December 2013

HAMMOND REEF GOLD PROJECT
Alternatives Assessment Report

VERSION 2

Submitted to:
Osisko Hammond Reef Gold Ltd.
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Distribution:

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Version 1 of the Alternatives Assessment Technical Support Document (TSD) has been significantly revised since published on February 15, 2013 as part of Osisko Hammond Reef Gold's (OHRG) Draft Environmental Impact Statement/Environmental Assessment (EIS/EA) Report.

The Draft EIS/EA Report underwent a seven-week public review comment period after which, on April 5, 2013 OHRG received comments from the public, Aboriginal groups and the Government Review Team (GRT) seeking clarification and requesting new information.

Approximately 35 comments regarding the Alternatives Assessment TSD and the alternatives assessment component of the EIS/EA Report were received from the GRT. Written responses were prepared for each comment and are provided in Appendix 1.IV of the EIS/EA Report.

The alternatives assessment chapter of the EIS/EA Report (Chapter 4) has been revised and updated and the Alternatives Assessment TSD has been significantly revised based on comments received. The following provides a summary of the changes incorporated into this revised TSD.

Assessment of Alternative Means

On May 27, 2013 Osisko met with MOE EAB, CEAA and MNDM to discuss comments on the Alternatives Assessment. Most of the comments received from the GRT were related to the assessment of 'alternatives means' (e.g., ore processing method, access road alignment, effluent discharge location, work accommodation, etc.). The comments requested a more detailed, organized and consistent assessment be provided for each alternative mean that is linked to the VECs and that consideration be given to the different project phases. The Alternatives Assessment TSD has been revised to address these comments.

Assessment of Mine Waste Alternatives

On July 23, 2013, Osisko met with the GRT to discuss the assessment of mine waste alternatives. At the meeting, Environment Canada provided suggestions for augmenting the sub-accounts and indicators used in the assessment and agreed to review and comment on a revised list. Subsequently, Osisko developed and issued a revised list of sub-accounts and indicators for use in the multiple accounts analysis of the Mine Waste Alternatives Assessment document. The revised indicator lists were developed based on the following:

- Records of consultation with Aboriginal groups, the Public and the GRT
- Comments and suggestions provided by the GRT;
- Example Mine Waste Alternative Assessment reports provided by Environment Canada: including the New Prosperity Project, the Meliadine Project, the Meadowbank Mine and the KSM Project.

Environment Canada reviewed the revised list and noted that the additional sub-accounts and indicators that are being proposed would enhance and improve the Alternatives Assessment document. Environment Canada also provided suggested additional indicators that were considered in the revised assessment. A summary of the key changes incorporated into the Mine Waste Alternatives Assessment is provided below:

- A clear description of the pre-screening of sites for consideration is provided including definition of screening criteria;
- Definitions of indicators and metrics used for evaluation are provided;

- A more thorough evaluation of alternatives through an expanded list of sub-accounts and indicators has been undertaken;
- Non-distinguishing indicators have been identified and the rationale for not including them in the multiple accounts analysis is provided; and
- A summary of key concerns raised during consultation and an explanation of how they are captured in the multiple accounts analysis is provided.

The revision provides a more comprehensive evaluation that better depicts the extensive engineering and consultation efforts undertaken by Osisko to select the most suitable alternatives for the Hammond Reef Project. Based on recommendations from EC, the revised Mine Waste Alternatives Assessment has been provided as a stand-alone report in Appendix 4.I of the Alternatives Assessment TSD.

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APPENDICES

1.0 INTRODUCTION

Osisko Hammond Reef Gold Ltd. (OHRG) proposes the development of an open pit gold mine in northwestern Ontario, herein referred to as the Hammond Reef Gold Project (Project). This Technical Support Document (TSD) is one of a series of reports in support of the Project's Environmental Impact Statement/Environmental Assessment Report (EIS/EA Report).

The following reports have been prepared to support the EIS/EA Report:

- Atmospheric Environment TSD.
- Geochemistry, Geology and Soil TSD.
- Hydrogeology TSD.
- Hydrology TSD.
- Lake Water Quality TSD.
- Site Water Quality TSD.
- Water and Sediment Quality TSD.
- Aquatic Environment TSD.
- Terrestrial Ecology TSD.
- Aboriginal Interests TSD.
- Cultural Heritage Resources TSD.
- Socio-economic Environment TSD.
- Human Health and Ecological Risk Assessment TSD.
- **Alternatives Assessment Report.**
- Conceptual Closure and Rehabilitation Plan.

The EIS/EA Report will summarize the findings of this Alternatives Assessment Report and of the above-listed supporting reports.

1.1 Purpose and Scope

The purpose of this report is to fulfill the assessment scope outlined in the Project's Terms of Reference (ToR) approved by the Ontario Minister of the Environment (July 2012), and in the Environmental Impact Statement Guidelines (EIS Guidelines) published by the Canadian Environmental Assessment Agency (CEA Agency) (December 2011).

As part of the environmental assessment process, the ToR and EIS Guidelines require the assessment of alternatives to the Project, alternative means of carrying out the Project and mine waste disposal alternatives for the Project.

The alternatives were selected through professional experience and consultation with Project stakeholders, including Regulatory Agencies, the public and Aboriginal communities (OHRG 2012). The screening criteria considered potential environmental effects, social acceptability, engineering feasibility and cost. This 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 report is structured as follows:

- Section 1 provides an overview of the purpose and scope of the report, and an overview of the Project.
- Section 2 outlines the methods for undertaking the alternatives assessment.
- Section 3 assesses alternative means (excluding the mine waste disposal alternative means) of carrying out the Project
- Section 4 assesses the mine waste disposal alternative means of carrying out the Project.
- Section 5 summarizes the conclusions of this report.

1.2 Project Justification

1.2.1 Purpose of the Project

The purpose of the Project is to extract gold ore for processing at an ore processing facility and to produce gold for sale to manufacturers worldwide in a manner that returns an economic benefit for OHRG.

1.2.2 Need for the Project

The need for the Project derives from a strong global demand for gold and the need for local economic development. Historically high gold prices present an opportunity for OHRG to supply the gold in the Hammond Reef deposit to the world market.

In addition, the Project has strong support from the municipal government, as the economic benefits of the Project to the local community are much anticipated. The Town of Atikokan has passed a resolution in support of the Project citing the recent closure of the two major employers, Atikokan Forest Products and Fibra Tech, as creating a great need for economic development in the area (OHRG 2012). The resolution urged regulators, consultants and OHRG to move forward with the permitting process as quickly as possible for the benefit of the community.

1.3 Project Overview

1.3.1 Project Location and Setting

The Project is located within the Thunder Bay Mining District in Northwestern Ontario, approximately 170 km west of Thunder Bay and 23 km northeast of the Town of Atikokan (Figure 1-1).

Access to the Hammond Reef property is presently via two routes: the Premier Lake Road, a gravel road that intersects Highway 623 near Sapawe and the Hardtack-Sawbill Road, a gravel road that intersects Highway 622 northwest of the Town of Atikokan. The exploration camp is located at the northern end of Sawbill Bay in Upper Marmion Reservoir. The property is also accessible by water from the southwest end of the Marmion Reservoir at its access point from Highway 622. The existing Hardtack-Sawbill road located to the north of Finlayson Lake has been upgraded to provide an improved and more direct linkage to the Project Site in support of the expanded exploration program.

The Hammond Reef deposit is located mainly on a peninsula of land extending into the north end of the Upper Marmion Reservoir. The peninsula containing the deposit is surrounded by the Marmion Reservoir on three sides with Sawbill Bay to the northwest and Lynxhead Bay to the southeast. The property also contains a number of smaller lakes. Mitta Lake is a small, steep-sided waterbody located atop mineralized zones of the deposit. Due to its location, the proposed open pits (east pit and west pit) will encompass Mitta Lake.

The Project is located in a typical boreal climate region, which is characterized by long, usually very cold winters, and short, cool to mild summers. The annual temperature average is 1.6°C for Atikokan with a seasonal maximum of 16.2°C (average) for summer and a minimum of minus 15.4°C (average) for winter. Temperatures lower than minus 37°C have been recorded during the fall and winter. The annual normal total for precipitation is 788 mm (568 mm of rainfall and 220 mm of snowfall) for Atikokan with a seasonal maximum of 299 mm for the summer period.

Chapter 5 of the EIS/EA Report provides a detailed description of the Project.

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 2012
Projection: Transverse Mercator Datum: NAD 83 Coordinate System: UTM Zone 15N

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Golder Associates
Mississauga, Ontario

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1.3.2 Project Components

The Project consists of the following eight main components:

- Mine, including two open pits (i.e., east pit and west pit).
- Waste Rock Management Facility.
- Ore Processing Facility.
- Tailings Management Facility.
- Support and Ancillary Infrastructure including an accommodation camp.
- Water Management System.
- Linear Infrastructure.
- Borrow Sites.

A detailed description of the Project components is provided in Chapter 5 of the EIS/EA Report.

1.3.3 Project Phases

The Project comprises four phases as following:

- Construction (2.5 years).
- Operations (11 years).
- Closure (2 years).
- Post-closure (10 years).

A detailed description of each Project phase is provided in Chapter 5 of the EIS/EA Report.

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2.0 ALTERNATIVES ASSESSMENT METHOD

"Alternative means" are the various technically and economically feasible ways the Project can be implemented or carried out (CEA Agency 1998). As outlined in the EIS Guidelines for the Project, the Project's environmental assessment shall 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" for the Project. 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).

As it is neither practicable nor necessary to evaluate alternative means for every aspect of the Project, this report focuses on assessing alternative means for those aspects of the Project that have the greatest potential for adverse environmental effects.

This section addresses the alternatives assessment of Project components that are not associated with the disposal of mine wastes. The assessment of alternatives for the disposal of mine wastes (e.g., waste rock, tailings) is addressed in Section 4 of this report.

2.1 Preliminary Screening of Alternatives Means

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 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 accommodation camp would be required to ensure the Project remained feasible.

Upon reaching the decision to include an on-site 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 onsite 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 Ontario Ministry of the Environment (MOE) Environmental Approvals Branch – September 20, 2012.
- Letter from CEA Agency to Aboriginal communities – October 26, 2012.
- Alternatives Assessment Workshop (provincial and federal government) – November 20, 2012.

Both options of an on-site accommodation camp and off-site accommodation are being re-considered and evaluated. The details of the on-site worker accommodation camp alternative are further discussed in Section 3.8.

For some components of the Project a single feasible alternative was identified. These Project components have become part of the Project design and are therefore not assessed further in this report. The components with a single feasible alternative are summarized below and described in detail in Chapter 5 of the EIS/EA Report.

- **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 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.

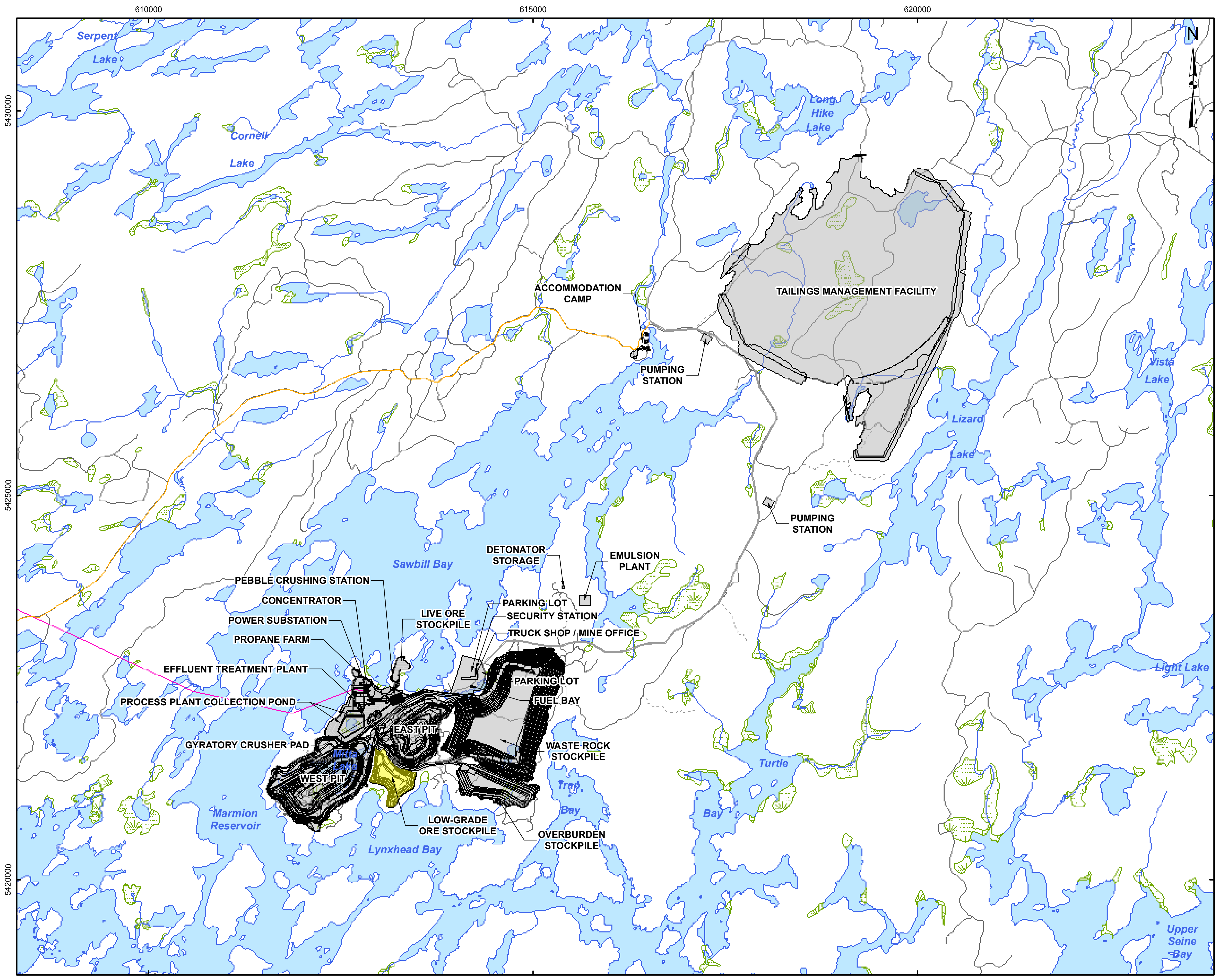
- **Auxiliary power line alignment:** An initial screening of alternatives for the auxiliary line route found that only one route is feasible. The selected route for the auxiliary power line follows an existing right of way. The purpose of the auxiliary line is to bring power from the existing provincial 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 below in Section 3.7, 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^3/d of water. Fresh water requirements based on processing plant make-up needs are estimated to be 17,000 m^3/d. 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 Tailings Management Facility (TMF) location as described in Appendix 4.I Mine Waste Disposal Alternatives Assessment of the Alternative 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 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 2-1), 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^2. 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.



LEGEND

- Road
- Trail
- River/Stream
- Lake
- Wetland
- Low-Grade Ore Stockpile
- 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

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SCALE 1:50,000 METERS

PROJECT
HAMMOND REEF GOLD PROJECT
ATIKOKAN, ONTARIO, CANADA

TITLE
LOW-GRADE ORE STOCKPILE LOCATION

Golder Associates
Mississauga, Ontario

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GIS	JO	2 Dec. 2013		
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2.2 Assessment of Alternative Means

The approach to assess the alternative means of carrying out the Project consisted of the following steps:

1) List potentially available alternatives.
2) Screen potentially available alternatives against selected criteria to determine feasible alternatives.
3) If more than one alternative is deemed feasible, the feasible alternatives are advanced for comparative evaluation.
4) Select the preferred alternative.

The alternatives assessment approach was designed to meet the requirements of the provincial environmental assessment process, whereby the Project is defined through an evaluation and selection of preferred alternatives. The defined Project is then described in detail and assessed for potential effects in the EIS/EA Report. The assessment approach is depicted in Figure 2-2.

The alternatives assessment is carried out using a bounding scenario approach. A bounding scenario approach considers the potential effects of a project component during each phase of the Project (i.e., construction, operations, closure and post-closure) and selects the phase which has the highest potential for effects as the basis for comparing the alternatives. The alternatives assessment therefore does not fully evaluate each project component during each phase of the Project, but instead selects the phase which represents the 'worst case' in terms of the selected evaluation criteria for comparison of the alternatives.

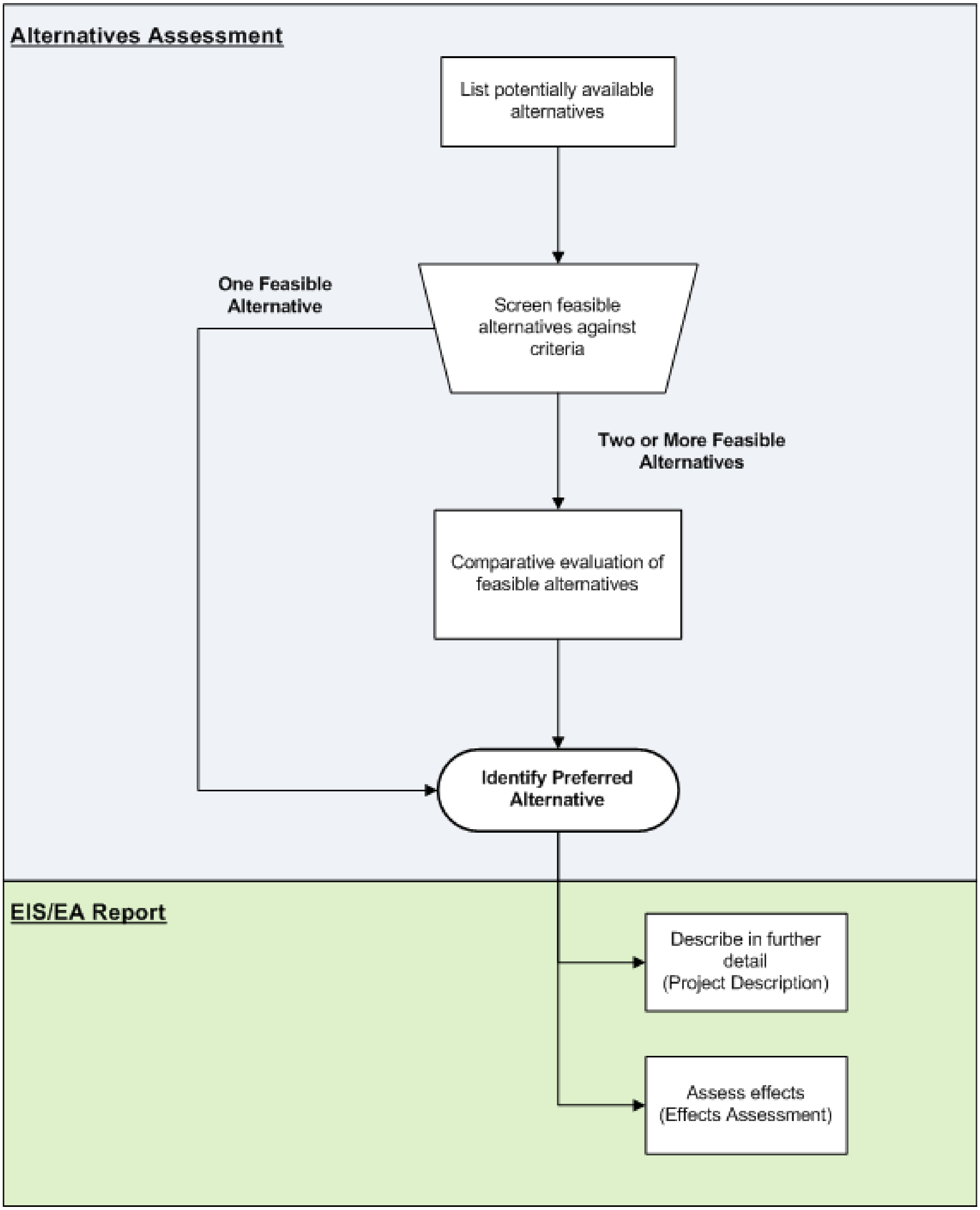


Figure 2-2: Assessment Approach for Alternative Means of Carrying Out the Project

2.2.1 Potentially Available Alternatives

The first step of the alternatives assessment is to list potentially available alternatives. Reasonable alternatives that could potentially meet the Project needs are identified. Potentially available alternatives include the alternatives carried forward from the ToR preliminary screening process and additional alternatives identified through subsequent advancement of site planning and mine planning work. The Project components, their bounding scenarios and the alternative means carried forward into the environmental assessment process are shown in Table 2-1.

Table 2-1: Alternatives Means of Carrying Out the Project Assessed for the Hammond Reef Gold Project

Project Component	Project Aspect	Bounding Scenario	Alternative Means Assessed
Ore Processing Facility	Ore Processing Method	Operations	Use of a cyanide destruction circuit
			Natural degradation of cyanide
Power Supply	Transmission Line Alignment	Construction	Transmission line along Hardtack/Sawbill Road
			Transmission line along Raft Lake Road
			Transmission line along Hardtack/Sawbill Road and crossing Sawbill Bay
Sewage Treatment Facility	Site Location	Operations	One centrally-located facility
			Dedicated facilities for the camp and the Mine
	Sewage Treatment Technology	Operations	Septic tank and tile field
			Package sewage treatment plant
Water Management	Water Discharge Location	Operations	Underwater pipeline with discharge to Lynxhead 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	Construction	Hardtack/Sawbill Road
			Raft Lake Road
Office and Support Facilities	Worker Accommodation	Operations	On-site Accommodation Camp
			Off-site Accommodations

2.2.2 Screening of Potentially Available Alternatives

The second step of the alternatives assessment is to carry out a screening of potentially available alternatives. The available alternatives are screened against preliminary criteria to eliminate options that are clearly less desirable than others in terms of potential environmental effects or technical, economic and social considerations. The screening consists of the following activities:

- Prepare a brief description of each alternative mean, their bounding scenario, their advantages and disadvantages, and predict what potential effects could occur if the alternative mean were implemented.
- Apply screening criteria to determine which alternatives are reasonable, feasible and practical.
- Identify feasible alternatives for comparative evaluation.

The result of the screening is either the identification of one alternative (i.e., the preferred alternative), or a number of viable alternatives that meet the screening criteria and are advanced for a comparative evaluation using environmental, technical, economic and social criteria. If only one alternative is considered feasible, it is advanced for consideration in the EIS/EA Report as the preferred alternative for that Project component, and the assessment is considered to be complete.

2.2.2.1 Screening Criteria

Screening criteria used in this alternatives assessment are 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 consists 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)?

2.2.3 Comparative Evaluation of Proposed Alternatives

The third step of the alternatives assessment is to carry out a comparative evaluation of proposed alternatives. If more than one feasible alternative is identified by the screening process, a comparative evaluation of the alternatives is completed to identify the preferred alternative. The comparative evaluation consists of the following activities:

- Collect information necessary to predict the potential effects of the proposed alternatives.
- Compare the potential effects of the alternatives against environmental, technical, economic and social criteria.

2.2.3.1 Evaluation Criteria

The alternative means were evaluated against the environmental, technical, economic and social criteria described below. The environmental and social criteria are directly tied to the Valued Ecosystem Components selected for the environmental assessment, as detailed in Chapter 2 of the EIS/EA Report.

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.

2.2.4 Selection of Preferred Alternative

The final step in the alternatives assessment is to select the preferred alternative. Following the comparative evaluation (or the screening process if only one viable alternative is identified), the preferred alternative is selected and is included in the Project description and advanced for consideration in the EIS/EA Report.

3.0 ASSESSMENT OF ALTERNATIVES

3.1 Alternatives to the Project

The "alternatives to the Project" are the functionally different ways to meet the Project need and achieve the Project purpose (CEA Agency 1998). The purpose of the Project is to produce gold for sale worldwide. As this purpose can only be accomplished by mining and processing gold ore, the only feasible alternative to proceeding with the Project is the Do Nothing Alternative.

3.1.1 Potentially Available Alternatives

3.1.1.1 Alternative 1 – Proceeding with the Project

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 may extend to a regional level.

Potential negative biophysical effects would include loss of fish-frequented habitat (i.e., Mitta Lake and TMF footprint), 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. Most of these effects would be considerably reduced once mitigation measures are applied.

Potential negative socio-economic effects would include increased risk of vehicular accidents in the access road (Hardtack/Sawbill), loss or damage to cultural resources, loss of fish habitat and of recreational fishing areas, and strain on community services and infrastructure due to increase in population (i.e., introduction of Project workers from outside of the Atikokan community). Appropriate mitigation measures considered in the EIS/EA Report include measures to address these potential effects.

Potential positive effects of the Project include: job creation, increased household and individual incomes, improved purchasing power, and improved access to training opportunities. The Project would contribute to the development of new business opportunities and economic growth in the Town of Atikokan and neighbouring communities, through the purchasing of goods and services during the Project's life cycle.

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 Mine and Ore Processing Facility will require approximately 100 MW of power to be supplied via a new 230 kV project transmission line, feeding a main substation in the Project Site. 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.

3.1.1.2 Alternative 2 – Do Nothing Alternative

The Do Nothing Alternative is the benchmark against which the consequences of other alternatives to the Project can be measured. The Do Nothing Alternative helps determine the extent to which other alternatives to the Project address the problem or opportunity represented by the Project.

In the Do Nothing Alternative, the Project would not be executed. None of the potential effects of the Project would occur and the existing conditions of the biophysical and socio-economic environment would remain unchanged. The Do Nothing Alternative would result in a loss of opportunities for the Atikokan and neighbouring communities, as the predicted socio-economic benefits of the Project would not occur.

3.1.2 Screening of Alternatives to the Project

Table 3-1 presents the screening assessment results for the Alternatives to the Project.

Table 3-1: Screening of Alternatives to the Project

Screening Criteria	Proceeding with the Project	Do Nothing Alternative
Does the alternative provide a viable solution to the problem or opportunity to be addressed?	Yes	No
Does the alternative use proven technologies, and is it technically feasible?	Yes	No
Is the alternative consistent with federal/provincial government priority initiatives?	Yes	Yes
Can the alternative be carried out without significant effects to important environmental features?	Yes	Yes
Is the alternative practical, financially realistic and economically viable?	Yes	Yes
Is the alternative within OHRG's ability to implement?	Yes	No
Can the alternative be implemented within the Project Site?	Yes	Yes
Is the alternative appropriate to the Proponent?	Yes	No
Is the alternative able to meet the purpose of the Canadian Environmental Assessment Act (CEAA)/ Environmental Assessment Act (EAA)?	Yes	Yes
Screening Results	**Selected as preferred alternative and advanced for assessment in the EIS/EA Report.**	**Not considered a viable alternative due to inability to provide a solution to the opportunity.**

3.1.3 Selection of Preferred Alternative to the Project

The Project is not expected to have significant negative effects on the biophysical and socio-economic environment. However, the potential positive socio-economic effects of the Project make it an attractive opportunity for the community of Atikokan, Aboriginal partners, and for neighbouring communities. Therefore the preferred alternative is 'Proceeding with the Project'.

3.2 Ore Processing Method

The Project will include the 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.

An off-site processing facility has been discounted as it would be uneconomical to transport low-grade ore to another processing facility and, in addition, the Town of Atikokan and surrounding Aboriginal communities prefer job opportunities to remain local. 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.

Two potentially available alternatives that involve cyanide have been identified as alternative ore processing methods. These methods differ in the means through which cyanide concentrations are reduced after use. Cyanide concentrations can be decreased through cyanide destruction treatment or natural degradation. These alternatives are described below.

The ore processing method will not have potential effects during construction and will have limited effect during closure and post-closure because cyanide is not being utilized during these project phases. The use and method of cyanide depletion will have the greatest potential to affect on-site water quality and effluent discharge during the operations phase. Therefore, the operations phase has been selected as the bounding scenario for the selection of ore processing methods.

3.2.1 Potentially Available Ore Processing Methods

3.2.1.1 Alternative 1 – Use of a Cyanide Destruction Circuit

Gold extraction using cyanide leaching is the most common method for large scale mines. A cyanide solution dissolves gold from host rocks and is later precipitated and collected. The cyanide by-products generated from this process are highly toxic to wildlife. Cyanide inhibits the function of a critical enzyme required in aerobic respiration processes. Ore processing requires 0.09 kilograms of sodium cyanide per dry tonne of ore fed to the plant (OHRG 2012), which yields 2,000 dry tonnes per year of sodium cyanide being required for the leaching process.

The cyanide destruction plant consists of reactor tanks, reagent mixing tanks, reagent holding tanks, reagent addition systems and agitators. Pumping and dosing equipment are located inside the process plant, while the agitated reactor tanks are located outside.

The chemicals used as reagents in the cyanide destruction process are sulfur dioxide (in any of the available product forms) and peroxide. Soluble copper from copper sulphate provides the catalyst to the cyanide destruction process reaction; dissociated metals are precipitated as hydroxides and strong cyanide complexes are precipitated as insoluble salts, predominantly in the presence of copper.

The system consists of reactors with agitators, a copper sulphate addition system, a hydrogen peroxide addition system and a Liquid SO_2 delivery system. These systems include pumps, on-line analysis and control systems and other miscellaneous equipment. The slurry pumped from the carbon in pulp tailing pumpbox is discharged in the reactor where the cyanide is destroyed. The slurry is pumped from the reactor to the flotation tailings discharge box to feed the tailings thickener. It is estimated that the cyanide destruction circuit will reduce cyanide concentrations in the tailings slurry to 5 ppm.

3.2.1.2 Alternative 2 – Natural Degradation of Cyanide

This alternative involves the same cyanide leaching method to extract gold from the ore as the previous alternative but uses the natural degradation cycle of cyanide, rather than adding subsequent chemicals (hydrogen peroxide and sulphur dioxide) to assist in the degradation process. Without cyanide destruction, cyanide concentrations in the tailings slurry would be about 14 ppm. This would further be reduced by natural degradation processes in the TMF reclaim pond.

Natural degradation processes that remove cyanide include volatilization, oxidation, bio-degradation, photodecomposition and adsorption (attachment) onto the surfaces of solids. Each mechanism is governed by variables such as pH, temperature and water chemistry. Free cyanide in the form of hydrogen cyanide (HCN) has a high vapour pressure and readily evaporates (volatilizes). Oxidation occurs when cyanide reacts with air and water to produce ammonia and bicarbonate. Several species of bacteria degrade cyanide, and this process is known as biodegradation. Photodecomposition occurs when ultraviolet radiation (sunlight) breaks down cyanide complexes. To enhance natural degradation, shallow ponds with large surface areas are used. This provides greater contact with atmospheric carbon dioxide which lowers the pH. This in turn increases the rate of conversion to HCN and hence volatilization.

3.2.1.3 Screening of Ore Processing Method Alternatives

Table 3-2 presents the screening assessment results for the ore processing method alternatives.

Table 3-2: Screening of Alternatives for Ore Processing Method

Screening Criteria	Processing using cyanide including a cyanide destruction circuit	Processing using cyanide using natural degradation of cyanide
Does the alternative provide a viable solution to the problem or opportunity to be addressed?	Yes	Yes
Does the alternative use proven technologies, and is it technically feasible?	Yes	Yes
Is the alternative consistent with federal/provincial government priority initiatives?	Yes	Yes

Table 3-2: Screening of Alternatives for Ore Processing Method (Continued)

Screening Criteria	Processing using cyanide including a cyanide destruction circuit	Processing using cyanide using natural degradation of cyanide
Can the alternative be carried out without significant effects to important environmental features?	Yes, cyanide concentrations will be reduced to levels not harmful to the environment and surrounding ecosystems.	No, higher cyanide concentrations will have adverse effects on biological receptors.
Is the alternative practical, financially realistic and economically viable?	Yes	Yes, although a much larger reclaim pond area is required.
Is the alternative within OHRG's ability to implement?	Yes	Yes
Can the alternative be implemented within the Project Site?	Yes	Yes
Is the alternative appropriate to the Proponent?	Yes	Yes
Is the alternative able to meet the purpose of the Canadian Environmental Assessment Act (CEAA)/ Environmental Assessment Act (EAA)?	Yes	Yes
Screening Results	**Selected as preferred alternative and advanced for assessment in the EIS/EA Report.**	**Not considered a viable alternative due to potential adverse effects to biological receptors and economic consideration.**

3.2.1.4 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.

3.3 Sewage Treatment Technology

The 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 operations 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 construction, 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.

3.3.1 Potentially Available Sewage Treatment Technology Alternatives

3.3.1.1 Alternative 1 – Septic Tank and Tile Bed System

A septic tank and tile bed system is the most conventional sewage treatment technology available. Some treatment occurs in the septic tank where the solids and scum are retained. The tile bed system is a network of perforated pipes that distributes effluent from the septic tank to into granular media surrounding the pipe where aerobic treatment occurs in the surrounding soil and gravel bed.

3.3.1.2 Alternative 2 – Package Sewage Treatment Plant

A packaged wastewater treatment plant consists of pre-engineered and pre-fabricated components designed for treating wastewater using biological processes. The system can be scaled to accommodate a variety of flow capacities and treated effluent discharge requirements.

The system makes use of aeration and attached growth media technology to maintain aerobic conditions in a digestion chamber of the treatment plant, thus ensuring optimum conditions for the micro-organisms to multiply and digest the sewage. The wastewater treatment system stimulates microorganisms that naturally grown in wastewater to form biomass colonies which can then be suspended in the liquid or attached to a growth media. By infusing air (oxygen) into the liquid, these microorganisms multiply at a more accelerated rate than would normally occur. This process results in larger than normal populations of aerobe microorganisms, causing an increased amount of nutrients to be digested. This is a continuous process for as long as the system is supplied with nutrients and oxygen. In addition to rapid absorption of the nutrients, the increased biomass contributes to better breakdown of solids resulting in lower total suspended solids content.

