</b>	<b>SUMMARY OF ALTERNATIVES</b>		
 Golder Associates Mississauga, Ontario	PROJECT NO. 13-1118-0010	SCALE AS SHOWN	VERSION 2
	DESIGN	CGE	14 Nov. 2008
	CHECK	SP	2 Dec. 2013
	REVIEW	SP	2 Dec. 2013
<b>FIGURE: 4-9</b>			

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