3.3.2 Screening of Sewage Treatment Technology Alternatives

Table 3-3 presents the screening assessment results for the sewage treatment technology alternatives.

Table 3-3: Screening of Feasible Alternatives for Sewage Treatment Facility Siting

Screening Criteria	Sewage Treatment Facility 1 – Septic Tank and Tile Bed	Sewage Treatment Facility 2 – Package Sewage Treatment Plant
Does the alternative provide a viable solution to the problem or opportunity to be addressed?	Yes	Yes
Does the alternative use proven technologies, and is it technically feasible?	No. The size and overall area of the tile beds required is large and in most area the soil mantle is inadequate for a tile bed.	Yes
Is the alternative consistent with federal/provincial government priority initiatives?	Yes	Yes
Can the alternative be carried out without significant effects to important environmental features?	No. Vegetation clearing is necessary, and there is greater potential for adverse impact to groundwater and surface water quality.	Yes
Is the alternative practical, financially realistic and economically viable?	No. The size of the system would require a large land area and decommissioning and removal of the system at closure would be onerous.	Yes
Is the alternative within OHRG's ability to implement?	Yes	Yes
Can the alternative be implemented within the Project Site?	Yes	Yes
Is the alternative appropriate to the Proponent?	Yes	Yes
Is the alternative able to meet the purpose of the Canadian Environmental Assessment Act (CEAA)/Environmental Assessment Act (EAA)?	Yes	Yes
Screening Results	**Not considered a viable alternative due to technical and environmental considerations.**	**Selected as preferred alternative and advanced for assessment in the EIS/EA Report.**

3.3.3 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.

3.4 Sewage Treatment Facility Location

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

3.4.1 Potentially Available Sewage Treatment Facility Location Alternatives

3.4.1.1 Alternative 1 – One Centrally-located Facility

The first sewage treatment location alternative is one centrally-located treatment facility that accommodates all sewage waste. The facility will be located near the accommodation camp and sewage would be pumped from the Mine site to the treatment facility.

3.4.1.2 Alternative 2 – Dedicated Facilities at the Accommodation Camp and Mine Site

The second alternative is multiple sewage treatment facilities distributed throughout the Project Site to accommodate specific areas. Four treatment facilities are proposed: a large facility located near the accommodation camp, and three smaller facilities designated for the process plant, truck shop, and emulsion plant respectively. The accommodation camp facility will discharge treated effluent directly south into Sawbill Bay. The treated effluent from the three Mine systems will be discharged through the same discharge pipe as the effluent treatment system.

3.4.2 Screening of Sewage Treatment Facility Location Alternatives

Table 3-4 presents the screening assessment results for the sewage treatment location alternatives.

Table 3-4: Screening of Feasible Alternatives for Sewage Treatment Facility Siting

Screening Criteria	Site Location 1 – One centrally-located facility near accommodation camp	Site Location 2 – Dedicated facilities for the camp and Mine
Does the alternative provide a viable solution to the problem or opportunity to be addressed?	Yes	Yes
Does the alternative use proven technologies, and is it technically feasible?	Yes	Yes
Is the alternative consistent with federal/provincial government priority initiatives?	Yes	Yes
Can the alternative be carried out without significant effects to important environmental features?	Yes	Yes
Is the alternative practical, financially realistic and economically viable?	No. Excessive pumping is not economical and additional pumping and piping systems complicate infrastructure.	Yes
Is the alternative within OHRG's ability to implement?	Yes	Yes
Can the alternative be implemented within the Project Site?	Yes	Yes
Is the alternative appropriate to the Proponent?	Yes	Yes
Is the alternative able to meet the purpose of the Canadian Environmental Assessment Act (CEAA)/Environmental Assessment Act (EAA)?	Yes	Yes
Screening Results	**Not considered a viable alternative due to economic and operability considerations.**	**Selected as preferred alternative and advanced for assessment in the EIS/EA Report.**

3.4.3 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.

3.5 Water Discharge

Water is required for domestic use and ore processing. Water will be sourced from the Upper Marmion Reservoir, recycled within the mining processes to the extent possible, and intermittently be discharged back to Upper Marmion Reservoir which consists of several bays and catchments. The major bays that surround the Project Site are Sawbill Bay and Lynxhead Bay.

Sawbill Bay and the Sawbill Bay Watershed are located to the west - northwest of the Project Site. Sawbill Bay has a volume of about 151 Mm^3; however, it is somewhat isolated from the main flow paths from the Seine River system, and has a relatively small watershed. As a result, this bay has a very low turnover rate (greater than 2 years). At some periods of the year, the flows are directed back into Sawbill Bay rather than out of the bay due to the management of water levels in the Upper Marmion Reservoir for power generation downstream.

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, a large amount of flow from the upstream Upper Seine River watershed is conveyed through this small zone. As a result, the turnover rate is high (less than 10 days).

Four alternatives have been identified as potential discharge locations and pipeline alignments have been proposed and considered for each. The four water discharge location alternatives are described below and their proposed locations are shown in Figure 3-1.

The operations phase is selected as the bounding scenario for the assessment of water discharge alternatives because effluent discharge rates are expected to be highest during the operations phase of the Project. During the construction, closure and post-closure phases, effluent discharge rates are expected to be lower or non-existent and, therefore, the potential for environmental effect is considered to be reduced during these phases.

3.5.1 Potentially Available Water Discharge Alternatives

3.5.1.1 Alternative 1 – Underwater pipeline with discharge to Lynxhead Narrows

The effluent would be conveyed through a pipeline initially to the northwest, then extending underwater around the mainland towards Lynxhead Bay and ultimately discharged to Lynxhead Narrows. This alternative has the longest pipeline requirement and is more complicated to construct and maintain compared to the other options. Discharging effluent to Lynxhead Narrows is the optimal location for mixing, presenting environmental benefits with respect to water quality. Consultation with Aboriginal groups, the public and the government review team has identified Lynxhead Narrows as a walleye spawning area.

3.5.1.2 Alternative 2 – Overland pipeline with discharge to Lynxhead Bay

The effluent would be conveyed initially to the northwest with an above ground pipeline along the shoreline. The pipeline would then enter the water at the southeast end of the peninsula and continue underwater, ultimately discharging to Lynxhead Bay. This location still yields the environmental benefits of mixing as the effluent is discharged into the main flow pathway of the Marmion Lake basin. This alternative requires only slightly less pipeline than Alternative 1. Consultation with Aboriginal groups, the public and the government review team has identified Lynxhead Narrows as a walleye spawning area.

3.5.1.3 Alternative 3 – Overland pipeline to the northwest with discharge into the central portion of Sawbill Bay

The effluent would be conveyed directly northwest and discharged into Sawbill Bay. This discharge location is the closest to the effluent treatment plant and therefore has the advantage of the shortest pipeline and least amount of potential pumping. This is the simplest option to implement and would also require less maintenance throughout the life of the mine.

The northerly section of Sawbill Bay does not provide good mixing conditions and, during some periods of the year, accumulates water due to backflow into the bay resulting from water level management of Upper Marmion Reservoir. Therefore, a more rigorous treatment system would be required before discharging the effluent into the bay at this location.

3.5.1.4 Alternative 4 – Overland pipeline to the south with discharge to the south end of Sawbill Bay

The effluent would be conveyed initially to the northwest, then directed along the shoreline with an above ground pipeline and ultimately discharged at the south end of Sawbill Bay. This alternative requires a moderate amount of pipeline compared to the other alternatives and takes advantage of some mixing by discharging closer to the main flow channel.

3.5.2 Screening of Water Discharge Alternatives

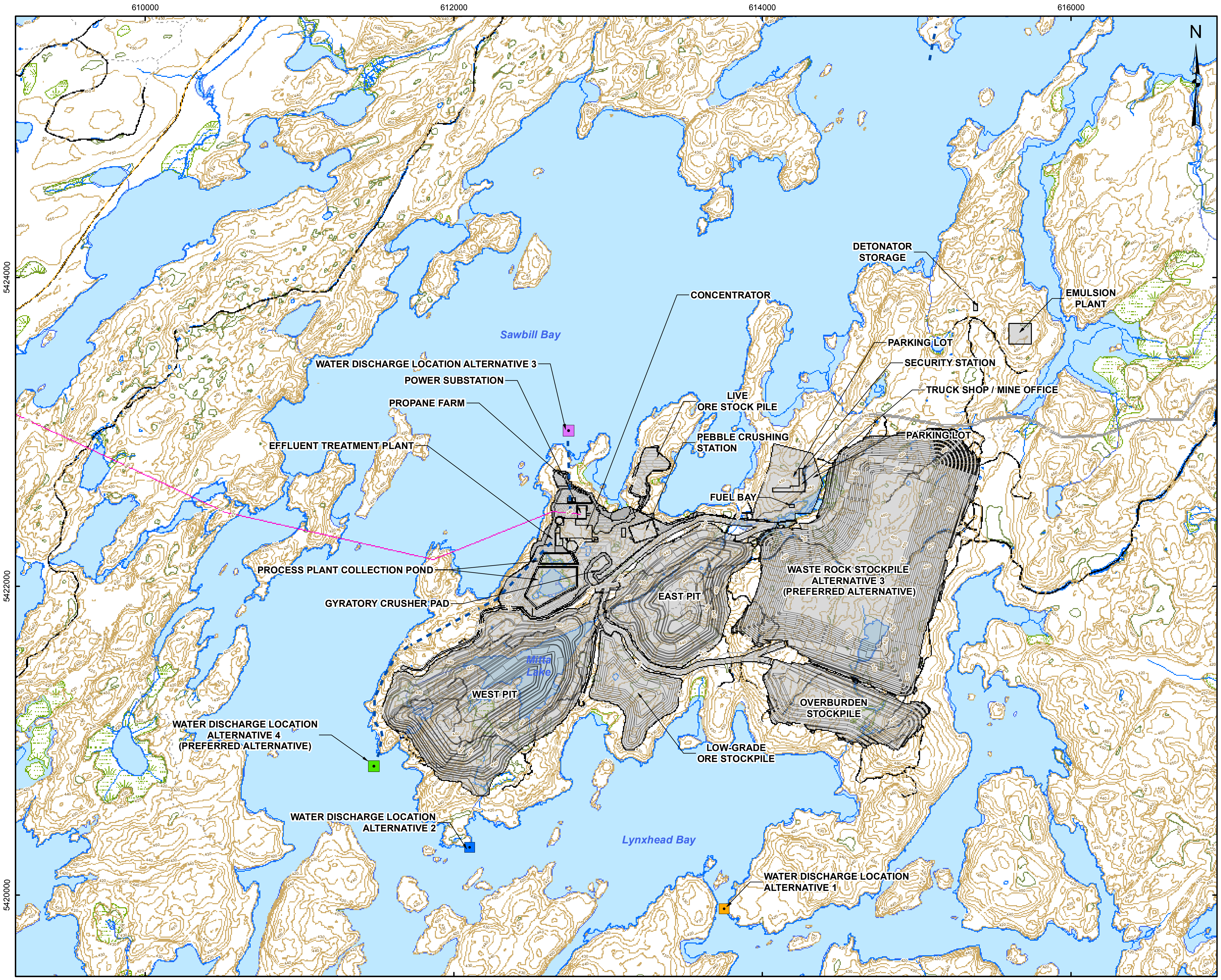
Table 3-5 presents the screening assessment results for the water discharge alternatives.

Table 3-5: Screening of Alternatives for Water Discharge

Screening Criteria	Alternative 1 – Underwater pipeline with discharge to Lynxhead 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
Does the alternative provide a viable solution to the problem or opportunity to be addressed?	Yes	Yes	Yes	Yes

Table 3-5: Screening of Alternatives for Water Discharge (Continued)

Screening Criteria	Alternative 1 – Underwater pipeline with discharge to Lynxhead 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
Does the alternative use proven technologies, and is it technically feasible?	Yes	Yes	Yes	Yes
Is the alternative consistent with federal/provincial government priority initiatives?	Yes	Yes	Yes	Yes
Can the alternative be carried out without significant effects to important environmental features?	Yes. Walleye spawning habitat identified near the discharge location.	Yes. Walleye spawning habitat identified near the discharge location.	Yes. Important fish habitat avoided.	Yes. Important fish habitat avoided.
Is the alternative practical, financially realistic and economically viable?	Yes. Longest pipeline. Therefore incurring greater capital, operating and maintenance costs.	Yes. Requires protection against freezing.	Yes. Shortest pipeline option and therefore, the most economical alternative.	Yes. Requires protection against freezing.
Is the alternative within OHRG's ability to implement?	Yes	Yes	Yes	Yes
Can the alternative be implemented within the Project Site?	Yes	Yes	Yes	Yes
Is the alternative appropriate to the Proponent?	Yes	Yes	Yes	Yes
Is the alternative able to meet the purpose of the Canadian Environmental Assessment Act (CEAA)/ Environmental Assessment Act (EAA)?	Yes	Yes	Yes	Yes
Screening Results	**Advanced for comparative evaluation.**	**Advanced for comparative evaluation.**	**Advanced for comparative evaluation.**	**Advanced for comparative evaluation.**



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

500 0 500 1,000 1,500

SCALE 1:25,000 METERS

PROJECT

HAMMOND REEF GOLD PROJECT
ATIKOKAN, ONTARIO, CANADA

TITLE

WATER DISCHARGE LOCATION ALTERNATIVES

Golder Associates
Mississauga, Ontario

PROJECT NO. 13-1118-0010			SCALE AS SHOWN	VERSION 2
DESIGN	CGE	14 Nov. 2008	**FIGURE: 3-1**	
GIS	JO	2 Dec. 2013		
CHECK	CH	2 Dec. 2013		
REVIEW	CH	2 Dec. 2013		

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3.5.3 Comparative Evaluation of Water Discharge Alternatives

Several environmental, technical, economic and social criteria were considered when choosing the best location to discharge treated effluent from the Project. The key environmental considerations include ambient mixing conditions in the receiving water and implications associated with aquatic habitats. The key technical factors considerations include the extent of water treatment needed to meet water quality requirements, pipeline interference with mine infrastructure, reliability and ease of maintenance, length of pipeline, functionality in freezing conditions, pipeline gradients and flow characteristics. Key economic considerations include potential capital, operating and maintenance costs. Key socio-economic considerations include potential effects to local resources and benefits to the local population and economy.

Environmental Criteria

Discharge water quality is estimated to meet Metal Mining Effluent Regulation (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 walleye 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.

Table 3-6 provides a summary of the comparison of the four alternatives in consideration of the environmental, technical, economic and social criteria.

Table 3-6: Comparative Evaluation of Feasible Alternatives for Water Discharge

POTENTIAL IMPACT	ALTERNATIVE			
	Alternative 1 - Underwater pipeline with discharge to Lynxhead 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**
Water Quality	■ Water quality expected to meet MMER. Potential to exceed provincial levels for copper and cyanide under some mixing conditions.	■ Water quality expected to meet MMER. Potential to exceed provincial levels for copper and cyanide under some mixing conditions.	■ Water quality expected to meet MMER. Potential to exceed provincial levels for copper and cyanide under some mixing conditions.	■ Water quality expected to meet MMER. Potential to exceed provincial levels for copper and cyanide under some mixing conditions.
Terrestrial Ecology	■ No effect to terrestrial habitat.	■ Small loss of habitat due to construction of above ground pipeline	■ No effect to terrestrial habitat.	■ No effect to terrestrial habitat.
Aquatic Environment	■ Presence of walleye spawning habitat	■ Presence of walleye spawning habitat	■ No identified fish spawning habitat.	■ No identified fish spawning habitat
Hydrology	■ Suitable mixing	■ Suitable mixing	■ Poor mixing characteristics	■ Suitable mixing
Hydrogeology	■ Negligible effects	■ Negligible effects	■ Negligible effects	■ Negligible effects
Air Quality	■ Negligible effects	■ Negligible effects	■ Negligible effects	■ Negligible effects
Technical	■ Longest pipeline	■ Risk of freezing presents challenges	■ Shortest pipeline ■ Risk of freezing presents challenges	■ Risk of freezing presents challenges
Economic	■ Highest capital cost ■ Lower maintenance costs	■ Higher maintenance costs due to risk of freezing	■ Lowest capital cost ■ Higher maintenance costs due to risk of freezing	■ Higher maintenance costs due to risk of freezing
Social	■ Potential effect to fishing resource.	■ Potential effect to fishing resource.	■ Potential effect to fishing resource.	■ No anticipated socio-economic effects.

3.5.4 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 the South end of Sawbill Bay at the Alternative 4 location provides favourable mixing conditions with a reduce potential to effect identified fish spawning habitat and decreased potential to effect the local fishing resource.

3.6 Access Road

The Project will require the upgrading of an existing gravel road to facilitate transport of equipment and supplies to the Mine. 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 access road to the Mine; the Hardtack/Sawbill road sequence (Alternative 1) and Raft Lake Road (Alternative 2). These roads already exist; however, both alternatives would require widening and upgrading to support heavy equipment and haul truck loads. The selection between these two 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 the access road alignment.

The two road alignments considered are shown in Figure 3-2.

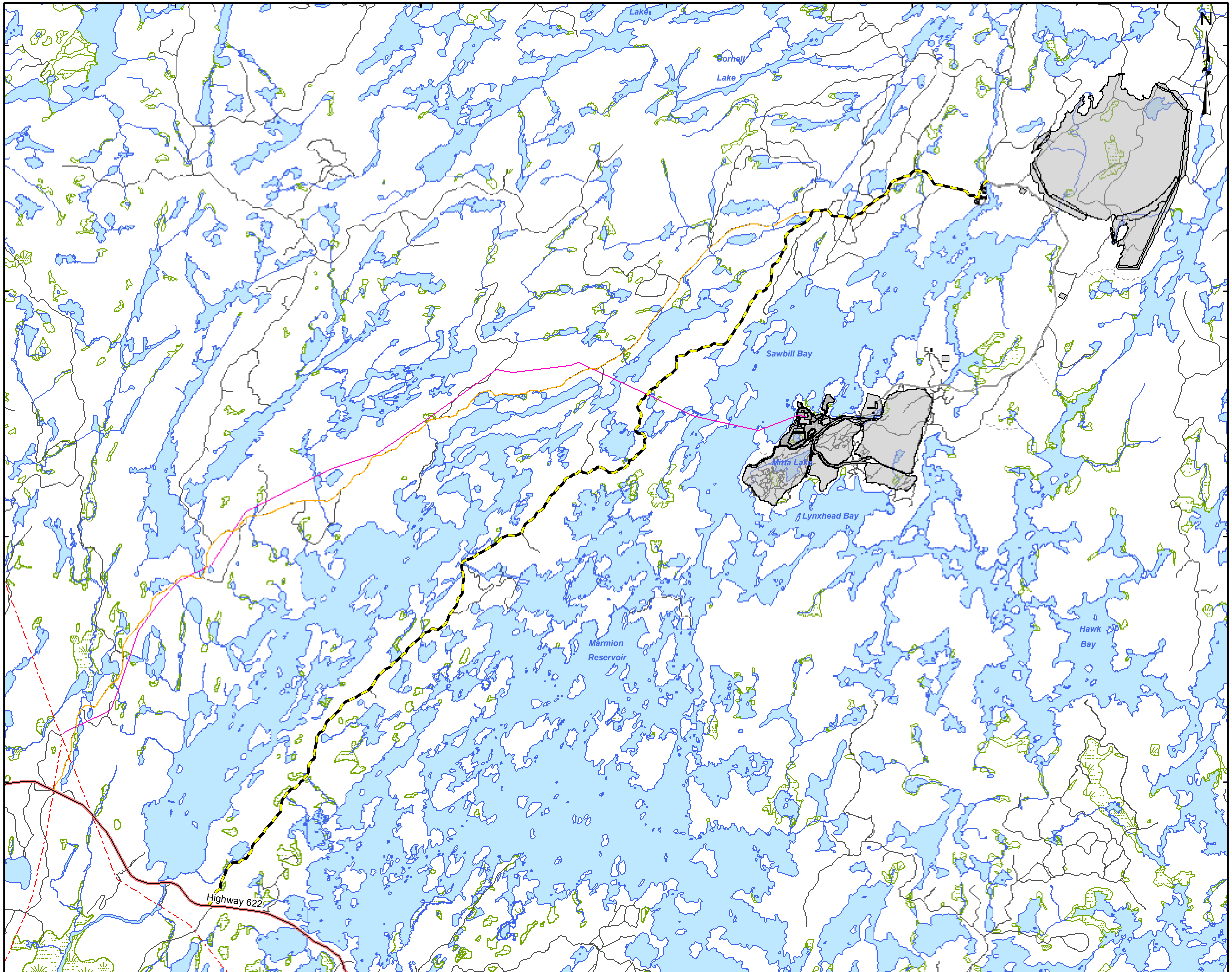
3.6.1 Potentially Available Access Road Alternatives

3.6.1.1 Alternative 1 – Hardtack/Sawbill Road

By summer 2010, the Sawbill Road had been upgraded to a primary standard gravel road. Both sections of road will be upgraded to a 10 m running surface using the same footprint as much as possible by minimizing steep curves and hills. The total length of the road is 26.1 km and the route has 14 existing water crossings.

3.6.1.2 Alternative 2 – Raft Lake Road

Some of the Raft Lake Road currently exists; however it requires considerable upgrading. In addition, it would be necessary to build some new roadway and a new water crossing over the Raft Lake Cut. The total length of the road would be 25.6 km and the route would have a total of seven water crossings.



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

1,000 0 1,000 2,000 3,000 4,000
SCALE 1:80,000 METRES

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	VERSION 2
DESIGN	CGE	14 Nov. 2008		
GIS	JO	2 Dec. 2013		
CHECK	CH	2 Dec. 2013		
REVIEW	CH	2 Dec. 2013		

FIGURE: 3-2

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3.6.2 Screening of Access Road Alternatives

Table 3-7 presents the screening assessment results for the access road alternatives.

Table 3-7: Screening of Feasible Alternatives for Access Road Alignment

Screening Criteria	Alternative 1 – Hardtack/ Sawbill Road	Alternative 2 – Raft Lake Road
Does the alternative provide a viable solution to the problem or opportunity to be addressed?	Yes	Yes
Does the alternative use proven technologies, and is it technically feasible?	Yes	Yes
Is the alternative consistent with federal/provincial government priority initiatives?	Yes	Yes
Can the alternative be carried out without significant effects to important environmental features?	Yes	Yes
Is the alternative practical, financially realistic and economically viable?	Yes	Yes
Is the alternative within OHRG's ability to implement?	Yes	Yes
Can the alternative be implemented within the Project Site?	No. The road is required to access the Project Site.	No. The road is required to access the Project Site.
Is the alternative appropriate to the Proponent?	Yes	Yes
Is the alternative able to meet the purpose of the Canadian Environmental Assessment Act (CEAA)/Environmental Assessment Act (EAA)?	Yes	Yes
Screening Results	**Advanced for comparative evaluation.**	**Advanced for comparative evaluation.**

3.6.3 Comparative Evaluation of Access Road Alignment

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 and constructing sections of new 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 sections 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.

Table 3-8 outlines and compares the two alternatives based on considerations associated with the environment, socio-economic impacts, constructability and economics.

Table 3-8: Comparative Evaluation of Feasible Alternatives for Access Road Alignment

POTENTIAL IMPACT	ALTERNATIVE	
	Alternative 1 – Hardtack/Sawbill Road	**Alternative 2 - Raft Lake Road**
Water Quality	■ Existing stream crossings will minimize in-stream works.	■ New stream crossings will need to be constructed increasing potential for elevated TSS.
Terrestrial Ecology	■ Minimal habitat loss due to existing road corridor.	■ Some terrestrial habitat loss due to clearing of currently undisturbed areas.
Aquatic Environment	■ Minor effects on aquatic habitat due to upgrade of existing stream crossings in some locations	■ New stream crossings will need to be constructed resulting in some loss of aquatic habitat in streams.
Hydrology	■ Temporary flow alterations during in-stream works.	■ Temporary flow alterations during in-stream works.
Hydrogeology	■ Minimal effects on groundwater quality and quantity.	■ Minimal effects on groundwater quality and quantity.
Air Quality	■ No effect on air quality.	■ No effect on air quality.
Social	■ Improved access to recreational areas ■ Potential increased hunting and fishing pressures ■ Economic benefits to local contractors	■ Increased access to recreational areas ■ Potential increased hunting and fishing pressures ■ Economic benefits to local contractors
Technical	■ Involves widening an existing roadway	■ Involves constructing new roadway as well as new water crossings, including the potential need for a new bridge.
Economics	■ Lower cost from upgrading and widening an existing roadway.	■ Higher costs as a result of constructing new roadway and the potential construction of a bridge.

3.6.4 Selection of Preferred Access Road Alignment

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. 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.

3.7 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.

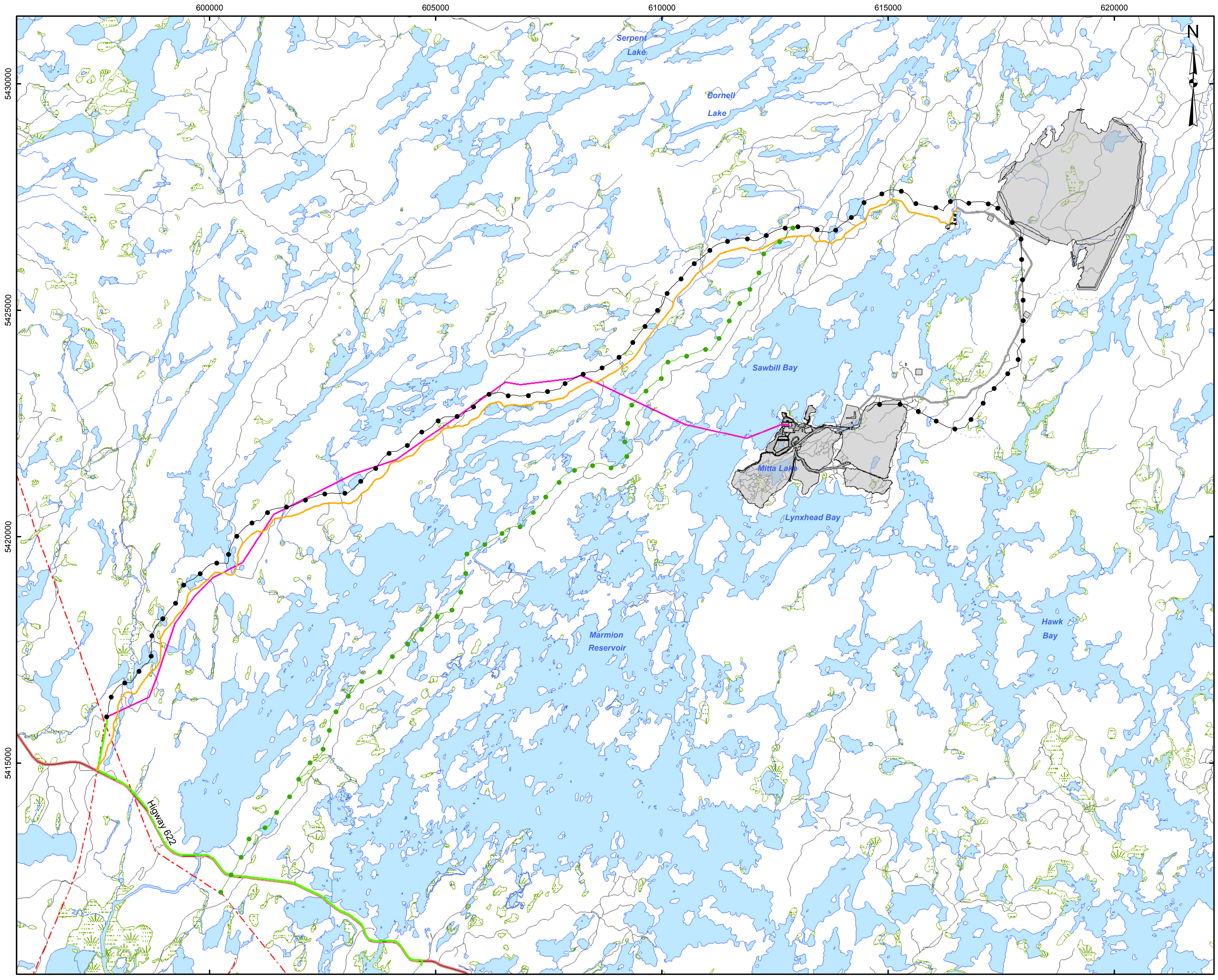
On site diesel generators were considered in the Project ToR, but excluded due to the high carbon footprint from the use of non-renewable fossil fuels and because the option is not cost-effective. Diesel generation will be used for back-up power supply only. On-site renewable power generation was also 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 3-3.

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)

- 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

1,000 0 1,000 2,000 3,000 4,000

SCALE 1:85,000 METRES

PROJECT

HAMMOND REEF GOLD PROJECT
ATIKOKAN, ONTARIO, CANADA

TITLE

TRANSMISSION LINE ALIGNMENT 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	CH	2 Dec. 2013	**FIGURE: 3-3**	
REVIEW	CH	2 Dec. 2013		

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3.7.1 Potentially Available Power Supply Alternatives

3.7.1.1 Alternative 1 – Transmission Line along Hardtack/Sawbill Road

The existing Hardtack/Sawbill road is the preferred access road alternative to access the mine site during construction and operations. Hardtack/Sawbill Road includes two sections. The “Hardtack” section runs north 7 km from Highway 622 where it joins the “Sawbill” section. The second section runs 22 km north where it intersects kilometre 46 of Premier Road. The total length of the transmission line would be 33.7 km long and would cross a total of 51 water crossings.

3.7.1.2 Alternative 2 – Transmission Line along Raft Lake Road

Raft Lake Road begins at Highway 622 and extends north until it meets up with Sawbill Road. The total length of Alternative 2 is 34.4 km and the transmission line would cross seven water crossings. Raft Lake Road requires considerable upgrading and full roadway construction in some stretches. Therefore, accessibility to install the transmission line is limited. More funding would be required to establish a transmission line along this corridor.

3.7.1.3 Alternative 3 – Transmission Line along Hardtack/Sawbill Road and Crossing Sawbill Bay

Alternative 3 is similar to Alternative 1, as it follows the same Hardtack Road and Sawbill Road alignment for 14.3 km until it crosses over Sawbill Bay. The transmission line will be strung across Sawbill Bay without any footings in the water, thereby eliminating any environmental risks associated with disturbing the waterbody. The total length of Alternative 3 is 18.7 km and the transmission line crosses 16 water crossings.

3.7.2 Screening of Power Supply Alternatives

Table 3-9 presents the screening assessment results for the power supply alternatives.

Table 3-9: Screening of Feasible Alternatives for Transmission Line

Screening Criteria	Alternative 1 – Transmission Line along Hardtack/Sawbill Road	Alternative 2 – Transmission Line along Raft Lake Road	Alternative 3 – Transmission Line along Hardtack/Sawbill Road Crossing Sawbill Bay
Does the alternative provide a viable solution to the problem or opportunity to be addressed?	Yes	Yes	Yes
Does the alternative use proven technologies, and is it technically feasible?	Yes	Yes	Yes
Is the alternative consistent with federal/provincial government priority initiatives?	Yes	Yes	Yes

Table 3-9: Screening of Feasible Alternatives for Transmission Line (Continued)

Screening Criteria	Alternative 1 – Transmission Line along Hardtack/Sawbill Road	Alternative 2 – Transmission Line along Raft Lake Road	Alternative 3 – Transmission Line along Hardtack/Sawbill Road Crossing Sawbill Bay
Can the alternative be carried out without significant effects to important environmental features?	Yes	Yes	Yes
Is the alternative practical, financially realistic and economically viable?	Yes	Yes	Yes
Is the alternative within OHRG's ability to implement?	Yes	Yes	Yes
Can the alternative be implemented within the Project Site?	No. The transmission line is required to bring electricity to the Project Site.	No. The transmission line is required to bring electricity to the Project Site.	No. The transmission line is required to bring electricity to the Project Site.
Is the alternative appropriate to the Proponent?	Yes	Yes	Yes
Is the alternative able to meet the purpose of the Canadian Environmental Assessment Act (CEAA)/ Environmental Assessment Act (EAA)?	Yes	Yes	Yes
Screening Results	**Advanced for comparative evaluation.**	**Advanced for comparative evaluation.**	**Advanced for comparative evaluation.**

3.7.3 Comparative Evaluation of Power Supply Alternatives

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.

Table 3-10 outlines and compares the three alternatives based on the above outlined criteria for environment, socio-economic impacts, constructability and economics.

Table 3-10: Comparative Evaluation of Feasible Alternatives for Project Transmission Line

POTENTIAL IMPACT	ALTERNATIVE		
	Alternative 1 Hardtack/Sawbill Road	**Alternative 2 Raft Lake Road**	**Alternative 3 Hardtack/Sawbill Road Crossing Sawbill Bay**
Water Quality	■ Transmission line will not affect water quality.	■ Transmission line will not affect water quality.	■ Transmission line will not affect water quality.
Terrestrial Ecology	■ Minimal land clearing required for construction due to alignment along existing road.	■ Additional land clearing required for construction of transmission line will result in some habitat loss.	■ Shorter route will require less land clearing with minimal habitat loss.
Aquatic Environment	■ Construction will avoid aquatic habitats.	■ Construction will avoid aquatic habitats.	■ Transmission line will avoid placement of footings in water.
Hydrology	■ Transmission line will not affect stream flows.	■ Transmission line will not affect stream flows.	■ Transmission line will not affect stream flows.
Hydrogeology	■ No effect on groundwater	■ No effect on groundwater	■ No effect on groundwater
Air Quality	■ No effect on air quality.	■ No effect on air quality.	■ No effect on air quality.
Socio-economic	■ No identified socio-economic effects.	■ No identified socio-economic effects.	■ Potential to effect local resources through change in visual landscape.
Constructability	■ Existing road simplifies construction and minimizes vegetation clearing.	■ Large sections of Raft Lake Road require construction of new roadway resulting in vegetation clearing and habitat loss.	■ Some new clearing would be required in sections that do not follow existing roadway. ■ Transmission line will be strung over the bay, avoiding construction in water.
Economics	■ Intermediate distance results in moderate material and installation costs.	■ Longest route results in the greatest material and installation costs.	■ Shortest route results in the lowest material and installation costs.

3.7.4 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.

3.8 Workers Accommodation

Osisko had initially ruled out an accommodation camp within the Project Site as the Town of Atikokan and surrounding communities favoured off-site accommodations for socio-economic benefits associated with increased populations in town. However, as the Project has continued to develop, issues with off-site accommodation have been brought to the attention of OHRG and additional benefits for on-site accommodation have been identified. Therefore, both options of an on-site accommodation camp and off-site accommodation are being re-considered and evaluated.

Some of the considerations for including an on-site workers accommodation camp are that Aboriginal communities are interested in working at the Site; however, it is over two hours from the closest First Nations community; the baseline socio-economic study showed that the demographics of the Town can't supply the necessary workforce; other mines are using fly in/fly out and Osisko must remain competitive to attract a skilled labour force. Although the Project will include an on-site accommodation camp, Osisko will provide incentives for workers to live in Town. The details of these incentives will be further informed through the Atikokan/Osisko committee.

Therefore, both options of an on-site accommodation camp and off-site accommodation are being reconsidered and evaluated. The location selected for the accommodation camp is within the Project Site and did not require additional baseline data collection.

The need to consider an on-site 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 making a daily commute from those communities impossible. An on-site 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 accommodation camp would be required to ensure the Project remained feasible.

Upon reaching the decision to include an on-site accommodation camp as an alternative means of carrying out the Project, the government, public and Aboriginal stakeholders were informed of this change. A detailed record of consultation activities that included information about the on-site accommodation camp is provided in Chapter 7 of the EIS/EA Report.

An on-site accommodation camp alternative with a capacity of 1,200 persons will be evaluated along with off-site accommodations in the Town of Atikokan. These alternatives are described and screened below.

3.8.1 Potentially Available Workers Accommodation Alternatives

3.8.1.1 Alternative 1 – On-site Accommodation Camp

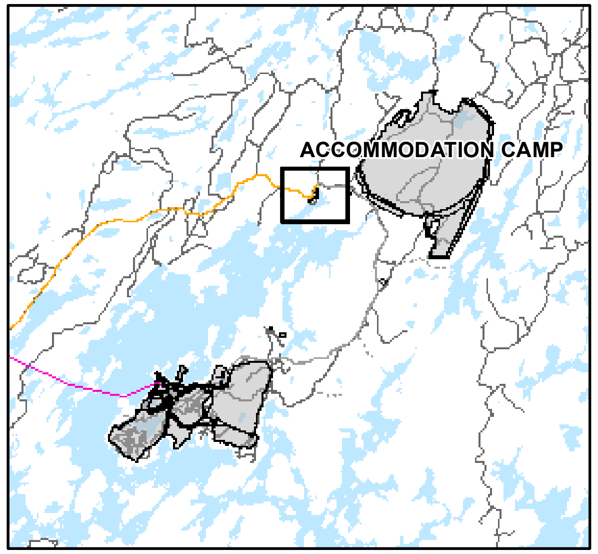
The first alternative is an on-site accommodation camp located near the north end of Sawbill Bay adjacent to the existing exploration camp. The location is shown in Figure 3-4. The camp will have a capacity of 1,200 persons and will be constructed and operated during the Project construction phase. The camp will remain in operation until the end of Project decommissioning. An on-site accommodation option can aid in recruiting skilled workers, as many workers are attracted to the benefits of paid food and accommodation.

3.8.1.2 Alternative 2 – Off-site Accommodations

Off-site accommodation in the Town of Atikokan and surrounding communities is the second alternative being considered. For this alternative, workers would be expected to be responsible for their own housing needs and employee transportation would be provided from Atikokan. Workers would also be allowed to commute independently via the access road (Hardtack/Sawbill). The off-site accommodation alternative would result in an increased population in the Town of Atikokan which could stimulate the local economy. The additional commuting time would increase traffic volume in Town and on access roads.

LEGEND

- Road
- Trail
- Index Contour (5m interval)
- River/Stream
- Lake
- Mine Site Road
- 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

100 0 100 200 300
SCALE 1:5,000 METERS

PROJECT
HAMMOND REEF GOLD PROJECT
ATIKOKAN, ONTARIO, CANADA

TITLE
ON-SITE ACCOMMODATION CAMP LOCATION

Golder Associates
Mississauga, Ontario

PROJECT NO. 13-1118-0010			SCALE AS SHOWN	VERSION 2
DESIGN	CGE	14 Nov. 2008	**FIGURE: 3-4**	
GIS	JO	2 Dec. 2013		
CHECK	CH	2 Dec. 2013		
REVIEW	CH	2 Dec. 2013		

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3.8.2 Screening of Workers Accommodation Alternatives

Table 3-11 presents the screening assessment results for the workers accommodation alternatives.

Table 3-11: Screening of Feasible Alternatives for Worker Accommodation

Screening Criteria	On-site Worker Accommodation Camp	Off-site Worker Accommodation
Does the alternative provide a viable solution to the problem or opportunity to be addressed?	Yes	Yes
Does the alternative use proven technologies, and is it technically feasible?	Yes	Yes
Is the alternative consistent with federal/provincial government priority initiatives?	Yes	Yes
Can the alternative be carried out without significant effects to important environmental features?	Yes	Yes
Is the alternative practical, financially realistic and economically viable?	Yes	Yes
Is the alternative within OHRG's ability to implement?	Yes	Yes
Can the alternative be implemented within the Project Site?	Yes	No. The off-site accommodation camp would be in the Town of Atikokan and surrounding communities.
Is the alternative appropriate to the Proponent?	Yes	Yes
Is the alternative able to meet the purpose of the Canadian Environmental Assessment Act (CEAA)/ Environmental Assessment Act (EAA)?	Yes	Yes
Screening Results	**Advanced for comparative evaluation.**	**Advanced for comparative evaluation.**

3.8.3 Comparative Evaluation of Workers Accommodation Alternatives

Several environmental, technical, economic and social criteria were considered when choosing the best alternative for workers 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 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 accommodations.

Some project-environment interactions are associated with the construction of a 1,200 person accommodation camp on site. Domestic wastewater discharge volumes will increase, and an additional discharge point will be included in the Project design near the accommodation camp. The effects to water quality are anticipated to be negligible because wastewater will be treated prior to discharge. An on-site 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 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 accommodation alterative. Throughout consultation activities, OHRG learned that the Town of Atikokan preferred an off-site 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 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 accommodation alternative is not anticipated to interact with cultural heritage or land and resource use.

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

Table 3-12 outlines and compares the two alternatives based on considerations associated with the environment, socio-economic impacts, constructability, and economics can be found below.

Table 3-12: Comparative Evaluation of Feasible Alternatives for Worker Accommodation

POTENTIAL IMPACT	ALTERNATIVE	
	Alternative 1 – On-Site Accommodation Camp	Alternative 2 – Off-Site Accommodation Camp
Water Quality	■ Increased potential to affect water quality through additional water discharge. Domestic waste water will be treated.	■ No effect on water quality.
Terrestrial Ecology	■ Loss of additional habitat on site. ■ Wildlife avoidance due to human disturbance.	■ No additional loss of habitat.
Aquatic Ecology	■ No effect on aquatic species due to treatment of domestic waste water discharged from the camp.	■ No effect on aquatic habitat.
Hydrology	■ Potential change in flows and water levels due to water withdrawals for accommodation camp use.	■ No change in surface water flows.
Hydrogeology	■ No anticipated changes to groundwater quality or quantity.	■ No change in groundwater quality or quantity.
Air Quality	■ No interaction with air quality.	■ Potential change to air quality due to increased daily working commuting.
Social	■ Less pronounced population growth or municipal tax base increase than off site alternative.	■ Increased traffic from workers commuting to site. ■ Increased demand on municipal services and infrastructure from increased population in Town. ■ Potential change to community character due to periodic presence of workers in Town.
Technical	■ Land available approximately 1 km from Site. ■ Sewage treatment facility required.	■ Ability to staff the Project without offering accommodation and meals is questionable. ■ Long commuting times for Aboriginal community members would require accommodation options closer to Site.
Economic	■ Capital and operating cost are higher.	■ Capital cost and operating cost are lower. ■ More economic benefits for Town through increased property taxes and population growth.

3.8.4 Selection of Preferred Workers 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 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.

3.9 Tailings Deposition Technology

The ore processing plant will generate tailings that must be deposited in the TMF. Two common tailings deposition technologies, conventional slurry tailings and thickened tailings, were investigated as available alternatives for the Project. 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.

3.9.1 Potentially Available Tailings Deposition Alternatives

3.9.1.1 Alternative 1 – Conventional Slurry Tailings

The first alternative is conventional slurry tailings. For the purposes of the alternatives assessment, conventional slurry tailings were defined to have a solids content of 37% (by mass). Conventional slurry tailings would be deposited from perimeter containment dams with an estimated 1% beach slope (above water). For the Project, the optimum conventional tailings deposition plan would discharge tailings from the north end of the TMF and would create a water reclaim water pond at the south end of the TMF.

The pipeline and pumping systems for the conventional tailings alternative would have to transport a higher volume of fluid to the TMF compared to the thickened tailings option. Process water transported to the TMF with the tailings slurry, as well as precipitation that comes in contact with tailings, must be contained and treated before being discharged to the environment. The conventional tailings alternative would need more water storage capacity to contain and reclaim all of the excess water required to transport the slurry tailings from the process plant in a pipeline. This would also result in a significantly higher volume of reclaim water being continually pumped back to the process plant, compared to the thickened tailings alternative. Consequently, larger diameter pipelines and more pumps would be required for the conventional tailings alternative.

Because conventional tailings have a flatter beach slope and the TMF must be capable of impounding more water, the perimeter containment dams would be higher and dam volumes would be larger than the thickened tailings alternative. In addition, conventional tailings will tend to segregate (i.e., coarser tailings will tend to settle out on the upper reaches of the tailings beaches and finer tailings (often referred to as 'slimes') will tend to settle out on the lower reaches, close to the reclaim pond). It will be more difficult to implement closure in the slimes areas.

3.9.1.2 Alternative 2 – Thickened Tailings

The second alternative is thickened tailings deposition. Thickened tailings are created using high compression thickeners to remove more water from the tailings at the process plant so that the tailings discharged to the TMF would have a solids content, in our case ranging from 63% to 68% (by mass). Thickened tailings are non-segregating so problematic slimes areas will be less likely to form. In addition, thickened tailings disposal greatly simplifies water management and reduces the overall risks typically associated with conventional slurry tailings disposal.

A thickened tailings management facility would require a smaller reclaim pond, compared with conventional tailings, since more water is recovered and recycled to the process plant at the thickener. Thickening tailings at the process plant would remove a significant quantity of water that can be immediately reused in the process plant and would reduce the volume of water pumped to the TMF in the tailings slurry and then back to the process plant as reclaim water. The thickened tailings alternative would result in a significant reduction in the quantity of water contained at the TMF and reclaimed to the process plant.

For the thickened tailings alternative, the expected deposition slope was estimated to be 3% (above water). The optimum thickened tailings deposition plan would discharge tailings from a central location to form a cone. This would result in lower perimeter containment dam crest elevations to provide the required tailings storage volume. Lower perimeter dam crest elevations would result in significantly smaller containment dam fill volumes.

Thickened tailings are non-segregating, which would result in lower permeability tailings and reduced seepage from the TMF. For this reason, only the perimeter dams adjacent to the reclaim water pond would be low-permeability (i.e., water retaining) for the thickened tailings alternative. Water retaining dams are more expensive to construct, therefore the thickened tailings alternative would have lower dam construction costs.

Another key advantage of thickened tailings is that they are generally easier to rehabilitate for site closure. Thickened tailings will avoid the formation of slimes areas and will thus provide a more trafficable surface for construction equipment to implement closure measures.

3.9.2 Screening of Tailings Deposition Alternatives

Table 3-13 presents the screening assessment results for the tailings deposition alternatives.

Table 3-13: Screening of Feasible Alternatives for Tailings Deposition

Screening Criteria	Conventional Tailings	Thickened Tailings
Does the alternative provide a viable solution to the problem or opportunity to be addressed?	Yes	Yes
Does the alternative use proven technologies, and is it technically feasible?	Yes	Yes
Is the alternative consistent with federal/provincial government priority initiatives?	Yes	Yes
Can the alternative be carried out without significant effects to important environmental features?	Yes	Yes
Is the alternative practical, financially realistic and economically viable?	Yes	Yes
Is the alternative within OHRG's ability to implement?	Yes	Yes
Can the alternative be implemented within the Project Site?	Yes	Yes
Is the alternative appropriate to the Proponent?	Yes	Yes
Is the alternative able to meet the purpose of the Canadian Environmental Assessment Act (CEAA)/ Environmental Assessment Act (EAA)?	Yes	Yes
Screening Results	**Advanced for comparative evaluation.**	**Advanced for comparative evaluation.**

3.9.3 Comparative Evaluation of Tailings Deposition Alternatives

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 visually 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.

Table 3-13 outlines and compares the two alternatives based on considerations associated with the environment, social, technical and economic criteria.

Table 3-13: Comparative Evaluation of Tailings Deposition Alternatives

POTENTIAL IMPACT	ALTERNATIVE	
	Alternative 1 – Conventional Tailings	**Alternative 2 – Thickened Tailings**
Water Quality	■ No effect on water quality expected with planned water management systems.	■ No effect on water quality expected with planned water management systems.
Terrestrial Ecology	■ Higher loss of terrestrial habitat due to larger reclaim water pond footprint.	■ Lower loss of terrestrial habitat due to smaller reclaim water pond footprint.
Aquatic Ecology	■ The tailings management facility footprint was constrained to reduce impact to aquatic habitat.	■ The tailings management facility footprint was constrained to reduce impact to aquatic habitat.
Hydrology	■ Containment and management of precipitation onto tailings will reduce downstream flow.	■ Containment and management of precipitation onto tailings will reduce downstream flow.
Hydrogeology	■ No predicted impact to groundwater quality with planned seepage collection and pump-back system.	■ No predicted impact to groundwater quality with planned seepage collection and pump-back system.
Air Quality	■ Potential for air quality impacts due to tailings dust generation. Risk of dusting will be higher than thickened tailings due to segregation of conventional slurry tailings during deposition resulting in coarse-sized particles that are more susceptible to wind erosion.	■ Risk of dusting will likely be lower than conventional tailings because thickened tailings are non-segregating resulting in a tailings surface with a mix of particle sizes that are less susceptible to wind erosion.
Social	■ Increased consequence of dam failure due to higher dams and larger impounded water volume. ■ Higher dams are more visually obtrusive.	■ Lower consequence of potential dam failure due to lower dams and less impounded water volume. ■ Lower dams are less visually obtrusive.

Table 3-13: Comparative Evaluation of Tailings Deposition Alternatives (Continued)

POTENTIAL IMPACT	ALTERNATIVE	
	Alternative 1 – Conventional Tailings	**Alternative 2 – Thickened Tailings**
Technical	■ Higher dams. Higher dam volumes. Larger water retaining dams. Higher risk of failure. Higher tailings and reclaim water pumping rates. Larger reclaim water pond.	■ Lower dams. Smaller dam volumes. Smaller water retaining dams. Lower risk of failure. Lower tailings and reclaim water pumping rates. Smaller reclaim water pond.
Economic	■ Capital and operating costs are higher. Closure costs may be higher due to more difficult equipment access on areas of tailings slimes.	■ Capital and operating costs are lower. Closure costs may be lower due to absence of areas of tailings slimes.

3.9.4 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.

4.0 MINE WASTE DISPOSAL ALTERNATIVES ASSESSMENT

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). 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)[1] per Schedule 2 of the MMER.

During a technical meeting held at the Environment Canada office in Gatineau Quebec on July 23, 2013 (OHRG 2013), it was suggested that the Mine Waste Alternatives Assessment be completed as a "stand-alone" document to facilitate discussions regarding designation of water bodies per Schedule 2 MMER. The Mine Waste Disposal Alternatives Assessment is included in Appendix 4.I.

[1] 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).

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5.0 SUMMARY OF PREFERRED ALTERNATIVE MEANS OF CARRYING OUT THE PROJECT

A full range of alternative methods of carrying out the Project have been examined and assessed. 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 component is presented below in Table 5-1.

Table 5-1: Summary of Preferred Alternative Means of Carrying out the Hammond Reef Gold Project

Project Component	Preferred Alternative
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 accommodation camp
Waste Rock Management Facility – Alternative 3	Located immediately east of the open pits and Ore Processing Facility.
Tailings Management Facility – Alternative 3 - Optimized “Base Case”	Located approximately 9 km northeast of the processing plant
Tailings Technology	Thickened tailings

The above alternatives will be included in the EIS/EA Report for an assessment of their environmental effects.

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6.0 LIST OF REFERENCES

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7.0 GLOSSARY OF TERMS

Table 7-1: Glossary of Terms

Term	Definition
Benchmark	A permanent point whose known elevation is tied to a national network. These points are created to serve as a point of reference. Benchmarks have generally been established by the USGS, but may have been established by other Federal or local agencies. Benchmarks can be found on USGS maps. (NOAA 2012).
Channel	An open conduit either naturally or artificially created which periodically or continuously contains moving water, or forms a connecting link between two bodies of water. River, creek, run, branch, anabranch and tributary are some of the terms used to describe natural channels. Natural channels may be single or braided. Canal and floodway are some of the terms used to describe artificial channels. (NOAA 2012).
Discharge	The release or extraction of water from an aquifer. Typical mechanisms of natural discharge are evapotranspiration by phreatophytes, springs, and drains to surface water bodies. Pumping is a man-caused discharge. (University of Idaho 2012).
Drainage	Process of removing surface or subsurface water from a soil or area. A technique to improve the productivity of some agricultural land by removing excess water from the soil; surface drainage is accomplished with open ditches; subsurface drainage uses porous conduits (drain tile) buried beneath the soil surface. (U.S. Department of Interior 2012).
Effluent	Partially or completely treated wastewater flowing out of a treatment facility, reservoir, or basin. (U.S. Department of Interior 2012).
Energy	Force or action of doing work. Measured in terms of the work it is capable of doing; electric energy, the electric capacity generated and/or delivered over time, is usually measured in kilowatt hours (kWh). (U.S. Department of Interior 2012).
Enhancement	Improvement of a facility beyond its originally designed purpose or condition. (U.S. Department of Interior 2012).
Erosion	Wearing away of the lands by running water, glaciers, winds, and waves, can be subdivided into three process: Corrasion, Corrosion, and Transportation. Weathering, although sometimes included here, is a distant process which does not imply removal of any material. (NOAA 2012).
Gradient	General slope or rate of change in vertical elevation per unit of horizontal distance of water surface of a flowing stream. Slope along a specific route, as of a road surface, channel or pipe. (U.S. Department of Interior 2012).
Groundwater	Water within the earth that supplies wells and springs; water in the zone of saturation where all openings in rocks and soil are filled, the upper surface of which forms the water table. Also termed Phreatic water. (NOAA 2012).

Table 7-1: Glossary of Terms (Continued)

Term	Definition
Hazardous Materials	Materials that pose the potential for grave, immediate, future, and genetic injury and illness when handled without proper equipment and precautions. Such materials may be toxic, flammable, explosive, corrosive, combinations of these, or otherwise injurious to life and health. Besides being potentially injurious to the discoverer of the materials, toxic materials may be transported to co-workers, children or pets from shoes or clothing. (U.S. Department of Interior 2012).
Intake	Any structure through which water can be drawn into a waterway. Any structure in a reservoir, dam or river through which water can be discharged. (U.S. Department of Interior 2012).
Landfill	An open area where trash is buried. Facility in which solid waste from municipal and/or industrial sources is disposed; sanitary landfills are those that are operated in accordance with environmental protection standards. (U.S. Department of Interior 2012).
Mitigation measures	Methods or plans to reduce, offset, or eliminate adverse project impacts. Action taken to avoid, reduce the severity of, or eliminate an adverse impact. (U.S. Department of Interior 2012).
Ore	Rock or earth containing workable quantities of a mineral or minerals of commercial value. (U.S. Department of Interior 2012).
Permeability	The ability of a material to transmit fluid through its pores when subjected to a difference in head. (NOAA 2012).
Precipitation	As used in hydrology, precipitation is the discharge of water, in a liquid or solid state, out of the atmosphere, generally onto a land or water surface. It is the common process by which atmospheric water becomes surface, or subsurface water. The term "precipitation" is also commonly used to designate the quantity of water that is precipitated. Precipitation includes rainfall, snow, hail, and sleet, and is therefore a more general term than rainfall. (NOAA 2012).
Reservoir	A man-made facility for the storage, regulation and controlled release of water. (NOAA 2012).
Seepage	The interstitial movement of water that may take place through a dam, its foundation, or abutments. (NOAA 2012).
Surface Water	Water that flows in streams and rivers and in natural lakes, in wetlands, and in reservoirs constructed by humans. (NOAA 2012).
Tailings	Second grade or waste material separated from pay material during screening or processing. (U.S. Department of Interior 2012).
Topography	Physical shape of the ground surface. Collective features of the Earth's surface, especially the relief and contour of the land. The arrangement of hills and valleys in a geographic area. (U.S. Department of Interior 2012).

Table 7-1: Glossary of Terms (Continued)

Term	Definition
Water Table	The level below the earth's surface at which the ground becomes saturated with water. The water table is set where hydrostatic pressure equals atmospheric pressure. (NOAA 2012).
Wetland	An area that is regularly wet or flooded and has a water table that stands at or above the land surface for at least part of the year. (NOAA 2012).

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8.0 LIST OF ABBREVIATIONS, ACRONYMS AND INITIALISMS

Table 8-1: List of Abbreviations, Acronyms and Initialisms

Acronym	Definition
CEA Agency	Canadian Environmental Assessment Agency
CEAA	Canadian Environmental Assessment Act
EA	Environmental Assessment
EAA	Environmental Assessment Act
EIS/EA Report	Environmental Impact Statement/Environmental Assessment Report
EIS Guidelines	Environmental Impact Statement Guidelines
HCN	Hydrogen Cyanide
MMER	Metal Mining Effluent Regulation
NOAA	National Oceanic and Atmospheric Administration
OHRG	Osisko Hammond Reef Gold Ltd.
MOE	Ontario Ministry of the Environment
TMF	Tailings Management Facility
ToR	Terms of Reference
TIA	Tailings Impoundment Areas
TSD	Technical Support Document
TSS	Total Suspended Solids
WRMF	Waste Rock Management Facility

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9.0 LIST OF UNITS

Table 9-1: List of Units

Abbreviation	Unit
°C	degrees Celsius
km	kilometre
kV	kilovolts
m	metre
m^3/d	cubic metres per day
mm	millimetre
Mm^3	million cubic metres
MW	megawatts (one million watt hours of electrical energy)
ppm	parts per million

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APPENDIX 4.I

Mine Waste Disposal Alternatives Assessment

December 2013

OSISKO
HAMMOND REEF GOLD

HAMMOND REEF GOLD PROJECT

Mine Waste Disposal Alternatives Assessment Report

VERSION 1

Submitted to:
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Hammond Reef Gold Project
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1.0 INTRODUCTION

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). 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)[1] 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. This document will demonstrate to external reviewers, regardless of technical background, that all reasonable mine waste disposal alternatives have been brought forward and assessed.

Section 2 of this report provides an overview of the Guidelines and the proposed Alternatives Assessment document structure prescribed by the Guidelines. The results of the assessment carried out following this standardized process are presented for the TMF in Section 3 and the WRMF in Section 4.

This Alternatives Assessment builds on supporting documentation previously issued for the Project including:

- Evaluation of Tailings Management Facility Dam Realignment (Golder 2012a);
- Scoping Level Tailings Transport Cost Estimate (Golder 2012b);
- Conceptual Tailings Deposition Plan and Thickened Tailings Evaluation (Golder 2012c);
- Hammond Reef Gold Project – Project Description (Golder 2011a) – since revised;
- Hammond Reef On-Site Tailings Management Facility Siting Options Evaluation (Golder 2011b); and
- Appendix A – Preliminary Tailings Assessment in the Terms of Reference (OHRG 2012.)

The Mine Waste Disposal Alternative Assessment has also considered comments and incorporated recommendations provided by the Environment Canada review team and discussed during a technical meeting held at the Environment Canada office in Gatineau Quebec on July 23, 2013 (OHRG 2013)

[1] 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).

2.0 ALTERNATIVES ASSESSMENT METHODOLOGY AND APPROACH

Environment Canada's Guidelines for the Assessment of Alternatives for Mine Waste Disposal describes a seven-step approach, as follows:

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

The following sections provide a clear description of the rationale and context expected in each step of the assessment process.

2.1 Identify Candidate Alternatives

A list of all possible alternatives for waste disposal is initially prepared. A 'possible' alternative is described as reasonable, conceivable and realistic, as outlined in the Guidelines. At this stage, the alternatives are conceptually developed to assess their technical and economic feasibility and potential impacts at a high-level.

Within this stage, basic threshold criteria are developed to establish regional boundaries for selecting candidate alternatives. Establishment of threshold criteria is necessary to confine the range of alternatives to a finite, manageable list.

The Guidelines suggest that, for each project component, at least one alternative that does not impact a natural water body that is frequented by fish (i.e., a "dry land" alternative) should be considered.

2.2 Pre-screening Assessment

The purpose of this stage is to optimize the decision making process by eliminating alternatives that are either unfeasible or have obvious deficiencies. Through this process, alternatives that exhibit fatal flaws such as the inability to achieve technical objectives, economic or environmental targets or alternatives that are not compliant with regulatory requirements are eliminated.

2.3 Alternative Characterization

To transition towards the next steps of the evaluation process, it is necessary to characterize the remaining 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 of 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.

2.4 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 step 3 – Alternative Characterization). Accounts are further broken down into specific *sub-accounts*, and measurable *indicators*. The MAA decision making tool is a vehicle 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.

2.5 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 of the Project Environmental Impact Statement/Environmental Assessment (EIS/EA) Report 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.

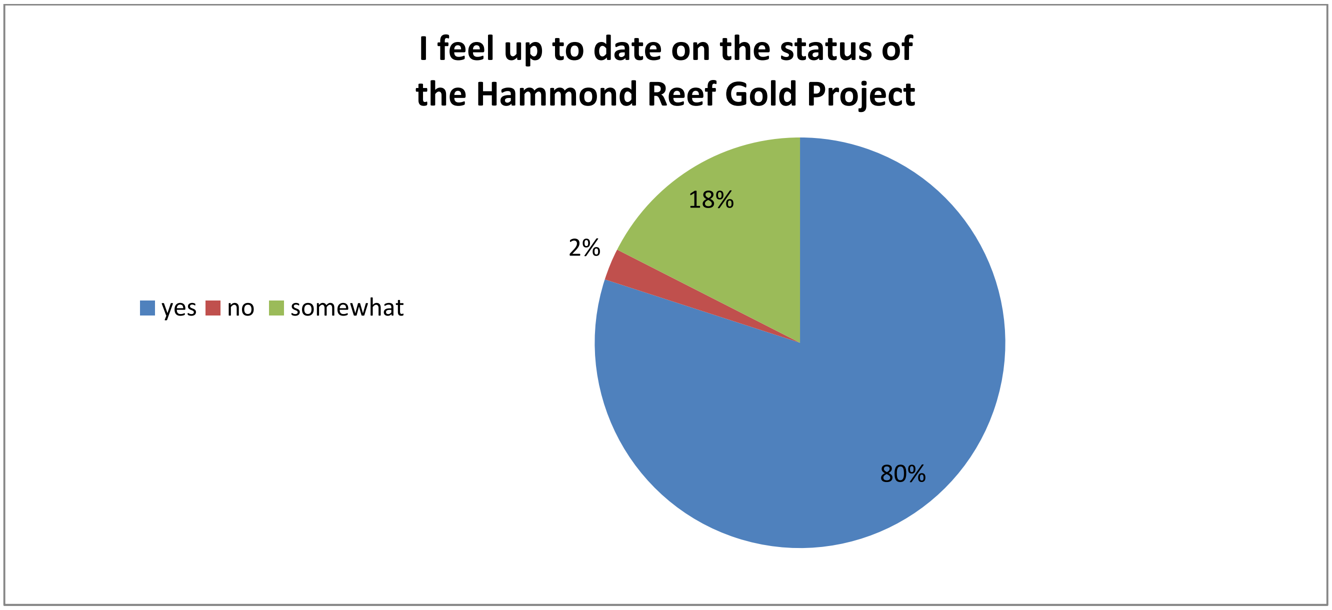
2.5.1 Public

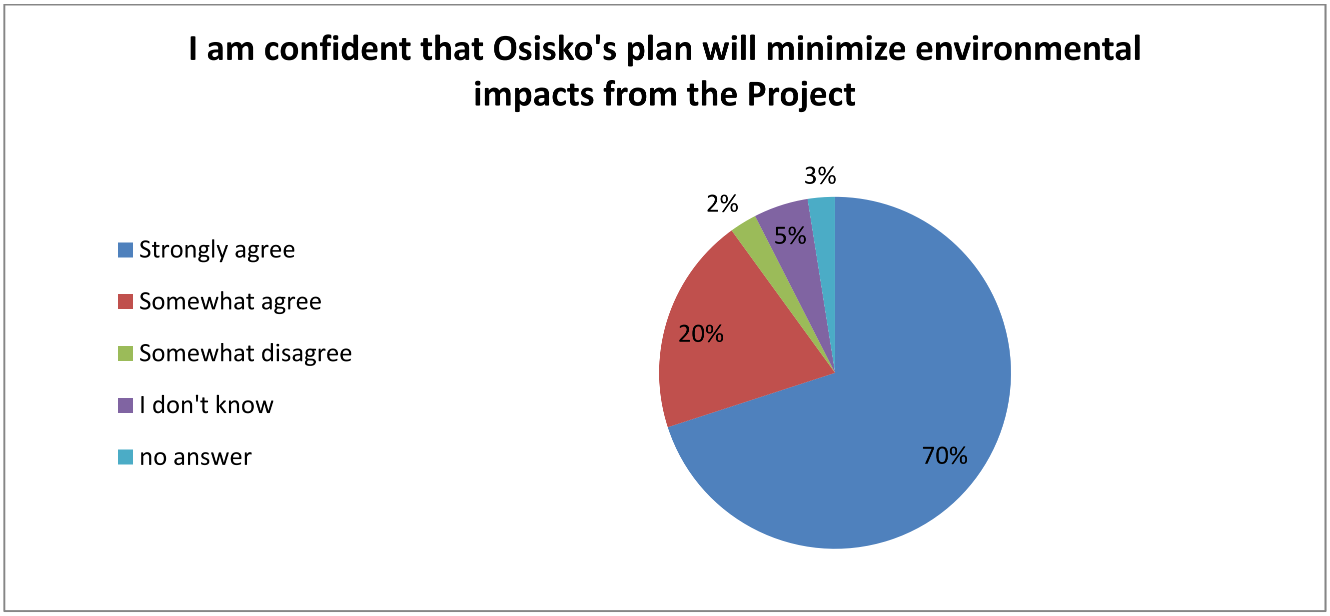
A Community News Brief has been published on a biweekly basis since November 2010. Examples of publication titles which touched on the topic of Project alternatives and the results of the assessment include:

- 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 between February 2011 and 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 forty 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
yes
no
somewhat
18%
2%
80%


I am confident that Osisko's plan will minimize environmental impacts from the Project
Strongly agree
Somewhat agree
Somewhat disagree
I don't know
no answer
3%
2%
5%
20%
70%

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

2.5.2 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 have also been provided to agencies and published as part of the Final EIS/EA Report.

The assessment of mine waste alternatives was a specific area of concern for Environment Canada and OHRG travelled to Gatineau to meet with Environment Canada regarding this topic on July 23, 2013. Correspondence subsequent 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 suggested indicators for consideration in the Environment, Economic and Socio-Economic accounts and sub-accounts. In response, OHRG incorporated many of the suggested revisions to the report as summarized in the Table 1 below. A complete list of proposed sub-accounts and indicators was prepared and provided to Environment Canada for review prior to carrying out the detailed assessment.

Table 1: 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
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

2.5.3 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 Fort Frances Chiefs Secretariat First Nation (10 meetings), the Lac Des Mille Lacs First Nation (8 meetings) and the Metis Nation of Ontario 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 features. 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 or trap line (i.e., 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 2 which also shows the corresponding MAA account/sub-account that addresses the concern.

Table 2: 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
	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	Groundwater	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
	Transmission Line Alternatives	Not included in Mine Waste Disposal Assessment – Considered in Alternative Means for the Project in Chapter 4
	Workers Camp Alternatives	Not included in Mine Waste Disposal Assessment – Considered in Alternative Means for the Project in Chapter 4

Table 2: Aboriginal Community Concern Concordance Table with MAA Account/Sub-account (Continued)

Community	Concern	Corresponding MAA (Account/Sub-account)
Metis Nation of Ontario (Continued)	Ore Processing Alternatives	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 of the EIS/EA Report
	EA Methods	Not included in Mine Waste Disposal Assessment – Considered in Chapter 2 of the EIS/EA Report

OHRG is committed to ongoing consultation with Aboriginal groups as detailed in Chapter 8 of the EIS/EA Report. 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.

2.6 Value-Based Decision Process

Through a value-based decision process, each alternative waste disposal facility is ranked using a transparent scoring system. A six-point scoring scheme is developed for all indicators where 6 is the best possible score, and 1 is the least possible score. Indicators that are quantifiable are scored according to discrete intervals. For indicators that require a qualitative evaluation, scoring schemes are developed based on the judgment of technical or environmental experts and/or the recommendations provided in the Guidelines.

After the alternatives have been evaluated and scored under each indicator, weighting factors are introduced to weight the relative importance of each account, sub-account and indicator. Each account is assigned a weighting factor based on the relative importance of the account compared to the others. The same process is followed for each sub-account and indicator. An account, sub-account or indicator assigned a higher weighting factor implies a perceived greater relative value or importance in comparison to the other indicators within that sub-account. Weighting factors were determined based on input from technical experts and environmental specialists, the recommendations laid out in the Guidelines and stakeholder interest and feedback received during consultation.

2.7 Sensitivity Analysis

To ensure integrity of the MAA, a sensitivity analysis is incorporated into the assessment to provide a transparent, comprehensible and unbiased evaluation. In the sensitivity analysis, the same quantitative calculations were completed with varying account weighting permutations. Although the opinions of the technical and environmental experts and stakeholders are reflected in the base case weighting system, a sensitivity analysis provides reassurance that the preferred alternative would still be selected if the assessment were to be carried out by an individual who holds different value perceptions of the accounts, sub accounts and indicators.

3.0 TAILINGS MANAGEMENT FACILITY LOCATION ASSESSMENT

The tailings management facility (TMF) is a management component for 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.

3.1 Identification of Candidate Alternatives

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.

Although the guidelines suggest that at least one of the alternatives should not impact a natural water body that is frequented by fish, considering the physical size requirements of the TMF for the Project, the abundance of fish-bearing water bodies that exist throughout the regional setting and the spatial constraint identified above, it was not possible to identify a viable ‘dry land’ alternative. However, one alternative (Hogarth Pit), involves depositing tailings into a former mine pit lake that is not considered suitable fish habitat. This option, although not a ‘dry land’ option, is an option that would not result impact a natural water body that is frequented by fish.

The six candidate TMF locations are shown on Figure 1 and are described below. All proposed sites would involve the transportation and deposition of the tailings as a thickened tailings slurry.

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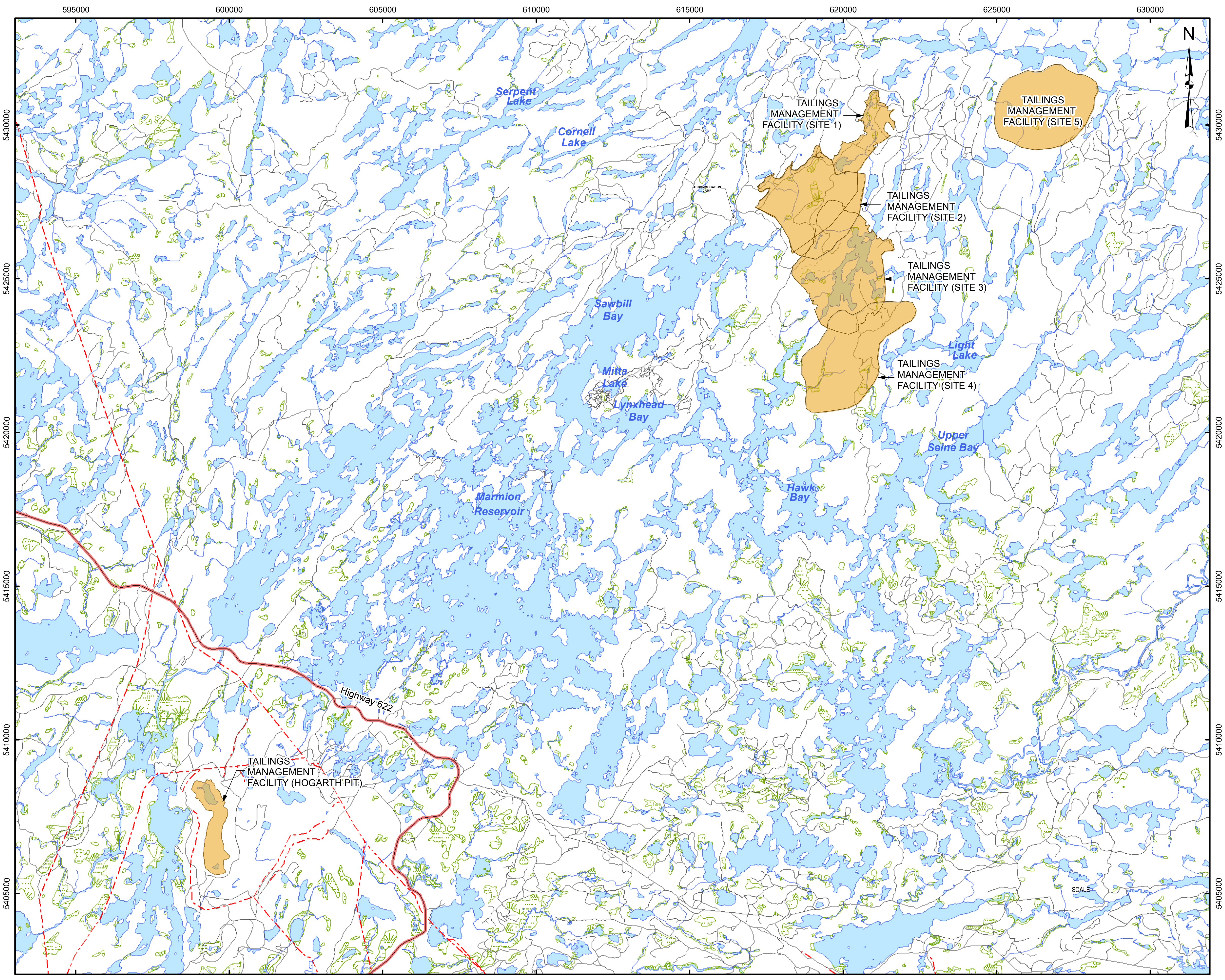

LEGEND

- Existing Power Transmission Line
- Trail
- Provincial Highway
- Road
- River/Stream
- Lake
- Wetland
- Tailings Management Facility Options

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

2,000 0 2,000 4,000 6,000

SCALE 1:125,000 METERS

PROJECT

HAMMOND REEF GOLD PROJECT
ATIKOKAN, ONTARIO, CANADA

TITLE

PRELIMINARY TAILINGS MANAGEMENT FACILITY SITING LOCATIONS

Golder Associates
Mississauga, Ontario

PROJECT NO. 13-1118-0010			SCALE AS SHOWN	VERSION 2
DESIGN	CGE	14 Nov. 2008	FIGURE: 1	
GIS	JO	8 Nov. 2013		
CHECK	CH	8 Nov. 2013		
REVIEW	CH	8 Nov. 2013		

G:\Projects\2013\13-1118-0010_Osisko_Hammond_Reef\GIS\MXDs\Reporting\Alternatives\TMF_Preliminary_locations.mxd

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On-Site Alternative TMF-1 – This TMF alternative is located northeast of the mine against a natural ridge that forms the northern containment for the TMF extending to the east. The TMF footprint would be approximately 8.6 M-m^2 and would include a small lake in the central portion as well as streams draining to the Lizard Lake watershed in the east. Alternative TMF-1 avoids a small lake along the eastern perimeter. Tailings would be pumped to the TMF via pipeline, with water reclamation and toe seepage collection at low points. The pipeline length would be approximately 9 km.

On-Site Alternative TMF-2 – This TMF alternative is located northeast of the mine site against a natural ridge that forms the northern containment for the TMF. Tailings dam construction would be required only along the east, south, and west sides. The TMF footprint would be approximately 10.8 M-m^2. Alternative TMF-2 would avoid 2 small lakes along the eastern perimeter. Tailings would be pumped to the TMF via pipeline, with water reclamation and toe seepage collection at low points. The pipeline length would be approximately 9 km.

On-Site Alternative TMF-3 - This TMF alternative is located northeast of the mine site in the Lizard Lake basin. The proposed facility would require construction of dams around almost the entire TMF, but would take advantage of natural depressions to reduce dam heights. The TMF footprint would be approximately 14.1 M-m^2. Alternative TMF-3 requires major diversion of the main inflow to the lake from the north, and damming of the former outflow to the south. Tailings would be pumped to the TMF via pipeline, with water reclamation and toe seepage collection at low points. The pipeline would require construction of a service road and the length would be approximately 7 km.

On-Site Alternative TMF-4 - This TMF alternative is located southeast of Lizard Lake in an upland area. The proposed facility would require dams constructed around the entire TMF, but would take advantage of locally higher topography to reduce dam height. The TMF footprint would be approximately 9 M-m^2. Tailings would be pumped to the TMF via pipeline, with water reclamation and toe seepage collection at low points. The pipeline would require construction of a service road and the length would be approximately 7.2 km.

On-Site Alternative TMF-5 - This TMF alternative is located northeast of the mine site and east of Premier Lake Road in an upland area. The proposed facility would require dams constructed around the entire TMF. The TMF footprint would be approximately 8.3 M-m^2. Tailings would be pumped to the TMF via pipeline, with water reclamation and toe seepage collection at low points. The pipeline length would be approximately 19.7 km.

Off-Site Alternative TMF-6 (Hogarth Pit) - This TMF alternative involves the tailings being pumped via pipeline to Hogarth Pit in the former Steep Rock Iron Mines site. The site would require minimal clearing and grubbing, but would require some local filling/dam construction to isolate the Pit from the existing Caland and Errington Pits and Steep Rock Lake. This site may include a discharge channel to Seine River, bypassing Steep Rock Lake. The pipeline length would be approximately 27 to 32 km long, depending on route. The alternative TMF-6 site location and part of the pipeline route is outside of the Osisko lease area and ownership. This alternative yields liability concerns regarding site security as well as spills and accidents along the pipeline and at the Pit. Areas of existing contamination would need to be identified and remediated where required. Hogarth Pit would be isolated from Caland Pit to eliminate water exchange through sealing of Mosher Point tunnel, and connections to local water bodies would need to be investigated and sealed where required.

3.2 Pre-Screening Assessment

The pre-screening assessment for the TMF alternatives was carried out and documented in January 2012 as part of the Terms of Reference (ToR) for the Project. This assessment is provided in Appendix A of this report and provides a detailed description of each TMF alternative and assesses the viability of each option based on the sites' potential effects on the hydrological/hydrogeological systems, terrestrial environment, aquatic environment, and potential socio-economic effects. The pre-screening assessment considered the following key criteria:

- Significant impact to fish habitat should be avoided;
- The required tailings pipeline length should be less than 25 km; and
- The site should be located on lands that under the control of OHRG.

A brief description of each candidate alternative is provided below and the results of the pre-screening assessment are provided below.

On-site Alternative TMF-3 is considered to have the lowest capital cost due to its topographic containment characteristics, however, it would involve filling Lizard Lake with tailings, resulting in significant impact to fish habitat. It would also require construction of a significant channel to divert the Lizard Lake watershed around the TMF. These major environmental alterations and the resulting impacts are considered to be too great for this alternative to be considered for further analysis.

On-site Alternative TMF-5 has the longest pipeline of all the on-site alternatives. Only approximately 50 percent of the pipeline route follows existing roads and therefore access roads following the remaining pipeline route must be constructed, broadening terrestrial disturbance and increasing construction requirements and costs. The long pipeline and construction requirements result in this option being the most expensive on-site alternative. Furthermore, the pipeline crosses a public road resulting in increased potential for pipeline tampering. Considerable adverse impacts on aquatic habitat are also expected due to the destruction and infilling of small lakes and a large pond within the TMF footprint. For these reasons, On-site Alternative TMF-5 was eliminated from further assessment.

Off-site Alternative TMF-6 (Hogarth Pit) was considered as an opportunity to make use of an already disturbed area and for a possible opportunity to remediate ongoing environmental liabilities. It is also an option that does not result in the removal of a natural water body that is frequented by fish. However, due to the remoteness of the Hogarth Pit from the Project Site, the location on lands not under the control of OHRG, the length of pipeline required (approximately 30 km), and the long term liabilities and security issues involved, this alternative was excluded from further consideration.

TMF-1, TMF-2 and TMF-4 were all 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. New identification was assigned to each alternative following the pre-screening assessment. The alternative titles were modified as follows:

- Alternative TMF-1 is carried forward as TMF-1
- Alternative TMF-4 is carried forward as TMF-2
- Alternative TMF-2 is carried forward as TMF-3 (base case)

TMF-3 (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, footprint area, capital costs, and improve protection of the environment by increasing setbacks from Lizard Lake. The TMF alternatives carried forward for detailed evaluation are shown on Figure 2.

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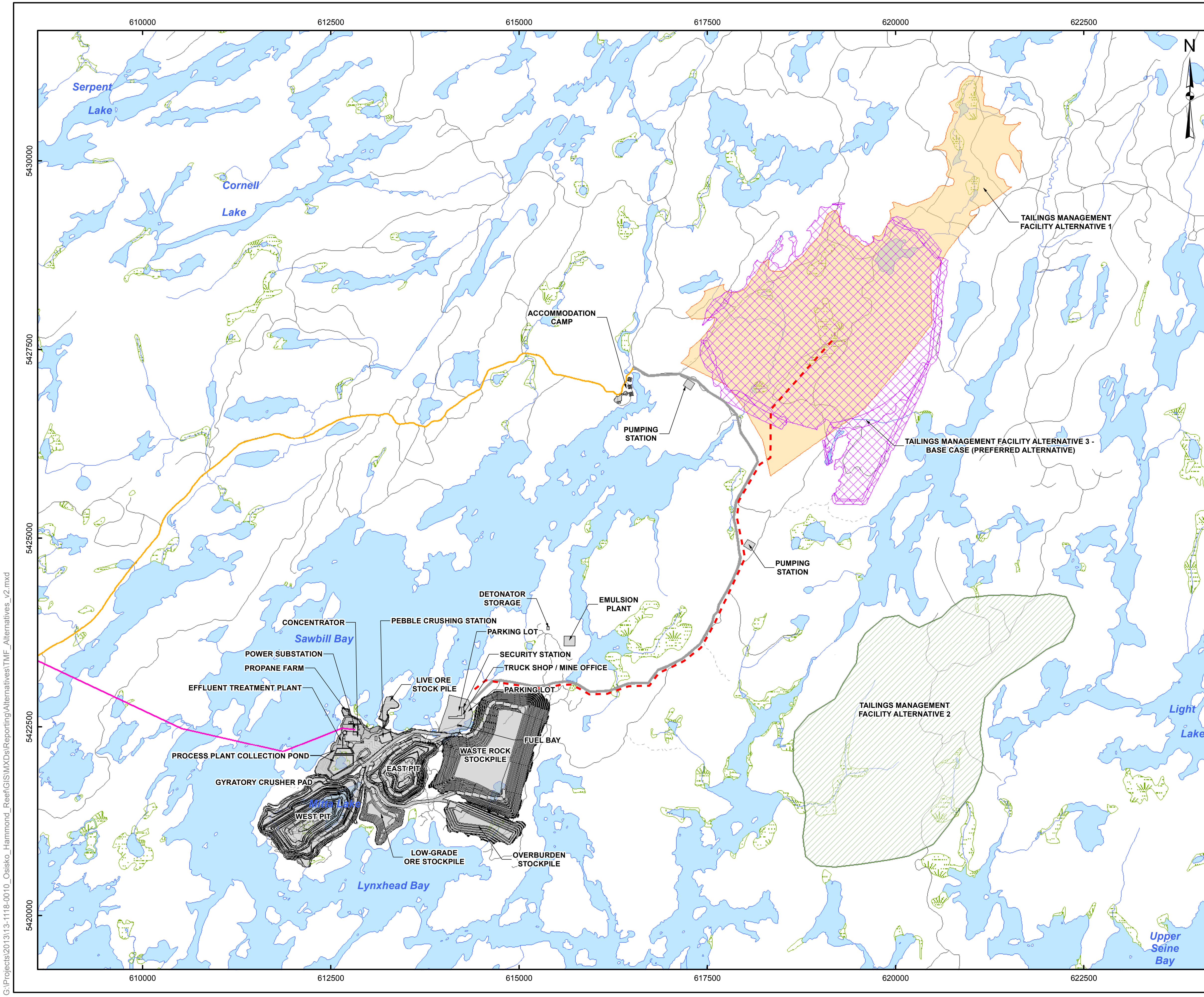

LEGEND

- Road
- River/Stream
- Lake
- Wetland

Tailings Management Facilitiy Alternatives

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

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

500 0 500 1,000 1,500 2,000

SCALE 1:50,000 METERS

PROJECT

HAMMOND REEF GOLD PROJECT
ATIKOKAN, ONTARIO, CANADA

TITLE

TAILINGS MANAGEMENT FACILITY SITING ALTERNATIVES

PROJECT NO. 13-1118-0010			SCALE AS SHOWN	VERSION 2
DESIGN	CGE	14 Nov. 2008		
GIS	JO	8 Nov. 2013		
CHECK	CH	8 Nov. 2013		
REVIEW	CH	8 Nov. 2013		

Golder Associates
Mississauga, Ontario

FIGURE: 2

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3.3 Alternative Characterization

The TMF alternatives have been characterized with respect to the environmental, technical, economic and social criteria described in Section 2.3. The assessment sub-accounts and indicators have been used as a framework for characterizing the alternatives and, therefore, the characterization of the TMF alternatives is presented and described in the following section along with the alternative scoring for each indicator. The alternative characterization considers the entire Project life cycle from construction through closure.

3.4 Multiple Accounts Assessment

A MAA was developed for each of the accounts identified above. In the MAA, the accounts were further broken down into sub-accounts and indicators that reflect specific considerations. The MAA for each account is presented and described in the following sections.

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 TMF alternatives. The environmental sub-accounts, indicators, and metrics for each indicator are summarized in Table 3.

Table 3: 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

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.

Table 4: 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	-

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 5.

Table 5: 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	$

3.4.4 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 6.

Table 6: 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	#

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.

3.4.5.1 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.

3.4.5.2 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.

3.4.5.3 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.

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 TMF footprints.

3.5 Value Bases Decision Process

As suggested by the Guidelines, a six point scoring scheme was developed for each indicator. Scores were assigned to each alternative with 6 being the "best" rank and 1 being the "worst" rank. Indicators with a quantitative nature were scored according to discrete intervals. For qualitative indicators, a value scale was developed using input from technical or environmental experts.

Within each account, sub-accounts were assigned a relative weighting factor to introduce a value bias between individual sub-accounts based on the relative importance of one sub-account to another. The same process was followed for each indicator within each sub-account. A higher weighting factor indicates a perceived greater relative value or importance. For example, the relative importance of the *impact on flora and fauna due to the TMF footprint* indicator within the *Terrestrial Habitat* sub-account is considered greater than the *impact on flora and fauna due to TMF infrastructure* indicator because the relative area of impact due to the TMF footprint is much larger compared to the area of impact due to the TMF infrastructure (e.g., pipeline, access road). Sub-account and indicator weightings were determined based on input from technical and environmental experts and feedback and opinions conveyed by stakeholders during consultation.

The following sections provide descriptions of each sub-account and indicator, the evaluation of TMF alternatives for each indicator, the indicator scoring scheme and the scoring assigned to each alternative.

3.5.1 Environmental Account

The environmental sub-accounts and indicators used to characterize and assess the TMF alternatives are described in the following sections.

3.5.1.1 Terrestrial Habitat Sub-Account

The following sections describe the indicators and scoring system used to characterize and assess the potential of the TMF alternatives to impact terrestrial habitat.

3.5.1.1.1 Impact to Flora and Fauna due to TMF Infrastructure Indicator

The major infrastructure associated with the TMF is the tailings pipeline and the associated access roads and pumping stations required. The pipeline would extend from the processing plant to the TMF. A greater pipeline length would result in greater disturbance to the surrounding terrestrial environment due to clearing of vegetation, installation and maintenance of the pipe, and construction of access roads and pumping stations. A longer pipeline would also increase the risk of pipeline failure and uncontrolled release of tailings to the environment. Therefore, the impact to flora and fauna due to TMF infrastructure has been ranked based on the length of tailings pipe. A shorter pipeline length was considered to be preferable. The scoring system used for the impact to flora and fauna due to TMF infrastructure indicator and the estimated length of the tailings pipeline for each alternative are provided in the following table.

Scoring Scheme			
Metric	**Score**	**Description**	
Length of tailings pipeline	6	< 10 km	
	5	10-12 km	
	4	12-14 km	
	3	14-16 km	
	2	16-18 km	
	1	> 18 km	
Scoring Results			
	TMF 1	**TMF 2**	**TMF 3**
Length of tailings pipeline	15.6 km	12.6 km	14.2 km
Score	3	4	3

3.5.1.1.2 Impact to Flora and Fauna due to TMF Footprint Indicator

The footprint of the TMF is defined as the area covered by the deposited tailings and containment dams. A larger TMF footprint is considered to have a greater impact to terrestrial habitat. Therefore, the footprint area was used to assign the relative scores and assess the potential impact of each alternative on existing flora and fauna. A smaller footprint area was considered to be preferable. The alternative scoring for the impact to flora and fauna due to TMF footprint indicator is provided in the following table.

Scoring Scheme			
Metric	**Score**	**Description**	
TMF footprint area	6	< 600 ha	
	5	600 – 700 ha	
	4	700 – 800 ha	
	3	800 – 900 ha	
	2	900 – 1000 ha	
	1	> 1000 ha	
Scoring Results			
	TMF 1	**TMF 2**	**TMF 3**
TMF footprint area	860 ha	900 ha	813 ha
Score	3	2.5	3

3.5.1.1.3 Percentage of Pipeline Following Existing Road Indicator

Access to the tailings pipeline route is necessary for installation during the construction stage and for maintenance during the operation stage. A pipeline route that follows an existing road is considered to be preferable because the clearing and construction of new roads and the resulting disturbance to the terrestrial environment can be avoided. The alternative scoring for the percentage of pipeline following existing road indicator is provided in the following table.

Scoring Scheme		
Metric	**Score**	**Description**
Percentage of pipeline following existing roads	6	> 90%
	5	70 – 90%
	4	50 – 70%
	3	30 – 50%
	2	10 – 30%
	1	< 10%

Scoring Results			
	TMF 1	**TMF 2**	**TMF 3**
Percentage of pipeline following existing roads	100%	50%	100%
Score	6	3.5	6

3.5.1.1.4 Effects on Wildlife Indicator

Potential effects to wildlife due to the TMF include the introduction of impediments to wildlife movement and change in habitat suitability due to additional sensory disturbances (i.e., light, noise, dust, human presence). The potential effects on wildlife have been assessed qualitatively based on these considerations. A TMF that significantly interrupts landscape connectivity and/or is located in an area that is isolated from existing or proposed anthropogenic disturbance is less preferred. The alternative scoring for the effects on wildlife indicator is provided in the following table.

Scoring Scheme		
Metric	**Score**	**Description**
Potential effect on wildlife	6	Negligible effect on wildlife
	5	Low potential effect on wildlife
	4	Moderate potential effect on wildlife
	3	High potential effect on wildlife
	2	Very high potential effect on wildlife
	1	Extreme potential effect on wildlife

Scoring Results			
	TMF 1	**TMF 2**	**TMF 3**
Potential effect on wildlife	Interrupts landscape connectivity to north of Lizard Lake. Located close to roadway and camp site; North area more isolated compared to TMF-3	Significantly interrupts landscape connectivity by creating impediment to wildlife movement. Located in area isolated from anthropogenic disturbance.	Limited interruption to landscape connectivity. Located close to roadway and camp site.
Score	4	2	5

3.5.1.1.5 Effects on Bird Habitat Indicator

Potential effects to bird habitat include loss of habitat area due to the TMF footprint and change in habitat suitability due to additional sensory disturbances (i.e., light, noise, dust, human presence). With the exception of the amount of wetland habitat, the diversity of available bird habitat does not vary significantly between alternatives. A TMF footprint that is located in an area that is currently isolated from existing or proposed anthropogenic disturbance and/or impacts a large amount of wetland habitat is less preferred. The potential effects on bird habitat have been assessed qualitatively based on these considerations. The alternative scoring for the effects on bird habitat indicator is provided in the following table.

Scoring Scheme			
Metric	**Score**	**Description**	
Potential effect on bird habitat	6	Negligible effect on bird habitat	
	5	Low potential effect on bird habitat	
	4	Moderate potential effect on bird habitat	
	3	High potential effect on bird habitat	
	2	Very high potential effect on bird habitat	
	1	Extreme potential effect on bird habitat	
Scoring Results			
	TMF 1	**TMF 2**	**TMF 3**
Potential effect on bird habitat	Located close to roadway and camp site; North area more isolated compared to TMF-3; About 42 ha of wetland impacted.	Located in area isolated from anthropogenic disturbance; About 26 ha of wetland impacted.	Located close to roadway and camp site; About 27 ha of wetland impacted.
Score	4	3	5

3.5.1.2 Aquatic Habitat Sub-Account

Loss of aquatic habitat due to the TMF footprint will be offset through the development and implementation of compensation measures as part of the overall project No Net Loss Plan. As a result, for any alternative chosen, the residual effect to aquatic habitat is considered to be negligible. Regardless, an alternative that results in greater impact to existing aquatic habitat is considered to be less desirable. The following sections describe the indicators and scoring system used to characterize and assess the potential of the TMF alternatives to impact existing aquatic habitat.

3.5.1.2.1 Number of Stream Crossings by Tailings Pipeline Indicator

This indicator was used to compare the potential for impact to water bodies along tailings pipeline due to watercourse crossings. Watercourse crossings may result in impact due to the removal/alteration of a section of the watercourse, sediment release during construction of the crossing, dust generated from traffic along the maintenance road and/or accidental tailings spill due to pipeline failure. An alternative with a tailings pipeline route that requires fewer water crossings is considered preferable. The alternative scoring for the number of stream crossings indicator is provided in the following table.

Scoring Scheme

Metric	Score	Description
Number of stream crossings	6	No stream crossings
	5	1 stream crossings
	4	2 stream crossings
	3	3 stream crossings
	2	4 stream crossings
	1	> 4 stream crossings

Scoring Results

	TMF 1	TMF 2	TMF 3
Number of stream crossings	1	4	1
Score	5	2	5

3.5.1.2.2 Permanent Streams Impacted Indicator

This indicator was used to assess the total length of permanent streams either directly impacted by the TMF footprint or indirectly impacted due to loss of watershed area. A stream was considered to be impacted if its watershed area was reduced by 25% or more due to the TMF footprint. Permanent streams were identified through review of information collected for the hydrology and aquatic environment assessments. An alternative that impacts a shorter length of permanent stream is considered to be preferable. The alternative scoring for the permanent streams impacted indicator is provided in the following table.

Scoring Scheme

Metric	Score	Description
Length of permanent streams impacted	6	No impact
	5	< 500 m
	4	500 – 1000 m
	3	1000 – 1500 m
	2	1500 – 2000 m
	1	> 2000 m

Scoring Results

	TMF 1	TMF 2	TMF 3
Length of permanent streams impacted	1350 m	1200 m	1350 m
Score	3	3	3

3.5.1.2.3 Ephemeral Streams Impacted Indicator

This indicator was used to assess the total length of ephemeral streams either directly impacted by the TMF footprint or indirectly impacted due to loss of watershed area. A stream was considered to be impacted if its watershed area was reduced by 25% or more due to the TMF footprint. Ephemeral streams were identified through review of information collected for the hydrology and aquatic environment assessments. An alternative that impacts a shorter length of ephemeral stream is considered to be preferable. The alternative scoring for the ephemeral streams impacted indicator is provided in the following table.

Scoring Scheme			
Metric	**Score**	**Description**	
Length of ephemeral streams impacted	6	No impact	
	5	< 2000 m	
	4	2000 – 4000 m	
	3	4000 – 6000 m	
	2	6000 – 8000 m	
	1	> 8000 m	
Scoring Results			
	TMF 1	**TMF 2**	**TMF 3**
Length of ephemeral streams impacted	8400 m	3600 m	5650 m
Score	1	4	3

3.5.1.2.4 Number of Fish-bearing Lakes Affected Indicator

This indicator was used to assess the number of fish-bearing lakes that are either directly impacted by the TMF footprint or indirectly impacted due to loss of watershed area. A lake was considered to be impacted if its watershed area was reduced by 25% or more due to the TMF footprint. Lakes were defined as fish bearing or non-fish bearing based on information collected for aquatic environment assessments. An alternative that impacts a fewer number of fish bearing lakes is considered to be preferable. The alternative scoring for the number of fish bearing lakes affected indicator is provided in the following table.

Scoring Scheme			
Metric	**Score**	**Description**	
Number of fish bearing lakes affected	6	0	
	5	1	
	4	2	
	3	3	
	2	4	
	1	> 5	
Scoring Results			
	TMF 1	**TMF 2**	**TMF 3**
Number of fish bearing lakes affected	6	0	2
Score	1	6	4

3.5.1.2.5 Area of Fish-bearing Lakes Affected Indicator

This indicator was used to assess the total area of fish-bearing lakes that are either directly impacted by the TMF footprint or indirectly impacted due to loss of watershed area. A lake was considered to be impacted if its watershed area was reduced by 25% or more due to the TMF footprint. Lakes were defined as fish bearing or non-fish bearing based on information collected for aquatic environment assessments. An alternative that impacts a fewer number of fish bearing lakes is considered to be preferable. The alternative scoring for the number of fish bearing lakes affected indicator is provided in the following table.

Scoring Scheme			
Metric	**Score**	**Description**	
Area of fish bearing lakes affected	6	< 5 ha	
	5	5 – 10 ha	
	4	10 – 15 ha	
	3	15 – 20 ha	
	2	20 – 25 ha	
	1	> 25 ha	
Scoring Results			
	TMF 1	**TMF 2**	**TMF 3**
Area of fish bearing lakes affected	32 ha	0 ha	16 ha
Score	1	6	3

3.5.1.3 Water Resources Sub-Account

Runoff collected within the TMF will not be released to the environment during the construction and operations phases of the project. Post-closure water will be released to the environment only after water quality is suitable for release. Therefore, the TMF will impact downstream receiving waterbodies due to diversion of flows. Alternatives that are able to minimize impacts to surface water hydrology are preferred. The following sections describe the indicators and scoring system used to characterize and assess the potential of the TMF alternatives to impact surface water hydrology and downstream water quality.

3.5.1.3.1 Impact on Surface Water Indicator

This indicator compares the relative number of watersheds directly affected by the TMF. Alternatives that affect a larger number of watersheds have an increased potential to impact hydrological conditions and water quality over a greater area in the event of a release of tailings contact water. Alternatives that minimize the number of catchments and/or watersheds directly impacted have fewer locations where surface water impacts would be imposed. Therefore, alternatives that impact fewer surface watersheds are considered preferable. The alternative scoring for the impact to surface water indicator is provided in the following table.

Scoring Scheme		
Metric	**Score**	**Description**
Number of watersheds affected	6	< 3
	5	3
	4	4
	3	5
	2	6
	1	> 6

Scoring Results			
	TMF 1	**TMF 2**	**TMF 3**
Number of watersheds affected	3	8	4
Score	5	1	4

3.5.1.3.2 Ability to Limit Impact to Water Quality in Surrounding Water Bodies Indicator

Selecting a TMF location with favorable topographic conditions (e.g., a location that provides natural containment) and/or with fewer, more distal or less significant downstream receiving water bodies can mitigate the potential for adverse impacts to downstream water quality. The alternatives were qualitatively assessed based on the ability of their location to mitigate potential impacts to downstream water bodies. The alternative scoring for the ability to limit impact to water quality in surrounding waterbodies indicator is provided in the following table.

Scoring Scheme		
Metric	**Score**	**Description**
Ability to Limit Impact to Water Quality in Surrounding Water Bodies	6	No impact
	5	High
	4	Moderate – High
	3	Moderate
	2	Low – Moderate
	1	Low

Scoring Results			
	TMF 1	**TMF 2**	**TMF 3**
Ability to Limit Impact to Water Quality in Surrounding Water Bodies	Natural watershed divide located along northwestern perimeter; Limits potential water release to southeast direction. Longer southeast perimeter compared to TMF 3	Footprint impacts 8 separate watersheds with potential for water release at 8 locations around entire perimeter	Natural watershed divide located along northwestern perimeter; Limits potential water release to southeast direction
Score	3	1	4

3.5.1.3.3 Impact to Groundwater Indicator

Groundwater flows from the TMF will be collected to the extent possible through a seepage interception system. This system will be comprise a number of ditches and collection ponds at low points along the TMF perimeter with collected water being pumped back to the TMF for eventual use by the processing plant. The relative potential for groundwater flow release and the requirements for maintenance of pumping infrastructure both increase with a larger number of seepage collection ponds. Therefore, the potential for impact to groundwater was evaluated based on the number of potential seepage collection ponds required. The number of collection ponds required was estimated through review of the topography along the perimeter of the TMF footprint. An alternative with less collection ponds was considered preferable. The alternative scoring for the impact to groundwater indicator is provided in the following table.

Scoring Scheme			
Metric	**Score**	**Description**	
Number of collection ponds required	6	< 5	
	5	5	
	4	6	
	3	7	
	2	8	
	1	> 8	
Scoring Results			
	TMF 1	**TMF 2**	**TMF 3**
Number of collection ponds required	8	7	5
Score	2	3	5

3.5.1.4 *Air Quality Sub-Account*

The following sections describe the indicators and scoring system used to characterize and assess the potential of the TMF alternatives to impact air quality.

3.5.1.4.1 Potential for Dust Generation Indicator

The exposed tailings surface is expected to be the primary source for dust generation due to the TMF. Therefore, the potential for dust generation was assessed based on the area of the tailings surface. A smaller tailings surface area is considered to be preferable. The alternative scoring for the potential for dust generation indicator is provided in the following table.

Scoring Scheme			
Metric	**Score**	**Description**	
Area of tailings	6	< 500 ha	
	5	500 – 600 ha	
	4	600 – 700 ha	
	3	700 – 800 ha	
	2	800 – 900 ha	
	1	> 900 ha	
Scoring Results			
	TMF 1	**TMF 2**	**TMF 3**
Area of tailings	715 ha	750 ha	675 ha
Score	3	3	4

3.5.1.4.2 Potential for Greenhouse Gas Emission during Construction Indicator

The potential for greenhouse gas (GHG) emission due to construction indicator is primarily dependent on the GHG produced by haul trucks conveying construction material from the waste rock stockpile to the TMF site. This indicator was assessed based on the distance from the TMF to the waste rock stockpile. For this assessment, the waste rock stockpile was assumed to be located adjacent to the east pit. The alternative with the lowest haul distance is considered to be preferred. The alternative scoring for the potential for greenhouse gas emissions during construction indicator is provided in the following table.

Scoring Scheme			
Metric	**Score**	**Description**	
Fill volume times km of haul	6	< 2 km	
	5	2 – 4 km	
	4	4 – 6 km	
	3	6 – 8 km	
	2	8 – 10 km	
	1	> 10 km	
Scoring Results			
	TMF 1	**TMF 2**	**TMF 3**
Fill volume times km of haul	9 km	6 km	7.5 km
Score	2	3.5	3

3.5.2 Technical Account

The technical sub-accounts and indicators used to characterize and assess the TMF alternatives are described in the following sections.

3.5.2.1 Complexity of Design and Construction Sub-Account

The performance and stability of the tailings facility will depend on the foundation conditions, foundation preparation, fill materials, and quality of the construction. Alternatives which have preferable site conditions and simple design configurations will be easier to design, construct and maintain and will be subject to fewer hazards and geotechnical risks. The following sections describe the indicators and scoring system used to characterize and assess the overall complexity of the design and construction of the TMF alternatives.

3.5.2.1.1 Foundation Conditions Indicator

Appropriate underlying geology is required for safe containment of tailings. Containment dams constructed on poor foundation conditions require additional stability measures (i.e., shallower slopes, stabilization berms, over-excavation, etc.). Options with more challenging foundation conditions pose greater engineering challenges and higher risks to the safety of the containment structures, and are thus less desirable. The alternative scoring for the foundation conditions indicator is provided in the following table.

Scoring Scheme			
Metric	**Score**	**Description**	
Foundation conditions	6	Excellent foundation conditions	
	5	Good foundation conditions	
	4	Fair foundation conditions	
	3	Moderate foundation conditions	
	2	Poor foundation conditions	
	1	Very poor foundation conditions	
Scoring Results			
	TMF 1	**TMF 2**	**TMF 3**
Foundation conditions	Overburden predominantly consists of loose to compact silts/ sands interbedded with layers of very soft clay	Overburden consists of interbedded layers of silt/clay and silt/sand, with a basal till unit before the bedrock contact	Overburden predominantly consists of loose to compact silts/ sands interbedded with layers of very soft clay
Score	3	5	3

3.5.2.1.2 Topographic Containment Indicator

An alternative that takes advantage of natural depressions and/or existing topography for containment is desirable. Topographic features such as ridges are geologically stable. The use of natural depressions at lower relative elevations and/or existing topography for containment considerably reduces the reliance on engineered structures, and the geotechnical and environmental risks associated with these structures is decreased. The topographic suitability of the alternatives is assessed based on the estimated dam fill required to contain the tailings. A smaller dam volume implies more effective use of topographic containment and is considered to be preferable. The alternative scoring for the topographic containment indicator is provided in the following table.

Scoring Scheme			
Metric	**Score**	**Description**	
Dam fill volume	6	< 5 Mm^3	
	5	5 Mm^3 - 10 Mm^3	
	4	10 Mm^3 - 15 Mm^3	
	3	15 Mm^3 - 20 Mm^3	
	2	20 Mm^3 - 25 Mm^3	
	1	> 25 Mm^3	
Scoring Results			
	TMF 1	**TMF 2**	**TMF 3**
Dam fill volume	16 Mm^3	28 Mm^3	23 Mm^3
Score	3	1	2

3.5.2.1.3 Pumping Requirements Indicator

The tailings transportation pumping requirements are primarily dependant on the length of the tailings pipeline. More energy for pumping is required overcome friction losses in the pipeline and friction losses increase with pipeline length. Therefore a shorter pipeline is considered to be preferable. The alternative scoring for the pumping requirements indicator is provided in the following table.

Scoring Scheme			
Metric	**Score**	**Description**	
Length of tailings pipeline	6	< 10 km	
	5	10-12 km	
	4	12-14 km	
	3	14-16 km	
	2	16-18 km	
	1	> 18 km	
Scoring Results			
	TMF 1	**TMF 2**	**TMF 3**
Length of tailings pipeline	15.6 km	12.6 km	14.2 km
Score	3	4	3

3.5.2.1.4 Percentage of Pipeline Following Existing Road Indicator

Access to the tailings pipeline route is necessary for installation during the construction stage and for ongoing maintenance during the operation stage. A pipeline route that follows an existing road is preferable to one that does not follow an existing road because less construction activity and borrow material is required for installation of the pipeline. The alternative scoring for the percentage of pipeline following existing road indicator is provided in the following table.

Scoring Scheme			
Metric	**Score**	**Description**	
Percent of pipeline following existing road	6	> 90%	
	5	70 – 90%	
	4	50 – 70%	
	3	30 – 50%	
	2	10 – 30%	
	1	< 10%	
Scoring Results			
	TMF 1	**TMF 2**	**TMF 3**
Percent of pipeline following existing road	100%	50%	100%
Score	6	3.5	6

3.5.2.1.5 Tailings Pipeline Length

TMF alternatives located further from the processing plant will require increased installation effort, pipe and maintenance during operations. In addition, a longer pipeline introduces a higher risk of pipe blockage due to freezing or sanding. An alternative with a shorter pipeline was considered preferable. The alternative scoring for the tailings pipeline length indicator is provided in the following table.

Scoring Scheme			
Metric	**Score**	**Description**	
Pipeline length	6	< 10 km	
	5	10 – 12 km	
	4	12 – 14 km	
	3	14 – 16 km	
	2	16 – 18 km	
	1	> 18 km	
Scoring Results			
	TMF 1	**TMF 2**	**TMF 3**
Pipeline length	15.6 km	12.6 km	14.2 km
Score	3	4	3

3.5.2.1.6 Geotechnical Risk Indicator

This indicator compares the potential geotechnical risk of each alternative. The indicator evaluates the maximum height of the containment dams. Higher dams have the potential to release a greater volume of tailings release should failure occur. An alternative with a higher dam requirement is considered to be less preferable in terms of geotechnical risk. The alternative scoring for the slope stability indicator is provided in the following table.

Scoring Scheme			
Metric	**Score**	**Description**	
Maximum height of dams	6	< 10 m	
	5	10 – 20 m	
	4	20 – 30 m	
	3	30 – 40 m	
	2	40 – 50 m	
	1	> 50 m	
Scoring Results			
	TMF 1	**TMF 2**	**TMF 3**
Maximum height of dams	~ 20 – 30 m	~ 40 - 45 m	~ 32 m
Score	4	2	3

3.5.2.1.7 Dam Hazard Classification Indicator

The dam hazard classification rating is based on the Canadian Dam Association's dam safety guidelines (CDA 2007). The dam class is based on four key criteria: population at risk (i.e. humans residing/working downstream of the dam) and the potential for loss of human life, loss of environmentally and culturally-valued components, loss of infrastructure and economic losses. A lower hazard classification corresponds to a lower risk in the event of dam failure and is considered to be preferable. The alternative scoring for the dam hazard classification indicator is provided in the following table. The dam hazard scores were ranked out of five instead of six as there are only five dam hazard classes.

Scoring Scheme			
Metric	**Score**	**Description**	
Dam class based on CDA dam safety guidelines	5	Low	
	4	Significant	
	3	High	
	2	Very high	
	1	Extreme	
Scoring Results			
	TMF 1	**TMF 2**	**TMF 3**
Dam class based on CDA dam safety guidelines	Significant dam class	Significant dam class	Significant dam class
Score	4	4	4

3.5.2.2 Water Management Sub-Account

The following sections describe the indicators and scoring systems used to characterize and assess the water management requirements of the TMF alternatives.

3.5.2.2.1 Net Run-off from Tailings Area Indicator

TMF alternatives with smaller catchment areas (i.e., tailings surface areas) will result in smaller volumes of process-affected runoff that are required to be managed. This reduces engineered containment requirements and risks associated with increased water storage. Alternatives that have smaller catchment areas are considered to be preferable. The alternative scoring for the net run-off from tailings indicator is provided in the following table.

Scoring Scheme			
Metric	**Qualitative Score**	**Description**	
Area of tailings	6	< 500 ha	
	5	500 – 600 ha	
	4	600 – 700 ha	
	3	700 – 800 ha	
	2	800 – 900 ha	
	1	> 900 ha	
Scoring Results			
	TMF 1	**TMF 2**	**TMF 3**
Area of tailings	715 ha	750 ha	675 ha
Qualitative Score	3	3	4

3.5.2.2.2 Number of Collection Ponds Indicator

A tailings management facility option with more collection ponds results in greater construction and maintenance commitments. Infrastructure requirements for pumping collected water back to the TMF also increases with a greater number of collection ponds. Therefore, alternatives with fewer collection ponds are considered to be preferable. The number of collection ponds required was estimated through review of the topography along the perimeter of the TMF footprint. The alternative scoring for the number of collection ponds indicator is provided in the following table.

Scoring Scheme			
Metric	**Score**	**Description**	
Number of collection ponds required	6	< 5	
	5	5	
	4	6	
	3	7	
	2	8	
	1	> 8	
Scoring Results			
	TMF 1	**TMF 2**	**TMF 3**
Number of collection ponds required	8	7	5
Score	2	3	5

3.5.2.2.3 Seepage Collection Ditches Indicator

This indicator was used to compare the length of seepage collection ditches required to contain seepage and surface runoff from the TMF dams. Longer seepage collection ditches require more construction and maintenance, and increase the potential for water to bypass the collection system. Alternatives with short seepage collection ditch requirements were considered preferable. The alternative scoring for the seepage collection ditches indicator is provided in the following table.

Scoring Scheme			
Metric	**Score**	**Description**	
Length of seepage collection ditches	6	< 6 km	
	5	6 – 8 km	
	4	8 – 10 km	
	3	10 – 12 km	
	2	12- 14 km	
	1	> 14 km	
Scoring Results			
	TMF 1	**TMF 2**	**TMF 3**
Length of seepage collection ditches	10.5 km	12 km	9 km
Qualitative Score	3	2.5	4

3.5.2.3 Closure Sub-Account

The following section describes the indicator and scoring system used to characterize and assess the closure of the TMF alternatives

3.5.2.3.1 Complexity of Closure Indicator

Closure of the TMF is assumed to involve the direct revegetation of the tailings surface through fertilization and seeding. If required, organic mulch (e.g., pulp mill sludge, or stabilized sewage sludge) will be spread if nutrient conditions are lacking. Therefore, the complexity of closure was considered to be dependent on the area of tailings to be covered. Facilities that have a smaller tailings area are considered preferable. The alternative scoring for the complexity of closure indicator is provided in the following table.

Scoring Scheme			
Metric	**Score**	**Description**	
Tailings area	6	< 500 ha	
	5	500 – 600 ha	
	4	600 – 700 ha	
	3	700 – 800 ha	
	2	800 – 900 ha	
	1	> 900 ha	
Scoring Results			
	TMF 1	**TMF 2**	**TMF 3**
Tailings area	715 ha	750 ha	675 ha
Score	3	3	4

3.5.3 Economics Account

The economic sub-accounts and indicators used to characterize and assess the TMF alternatives are described in the following sections.

3.5.3.1 Capital Cost Sub-Account

The following section describes the indicator and scoring system used to characterize and assess the capital cost of the TMF alternatives.

3.5.3.1.1 Total Estimated Capital Costs Indicator

The capital costs of the TMF are primarily incurred due to foundation preparation, dam and pipeline construction, and water management system construction. Factors such as large dam fill volume requirements, long pipeline and access road lengths and poor foundation conditions will increase capital costs. Preliminary estimates of the capital costs of each alternative were calculated. An alternative with a lower capital cost was considered to be preferable. The alternative scoring for the capital cost indicator is provided in the following table.

Scoring Scheme			
Metric	**Score**	**Description**	
Estimated Capital Cost	6	< $50 M	
	5	$50 – 75 M	
	4	$75 – 100 M	
	3	$100 – 125 M	
	2	$125 – 150 M	
	1	> $150 M	
Scoring Results			
	TMF 1	**TMF 2**	**TMF 3**
Estimated Capital Cost	$110 M	$169 M	$86 M
Score	3	1	4

3.5.3.2 Operating Cost Sub-Account

The following section describes the indicator and scoring system used to characterize and assess the operating cost of the TMF alternatives

3.5.3.2.1 Total Estimated Operating Costs per Year Indicator

The operational costs of the tailings management facility are primarily incurred due to the transportation of tailings from the processing plant to the TMF. Factors such as the distance and elevation difference from the processing plant to the TMF affect the pumping and maintenance requirements and, therefore, the operational costs. Preliminary estimates of the operational costs per year for each alternative were calculated. An alternative with a lower annual operating cost was considered to be preferable. The alternative scoring for the operating cost indicator is provided in the following table.

Scoring Scheme			
Metric	**Score**	**Description**	
Annual operating costs	6	< $500,000	
	5	$0.5 – 1 M	
	4	$1 – 1.5 M	
	3	$1.5 – 2 M	
	2	$2 – 2.5 M	
	1	> $2.5 M	
Scoring Results			
	TMF 1	**TMF 2**	**TMF 3**
Annual operating costs	$1.25 M	$1 M	$1.14 M
Score	4	4.5	4

3.5.3.3 Closure Cost Sub-Account

The following section describes the indicator and scoring system used to characterize and assess the closure cost of the TMF alternatives.

3.5.3.3.1 Total Estimated Closure Cost Indicator

The closure costs of the tailings management facility are primarily incurred due to revegetation of the tailings surface area. Therefore, closure costs are directly related to the surface area of the tailings. Preliminary estimates of the closure costs for each alternative were calculated. An alternative with a lower closure cost was considered to be preferable. The alternative scoring for the closure cost indicator is provided in the following table.

Scoring Scheme			
Metric	**Score**	**Description**	
Estimated closure cost	6	< $4,000,000	
	5	$4,000,000 – 5,000,000	
	4	$5,000,000 – 6,000,000	
	3	$6,000,000 – 7,000,000	
	2	$7,000,000 – 8,000,000	
	1	> $8,000,000	
Scoring Results			
	TMF 1	**TMF 2**	**TMF 3**
Estimated closure cost	$6,700,000	$7,000,000	$6,300,000
Score	3	2.5	3

3.5.3.4 Fish Habitat Compensation Sub-Account

Where an alternative directly or indirectly impacts water bodies that are frequented by fish, compensation measures may be required. The following section describes the indicator and scoring system used to characterize and assess the potential fish habitat compensation costs of the TMF alternatives.

3.5.3.4.1 Total Fish Habitat Compensation Cost Indicator

Aquatic habitat compensation measures will be implemented to offset habitat loss as a result of construction of the TMF. Preliminary estimates of fish habitat compensation costs for each alternative were calculated based on the estimated quantity of fish bearing lakes/streams impacted. As detailed habitat modelling assessments are not available for all alternatives, the assessment carried out under the aquatic habitat sub-account was used as a basis for estimating fish habitat losses. Impacts to fish bearing lakes and permanent streams were assumed to appropriately estimate of fish habitat losses and compensation costs were scaled based on estimated habitat losses. An alternative with a lower fish habitat compensation cost was considered to be preferable. The alternative scoring for the fish habitat compensation cost indicator is provided in the following table.

Scoring Scheme			
Metric	**Score**	**Description**	
Estimated fish habitat compensation cost	6	< $250K	
	5	$250 – 500K	
	4	$500 – 750K	
	3	$750K – 1M	
	2	$1M – 1.25M	
	1	> $1.25M	
Scoring Results			
	TMF 1	**TMF 2**	**TMF 3**
Estimated fish habitat compensation cost	$1,500,000	<$100,000	$800,000
Score	1	6	3

3.5.4 Socio-Economics Account

The economic sub-accounts and indicators used to characterize and assess the TMF alternatives are described in the following sections.

3.5.4.1 Archaeology Sub-Account

There are known archaeological and cultural heritage sites that exist within the project area. Tailings management facilities that avoid these areas are considered to be more desirable than facilities that will result in the loss these sites. The following section describes the indicator and scoring system used to characterize and assess archaeological considerations of the TMF alternatives.

3.5.4.1.1 Effects on Cultural Heritage Sites Indicator

TMF alternatives that impact archaeological resources will potentially require additional investigation, permitting, and may attract adverse public concern. The alternatives were scored based on direct impacts to known archaeological sites within the TMF footprint. An alternative that overlays fewer archaeological sites is considered to be preferable. The alternative scoring for the effects on cultural heritage sites indicator is provided in the following table. Archaeological data in the area of alternative TMF 2 was not available for this assessment and therefore this alternative was assigned a neutral score.

Scoring Scheme			
Metric	**Score**	**Description**	
Number of areas with archaeological potential	6	0	
	5	1	
	4	2	
	3	3	
	2	4	
	1	> 4	
Scoring Results			
	TMF 1	**TMF 2**	**TMF 3**
Number of areas with archaeological potential	2	N/A	0
Score	4	3.5	6

3.5.4.2 Visual Impacts Sub-Account

A TMF that is more visually conspicuous may attract adverse public concern. The relative visual impact for each facility was evaluated based on factors representing the visibility and relative contrast of the TMF alternatives with respect to the surrounding terrain. A facility with a low profile that blends in with the surrounding area is considered to be more desirable than a facility with high topographic relief that does not blend into the surrounding area. The following section describes the indicator and scoring system used to characterize and assess the potential visual impacts of the TMF alternatives.

3.5.4.2.1 Maximum Height of TMF Indicator

A TMF that consists of higher dams or a higher tailings stack is more visually noticeable than one with smaller dams/tailings stack. This indicator was ranked based on the maximum crest height of dams at the ultimate stage or on the maximum height of the tailings stack (whichever was greatest). An alternative that has a lower height was considered to be preferable. The alternative scoring for the maximum height of TMF indicator is provided in the following table.

Scoring Scheme			
Metric	**Score**	**Description**	
Maximum TMF height	6	No visual impact	
	5	>20 m above natural topography	
	4	>40 m above natural topography	
	3	>60 m above natural topography	
	2	>80 m above natural topography	
	1	>100 m above natural topography	
Scoring Results			
	TMF 1	**TMF 2**	**TMF 3**
Maximum TMF height	Tailings stack/cone with max height of about 67 m above lowest ground surface elevation. Dams up to 35 m	Tailings stack/cone with max height of about 82 m above lowest ground surface elevation. Dams up to 45 m	Tailings stack/cone with max height of about 63 m above lowest ground surface elevation. Dams up to 32 m in height
Score	3	2	3

3.5.4.2.2 Distance from Marmion Reservoir Indicator

As the Marmion Reservoir is used for recreational activities, this indicator considers the potential for users of Marmion Reservoir to be within close proximity to the TMF. Scores for each alternative were assigned based on the shortest distance of each alternative to Marmion Reservoir. An alternative located further away from the Marmion Reservoir was considered preferable. The alternative scoring for the distance from Marmion Reservoir indicator is provided in the following table.

Scoring Scheme			
Metric	**Score**	**Description**	
Shortest distance from Marmion Reservoir	6	> 500	
	5	400 – 499 m	
	4	300 – 399 m	
	3	200 – 299 m	
	2	100 – 199 m	
	1	< 100 m	
Scoring Results			
	TMF 1	**TMF 2**	**TMF 3**
Shortest distance from Marmion Reservoir	200 m	125 m	100 m
Score	3	2	2

3.5.4.3 Land Claims Sub-Account

The following section describes the indicator and scoring system used to characterize and assess land tenure considerations of the TMF alternatives.

3.5.4.3.1 Number of Osisko Land Claims Indicator

The footprints of the TMF alternatives were compared against the known mineral claims that are controlled by Osisko. If an alternative was located on lands in which Osisko does not hold mineral claims, the alternative would be considered less preferable and would warrant a lower score. The alternative scoring for the number of Osisko land claims indicator is provided in the following table.

Scoring Scheme			
Metric	**Score**	**Description**	
Number of land claims not controlled by Osisko	6	All claims controlled by Osisko	
	5	1 claim not controlled by Osisko	
	4	2 claims not controlled by Osisko	
	3	3 claims not controlled by Osisko	
	2	4 claims not controlled by Osisko	
	1	5 claims not controlled by Osisko	
Scoring Results			
	TMF 1	**TMF 2**	**TMF 3**
Number of land claims not controlled by Osisko	Osisko controls all claims	Osisko controls all claims	Osisko controls all claims
Score	6	6	6

3.5.4.4 Effects on Land Use Sub-Account

The indicators within this sub-account were developed to compare the perceived land use value attributed to the land that each TMF alternative will occupy. Land use was characterized by recreational activities including hunting, fishing, and tourism and recreation. The following section describes the indicators and scoring systems used to characterize and assess the potential effects of the TMF alternatives on land use.

3.5.4.4.1 Effects on Hunting Indicator

The effects of the TMF alternatives on hunting were assessed based on known hunting/trapping activities occurring within the TMF footprint. Known hunting/trapping activities were determined based on information collected for use in the socio-economic assessment and considered trap lines, trapper cabins and bear baiting stations. An alternative that will not affect known hunting/trapping activities is considered to be preferable. The alternative scoring for the effects on hunting indicator is provided in the following table.

Scoring Scheme			
Metric	**Score**	**Description**	
Number of traplines, trapper cabins and/or bear baiting stations	6	0	
	5	1	
	4	2	
	3	3	
	2	4	
	1	> 4	
Scoring Results			
	TMF 1	**TMF 2**	**TMF 3**
Number of trap lines, trapper cabins and/or bear baiting stations	0	2	0
Score	6	4	6

3.5.4.4.2 Effects on Fishing Indicator

The effects of the TMF alternatives on fishing were assumed to be directly linked to loss of fish habitat due to the TMF footprint. As detailed habitat modelling assessments are not available for all alternatives, the assessment carried out under the aquatic habitat sub-account was used as a basis for estimating fish habitat losses. Impacts to fish bearing lakes and permanent streams were assumed to appropriately estimate of fish habitat losses. An alternative that impacts fewer fish bearing lakes and permanent streams is considered to be preferable. The alternative scoring for the effects on fishing indicator is provided in the following table.

Scoring Scheme			
Metric	**Score**	**Description**	
Number of fish-bearing lakes and/or permanent streams	6	0	
	5	1	
	4	2	
	3	3	
	2	4	
	1	> 4	
Scoring Results			
	TMF 1	**TMF 2**	**TMF 3**
Number of fish-bearing lakes and/or permanent streams	7	1	3
Score	1	5	3

3.5.4.4.3 Effects on Tourism and Recreation Indicator

The effects of the TMF alternatives on tourism and recreation were assessed based on known activities occurring within or near the TMF footprint. Known activities were determined based on information collected for use in the socio-economic assessment and considered tourism establishments and known camping areas. An alternative that will not affect known tourism and recreation activities is considered to be preferable. The alternative scoring for the effects on tourism and recreation indicator is provided in the following table.

Scoring Scheme			
Metric	**Score**	**Description**	
Number of tourism establishments and/or camping areas	6	0	
	5	1	
	4	2	
	3	3	
	2	4	
	1	> 4	
Scoring Results			
	TMF 1	**TMF 2**	**TMF 3**
Number of tourism establishments and/or camping areas	0	0	0
Score	6	6	6

3.6 Results and Sensitivity Analysis

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 final results and rankings of the base case and sensitivity cases are presented in Table 7. The detailed assessment results for all cases are provided in Table 8 through Table 12.

The TMF 3 alternative scored the highest for all cases and is, therefore, regarded as the preferred alternative.

Table 7: Base Case and Sensitivity Analysis Results

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

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Table 8: TMF MAA – Base Case

Weightings						Scoring		
Account	Account Weighting (W_A)	Sub-Account	Sub-Account Weighting (W_S)	Indicator	Indicator Weighting (W_I)	TMF 1	TMF 2	TMF 3
Environment	6	Terrestrial Habitat	5	Impact on flora and fauna due to TMF infrastructure	1	3	4	3
				Impact on flora and fauna due to TMF footprint	6	3	2.5	3
				Percentage of pipeline following existing road	2	6	3.5	6
				Effects on wildlife	4	4	2	5
				Effects on birds	4	4	3	5
				Sub-Account Merit Rating		**3.82**	**2.71**	**4.29**
		Aquatic Habitat	6	Number of stream crossings by tailings pipeline	2	5	2	5
				Permanent streams impacted	6	3	3	3
				Ephemeral Streams Impacted	3	1	4	3
				Number of fish-bearing lakes affected	4	1	6	4
				Area of fish-bearing lakes affected	6	1	6	3
				Sub-Account Merit Rating		**1.95**	**4.48**	**3.38**
		Water Resources	4	Impact on surface water	6	5	1	4
				Ability to limit impact water quality in surrounding water bodies	3	3	1	4
				Impact to groundwater	4	2	3	5
				Sub-Account Merit Rating		**3.62**	**1.62**	**4.31**
		Air Quality	2	Potential for dust generation	4	3	3	4
				Potential for greenhouse gas emission due to construction	4	2	3.5	3
				Sub-Account Merit Rating		**2.50**	**3.25**	**3.50**
				Account Merit Rating		**2.96**	**3.14**	**3.88**
Technical	3	Complexity of Design and Construction	6	Foundation Conditions	5	3	5	3
				Topography containment	6	3	1	2
				Pumping Requirements	6	3	4	3
				Percentage of pipeline following existing road	2	6	3.5	6
				Tailings pipeline length	3	3	4	3
				Geotechnical Risk	3	4	2	3
				Dam hazard classification	4	4	4	4
				Sub-Account Merit Rating		**3.45**	**3.31**	**3.14**
		Water Management	4	Net run-off from tailings area	3	3	3	4
				Number of collection ponds required	6	2	3	5
				Seepage collection ditches	3	3	2.5	4
				Sub-Account Merit Rating		**2.50**	**2.88**	**4.50**
		Closure	3	Complexity of Closure	6	3	3	4
				Sub-Account Merit Rating		**3.00**	**3.00**	**4.00**
				Account Merit Rating		**3.05**	**3.10**	**3.76**

Table 8: TMF MAA – Base Case (Continued)

Weightings						Scoring		
Account	**Account Weighting (W_A)**	**Sub-Account**	**Sub-Account Weighting (W_S)**	**Indicator**	**Indicator Weighting (W_I)**	**TMF 1**	**TMF 2**	**TMF 3**
Economics	1.5	Capital Cost	6	Total estimated capital cost	6	3	1	4
				Sub-Account Merit Rating		**3.00**	**1.00**	**4.00**
		Operating Cost	2	Total estimated operational costs per year	2	4	4.5	4
				Sub-Account Merit Rating		**4.00**	**4.50**	**4.00**
		Closure Cost	1	Total estimated closure costs	1	3	2.5	3
				Sub-Account Merit Rating		**3.00**	**2.50**	**3.00**
		Fish Habitat Compensation	1	Total estimated fish habitat compensation cost	1	1	6	3
				Sub-Account Merit Rating		**1.00**	**6.00**	**3.00**
				Account Merit Rating		**3.00**	**2.35**	**3.80**
Socio-Economics	3	Archaeology	2	Effects on cultural heritage sites	6	4	3.5	6
				Sub-Account Merit Rating		**4.00**	**-**	**6.00**
		Visual Impacts	5	Maximum Height of TMF	6	3	2	3
				Distance from Marmion Reservoir	4	3	2	2
				Sub-Account Merit Rating		**3.00**	**2.00**	**2.60**
		Land Claims	1	Number of known claims	6	6	6	6
						6.00	**6.00**	**6.00**
		Effects on Land Use	6	Effects on Hunting	4	5	4	5
				Effects on Fishing	6	1	5	3
				Effects on tourism and recreation	3	6	6	6
				Sub-Account Merit Rating		**3.38**	**4.92**	**4.31**
				Account Merit Rating		**3.52**	**3.79**	**4.06**
FINAL RANKING						**3.11**	**3.19**	**3.88**

Table 9: TMF MAA – Sensitivity Case 1

Weightings						Scoring		
Account	**Account Weighting (W_A)**	**Sub-Account**	**Sub-Account Weighting (W_S)**	**Indicator**	**Indicator Weighting (W_I)**	**TMF 1**	**TMF 2**	**TMF 3**
Environment	6	Terrestrial Habitat	5	Impact on flora and fauna due to TMF infrastructure	1	3	4	3
				Impact on flora and fauna due to TMF footprint	6	3	2.5	3
				Percentage of pipeline following existing road	2	6	3.5	6
				Effects on wildlife	4	4	2	5
				Effects on birds	4	4	3	5
				Sub-Account Merit Rating		**3.82**	**2.71**	**4.29**
		Aquatic Habitat	6	Number of stream crossings by tailings pipeline	2	5	2	5
				Permanent streams impacted	6	3	3	3
				Ephemeral Streams Impacted	3	1	4	3
				Number of fish-bearing lakes affected	4	1	6	4
				Area of fish-bearing lakes affected	6	1	6	3
				Sub-Account Merit Rating		**1.95**	**4.48**	**3.38**
		Water Resources	4	Impact on surface water	6	5	1	4
				Ability to limit impact water quality in surrounding water bodies	3	3	1	4
				Impact to groundwater	4	2	3	5
				Sub-Account Merit Rating		**3.62**	**1.62**	**4.31**
		Air Quality	2	Potential for dust generation	4	3	3	4
				Potential for greenhouse gas emission due to construction	4	2	3.5	3
				Sub-Account Merit Rating		**2.50**	**3.25**	**3.50**
				Account Merit Rating		**2.96**	**3.14**	**3.88**
Technical	3	Complexity of Design and Construction	6	Foundation Conditions	5	3	5	3
				Topography containment	6	3	1	2
				Pumping Requirements	6	3	4	3
				Percentage of pipeline following existing road	2	6	3.5	6
				Tailings pipeline length	3	3	4	3
				Geotechnical Risk	3	4	2	3
				Dam hazard classification	4	4	4	4
				Sub-Account Merit Rating		**3.45**	**3.31**	**3.14**
		Water Management	4	Reclaim water volume	3	3	3	4
				Number of collection ponds required	6	2	3	5
				Seepage collection ditches	3	3	2.5	4
				Sub-Account Merit Rating		**2.50**	**2.88**	**4.50**
		Closure	3	Complexity of Closure	6	3	3	4
				Sub-Account Merit Rating		**3.00**	**3.00**	**4.00**
				Account Merit Rating		**3.05**	**3.10**	**3.76**

Table 9: TMF MAA – Sensitivity Case 1 (Continued)

Weightings						Scoring		
Account	**Account Weighting (W_A)**	**Sub-Account**	**Sub-Account Weighting (W_S)**	**Indicator**	**Indicator Weighting (W_I)**	**TMF 1**	**TMF 2**	**TMF 3**
Economics	0	Capital Cost	6	Total estimated capital cost	6	3	1	4
				Sub-Account Merit Rating		**3.00**	**1.00**	**4.00**
		Operating Cost	2	Total estimated operational costs per year	2	4	4.5	4
				Sub-Account Merit Rating		**4.00**	**4.50**	**4.00**
		Closure Cost	1	Total estimated closure costs	1	3	2.5	3
				Sub-Account Merit Rating		**3.00**	**2.50**	**3.00**
		Fish Habitat Compensation	1	Total estimated fish habitat compensation cost	1	1	6	3
				Sub-Account Merit Rating		**1.00**	**6.00**	**3.00**
				Account Merit Rating		**3.00**	**2.35**	**3.80**
Socio-Economics	3	Archaeology	2	Effects on cultural heritage sites	6	4	3.5	6
				Sub-Account Merit Rating		**4.00**	**-**	**6.00**
		Visual Impacts	5	Maximum Height of TMF	6	3	2	3
				Distance from Marmion Reservoir	4	3	2	2
				Sub-Account Merit Rating		**3.00**	**2.00**	**2.60**
		Land Claims	1	Number of known claims	6	6	6	6
						6.00	**6.00**	**6.00**
		Effects on Land Use	6	Effects on Hunting	4	5	4	5
				Effects on Fishing	6	1	5	3
				Effects on tourism and recreation	3	6	6	6
				Sub-Account Merit Rating		**3.38**	**4.92**	**4.31**
				Account Merit Rating		**3.52**	**3.79**	**4.06**
FINAL RANKING						**3.12**	**3.29**	**3.89**

Table 10: TMF MAA – Sensitivity Case 2

Weightings						Scoring		
Account	**Account Weighting (W_A)**	**Sub-Account**	**Sub-Account Weighting (W_S)**	**Indicator**	**Indicator Weighting (W_I)**	**TMF 1**	**TMF 2**	**TMF 3**
Environment	6	Terrestrial Habitat	5	Impact on flora and fauna due to TMF infrastructure	1	3	4	3
				Impact on flora and fauna due to TMF footprint	6	3	2.5	3
				Percentage of pipeline following existing road	2	6	3.5	6
				Effects on wildlife	4	4	2	5
				Effects on birds	4	4	3	5
				Sub-Account Merit Rating		**3.82**	**2.71**	**4.29**
		Aquatic Habitat	6	Number of stream crossings by tailings pipeline	2	5	2	5
				Permanent streams impacted	6	3	3	3
				Ephemeral Streams Impacted	3	1	4	3
				Number of fish-bearing lakes affected	4	1	6	4
				Area of fish-bearing lakes affected	6	1	6	3
				Sub-Account Merit Rating		**1.95**	**4.48**	**3.38**
		Water Resources	4	Impact on surface water	6	5	1	4
				Ability to limit impact water quality in surrounding water bodies	3	3	1	4
				Impact to groundwater	4	2	3	5
				Sub-Account Merit Rating		**3.62**	**1.62**	**4.31**
		Air Quality	2	Potential for dust generation	4	3	3	4
				Potential for greenhouse gas emission due to construction	4	2	3.5	3
				Sub-Account Merit Rating		**2.50**	**3.25**	**3.50**
				Account Merit Rating		**2.96**	**3.14**	**3.88**
Technical	0	Complexity of Design and Construction	6	Foundation Conditions	5	3	5	3
				Topography containment	6	3	1	2
				Pumping Requirements	6	3	4	3
				Percentage of pipeline following existing road	2	6	3.5	6
				Tailings pipeline length	3	3	4	3
				Geotechnical Risk	3	4	2	3
				Dam hazard classification	4	4	4	4
				Sub-Account Merit Rating		**3.45**	**3.31**	**3.14**
		Water Management	4	Reclaim water volume	3	3	3	4
				Number of collection ponds required	6	2	3	5
				Seepage collection ditches	3	3	2.5	4
				Sub-Account Merit Rating		**2.50**	**2.88**	**4.50**
		Closure	3	Complexity of Closure	6	3	3	4
				Sub-Account Merit Rating		**3.00**	**3.00**	**4.00**
				Account Merit Rating		**3.05**	**3.10**	**3.76**

Table 10: TMF MAA – Sensitivity Case 2 (Continued)

Weightings						Scoring		
Account	**Account Weighting (W_A)**	**Sub-Account**	**Sub-Account Weighting (W_S)**	**Indicator**	**Indicator Weighting (W_I)**	**TMF 1**	**TMF 2**	**TMF 3**
Economics	0	Capital Cost	6	Total estimated capital cost	6	3	1	4
				Sub-Account Merit Rating		**3.00**	**1.00**	**4.00**
		Operating Cost	2	Total estimated operational costs per year	2	4	4.5	4
				Sub-Account Merit Rating		**4.00**	**4.50**	**4.00**
		Closure Cost	1	Total estimated closure costs	1	3	2.5	3
				Sub-Account Merit Rating		**3.00**	**2.50**	**3.00**
		Fish Habitat Compensation	1	Total estimated fish habitat compensation cost	1	1	6	3
				Sub-Account Merit Rating		**1.00**	**6.00**	**3.00**
				Account Merit Rating		**3.00**	**2.35**	**3.80**
Socio-Economics	3	Archaeology	2	Effects on cultural heritage sites	6	4	3.5	6
				Sub-Account Merit Rating		**4.00**	**-**	**6.00**
		Visual Impacts	5	Maximum Height of TMF	6	3	2	3
				Distance from Marmion Reservoir	4	3	2	2
				Sub-Account Merit Rating		**3.00**	**2.00**	**2.60**
		Land Claims	1	Number of known claims	6	6	6	6
						6.00	**6.00**	**6.00**
		Effects on Land Use	6	Effects on Hunting	4	5	4	5
				Effects on Fishing	6	1	5	3
				Effects on tourism and recreation	3	6	6	6
				Sub-Account Merit Rating		**3.38**	**4.92**	**4.31**
				Account Merit Rating		**3.52**	**3.79**	**4.06**
FINAL RANKING						**3.15**	**3.36**	**3.94**

Table 11: TMF MAA – Sensitivity Case 3

Weightings						Scoring		
Account	Account Weighting (W_A)	Sub-Account	Sub-Account Weighting (W_S)	Indicator	Indicator Weighting (W_I)	TMF 1	TMF 2	TMF 3
Environment	1	Terrestrial Habitat	5	Impact on flora and fauna due to TMF infrastructure	1	3	4	3
				Impact on flora and fauna due to TMF footprint	6	3	2.5	3
				Percentage of pipeline following existing road	2	6	3.5	6
				Effects on wildlife	4	4	2	5
				Effects on birds	4	4	3	5
				Sub-Account Merit Rating		**3.82**	**2.71**	**4.29**
		Aquatic Habitat	6	Number of stream crossings by tailings pipeline	2	5	2	5
				Permanent streams impacted	6	3	3	3
				Ephemeral Streams Impacted	3	1	4	3
				Number of fish-bearing lakes affected	4	1	6	4
				Area of fish-bearing lakes affected	6	1	6	3
				Sub-Account Merit Rating		**1.95**	**4.48**	**3.38**
		Water Resources	4	Impact on surface water	6	5	1	4
				Ability to limit impact water quality in surrounding water bodies	3	3	1	4
				Impact to groundwater	4	2	3	5
				Sub-Account Merit Rating		**3.62**	**1.62**	**4.31**
		Air Quality	2	Potential for dust generation	4	3	3	4
				Potential for greenhouse gas emission due to construction	4	2	3.5	3
				Sub-Account Merit Rating		**2.50**	**3.25**	**3.50**
				Account Merit Rating		**2.96**	**3.14**	**3.88**
Technical	1	Complexity of Design and Construction	6	Foundation Conditions	5	3	5	3
				Topography containment	6	3	1	2
				Pumping Requirements	6	3	4	3
				Percentage of pipeline following existing road	2	6	3.5	6
				Tailings pipeline length	3	3	4	3
				Geotechnical Risk	3	4	2	3
				Dam hazard classification	4	4	4	4
				Sub-Account Merit Rating		**3.45**	**3.31**	**3.14**
		Water Management	4	Reclaim water volume	3	3	3	4
				Number of collection ponds required	6	2	3	5
				Seepage collection ditches	3	3	2.5	4
				Sub-Account Merit Rating		**2.50**	**2.88**	**4.50**
		Closure	3	Complexity of Closure	6	3	3	4
				Sub-Account Merit Rating		**3.00**	**3.00**	**4.00**
				Account Merit Rating		**3.05**	**3.10**	**3.76**

Table 11: TMF MAA – Sensitivity Case 3 (Continued)

Weightings						Scoring		
Account	**Account Weighting (W_A)**	**Sub-Account**	**Sub-Account Weighting (W_S)**	**Indicator**	**Indicator Weighting (W_I)**	**TMF 1**	**TMF 2**	**TMF 3**
Economics	1	Capital Cost	6	Total estimated capital cost	6	3	1	4
				Sub-Account Merit Rating		**3.00**	**1.00**	**4.00**
		Operating Cost	2	Total estimated operational costs per year	2	4	4.5	4
				Sub-Account Merit Rating		**4.00**	**4.50**	**4.00**
		Closure Cost	1	Total estimated closure costs	1	3	2.5	3
				Sub-Account Merit Rating		**3.00**	**2.50**	**3.00**
		Fish Habitat Compensation	1	Total estimated fish habitat compensation cost	1	1	6	3
				Sub-Account Merit Rating		**1.00**	**6.00**	**3.00**
				Account Merit Rating		**3.00**	**2.35**	**3.80**
Socio-Economics	1	Archaeology	2	Effects on cultural heritage sites	6	4	3.5	6
				Sub-Account Merit Rating		**4.00**	**-**	**6.00**
		Visual Impacts	5	Maximum Height of TMF	6	3	2	3
				Distance from Marmion Reservoir	4	3	2	2
				Sub-Account Merit Rating		**3.00**	**2.00**	**2.60**
		Land Claims	1	Number of known claims	6	6	6	6
						6.00	**6.00**	**6.00**
		Effects on Land Use	6	Effects on Hunting	4	5	4	5
				Effects on Fishing	6	1	5	3
				Effects on tourism and recreation	3	6	6	6
				Sub-Account Merit Rating		**3.38**	**4.92**	**4.31**
				Account Merit Rating		**3.52**	**3.79**	**4.06**
FINAL RANKING						**3.13**	**3.10**	**3.87**

Table 12: TMF MAA – Sensitivity Case 4

Weightings						Scoring		
Account	**Account Weighting (W_A)**	**Sub-Account**	**Sub-Account Weighting (W_S)**	**Indicator**	**Indicator Weighting (W_I)**	**TMF 1**	**TMF 2**	**TMF 3**
Environment	1	Terrestrial Habitat	1	Impact on flora and fauna due to TMF infrastructure	1	3	4	3
				Impact on flora and fauna due to TMF footprint	1	3	2.5	3
				Percentage of pipeline following existing road	1	6	3.5	6
				Effects on wildlife	1	4	2	5
				Effects on birds	1	4	3	5
				Sub-Account Merit Rating		**4.00**	**3.00**	**4.40**
		Aquatic Habitat	1	Number of stream crossings by tailings pipeline	1	5	2	5
				Permanent streams impacted	1	3	3	3
				Ephemeral Streams Impacted	1	1	4	3
				Number of fish-bearing lakes affected	1	1	6	4
				Area of fish-bearing lakes affected	1	1	6	3
				Sub-Account Merit Rating		**2.20**	**4.20**	**3.60**
		Water Resources	1	Impact on surface water	1	5	1	4
				Ability to limit impact water quality in surrounding water bodies	1	3	1	4
				Impact to groundwater	1	2	3	5
				Sub-Account Merit Rating		**3.33**	**1.67**	**4.33**
		Air Quality	1	Potential for dust generation	1	3	3	4
				Potential for greenhouse gas emission due to construction	1	2	3.5	3
				Sub-Account Merit Rating		**2.50**	**3.25**	**3.50**
				Account Merit Rating		**3.01**	**3.03**	**3.96**
Technical	1	Complexity of Design and Construction	1	Foundation Conditions	1	3	5	3
				Topography containment	1	3	1	2
				Pumping Requirements	1	3	4	3
				Percentage of pipeline following existing road	1	6	3.5	6
				Tailings pipeline length	1	3	4	3
				Geotechnical Risk	1	4	2	3
				Dam hazard classification	1	4	4	4
				Sub-Account Merit Rating		**3.71**	**3.36**	**3.43**
		Water Management	1	Reclaim water volume	1	3	3	4
				Number of collection ponds required	1	2	3	5
				Seepage collection ditches	1	3	2.5	4
				Sub-Account Merit Rating		**2.67**	**2.83**	**4.33**
		Closure	1	Complexity of Closure	1	3	3	4
				Sub-Account Merit Rating		**3.00**	**3.00**	**4.00**
				Account Merit Rating		**3.13**	**3.06**	**3.92**

Table 12: TMF MAA – Sensitivity Case 4 (Continued)

Weightings						Scoring		
Account	**Account Weighting (W_A)**	**Sub-Account**	**Sub-Account Weighting (W_S)**	**Indicator**	**Indicator Weighting (W_I)**	**TMF 1**	**TMF 2**	**TMF 3**
Economics	1	Capital Cost	1	Total estimated capital cost	1	3	1	4
				Sub-Account Merit Rating		**3.00**	**1.00**	**4.00**
		Operating Cost	1	Total estimated operational costs per year	1	4	4.5	4
				Sub-Account Merit Rating		**4.00**	**4.50**	**4.00**
		Closure Cost	1	Total estimated closure costs	1	3	2.5	3
				Sub-Account Merit Rating		**3.00**	**2.50**	**3.00**
		Fish Habitat Compensation	1	Total estimated fish habitat compensation cost	1	1	6	3
				Sub-Account Merit Rating		**1.00**	**6.00**	**3.00**
				Account Merit Rating		**2.75**	**3.50**	**3.50**
Socio-Economics	1	Archaeology	1	Effects on cultural heritage sites	1	4	3.5	6
				Sub-Account Merit Rating		**4.00**	**-**	**6.00**
		Visual Impacts	1	Maximum Height of TMF	1	3	2	3
				Distance from Marmion Reservoir	1	3	2	2
				Sub-Account Merit Rating		**3.00**	**2.00**	**2.50**
		Land Claims	1	Number of known claims	1	6	6	6
						6.00	**6.00**	**6.00**
		Effects on Land Use	1	Effects on Hunting	1	5	4	5
				Effects on Fishing	1	1	5	3
				Effects on tourism and recreation	1	6	6	6
				Sub-Account Merit Rating		**4.00**	**5.00**	**4.67**
				Account Merit Rating		**4.25**	**4.33**	**4.79**
FINAL RANKING						**3.28**	**3.48**	**4.04**

4.0 WASTE ROCK MANAGEMENT FACILITY LOCATION ASSESSMENT

The Project is expected to generate approximately 260.3 million tonnes of waste rock during the life of mine. The volume of waste rock generated from the east and west pits is estimated to be 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 Waste Rock Management Facility (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 following assessment was carried out to evaluate and select the most appropriate WRMF configuration and location.

4.1 Identification of Candidate Alternatives

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.

Although the Guidelines suggest that at least one of the alternatives should not impact a natural water body that is frequented by fish, considering the location of the Project on a Peninsula, the physical size requirements of the WRMF, the abundance of fish-bearing water bodies that exist throughout the Project area and the spatial constraint identified above, it was not possible to identify a viable 'dry land' alternative.

Four potential WRMF locations, as shown on Figure 3, were identified within the 7 km radius from the mine pits. A brief description of each candidate alternative is provided below. The estimated footprint areas for the alternatives all include 0.4 km^2 for disposal of the estimated 12.5 tonnes of overburden expected to be generated from mining activities.

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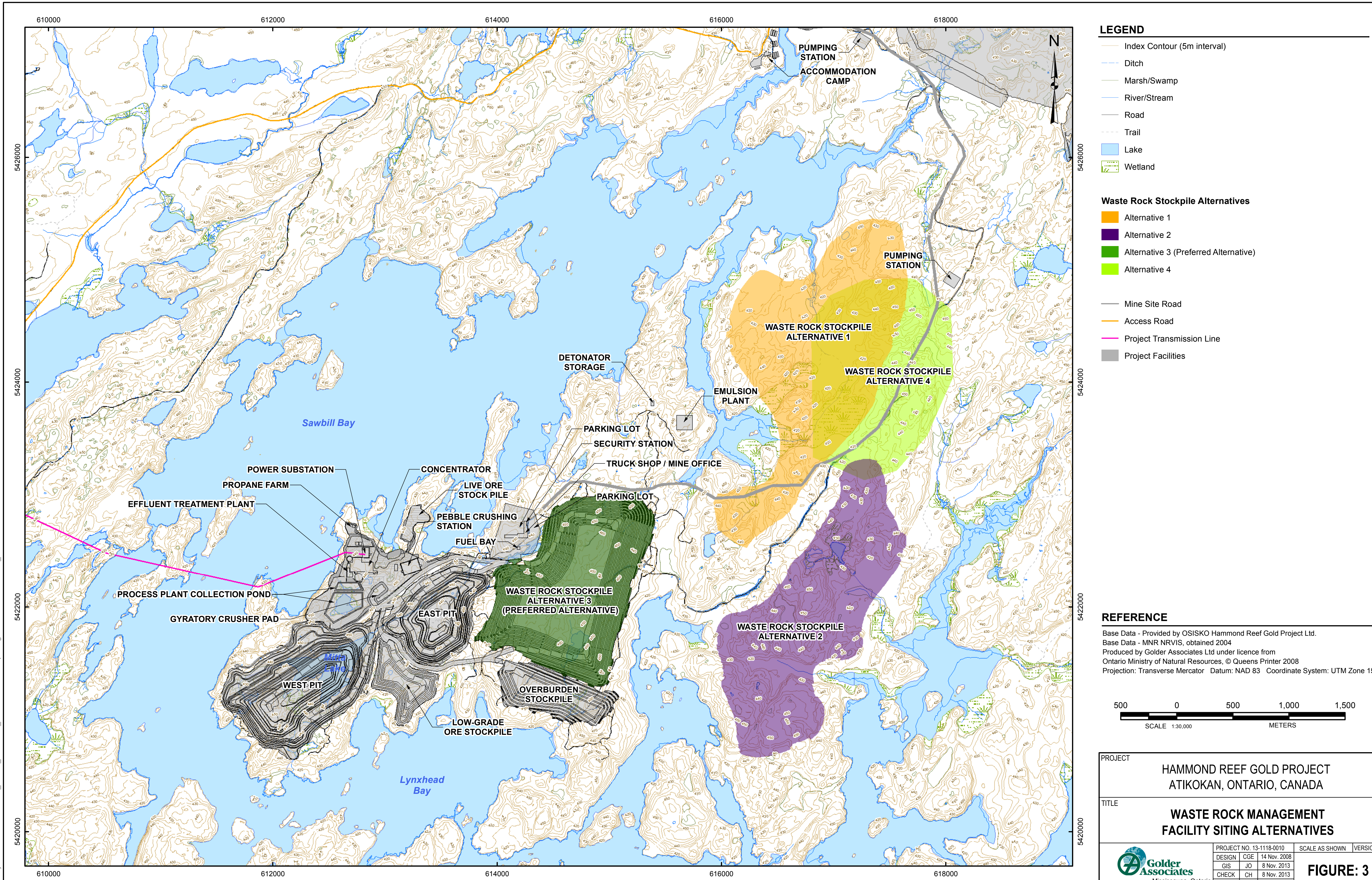

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WRMF-1 – This WRMF alternative is located northeast of the mine. The WRMF-1 footprint is approximately 3.0 km^2 and includes small intermittent streams, small ponds and wetlands. Alternative WRMF-1 is located in a local valley where the foundation conditions include shallow bedrock underlying a thin layer of dense till. Baseline aquatic studies indicated Finescale Dace and Fathead Minnow present in the pond within the WRMF footprint and inlet into Sawbill Bay. The haul road length would be approximately 4.8 km.

WRMF-2 – This WRMF alternative is located east of the mine. The WRMF-2 footprint is approximately 2.5 km^2 and is located in a local valley where the foundation conditions include shallow bedrock underlying a thin layer of dense till. Baseline aquatic studies indicate no fish presence in the small pond, though yellow perch and white sucker were found in the outlet stream. The haul road length would be approximately 3.8 km.

WRMF-3 - This WRMF alternative is located east of the mine (in closer proximity to the mine pits than WRMF-2). The WRMF footprint is approximately 2.1 km^2 and is located on top of a ridge sloping down to the west and to the east. Foundation conditions include shallow bedrock underlying thin layer of dense till. Baseline aquatic studies indicate Finescale Dace, Northern Redbelly Dace and Fathead Minnow presence in the pond within the footprint. The haul road length would be approximately 1.8 km.

WRMF-4 – This WRMF alternative was proposed by Environment Canada because it was perceived to have limited impact to aquatic habitat. WRMF-4 is located northeast of the mine with a footprint area of approximately 2.3 km^2. A wetland area and permanent streams are located within and downstream of the facility footprint. This alternative is located on top of a ridge sloping down to the west and to the east. Foundation conditions include shallow bedrock underlying thin layer of dense till. The haul road length would be approximately 5.3 km. WRMF-4 would require rerouting about 2.5 km of the existing access road and tailings pipeline closer to the surrounding waterbodies.

4.2 Pre-Screening Assessment

Pre-screening based on spatial considerations (i.e., maximum distance of 7 km from the pits) was carried out during the ‘Identification of Candidate Alternatives’ step. None of the proposed WRMF alternatives within the boundary were determined to possess a fatal flaw. Therefore, all four alternatives are considered to be viable candidates and have been carried forward for detailed evaluation using the MAA.

4.3 Alternative Characterization

The WRMF alternatives have been characterized with respect to the environmental, technical, economic and social accounts described in Section 2.3. The assessment sub-accounts and indicators have been used as a framework for characterizing the alternatives and the characterization of the WRMF alternatives is, therefore, presented and described in the following sections along with the alternative scoring for each indicator. The alternative characterization considers the entire Project life cycle from construction through closure.

4.4 Multiple Accounts Assessment

A MAA was developed for each of the accounts identified above. In the MAA, the accounts were further broken down into sub-accounts and indicators that reflect specific considerations. The MAA for each account is presented and described in the following sections.

4.4.1 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 13.

Table 13: 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^2
		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_2 Emissions	tonnes
	Noise	Haul road distance	Length of haul roads	M

4.4.2 Technical Account

The technical account assesses the technical merits of the alternatives. The account considers the full life cycle of the Project (i.e., construction, operation, and closure). The technical sub-accounts, indicators, and metrics for each indicator are summarized in Table 14.

Table 14: 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	#

4.4.3 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 15.

Table 15: 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	$

4.4.4 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 16.

Table 16: 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	#

4.4.5 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.

4.4.5.1 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.

4.4.5.2 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.

4.4.5.3 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.

4.4.5.4 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.

4.5 Value Bases Decision Process

As suggested by the Guidelines, a six point scoring scheme was developed for each indicator. Scores were assigned to each alternative with 6 being the "best" rank and 1 being the "worst" rank. Indicators with a quantitative nature were scored according to discrete intervals. For qualitative indicators, a value scale was developed using input from technical or environmental experts.

Within each account, sub-accounts were assigned a relative weighting factor to introduce a value bias between individual sub-accounts based on the relative importance of one sub-account to another. The same process was followed for each indicator within each sub-account. A higher weighting factor indicates a perceived greater relative value or importance. For example, the relative importance of the *impact on flora and fauna due to the WRMF footprint* indicator within the *Terrestrial Habitat* sub-account is considered greater than the *impact on flora and fauna due to WRMF infrastructure* indicator because the relative area of impact due to the WRMF footprint is much larger compared to the area of impact due to the WRMF infrastructure (e.g., haul roads). Sub-account and indicator weightings were determined based on input from technical and environmental experts and feedback and opinions conveyed by stakeholders during consultation.

The following sections provide descriptions of each sub-account and indicator, the evaluation of WRMF alternatives for each indicator, the indicator scoring scheme and the scoring assigned to each alternative.

4.5.1 Environmental Account

The environmental sub-accounts and indicators used to characterize and assess the WRMF alternatives are described in the following sections.

4.5.1.1 Terrestrial Habitat Sub-Account

The following sections describe the indicators and scoring system used to characterize and assess the potential of the WRMF alternatives to impact terrestrial habitat.

4.5.1.1.1 Impact to Flora and Fauna due to WRMF Infrastructure Indicator

The major infrastructure associated with the WRMF is the haul road that extends from the open pit to the stockpile location. A longer haul road results in greater disturbance to the surrounding terrestrial environment due to increased clearing of vegetation and road construction. Therefore, the impact to flora and fauna due to WRMF infrastructure is ranked based on the length of haul road required from the open pit to the WRMF. An alternative requiring a shorter haul road was considered to be preferable. The scoring of the impact to flora and fauna due to WRMF infrastructure indicator is provided in the following table.

Scoring Scheme				
Metric	**Score**	**Description**		
Haul road length	6	< 1 km		
	5	1 – 2 km		
	4	2 – 3 km		
	3	3 – 4 km		
	2	4 – 5 km		
	1	> 5 km		
Scoring Results				
	WRMF 1	**WRMF 2**	**WRMF 3**	**WRMF 4**
Haul road length	4.8 km	3.8 km	1.8 km	5.3 km
Score	2	3	5	1

4.5.1.1.2 Impact to Flora and Fauna due to WRMF Footprint Indicator

The footprint of the WRMF is defined as the area covered by the base of the waste rock stockpile. The total footprint area was used to assign the relative scores and to assess the potential impact of each alternative. A larger WRMF footprint will have a greater impact to terrestrial habitat. Therefore, a smaller footprint area is considered to be preferable. The alternative scoring for the impact to flora and fauna due to WRMF footprint indicator is provided in the following table.

Scoring Scheme				
Metric	**Score**	**Description**		
WRMF footprint area	6	< 150 ha		
	5	150 – 175 ha		
	4	175 – 200 ha		
	3	200 – 225 ha		
	2	225 – 250 ha		
	1	> 250 ha		
Scoring Results				
	WRMF 1	**WRMF 2**	**WRMF 3**	**WRMF 4**
WRMF footprint area	293 ha	249 ha	203 ha	223 ha
Score	1	2	3	3

4.5.1.1.3 Effects on Wildlife Indicator

The potential effects of the WRMF on wildlife are mainly the result of a change in habitat suitability due to additional sensory disturbance (i.e., light, noise, dust, human presence). Mining activity near the open pits is considered to be the main source of sensory disturbance factors. Habitat suitability is considered to increase with distance from the mine pits. Additionally, the likelihood of wildlife-vehicle collisions is assumed to increase with haul road length. Therefore, a WRMF located close to the mine pits is considered to be preferable. The alternative scoring for the effects on wildlife indicator is provided in the following table.

Scoring Scheme				
Metric	**Qualitative Score**	**Description**		
Distance from mine pits	6	< 1 km		
	5	1 – 2 km		
	4	2 – 3 km		
	3	3 – 4 km		
	2	4 – 5 km		
	1	> 5 km		
Scoring Results				
	WRMF 1	**WRMF 2**	**WRMF 3**	**WRMF 4**
Distance from mine pits	4.8 km	3.8 km	1.8 km	5.3 km
Qualitative Score	2	3	5	1

4.5.1.1.4 Effects on Bird Habitat Indicator

Potential effects to bird habitat due to the WRMF include loss of habitat area due to the WRMF footprint, change in habitat suitability due to additional sensory disturbance (i.e., light, noise, dust, human presence), and potential interruption to travel corridors due to the potential high waste rock stockpile near open water areas. With the exception of the amount of wetland habitat, the diversity of available bird habitat is not considered to vary significantly between alternatives. The potential effects on bird habitat have been assessed qualitatively based on these considerations. The alternative scoring for the effects on bird habitat indicator is provided in the following table.

Scoring Scheme				
Metric	**Score**	**Description**		
Potential effects to bird habitat	6	Negligible effect on bird habitat		
	5	Low potential effect on bird habitat		
	4	Moderate potential effect on bird habitat		
	3	High potential effect on bird habitat		
	2	Very high potential effect on bird habitat		
	1	Extreme potential effect on bird habitat		
Scoring Results				
	WRMF 1	**WRMF 2**	**WRMF 3**	**WRMF 4**
Potential effects to bird habitat	About 30 ha of wetland area directly impacted; Close proximity to open water areas to west;	About 4 ha of wetland area directly impacted; Close proximity to open water areas to east;	About 2 ha of wetland area directly impacted; Close proximity to open water areas to east;	About 16 ha of wetland area directly impacted; Furthest from open water areas
Score	2	4	5	4

4.5.1.2 Aquatic Habitat Sub-Account

Loss of aquatic habitat due to the WRMF will be offset through the development and implementation of compensation measures as part of the overall project No Net Loss Plan. As a result, for any alternative chosen, the net residual effect to aquatic habitat is considered to be negligible. Regardless, an alternative that results in greater impact to existing aquatic habitat is considered to be less desirable. The following sections describe the indicators and scoring system used to characterize and assess the potential of the WRMF alternatives to impact existing aquatic habitat.

4.5.1.2.1 Number of Stream Crossings by Haul Road Indicator

This indicator was used to compare the potential for impact to water bodies due to haul road watercourse crossings. Watercourse crossings may result in impacts due to the removal/alteration of a section of the watercourse, sediment release during construction of the crossing and/or dust generated from traffic along the haul road. An alternative that requires fewer haul roads water crossings is considered preferable. The alternative scoring for the number of stream crossings indicator is provided in the following table.

Scoring Scheme				
Metric	**Score**	**Description**		
Number of haul road stream crossings	6	None		
	5	1		
	4	2		
	3	3		
	2	4		
	1	> 4		
Scoring Results				
	WRMF 1	**WRMF 2**	**WRMF 3**	**WRMF 4**
Number of haul road stream crossings	0	0	0	0
Score	6	6	6	6

4.5.1.2.2 Permanent Streams Impacted Indicator

This indicator represents the total length of permanent streams either directly impacted by the WRMF footprint or indirectly impacted due to loss of watershed area. A stream was considered to be impacted if its watershed area was reduced by 25% or more due to the WRMF footprint. Permanent streams were identified through review of information collected for the hydrology and aquatic environment assessments. An alternative that impacts a shorter length of permanent stream is considered to be preferable. The alternative scoring for the permanent streams impacted indicator is provided in the following table.

Scoring Scheme				
Metric	**Score**	**Description**		
Length of permanent stream impacted	6	No impact		
	5	< 500 m		
	4	500 – 1000 m		
	3	1000 – 1500 m		
	2	1500 – 2000 m		
	1	> 2000 m		
Scoring Results				
	WRMF 1	**WRMF 2**	**WRMF 3**	**WRMF 4**
Length of permanent stream impacted	1800	0	0	1800
Score	2	6	6	2

4.5.1.2.3 Ephemeral Streams Impacted Indicator

This indicator represents the total length of ephemeral streams either directly impacted by the WRMF footprint or indirectly impacted due to loss of watershed area. A stream was considered to be impacted if its watershed area was reduced by 25% or more due to the WRMF footprint. Ephemeral streams were identified through review of information collected for the hydrology and aquatic environment assessments. An alternative that impacts a shorter length of ephemeral stream is considered to be preferable. The alternative scoring for the ephemeral streams impacted indicator is provided in the following table.

Scoring Scheme				
Metric	**Score**	**Description**		
Length of ephemeral stream impacted	6	No impact		
	5	< 500 m		
	4	500 – 1000 m		
	3	1000 – 1500 m		
	2	1500 – 2000 m		
	1	> 2000 m		
Scoring Results				
	WRMF 1	**WRMF 2**	**WRMF 3**	**WRMF 4**
Length of ephemeral stream impacted	800	1000	800	1000
Score	4	3.5	4	3.5

4.5.1.2.4 Number of Fish-bearing Lakes Affected Indicator

This indicator was used to assess the number of fish-bearing lakes that are either directly impacted by the WRMF footprint or indirectly impacted due to loss of watershed area. A lake was considered to be impacted if its watershed area was reduced by 25% or more due to the WRMF footprint. Lakes were defined as fish bearing or non-fish bearing based on information collected for aquatic environment assessments. An alternative that impacts a fewer number of fish bearing lakes is considered to be preferable. The alternative scoring for the number of fish bearing lakes affected indicator is provided in the following table.

Scoring Scheme				
Metric	**Score**	**Description**		
Number of fish-bearing lake impacted	6	0		
	5	1		
	4	2		
	3	3		
	2	4		
	1	> 5		
Scoring Results				
	WRMF 1	**WRMF 2**	**WRMF 3**	**WRMF 4**
Number of fish-bearing lake impacted	1	0	1	0
Score	5	6	5	6

Area of Fish-bearing Lakes Affected Indicator

This indicator was used to assess the area of fish-bearing lakes that are either directly impacted by the WRMF footprint or indirectly impacted due to loss of watershed area. A lake was considered to be impacted if its watershed area was reduced by 25% or more due to the WRMF footprint. Lakes were defined as fish bearing or non-fish bearing based on information collected for aquatic environment assessments. An alternative that impacts a fewer number of fish bearing lakes is considered to be preferable. The alternative scoring for the number of fish bearing lakes affected indicator is provided in the following table.

Scoring Scheme				
Metric	**Score**	**Description**		
Area of fish-bearing lake impacted	6	< 0.5 ha		
	5	0.5 – 1.0 ha		
	4	1.0 – 1.5 ha		
	3	1.5 – 2.0 ha		
	2	2.0 – 2.5 ha		
	1	> 2.5 ha		
Scoring Results				
	WRMF 1	**WRMF 2**	**WRMF 3**	**WRMF 4**
Area of fish-bearing lake impacted	1.6	0	2.8	0
Score	3	6	1	6

4.5.1.3 Water Resources Sub-Account

Runoff collected from the WRMF will not be released to the environment during the construction and operations phases of the project. Post-closure water will be released to the environment only after water quality is suitable for release. Therefore, the WRMF will impact downstream receiving waterbodies due to diversion of flows. Alternatives that are able to minimize impacts to surface water hydrology and water quality are preferred. The following sections describe the indicators and scoring system used to characterize and assess the potential of the TMF alternatives to impact surface water hydrology and downstream water quality.

4.5.1.3.1 Impact on Surface Water Indicator

This indicator compares the relative number of watersheds directly affected by the WRMF. Alternatives that affect a larger number of watersheds have an increased potential to impact hydrological conditions and water quality over a greater area in the event of groundwater flow release. Alternatives that minimize the number of watersheds directly impacted have fewer locations where surface water impacts would be imposed. Therefore, alternatives that impact fewer surface watersheds are considered preferable. The alternative scoring for the impact to surface water indicator is provided in the following table.

Scoring Scheme		
Metric	**Score**	**Description**
Number of watersheds affected	6	< 4
	5	4
	4	5
	3	6
	2	7
	1	> 7

Scoring Results				
	WRMF 1	**WRMF 2**	**WRMF 3**	**WRMF 4**
Number of watersheds affected	7	5	6	5
Score	2	4	3	4

4.5.1.3.2 Ability to Limit Impact to Water Quality in Surrounding Water Bodies Indicator

Selecting a WRMF location with fewer, more distal or less significant downstream receiving water bodies can mitigate the potential for impacts to water quality. The alternatives were qualitatively assessed based on the ability of their location to mitigate potential impacts to downstream water bodies. The alternative scoring for the ability to limit impact to water quality in surrounding waterbodies indicator is provided in the following table.

Scoring Scheme		
Metric	**Score**	**Description**
Qualitative Rank	6	No impact
	5	High
	4	Moderate – High
	3	Moderate
	2	Low – Moderate
	1	Low

Scoring Results				
	WRMF 1	**WRMF 2**	**WRMF 3**	**WRMF 4**
Qualitative Rank	One entire side straddles Sawbill Bay and tributaries	One entire side straddles Inlet Bay to Lynxhead Bay and tributaries, shorter total distance and further away from water than WRMF 1	Part of east side close to bay north of Lynxhead Bay; Close to pits - most seepage will go to pits	Located furthest away from Sawbill and Lynxhead Bay; Close to tributary creeks at some locations
Score	1	2	4	5

4.5.1.3.3 Impact to Groundwater Indicator

Groundwater flows from the WRMF will be collected to the extent possible through a seepage interception system. This system will be comprise a number of ditches and collection ponds at low points along the WRMF perimeter with collected water being pumped back to Processing Plant Collection Pond (PPCP) for use by the processing plant. The relative potential for groundwater flow release and requirements for maintenance of pumping infrastructure increase with a larger number of seepage collection ponds. Therefore, the potential for impacts to groundwater was evaluated based on the number of potential seepage collection ponds required. The number of collection ponds required was estimated through review of the topography along the perimeter of the WRMF alternative footprints. An alternative with more collection ponds was given a lower score compared to an alternative with fewer seepage collection ponds. The alternative scoring for the impact to groundwater indicator is provided in the following table.

Scoring Scheme				
Metric	**Score**	**Description**		
Number of collection ponds required	6	< 4		
	5	4		
	4	5		
	3	6		
	2	7		
	1	> 7		
Scoring Results				
	WRMF 1	**WRMF 2**	**WRMF 3**	**WRMF 4**
Number of collection ponds required	5	7	4	5
Score	4	2	5	4

4.5.1.4 Air Quality Sub-Account

The following sections describe the indicators and scoring system used to characterize and assess the potential of the WRMF alternatives to impact air quality.

4.5.1.4.1 Potential for Dust Generation Indicator

Haul roads conveying waste rock for the mine pits to the WRMF are considered to be the primary source for dust generation associated with the WRMF. The potential for dust generation was assessed by estimating the total quantity of dust generated over the life of the mine using an average emissions rate of 1.83 kg per vehicle kilometer travelled. The alternative scoring for the potential for dust generation indicator is provided in the following table.

Scoring Scheme				
Metric	**Score**	**Description**		
Life of mine dust emissions	6	< 4 M-kg		
	5	4 – 8 M-kg		
	4	8 – 12 M-kg		
	3	12 – 16 M-kg		
	2	16 – 20 M-kg		
	1	> 20 M-kg		
Scoring Results				
	WRMF 1	**WRMF 2**	**WRMF 3**	**WRMF 4**
Life of mine dust emissions	16.6 M-kg	13.3 M-kg	6.2 M-kg	18.3 M-kg
Score	2	3	5	2

4.5.1.4.2 Potential for Greenhouse Gas Emission Indicator

Greenhouse gas (GHG) emissions will be generated by mine trucks hauling waste rock from the pits to the WRMF. The amount of GHGs is considered to be primarily dependent the length of haul road. This indicator has been assessed by estimating the total quantity of GHG emissions generated over the life of the mine using an average emissions rate of 2.66 kg CO_2 per liter of diesel fuel consumed. The alternative scoring for the potential for greenhouse gas emission indicator is provided in the following table.

Scoring Scheme				
Metric	**Score**	**Description**		
Life of mine CO_2 emissions	6	> 150,000 t		
	5	150,000 – 200,000 t		
	4	200,000 – 250,000 t		
	3	250,000 – 300,000 t		
	2	300,000 – 350,000 t		
	1	> 350,000 t		
Scoring Results				
	WRMF 1	**WRMF 2**	**WRMF 3**	**WRMF 4**
Life of mine CO_2 emissions	308,000 t	265,000 t	174,000 t	331,000 t
Score	2	3	5	2

4.5.1.5 Noise

The following sections describe the indicators and scoring system used to characterize and assess the WRMF alternatives with respect to noise considerations.

4.5.1.5.1 Haul Road Distance Indicator

Noise is generated from the vehicles transporting the waste rock to the WRMF from the open pit. A longer haul distance expands the noise source and results in longer cycle times for haul trucks and consequently a larger mobile fleet would be required (which would generate more noise). Therefore, an alternative with a shorter haul distance is considered preferable. The alternative scoring for the haul road distance indicator is provided in the following table.

Scoring Scheme				
Metric	**Qualitative Score**	**Description**		
Length of haul roads	6	< 1 km		
	5	1 – 2 km		
	4	2 – 3 km		
	3	3 – 4 km		
	2	4 – 5 km		
	1	> 5 km		
Scoring Results				
	WRMF 1	**WRMF 2**	**WRMF 3**	**WRMF 4**
Length of haul roads	4.8 km	3.84 km	1.8 km	5.3 km
Qualitative Score	2	3	5	1

4.5.2 Technical Account

The technical sub-accounts and indicators used to characterize and assess the WRMF alternatives are described in the following sections.

4.5.2.1 Complexity of Design and Construction Sub-Account

The performance and stability of the WRMF will depend on the foundation conditions, foundation preparation and maximum height. Alternatives that have favourable site conditions and simple design configurations will be easier to design, construct and maintain and will be subject to fewer hazards and geotechnical risks. The following sections describe the indicators and scoring systems used to characterize and assess the overall complexity of the design and construction of the WRMF alternatives.

4.5.2.1.1 Foundation Conditions Indicator

Appropriate underlying geology is required for stability of the waste rock stockpile. Stockpiles constructed on poor foundation conditions require additional stability measures (i.e., shallower slopes, stabilization berms, over-excavation, etc.). Options with more challenging foundation conditions pose greater engineering challenges and higher risks to the long-term safety of the containment structure, and are, thus, less desirable. The alternative scoring for the foundation conditions indicator is provided in the following table.

Scoring Scheme				
Metric	**Score**	**Description**		
Qualitative Rank	6	Excellent foundation conditions		
	5	Good foundation conditions		
	4	Fair foundation conditions		
	3	Moderate foundation conditions		
	2	Poor foundation conditions		
	1	Very poor foundation conditions		
Scoring Results				
	WRMF 1	**WRMF 2**	**WRMF 3**	**WRMF 4**
Qualitative Rank	Shallow bedrock underlying thin layer of dense till	Shallow bedrock underlying thin layer of dense till	Shallow bedrock underlying thin layer of dense till	Shallow bedrock underlying thin layer of dense till
Score	5	5	5	5

4.5.2.1.2 Topography Containment Indicator

An alternative that takes advantage of natural depressions and/or flat areas is desirable. The use of natural depressions increases the overall storage capacity of a site within a given footprint. Alternatives located on sloping terrain do not provide preferable conditions for waste rock storage and may result in higher or more extensive stockpile designs. The alternative scoring for the topographic containment indicator is provided in the following table.

Scoring Scheme				
Metric	**Score**	**Description**		
Topographic containment	6	Complete natural topographic containment		
	5	Good natural topographic containment		
	4	Fair natural topographic containment		
	3	Moderate natural topographic containment		
	2	Poor natural topographic containment		
	1	Zero natural topographic containment		
Scoring Results				
	WRMF 1	**WRMF 2**	**WRMF 3**	**WRMF 4**
Topographic containment	Located in a local valley (bottom elevation of 420 m)	Located within a thin valley (bottom elevation of 420 m); undulating relief	Located on top of a ridge (elev. ~ 460 to 470 m), sloping down to the west to Elev. 430 m, and to the east to Elev. 440 m	Terrain sloping westward from 435-450 m on east side to 415-420 on west side
Score	4	4	3	3

4.5.2.1.3 Maximum Height Indicator

A higher WRMF poses greater construction challenges as the waste rock stockpile fills and the haul trucks require a longer distance to reach the top. Design objectives to minimize the footprint lead to higher stockpiles and potentially steeper slopes. Depending on the design, these conditions could potentially reduce the stability of the stockpile. Therefore, an alternative with a lower maximum height is considered to be preferable. The alternative scoring for the maximum height indicator is provided in the following table.

Scoring Scheme				
Metric	**Score**	**Description**		
Maximum height of stockpile	6	< 50 m		
	5	50 – 75 m		
	4	75 – 100 m		
	3	100 – 150 m		
	2	150 – 200 m		
	1	> 200 m		
Scoring Results				
	WRMF 1	**WRMF 2**	**WRMF 3**	**WRMF 4**
Maximum height of stockpile	60 m	90 m	155 m	95 m
Score	5	4	2	4

4.5.2.1.4 Potential Impact to Other Infrastructure Indicator

This indicator assesses the potential impact that each WRMF will have on other existing and planned mine infrastructure such as access roads and tailings pipelines. Alternatives that do not impact existing or planned infrastructure are preferred. The alternative scoring for the potential impact to other infrastructure indicator is provided in the following table.

Scoring Scheme				
Metric	**Score**	**Description**		
Potential impact to other infrastructure	6	Negligible impact to other infrastructure		
	5	Small impact to other infrastructure		
	4	Moderate impact to other infrastructure		
	3	Significant impact to other infrastructure		
	2	Very significant impact to other infrastructure		
	1	Extreme impact to other infrastructure		
Scoring Results				
	WRMF 1	**WRMF 2**	**WRMF 3**	**WRMF 4**
Potential impact to other infrastructure	Requires realignment of about 1 km of the Mine Site Road and tailings pipeline	No impact to other infrastructure	No impact to other infrastructure	Requires realignment of about 2.5 km of the Mine Site Road and tailings pipeline closer to water bodies
Score	4	6	6	2

4.5.2.2 Water Management Sub-Account

The following sections describe the indicators and scoring systems used to characterize and assess the water management requirements of the WRMF alternatives.

4.5.2.2.1 Number of Collection Ponds Required Indicator

A WRMF alternative with more collection ponds results in greater construction and maintenance commitments. Infrastructure requirements for pumping collected water back to the Processing Plant Collection Pond (PPCP) also increase with a greater number of collection ponds. Therefore, alternatives with fewer collection ponds are considered to be preferable. The number of collection ponds required was estimated through review of the topography along the perimeter of the WRMF alternative footprints. The alternative scoring for the number of collection ponds indicator is provided in the following table.

Scoring Scheme				
Metric	**Score**	**Description**		
Number of collection ponds required	6	< 3		
	5	4		
	4	5		
	3	6		
	2	7		
	1	> 7		
Scoring Results				
	WRMF 1	**WRMF 2**	**WRMF 3**	**WRMF 4**
Number of collection ponds required	5	7	4	5
Score	4	2	5	4

4.5.2.2.2 Seepage Collection Ditches Indicator

This indicator was used to compare the length of seepage collection ditches required to contain seepage and surface runoff from the WRMF. Longer seepage collection ditches require more construction and maintenance, and increase the potential for water to bypass the collection system under extreme events or malfunctions. Alternatives with short seepage collection ditch requirements were considered preferable. The alternative scoring for the seepage collection ditches indicator is provided in the following table.

Scoring Scheme				
Metric	**Score**	**Description**		
Length of seepage collection ditches	6	< 5 km		
	5	5 – 6 km		
	4	6 – 7 km		
	3	7 – 8 km		
	2	8 – 9 km		
	1	> 9 km		
Scoring Results				
	WRMF 1	**WRMF 2**	**WRMF 3**	**WRMF 4**
Length of seepage collection ditches	8.5 km	7.5 km	5.5 km	5.2 km
Score	2	3	5	5

4.5.2.3 Closure Sub-Account

The following section describes the indicator and scoring system used to characterize and assess the closure of the WRMF alternatives.

4.5.2.3.1 Complexity of Closure Indicator

Closure of the WRMF will consist of minor regrading of the benches and construction of drainage facilities to ensure drainage from the stockpile will not cause erosion over the long term. Therefore, the complexity of closure was ranked based on the estimated area of the slope face for each alternative. Facilities that have a smaller slope area are considered to be preferable. The alternative scoring for the complexity of closure indicator is provided in the following table.

Scoring Scheme				
Metric	**Score**	**Description**		
Slope area	6	< 100 ha		
	5	100 – 120 ha		
	4	120 – 140 ha		
	3	140 – 160 ha		
	2	160 – 180 ha		
	1	> 180 ha		
Scoring Results				
	WRMF 1	**WRMF 2**	**WRMF 3**	**WRMF 4**
Slope area	130 ha	160 ha	165 ha	110 ha
Score	4	2.5	2	5

4.5.3 Economics Account

The economic sub-accounts and indicators used to characterize and assess the WRMF alternatives are described in the following sections.

4.5.3.1 Capital Cost Sub-Account

4.5.3.1.1 Total Estimated Capital Costs Indicator

The capital costs of the WRMF are primarily incurred from the cost of haul trucks. Increased haul road length would result in longer cycle times for haul trucks and therefore more trucks would be required to sustain the flow of waste rock to the disposal facility. Preliminary estimates of the capital costs of each alternative were calculated based on the estimated number of trucks required for each alternative. An alternative with a lower capital cost was considered preferable. The alternative scoring for the capital cost indicator is provided in the following table.

Scoring Scheme				
Metric	**Score**	**Description**		
Estimated capital cost	6	< $90 M		
	5	$90 – 95 M		
	4	$95 – 100 M		
	3	$100 – 105 M		
	2	$105 – 110 M		
	1	> $110 M		
Scoring Results				
	WRMF 1	**WRMF 2**	**WRMF 3**	**WRMF 4**
Estimated capital cost	$110 M	$105 M	$91 M	$110 M
Score	1.5	2.5	5	1.5

4.5.3.2 Operating Cost Sub-Account

The following section describes the indicator and scoring system used to characterize and assess the operating cost of the WRMF alternatives.

4.5.3.2.1 Total Estimated Operating Costs Indicator

The operational costs associated with the WRMF are primarily the cost of diesel fuel and ongoing maintenance of the haul trucks. Preliminary estimates of the operational costs per year for each alternative were calculated based on expected fuel consumption and truck maintenance costs. An alternative with a lower annual operating cost was considered preferable. The alternative scoring for the capital cost indicator is provided in the following table.

Scoring Scheme				
Metric	**Score**	**Description**		
Estimated annual operating costs	6	< $2 M		
	5	$2 – 3.5 M		
	4	$3.5 – 5 M		
	3	$5 – 6.5 M		
	2	$6.5 – 8 M		
	1	> $8 M		
Scoring Results				
	WRMF 1	**WRMF 2**	**WRMF 3**	**WRMF 4**
Estimated annual operating costs	$7.3 M	$5.8 M	$2.7 M	$8.1 M
Score	2	3	5	1

4.5.3.3 Closure Cost Sub-Account

The following section describes the indicator and scoring system used to characterize and assess the closure cost of the WRMF alternatives.

4.5.3.3.1 Total Estimated Closure Cost Indicator

The closure costs associated with the WRMF are primarily related to re-grading the slopes of the stockpile to provide sustainable drainage systems. Preliminary closure costs were estimated for WRMF based on slope area requiring re-grading. An alternative with a lower closure cost was considered preferable. The alternative scoring for the capital cost indicator is provided in the following table.

Scoring Scheme				
Metric	**Score**	**Description**		
Estimated closure cost	6	< $180,000		
	5	$180,000 – 200,000		
	4	$200,000 – 220,000		
	3	$220,000 – 240,000		
	2	$240,000 – 260,000		
	1	> $260,000		
Scoring Results				
	WRMF 1	**WRMF 2**	**WRMF 3**	**WRMF 4**
Estimated closure cost	$200,000	$240,000	$250,000	$170,000
Qualitative Score	4.5	2.5	2	6

4.5.3.4 Fish Habitat Compensation Sub-Account

Where an alternative directly or indirectly impacts water bodies that are frequented by fish, compensation measures may be required. The following section describes the indicator and scoring system used to characterize and assess the potential fish habitat compensation costs of the WRMF alternatives.

4.5.3.4.1 Total Fish Habitat Compensation Cost Indicator

Aquatic habitat compensation measures will be implemented to offset habitat loss as a result of construction of the WRMF. Preliminary estimates of fish habitat compensation costs for each alternative were calculated based on the estimated quantity of fish bearing lakes/streams impacted. As detailed habitat modelling assessments are not available for all alternatives, the assessment carried out under the aquatic habitat sub-account was used as a basis for estimating fish habitat losses. Impacts to fish bearing lakes and permanent streams were assumed to appropriately estimate the value of fish habitat losses and compensation costs were scaled based on estimated habitat losses. An alternative with a lower fish habitat compensation cost was considered to be preferable. The alternative scoring for the fish habitat compensation cost indicator is provided in the following table.

Scoring Scheme				
Metric	**Score**	**Description**		
Estimated fish habitat compensation cost	6	< $25K		
	5	$25 – 50K		
	4	$50 – 75K		
	3	$55 – 100K		
	2	$100 – 125K		
	1	> $125K		
Scoring Results				
	WRMF 1	**WRMF 2**	**WRMF 3**	**WRMF 4**
Estimated fish habitat compensation cost	$95K	$10K	$140K	$20K
Qualitative Score	3	6	1	6

4.5.4 Socio-Economics Account

The economic sub-accounts and indicators used to characterize and assess the WRMF alternatives are described in the following sections.

4.5.4.1 Archaeology Sub-Account

There are known archaeological and cultural heritage sites that exist within the mine site area. WRMF sites that avoid these areas are considered to be more desirable than facilities that will result in the loss of one of these sites. The following section describes the indicator and scoring system used to characterize and assess archaeological considerations of the WRMF alternatives.

4.5.4.1.1 Effects on Cultural Heritage Sites Indicator

WRMF alternatives that impact archaeological resources will potentially require additional investigation, permitting, and may attract adverse public concern. The alternatives were scored based on direct impacts to known archaeological sites within the WRMF footprints. An alternative that overlays fewer archaeological sites is considered to be preferable. The alternative scoring for the effects on cultural heritage sites indicator is provided in the following table. Archaeological data in the area of alternative WRMF 4 was not available for this assessment and therefore this alternative was assigned a neutral score.

Scoring Scheme				
Metric	**Score**	**Description**		
Number of areas with archaeological potential	6	0		
	5	1		
	4	2		
	3	3		
	2	4		
	1	> 4		
Scoring Results				
	WRMF 1	**WRMF 2**	**WRMF 3**	**WRMF 4**
Number of areas with archaeological potential	2	1	0	N/A
Qualitative Score	4	5	6	3.5

4.5.4.2 Visual Impacts Sub-Account

A WRMF that is more visually conspicuous may attract adverse public concern. The relative visual impact for each facility was evaluated based on factors representing the visibility and relative contrast of a WRMF alternative with the surrounding terrain. A facility with a low profile that blends in with the surrounding area is considered to be more desirable than a facility with high topographic relief that does not blend into the surrounding area. The following section describes the indicator and scoring system used to characterize and assess the potential visual impacts of the WRMF alternatives.

4.5.4.2.1 Maximum Height of Stockpile Indicator

A WRMF that has a greater ultimate height is visually more noticeable than one that is lower. This indicator was ranked based on the maximum height of the waste rock stockpile at the ultimate stage. An alternative that has a lower maximum height was considered to be preferable. The alternative scoring for the maximum height of WRMF indicator is provided in the following table.

Scoring Scheme				
Metric	**Score**	**Description**		
Maximum stockpile height	6	< 50 m		
	5	50 – 75 m		
	4	75 – 100 m		
	3	100 – 150 m		
	2	150 – 200 m		
	1	> 200 m		
Scoring Results				
	WRMF 1	**WRMF 2**	**WRMF 3**	**WRMF 4**
Maximum stockpile height	60 m	90 m	155 m	95 m
Score	5	4	2	4

4.5.4.2.2 Distance from Marmion Reservoir Indicator

As the Marmion Reservoir is used for recreational activities, this indicator considers the potential for users of Marmion Reservoir to be within close proximity to the WRMF. Scores for each alternative were assigned based on the shortest distance of each alternative to Marmion Reservoir. An alternative located further away from the Marmion Reservoir was considered to be preferable. The alternative scoring for the distance from Marmion Reservoir indicator is provided in the following table.

Scoring Scheme				
Metric	**Score**	**Description**		
Length	6	> 200 m		
	5	150 – 200 m		
	4	100 – 150 m		
	3	75 – 100 m		
	2	50 – 75 m		
	1	< 50 m		
Scoring Results				
	WRMF 1	**WRMF 2**	**WRMF 3**	**WRMF 4**
Length	25 m	120 m	80 m	210 m
Score	1	4	3	6

4.5.4.3 Land Claims Sub-Account

The following section describes the indicator and scoring system used to characterize and assess land tenure considerations of the WRMF alternatives.

4.5.4.3.1 Number of Osisko Land Claims Indicator

The footprints of the WRMF alternatives were compared against the known mineral claims that are leased by Osisko. If an alternative was located on lands in which Osisko does not hold mineral claims, the alternative would be considered less preferable and would warrant a lower score. The alternative scoring for the number of Osisko land claims indicator is provided in the following table. All alternatives are fully located in areas that Osisko holds mineral claims.

Scoring Scheme				
Metric	**Qualitative Score**	**Description**		
Number of land claims controlled by Osisko	6	All claims controlled by Osisko		
	5	1 claim not controlled by Osisko		
	4	2 claims not controlled by Osisko		
	3	3 claims not controlled by Osisko		
	2	4 claims not controlled by Osisko		
	1	5 claims not controlled by Osisko		
Scoring Results				
	WRMF 1	**WRMF 2**	**WRMF 3**	**WRMF 4**
Number of land claims controlled by Osisko	Osisko controls all claims	Osisko controls all claims	Osisko controls all claims	Osisko controls all claims
Score	6	6	6	6

4.5.4.4 Effects on Land Use Sub-Account

The indicators within this sub-account were developed to compare the perceived land use value attributed to the area that each WRMF alternative will occupy. Land use was characterized by recreational activities including hunting and fishing. The following section describes the indicators and scoring systems used to characterize and assess the potential effects of the WRMF alternatives on land use.

4.5.4.4.1 Effects on Hunting Indicator

The effects of the WRMF alternatives on hunting were assessed based on known hunting/trapping activities occurring within the WRMF footprint. Known hunting/trapping activities were determined based on information collected for use in the socio-economic assessment and considered trap lines, trapper cabins and bear baiting stations. An alternative that will not affect known hunting/trapping activities is considered to be preferable. The alternative scoring for the effects on hunting indicator is provided in the following table.

Scoring Scheme				
Metric	**Score**	**Description**		
Number of trap lines, trapper cabins and/or bear baiting stations	6	0		
	5	1		
	4	2		
	3	3		
	2	4		
	1	> 4		
Scoring Results				
	WRMF 1	**WRMF 2**	**WRMF 3**	**WRMF 4**
Number of trap lines, trapper cabins and/or bear baiting stations	0	1	1	0
Score	6	5	5	6

4.5.4.4.2 Effects on Fishing Indicator

The effects of the WRMF alternatives on fishing were assumed to be directly linked to loss of fish habitat due to the WRMF footprint. As detailed habitat modelling assessments are not available for all alternatives, the assessment carried out under the aquatic habitat sub-account was used as a basis for estimating fish habitat losses. Impacts to fish bearing lakes and permanent streams were assumed to provide an appropriate estimate of fish habitat losses. An alternative that impacts fewer fish bearing lakes and permanent streams is considered to be preferable. The alternative scoring for the effects on fishing indicator is provided in the following table.

Scoring Scheme				
Metric	**Score**	**Description**		
Number of fish-bearing lakes and/or permanent streams	6	0		
	5	1		
	4	2		
	3	3		
	2	4		
	1	> 4		
Scoring Results				
	WRMF 1	**WRMF 2**	**WRMF 3**	**WRMF 4**
Number of fish-bearing lakes and/or permanent streams	3	0	1	2
Score	3	6	5	4

4.6 Results and Sensitivity Analysis

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:

6) Base Case: Account weightings were selected based on the recommendations of the Guidelines (i.e., 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 and stakeholders.

7) Sensitivity Case 1: Same as the base case but with the economics account removed (i.e. economics account weighting equal to zero).

8) 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).

9) Sensitivity Case 3: Same indicators and sub-account weighting as the base case and all accounts weighted equally.

10) Sensitivity Case 4: All weighting factors (i.e., accounts, sub-accounts, indicators) weighted equally

The final results and rankings of the base case and sensitivity cases are presented in Table 17. The detailed assessment results are provided in Table 18 through Table 22 for all cases.

The WRMF-3 alternative scored the highest for all cases and is therefore regarded as the preferred alternative.

Table 17: Summary of 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

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Table 18: WRMF MAA – Base Case

Weightings						Scoring			
Account	**Account Weighting (W_A)**	**Sub-Account**	**Sub-Account Weighting (W_S)**	**Indicator**	**Indicator Weighting (W_I)**	**WRMF 1**	**WRMF 2**	**WRMF 3**	**WRMF 4**
Environment	6	Terrestrial Habitat	5	Impact on flora and fauna due to WRMF infrastructure	2	2	3	5	1
				Impact on flora and fauna due to WRMF footprint	6	1	2	3	3
				Effects on wildlife	4	2	3	5	1
				Effects on bird habitat	4	2	4	5	4
				Sub-Account Merit Rating		**1.63**	**2.88**	**4.25**	**2.50**
		Aquatic Habitat	6	Number of stream crossings by haul road	2	6	6	6	6
				Permanent streams impacted	6	2	6	6	2
				Ephemeral streams Impacted	3	4	3.5	4	3.5
				Number of fish-bearing lakes affected	4	5	6	5	6
				Area of fish-bearing lakes affected	6	3	6	1	6
				Sub-Account Merit Rating		**3.52**	**5.64**	**4.10**	**4.50**
		Water Resources	4	Impact on surface water	6	2	4	3	4
				Ability to limit impact on Sawbill Bay and Lynxhead Bay	3	1	2	4	5
				Impact to groundwater	4	4	2	5	4
				Sub-Account Merit Rating		**2.38**	**2.92**	**3.85**	**4.23**
		Air Quality	4	Potential for dust generation	4	2	3	5	2
				Potential for greenhouse gas emission	6	2	3	5	2
				Sub-Account Merit Rating		**2.00**	**3.00**	**5.00**	**2.00**
		Noise	1	Haul road distance	6	2	3	5	1
				Sub-Account Merit Rating		**2.00**	**3.00**	**5.00**	**1.00**
				Account Merit Rating		**2.44**	**3.75**	**4.31**	**3.27**
Technical	3	Complexity of Design and Construction	6	Foundation Conditions	6	5	5	5	5
				Topography Containment	5	4	4	3	3
				Maximum Height	3	5	4	2	4
				Potential impact to other infrastructure	4	4	6	6	2
				Sub-Account Merit Rating		**4.50**	**4.78**	**4.17**	**3.61**
		Water Management	4	Number of potential settling ponds required	6	4	2	5	4
				Seepage collection ditches	3	2	3	5	5
				Sub-Account Merit Rating		**3.33**	**2.33**	**5.00**	**4.33**
		Closure	3	Feasibility of Closure	6	4	2.5	2	5
				Sub-Account Merit Rating		**4.00**	**2.50**	**2.00**	**5.00**
				Account Merit Rating		**4.03**	**3.50**	**3.92**	**4.15**

Table 18: WRMF MAA – Base Case (Continued)

Weightings						Scoring			
Account	Account Weighting (W_A)	Sub-Account	Sub-Account Weighting (W_S)	Indicator	Indicator Weighting (W_I)	WRMF 1	WRMF 2	WRMF 3	WRMF 4
Economics	1.5	Capital Cost	3	Total estimated capital cost	3	1.5	2.5	5	1.5
				Sub-Account Merit Rating		**1.50**	**2.50**	**5.00**	**1.50**
		Operating Cost	6	Total estimated operational costs per year	6	2	3	5	1
				Sub-Account Merit Rating		**2.00**	**3.00**	**5.00**	**1.00**
		Closure Cost	1	Total estimated closure costs	1	4.5	2.5	2	6
				Sub-Account Merit Rating		**4.50**	**2.50**	**2.00**	**6.00**
		Fish Habitat Compensation	1	Total estimated fish habitat compensation cost	1	3	6	1	6
				Sub-Account Merit Rating		**3.00**	**6.00**	**1.00**	**6.00**
				Account Merit Rating		**2.18**	**3.09**	**4.36**	**2.05**
Socio-Economics	3	Archaeology	2	Effects on cultural heritage sites	6	4	5	6	3.5
				Sub-Account Merit Rating		**4.00**	**5.00**	**6.00**	**3.50**
		Visual Impacts	5	Maximum Height of Stockpile	6	5	4	2	4
				Distance from Marmion Reservoir	4	1	4	3	6
				Sub-Account Merit Rating		**3.40**	**4.00**	**2.40**	**4.80**
		Land Claims	1	Number of known claims	6	6	6	6	6
				Sub-Account Merit Rating		**6.00**	**6.00**	**6.00**	**6.00**
		Effects on Land Use	6	Effects on Hunting	4	6	5	5	6
				Effects on Fishing	6	3	6	5	4
				Sub-Account Merit Rating		**4.20**	**5.60**	**5.00**	**4.80**
				Account Merit Rating		**4.01**	**4.97**	**4.29**	**4.70**
FINAL RANKING						**3.11**	**3.89**	**4.22**	**3.65**

Table 19: WRMF MAA – Sensitivity Case 1

Weightings						Scoring			
Account	**Account Weighting (W_A)**	**Sub-Account**	**Sub-Account Weighting (W_S)**	**Indicator**	**Indicator Weighting (W_I)**	**WRMF 1**	**WRMF 2**	**WRMF 3**	**WRMF 4**
Environment	6	Terrestrial Habitat	5	Impact on flora and fauna due to WRMF infrastructure	2	2	3	5	1
				Impact on flora and fauna due to WRMF footprint	6	1	2	3	3
				Effects on wildlife	4	2	3	5	1
				Effects on bird habitat	4	2	4	5	4
				Sub-Account Merit Rating		**1.63**	**2.88**	**4.25**	**2.50**
		Aquatic Habitat	6	Number of stream crossings by haul road	2	6	6	6	6
				Permanent streams impacted	6	2	6	6	2
				Ephemeral streams Impacted	3	4	3.5	4	3.5
				Number of fish-bearing lakes affected	4	5	6	5	6
				Area of fish-bearing lakes affected	6	3	6	1	6
				Sub-Account Merit Rating		**3.52**	**5.64**	**4.10**	**4.50**
		Water Resources	4	Impact on surface water	6	2	4	3	4
				Ability to limit impact on Sawbill Bay and Lynxhead Bay	3	1	2	4	5
				Impact to groundwater	4	4	2	5	4
				Sub-Account Merit Rating		**2.38**	**2.92**	**3.85**	**4.23**
		Air Quality	4	Potential for dust generation	4	2	3	5	2
				Potential for greenhouse gas emission	6	2	3	5	2
				Sub-Account Merit Rating		**2.00**	**3.00**	**5.00**	**2.00**
		Noise	1	Haul road distance	6	2	3	5	1
				Sub-Account Merit Rating		**2.00**	**3.00**	**5.00**	**1.00**
				Account Merit Rating		**2.44**	**3.75**	**4.31**	**3.27**
Technical	3	Complexity of Design and Construction	6	Foundation Conditions	6	5	5	5	5
				Topography Containment	5	4	4	3	3
				Maximum Height	3	5	4	2	4
				Potential impact to other infrastructure	4	4	6	6	2
				Sub-Account Merit Rating		**4.50**	**4.78**	**4.17**	**3.61**
		Water Management	4	Number of potential settling ponds required	6	4	2	5	4
				Seepage collection ditches	3	2	3	5	5
				Sub-Account Merit Rating		**3.33**	**2.33**	**5.00**	**4.33**
		Closure	3	Feasibility of Closure	6	4	2.5	2	5
				Sub-Account Merit Rating		**4.00**	**2.50**	**2.00**	**5.00**
				Account Merit Rating		**4.03**	**3.50**	**3.92**	**4.15**

Table 19: WRMF MAA – Sensitivity Case 1 (Continued)

Weightings						Scoring			
Account	Account Weighting (W_A)	Sub-Account	Sub-Account Weighting (W_S)	Indicator	Indicator Weighting (W_I)	WRMF 1	WRMF 2	WRMF 3	WRMF 4
Economics	0	Capital Cost	3	Total estimated capital cost	3	1.5	2.5	5	1.5
				Sub-Account Merit Rating		**1.50**	**2.50**	**5.00**	**1.50**
		Operating Cost	6	Total estimated operational costs per year	6	2	3	5	1
				Sub-Account Merit Rating		**2.00**	**3.00**	**5.00**	**1.00**
		Closure Cost	1	Total estimated closure costs	1	4.5	2.5	2	6
				Sub-Account Merit Rating		**4.50**	**2.50**	**2.00**	**6.00**
		Fish Habitat Compensation	1	Total estimated fish habitat compensation cost	1	3	6	1	6
				Sub-Account Merit Rating		**3.00**	**6.00**	**1.00**	**6.00**
				Account Merit Rating		**2.18**	**3.09**	**4.36**	**2.05**
Socio-Economics	3	Archaeology	2	Effects on cultural heritage sites	6	4	5	6	3.5
				Sub-Account Merit Rating		**4.00**	**5.00**	**6.00**	**3.50**
		Visual Impacts	5	Maximum Height of Stockpile	6	5	4	2	4
				Distance from Marmion Reservoir	4	1	4	3	6
				Sub-Account Merit Rating		**3.40**	**4.00**	**2.40**	**4.80**
		Land Claims	1	Number of known claims	6	6	6	6	6
				Sub-Account Merit Rating		**6.00**	**6.00**	**6.00**	**6.00**
		Effects on Land Use	6	Effects on Hunting	4	6	5	5	6
				Effects on Fishing	6	3	6	5	4
				Sub-Account Merit Rating		**4.20**	**5.60**	**5.00**	**4.80**
				Account Merit Rating		**4.01**	**4.97**	**4.29**	**4.70**
FINAL RANKING						**3.23**	**3.99**	**4.21**	**3.85**

Table 20: WRMF MAA – Sensitivity Case 2

Weightings						Scoring			
Account	**Account Weighting (W_A)**	**Sub-Account**	**Sub-Account Weighting (W_S)**	**Indicator**	**Indicator Weighting (W_I)**	**WRMF 1**	**WRMF 2**	**WRMF 3**	**WRMF 4**
Environment	6	Terrestrial Habitat	5	Impact on flora and fauna due to WRMF infrastructure	2	2	3	5	1
				Impact on flora and fauna due to WRMF footprint	6	1	2	3	3
				Effects on wildlife	4	2	3	5	1
				Effects on bird habitat	4	2	4	5	4
				Sub-Account Merit Rating		**1.63**	**2.88**	**4.25**	**2.50**
		Aquatic Habitat	6	Number of stream crossings by haul road	2	6	6	6	6
				Permanent streams impacted	6	2	6	6	2
				Ephemeral streams Impacted	3	4	3.5	4	3.5
				Number of fish-bearing lakes affected	4	5	6	5	6
				Area of fish-bearing lakes affected	6	3	6	1	6
				Sub-Account Merit Rating		**3.52**	**5.64**	**4.10**	**4.50**
		Water Resources	4	Impact on surface water	6	2	4	3	4
				Ability to limit impact on Sawbill Bay and Lynxhead Bay	3	1	2	4	5
				Impact to groundwater	4	4	2	5	4
				Sub-Account Merit Rating		**2.38**	**2.92**	**3.85**	**4.23**
		Air Quality	4	Potential for dust generation	4	2	3	5	2
				Potential for greenhouse gas emission	6	2	3	5	2
				Sub-Account Merit Rating		**2.00**	**3.00**	**5.00**	**2.00**
		Noise	1	Haul road distance	6	2	3	5	1
				Sub-Account Merit Rating		**2.00**	**3.00**	**5.00**	**1.00**
				Account Merit Rating		**2.44**	**3.75**	**4.31**	**3.27**
Technical	0	Complexity of Design and Construction	6	Foundation Conditions	6	5	5	5	5
				Topography Containment	5	4	4	3	3
				Maximum Height	3	5	4	2	4
				Potential impact to other infrastructure	4	4	6	6	2
				Sub-Account Merit Rating		**4.50**	**4.78**	**4.17**	**3.61**
		Water Management	4	Number of potential settling ponds required	6	4	2	5	4
				Seepage collection ditches	3	2	3	5	5
				Sub-Account Merit Rating		**3.33**	**2.33**	**5.00**	**4.33**
		Closure	3	Feasibility of Closure	6	4	2.5	2	5
				Sub-Account Merit Rating		**4.00**	**2.50**	**2.00**	**5.00**
				Account Merit Rating		**4.03**	**3.50**	**3.92**	**4.15**

Table 20: WRMF MAA – Sensitivity Case 2 (Continued)

Weightings						Scoring			
Account	Account Weighting (W_A)	Sub-Account	Sub-Account Weighting (W_S)	Indicator	Indicator Weighting (W_I)	WRMF 1	WRMF 2	WRMF 3	WRMF 4
Economics	0	Capital Cost	3	Total estimated capital cost	3	1.5	2.5	5	1.5
				Sub-Account Merit Rating		**1.50**	**2.50**	**5.00**	**1.50**
		Operating Cost	6	Total estimated operational costs per year	6	2	3	5	1
				Sub-Account Merit Rating		**2.00**	**3.00**	**5.00**	**1.00**
		Closure Cost	1	Total estimated closure costs	1	4.5	2.5	2	6
				Sub-Account Merit Rating		**4.50**	**2.50**	**2.00**	**6.00**
		Fish Habitat Compensation	1	Total estimated fish habitat compensation cost	1	3	6	1	6
				Sub-Account Merit Rating		**3.00**	**6.00**	**1.00**	**6.00**
				Account Merit Rating		**2.18**	**3.09**	**4.36**	**2.05**
Socio-Economics	3	Archaeology	2	Effects on cultural heritage sites	6	4	5	6	3.5
				Sub-Account Merit Rating		**4.00**	**5.00**	**6.00**	**3.50**
		Visual Impacts	5	Maximum Height of Stockpile	6	5	4	2	4
				Distance from Marmion Reservoir	4	1	4	3	6
				Sub-Account Merit Rating		**3.40**	**4.00**	**2.40**	**4.80**
		Land Claims	1	Number of known claims	6	6	6	6	6
				Sub-Account Merit Rating		**6.00**	**6.00**	**6.00**	**6.00**
		Effects on Land Use	6	Effects on Hunting	4	6	5	5	6
				Effects on Fishing	6	3	6	5	4
				Sub-Account Merit Rating		**4.20**	**5.60**	**5.00**	**4.80**
				Account Merit Rating		**4.01**	**4.97**	**4.29**	**4.70**
FINAL RANKING						**2.96**	**4.15**	**4.30**	**3.75**

Table 21: WRMF MAA – Sensitivity Case 3

Account	Account Weighting (W_A)	Sub-Account	Sub-Account Weighting (W_S)	Indicator	Indicator Weighting (W_I)	WRMF 1	WRMF 2	WRMF 3	WRMF 4
Weightings						Scoring			
Environment	1	Terrestrial Habitat	5	Impact on flora and fauna due to WRMF infrastructure	2	2	3	5	1
				Impact on flora and fauna due to WRMF footprint	6	1	2	3	3
				Effects on wildlife	4	2	3	5	1
				Effects on bird habitat	4	2	4	5	4
				Sub-Account Merit Rating		**1.63**	**2.88**	**4.25**	**2.50**
		Aquatic Habitat	6	Number of stream crossings by haul road	2	6	6	6	6
				Permanent streams impacted	6	2	6	6	2
				Ephemeral streams Impacted	3	4	3.5	4	3.5
				Number of fish-bearing lakes affected	4	5	6	5	6
				Area of fish-bearing lakes affected	6	3	6	1	6
				Sub-Account Merit Rating		**3.52**	**5.64**	**4.10**	**4.50**
		Water Resources	4	Impact on surface water	6	2	4	3	4
				Ability to limit impact on Sawbill Bay and Lynxhead Bay	3	1	2	4	5
				Impact to groundwater	4	4	2	5	4
				Sub-Account Merit Rating		**2.38**	**2.92**	**3.85**	**4.23**
		Air Quality	4	Potential for dust generation	4	2	3	5	2
				Potential for greenhouse gas emission	6	2	3	5	2
				Sub-Account Merit Rating		**2.00**	**3.00**	**5.00**	**2.00**
		Noise	1	Haul road distance	6	2	3	5	1
				Sub-Account Merit Rating		**2.00**	**3.00**	**5.00**	**1.00**
				Account Merit Rating		**2.44**	**3.75**	**4.31**	**3.27**
Technical	1	Complexity of Design and Construction	6	Foundation Conditions	6	5	5	5	5
				Topography Containment	5	4	4	3	3
				Maximum Height	3	5	4	2	4
				Potential impact to other infrastructure	4	4	6	6	2
				Sub-Account Merit Rating		**4.50**	**4.78**	**4.17**	**3.61**
		Water Management	4	Number of potential settling ponds required	6	4	2	5	4
				Seepage collection ditches	3	2	3	5	5
				Sub-Account Merit Rating		**3.33**	**2.33**	**5.00**	**4.33**
		Closure	3	Feasibility of Closure	6	4	2.5	2	5
				Sub-Account Merit Rating		**4.00**	**2.50**	**2.00**	**5.00**
				Account Merit Rating		**4.03**	**3.50**	**3.92**	**4.15**

Table 21: WRMF MAA – Sensitivity Case 3 (Continued)

Weightings						Scoring			
Account	**Account Weighting (W_A)**	**Sub-Account**	**Sub-Account Weighting (W_S)**	**Indicator**	**Indicator Weighting (W_I)**	**WRMF 1**	**WRMF 2**	**WRMF 3**	**WRMF 4**
Economics	1	Capital Cost	3	Total estimated capital cost	3	1.5	2.5	5	1.5
				Sub-Account Merit Rating		**1.50**	**2.50**	**5.00**	**1.50**
		Operating Cost	6	Total estimated operational costs per year	6	2	3	5	1
				Sub-Account Merit Rating		**2.00**	**3.00**	**5.00**	**1.00**
		Closure Cost	1	Total estimated closure costs	1	4.5	2.5	2	6
				Sub-Account Merit Rating		**4.50**	**2.50**	**2.00**	**6.00**
		Fish Habitat Compensation	1	Total estimated fish habitat compensation cost	1	3	6	1	6
				Sub-Account Merit Rating		**3.00**	**6.00**	**1.00**	**6.00**
				Account Merit Rating		**2.18**	**3.09**	**4.36**	**2.05**
Socio-Economics	1	Archaeology	2	Effects on cultural heritage sites	6	4	5	6	3.5
				Sub-Account Merit Rating		**4.00**	**5.00**	**6.00**	**3.50**
		Visual Impacts	5	Maximum Height of Stockpile	6	5	4	2	4
				Distance from Marmion Reservoir	4	1	4	3	6
				Sub-Account Merit Rating		**3.40**	**4.00**	**2.40**	**4.80**
		Land Claims	1	Number of known claims	6	6	6	6	6
				Sub-Account Merit Rating		**6.00**	**6.00**	**6.00**	**6.00**
		Effects on Land Use	6	Effects on Hunting	4	6	5	5	6
				Effects on Fishing	6	3	6	5	4
				Sub-Account Merit Rating		**4.20**	**5.60**	**5.00**	**4.80**
	Account Merit Rating					**4.01**	**4.97**	**4.29**	**4.70**
FINAL RANKING						**3.17**	**3.83**	**4.22**	**3.54**

Table 22: WRMF MAA – Sensitivity Case 4

Weightings						Scoring			
Account	Account Weighting (W_A)	Sub-Account	Sub-Account Weighting (W_S)	Indicator	Indicator Weighting (W_I)	WRMF 1	WRMF 2	WRMF 3	WRMF 4
Environment	1	Terrestrial Habitat	1	Impact on flora and fauna due to WRMF infrastructure	1	2	3	5	1
				Impact on flora and fauna due to WRMF footprint	1	1	2	3	3
				Effects on wildlife	1	2	3	5	1
				Effects on bird habitat	1	2	4	5	4
				Sub-Account Merit Rating		**1.75**	**3.00**	**4.50**	**2.25**
		Aquatic Habitat	1	Number of stream crossings by haul road	1	6	6	6	6
				Permanent streams impacted	1	2	6	6	2
				Ephemeral streams Impacted	1	4	3.5	4	3.5
				Number of fish-bearing lakes affected	1	5	6	5	6
				Area of fish-bearing lakes affected	1	3	6	1	6
				Sub-Account Merit Rating		**4.00**	**5.50**	**4.40**	**4.70**
		Water Resources	1	Impact on surface water	1	2	4	3	4
				Ability to limit impact on Sawbill Bay and Lynxhead Bay	1	1	2	4	5
				Impact to groundwater	1	4	2	5	4
				Sub-Account Merit Rating		**2.33**	**2.67**	**4.00**	**4.33**
		Air Quality	1	Potential for dust generation	1	2	3	5	2
				Potential for greenhouse gas emission	1	2	3	5	2
				Sub-Account Merit Rating		**2.00**	**3.00**	**5.00**	**2.00**
		Noise	1	Haul road distance	1	2	3	5	1
				Sub-Account Merit Rating		**2.00**	**3.00**	**5.00**	**1.00**
				Account Merit Rating		**2.42**	**3.43**	**4.58**	**2.86**
Technical	1	Complexity of Design and Construction	1	Foundation Conditions	1	5	5	5	5
				Topography Containment	1	4	4	3	3
				Maximum Height	1	5	4	2	4
				Potential impact to other infrastructure	1	4	6	6	2
				Sub-Account Merit Rating		**4.50**	**4.75**	**4.00**	**3.50**
		Water Management	1	Number of potential settling ponds required	1	4	2	5	4
				Seepage collection ditches	1	2	3	5	5
				Sub-Account Merit Rating		**3.00**	**2.50**	**5.00**	**4.50**
		Closure	1	Feasibility of Closure	1	4	2.5	2	5
				Sub-Account Merit Rating		**4.00**	**2.50**	**2.00**	**5.00**
				Account Merit Rating		**3.83**	**3.25**	**3.67**	**4.33**

Table 22: WRMF MAA – Sensitivity Case 4 (Continued)

Weightings						Scoring			
Account	**Account Weighting (W_A)**	**Sub-Account**	**Sub-Account Weighting (W_S)**	**Indicator**	**Indicator Weighting (W_I)**	**WRMF 1**	**WRMF 2**	**WRMF 3**	**WRMF 4**
Economics	1	Capital Cost	1	Total estimated capital cost	1	1.5	2.5	5	1.5
				Sub-Account Merit Rating		**1.50**	**2.50**	**5.00**	**1.50**
		Operating Cost	1	Total estimated operational costs per year	1	2	3	5	1
				Sub-Account Merit Rating		**2.00**	**3.00**	**5.00**	**1.00**
		Closure Cost	1	Total estimated closure costs	1	4.5	2.5	2	6
				Sub-Account Merit Rating		**4.50**	**2.50**	**2.00**	**6.00**
		Fish Habitat Compensation	1	Total estimated fish habitat compensation cost	1	3	6	1	6
				Sub-Account Merit Rating		**3.00**	**6.00**	**1.00**	**6.00**
	Account Merit Rating					**2.75**	**3.50**	**3.25**	**3.63**
Socio-Economics	1	Archaeology	1	Effects on cultural heritage sites	1	4	5	6	3.5
				Sub-Account Merit Rating		**4.00**	**5.00**	**6.00**	**3.50**
		Visual Impacts	1	Maximum Height of Stockpile	1	5	4	2	4
				Distance from Marmion Reservoir	1	1	4	3	6
				Sub-Account Merit Rating		**3.00**	**4.00**	**2.50**	**5.00**
		Land Claims	1	Number of known claims	1	6	6	6	6
				Sub-Account Merit Rating		**6.00**	**6.00**	**6.00**	**6.00**
		Effects on Land Use	1	Effects on Hunting	1	6	5	5	6
				Effects on Fishing	1	3	6	5	4
				Sub-Account Merit Rating		**4.50**	**5.50**	**5.00**	**5.00**
				Account Merit Rating		**4.38**	**5.13**	**4.88**	**4.88**
FINAL RANKING						**3.34**	**3.83**	**4.09**	**3.92**

REFERENCES

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APPENDIX A

PRELIMINARY TAILINGS ASSESSMENT

TERMS OF REFERENCE

Hammond Reef

Gold Project

APPENDIX A – PRELIMINARY TAILINGS ASSESSMENT

TERMS OF REFERENCE

January 2012

Appendix A - Preliminary Tailings Assessment

To support the selection of the tailings management facility (TMF) alternative to be considered in the Project Description, 5 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 initial locations were based on an assessment that considered the presence of suitable terrain that would provide some natural containment to serve as the base upon which to construct the necessary containment berms, and the distance of the site from the processing plant.

In the assessment considered in this Appendix, the baseline work conducted to date, in conjunction with discussions with regulatory agencies to identify permitting constraints was used to further refine the list of suitable Alternatives. The additional assessment considered both constructability, operability, environmental impacts and social concerns. The final selection of alternatives that were carried forward into the Project Description was based on minimizing environmental concerns, particularly fisheries issues that could result in significant adverse impacts that would present serious permitting constraints, and social issues.

Osisko wishes to acknowledge the helpful assistance being provided by the Regulators in reviewing the environmental concerns associated with the 6 alternative at the meeting on March 9, 2011, and the provision of their valued input with regard to permit time and permitting requirements for each of the options presented below.

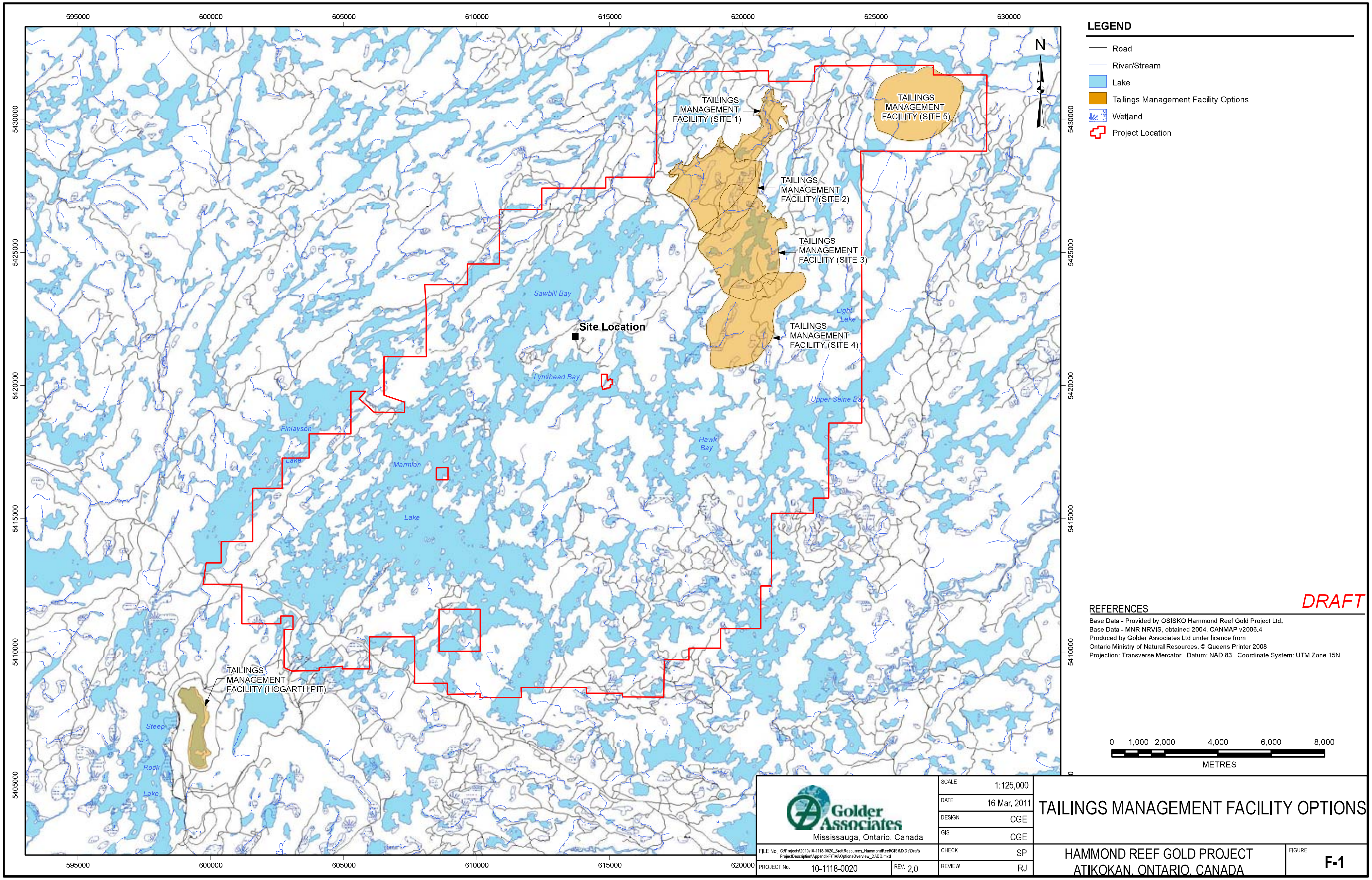
Five (5) on- site and one (1) off-site TMF options are reviewed in the summary table (Table F-1) in this Appendix. Figure F-1 of this technical memorandum provides a plan view which locates the five (5) on-site TMF being considered in this review as well as the one (1) off-site Hogarth Pit Tailings Option. Figures F-2 to F-6 provide additional detail on each of the onsite proposed TMFs. Figure F-7 identifies the off-site Hogarth Pit Tailings Option with potential pipeline routeing considerations. Descriptions regarding each TMF including potential hydrological and hydrogeological effects, the potential terrestrial and aquatic environment affects and social and/or economic effects are provided in Table F-1.

Based on a comparison of the identified permitting requirements along with other determining factors, Osisko has carried forward three TMF options into the revised Project Description for this proposed development. The selected TMF alternatives were TMF-2 as the Base Case and TMF-1 as Alternate #1 and TMF-4 as Alternate #2.

Table A-1: Preliminary Tailings Assessment

Tailings Alternative	Description	Potential Hydrological/ Hydrogeological Effects	Potential Terrestrial Environments Affected	Potential Aquatic Environments Affected	Potential Social and/or Economic Effects	Summary
On-Site Alternative TMF-1 (Figure F-2)	• Located northeast of the mine site against a natural ridge that forms the northern containment for the TMF extending to the east. TMF footprint of approximately 8.6 M m^2. • Requires berm raised around ~60% of perimeter. • Footprint would be cleared of vegetation. Some excavation of dam foundations with dams constructed in stages as mining progresses. Dam material to be sourced from local quarries and waste rock (pending geochemical assessment). • Tailings would be pumped to TMF via pipeline, possibly as thickened tailings, with water reclamation and toe seepage collection at low points. • Excess water would be treated as required and discharged from a central WTF near the processing plant site. • Site fresh water needs of up to approximately 20,000 m^3/day. The tailings pipeline length is approximately 9 km. Pipeline routing shown on Figure F-2. • TMF extends to the east and includes a small lake in the central portion and streams draining to the Lizard Lake watershed in the east. • Avoids small lake along eastern perimeter. • Tailings and pipeline are contained within the Osisko lease area.	• Loss of small streams (<0.5 m width) at west end that drain to the north end of Sawbill Bay. • Loss of wetlands in central area with no obvious drainage to nearby lakes. • Loss of small tributaries to Lizard Lake at east end of TMF. • Loss of small lake/large pond in central portion of the TMF. • Minimal watershed area affected. • Daily fresh water makeup needs of up to 20,000 m^3/day to be sourced from Marmion Lake. • Potential effects of seepage to groundwater to be confirmed.	• Vegetation and terrestrial habitat loss in TMF footprint and along pipeline route. • Area comprised of mixed boreal forest and open wetlands. • Common tree species are: Black Spruce, Jack Pine, Trembling Aspen, White Birch, White Cedar, White Pine, Tamarack, Balsam Fir, Speckled Alder, Mountain Maple, American Mountain Ash, Showy Mountain Ash, Green Alder and Willow.. • Wildlife species observed and/or known do not include rare, threatened or endangered species.	• Fish species observed in small lake and small streams draining from local ponds include: Finescale Dace, Pearl Dace, Fathead Minnow, Pumpkinseed, Yellow Perch, Northern Pike, White Sucker, Northern Red Belly Dace, Burbot, Cisco and Smallmouth Bass	• No human uses identified in the area.	• Second lowest construction costs of the on-site alternatives. • Potential permitting issues with loss of aquatic habitats. • Pipeline route follows existing road facilitating servicing and maintenance, and facilitating cleanup in the event of any spills. • Mineralization may extend across southern portion of the footprint, resulting in sterilization of potential economic ore.
On-Site Alternative TMF-2 (Figure F-3)	• Located northeast of the mine site against a natural ridge that forms the northern containment for the TMF. Tailings dams constructed only along east, south and west sides. Footprint area approximately 10.8 M m^2. • Requires berm raised around ~80% of perimeter. • Footprint would be cleared of vegetation. Some excavation of dam foundations with dams constructed in stages as mining progresses. Dam material to be sourced from local quarries and waste rock (pending geochemical assessment). • Tailings would be pumped to TMF via pipeline, possibly as thickened tailings, with water reclamation and toe seepage collection at low points at low points. • Excess water would be treated as required and discharged from a central WTF near the processing plant site. • Site fresh water needs of up to approximately 20,000 m^3/day with reclamation. • Tailings pipeline from mine follows mine access road. The Tailings pipeline length is approximately 9 km. Pipeline routing is shown on Figure F-3. • Avoids 2 small lakes along eastern perimeter. • Tailings and pipeline are contained within the Osisko lease area.	• Loss of small streams (<0.5 m width) at west end draining to the north end of Sawbill Bay. • Loss of wetlands in central area with no obvious drainage to adjacent lakes. • Minimal watershed area affected. • Small streams (<0.5m width) drain from wetlands and beaver ponds. • Small tributary to northwest end of Lizard Lake is affected. • Tailings pipeline will not affect small local streams. • Daily fresh water makeup needs of up to 20,000 m^3/day to be sourced from Marmion Lake. • Potential effects of seepage to groundwater to be confirmed.	• Vegetation and terrestrial habitat loss in TMF footprint and along pipeline route. • Area comprised of mixed boreal forest and open wetlands. • Common tree species are: Black Spruce, Jack Pine, Trembling Aspen, White Birch, White Cedar, White Pine, Tamarack, Balsam Fir, Speckled Alder, Mountain Maple, American Mountain Ash, Showy Mountain Ash, Green Alder and Willow. • Wildlife species observed and/or known do not include rare, threatened or endangered species.	• A pond and small stream are located in the central portion of the area. Fish species observed include: Finescale Dace, Pearl Dace, Fathead Minnow, Northern Red Belly Dace, and White Sucker.	• No human uses identified in the area. • Local residents indicate streams are not suitable/used for recreational fishing.	• Moderate on-site construction cost alternative. • Alternative with fewest potential aquatic impacts. • Pipeline route follows existing road facilitating servicing and maintenance, and facilitating cleanup in the event of any spills. • Mineralization may extend across southern portion of the footprint, resulting in sterilization of potential economic ore.
On-Site Alternative TMF-3 (Figure F-4).	• Located northeast of mine site in Lizard Lake basin. Requires construction of dams around almost the entire TMF, but takes advantage of natural depression to reduce dam heights. TMF footprint is approximately14.1 M m^2. • Requires berm raised around ~85% of perimeter. • Footprint would be cleared of vegetation. Some excavation of dam foundations with dams constructed in stages as mining progresses. Dam material to be sourced from local quarries and waste rock (pending geochemical assessment). • Tailings would be pumped to TMF via pipeline, with water reclamation and toe seepage collection at the low points. • Excess water would be treated as required and discharged from a central WTF near the processing plant site. • Site fresh water needs of up to approximately 20,000 m^3/day with reclamation.. • Tailings pipeline will require construction of a service road. The tailings pipeline length is approximately 7 km. Pipeline routing is shown on Figure 4. • Requires major diversion of main inflow to the lake from the north, and damming of former outflow to the south. • Tailings and pipeline are contained within the Osisko lease area.	• Upstream end of Lizard Lake will require flow diversion, increasing flow to Vista & Light Lakes. • Lizard Lake will be drained, with resultant loss of flow to Trap Bay (Marmion Lake). Potential reduced circulation in northern arm of Turtle Bay. • Daily fresh water makeup needs of up to 20,000 m^3/day to be sourced from Marmion Lake. • Potential effects of seepage to groundwater to be confirmed.	• Vegetation and terrestrial habitat loss in TMF footprint and along pipeline route. • Area comprised of mixed boreal forest, open wetlands and lake margins. • Common tree species anticipated are: Black Spruce, Jack Pine, Trembling Aspen, White Birch, White Cedar, White Pine, Tamarack, Balsam Fir, Speckled Alder, Mountain Maple, American Mountain Ash, Showy Mountain Ash, Green Alder and Willow. • Wildlife species observed and/or known do not include rare, threatened or endangered species.	• A small lake and stream that drain into Lizard Lake, and Lizard Lake will be eliminated through draining of the lake, and fish habitat lost. Fish species observed include: Smallmouth Bass, Yellow Perch, Northern Pike, Blacknose Shiner and Pumpkinseed. MNR (1975) indicate additional species in Lizard Lake include: Lake Herring, Burbot, White Sucker, Walleye, Spottail Shiner, Longnose Dace, Pearl Dace and Iowa Darter. • Fish habitat in Trap Bay may also be affected through loss of flow from outlet of Lizard Lake. • Habitat effects in Vista Lake due to flow diversion.	• Would require relocation of a local resident, and compensation for loss of trap line. • Lizard Lake is used by local residents for recreational fishing.	• Lowest cost alternative. • Adverse effects on aquatic habitats due to loss of Lizard Lake and other small lakes. • Pipeline route follows existing road facilitating servicing and maintenance, and facilitating cleanup in the event of any spills. • Significant permitting constraints under Fisheries Act and MMER.

Tailings Alternative	Description	Potential Hydrological/ Hydrogeological Effects	Potential Terrestrial Environments Affected	Potential Aquatic Environments Affected	Potential Social and/or Economic Effects	Summary
On-Site Alternative TMF-4 (Figure F-5)	• Located east of mine site, southeast of Lizard Lake in an upland area. Requires dams constructed around entire TMF, but takes advantage of locally higher topography to reduce dam height. TMF footprint is approximately 9 M m^2. • Requires berm raised around ~100% of perimeter. • Footprint would be cleared of vegetation. Some excavation of dam foundations with dams constructed in stages as mining progresses. Dam material to be sourced from local quarries and waste rock (pending geochemical assessment). • Minimizes affected aquatic habitats. • Tailings would be pumped to TMF via pipeline, with water reclamation and seepage collection around dam. • Excess water would be treated as required and discharged from a central WTF near the processing plant site. • Site freshwater needs of up to approximately 20,000 m^3/day with reclamation. • Tailings pipeline will require construction of a service road. The tailings pipeline length is approximately 7.2 km. Pipeline routing is shown on Figure 5. • Tailings and pipeline are contained within the Osisko lease area.	• Loss of small intermittent tributaries to Lizard Lake and Light Lake (west arm) • Loss of small tributary to Turtle Bay. • Daily fresh water makeup needs of 20,000 m^3/day to be sourced from Marmion Lake. • Potential effects of seepage to groundwater to be confirmed.	• Vegetation and terrestrial habitat loss in TMF footprint and along pipeline route. • Area comprised of mixed boreal forest, open wetlands and lake margins. • Common tree species are: Black Spruce, Jack Pine, Trembling Aspen, White Birch, White Cedar, White Pine, Tamarack, Balsam Fir, Speckled Alder, Mountain Maple, American Mountain Ash, Showy Mountain Ash, Green Alder and Willow. • Wildlife species observed and/or known do not include rare, threatened or endangered species.	• Small intermittent streams may not be fish bearing and may be ephemeral in nature. • Small tributary to Turtle Bay represents a loss of marginal fish habitat. • Fish communities to be assessed in 2011.	• No human uses identified in the area. • Local residents indicate small streams are not suitable/used for recreational fishing.	• Second most expensive on-site alternative. • Only small streams affected in footprint. • Pipeline follows existing road for >50% of length, facilitating construction, servicing and maintenance of pipeline.
On-Site Alternative TMF-5 (Figure F-6)	• TMF located northeast of mine site, east of Premier Lake Road in an upland area. Requires dams constructed around entire TMF. TMF footprint is approximately 8.3 M m^2. • Requires berm raised around ~100% of perimeter. • Footprint would be cleared of vegetation. Some excavation of dam foundations with dams constructed in stages as mining progresses. Dam material to be sourced from local quarries and waste rock (pending geochemical assessment). • Tailings would be pumped to TMF via pipeline as thickened tailings, with water reclamation, and seepage collection around dam. • Excess water would be treated as required and discharged from a central WTF near the processing plant site. • Site freshwater needs of up to approximately 20,000 m^3/day with reclamation. • The tailings pipeline length is approximately 19.7 km. The pipeline routing is shown on Figure 6. • Tailings and pipeline are contained within the Osisko lease area.	• Loss of small, intermittent stream to Franklin Lake. • Loss of small ponds and wetlands with no apparent connection to adjacent lakes. • Daily fresh water makeup needs of 20,000 m^3/day to be sourced from Marmion Lake. • Potential effects of seepage to groundwater to be confirmed.	• Vegetation and terrestrial habitat loss in TMF footprint and along pipeline route. • Area comprised of mixed boreal forest, open wetlands and lake margins. • Common tree species are: Black Spruce, Jack Pine, Trembling Aspen, White Birch, White Cedar, White Pine, Tamarack, Balsam Fir, Speckled Alder, Mountain Maple, American Mountain Ash, Showy Mountain Ash, Green Alder and Willow. • Wildlife species observed and/or known do not include rare, threatened or endangered species.	• Streams and a small pond are present which may be fish bearing. • Fish species to be assessed in 2011 if alternative is carried forward.	• No human uses identified in the area.	• Most expensive on-site alternative. • Longest pipeline, <50% follows existing roads, and crosses public road. • Potential effects on fisheries, and permitting requirements due to small lakes/large pond within TMF area.
Off-Site Alternative TMF-6 (Hogarth Pit) (Figure F-7)	• Tailings would be pumped via pipeline to Hogarth Pit in the former Steep Rock Iron Mines site, see Figure 7. • Site requires minimal clearing and grubbing, but will require some local filling/dam construction to isolate the Pit from Caland/Errington Pits and Steep Rock Lake. • May include discharge channel to Seine River, bypassing Steep Rock Lake. • Alternative includes pipeline (27 to 32 km long, depending on route). Three alternative routes have been identified. • Tailing disposal site and part of pipeline route are outside of lease area and ownership. Liability concerns regarding spills and accidents along pipeline and at the Pit. • Site would need to be secured (fencing, etc.). • Areas of existing contamination would need to be identified and remediated where required. • Hogarth Pit would be isolated from Caland Pit to eliminate water exchange through sealing of Mosher Point tunnel. • Connections to local waterbodies would need to be investigated and sealed where required. • Site fresh water makeup needs are approximately 20,000 m^3/day with reclaim pipeline. • Water treatment will likely be required, starting at the time of pit overflow (approximately 14 years).	• Pit will fill faster and overflow to Seine River system sooner than currently predicted (in roughly 14 years rather than 20 years). • With reclaim, higher discharge due to displacement of volume by tailings (16,000 m^3/day). • Flow could result in re-suspension of sediments in West Arm of Steep Rock Lake and may need to be diverted south to Seine River. • With reclaim, daily fresh water makeup needs of 20,000 m^3/day to be sourced from Marmion Lake. • Effects of raising Pit water level on local groundwater flow unknown. • Effects and extent of historic subsurface excavations unknown.	• Limited effects on terrestrial habitat due to limited revegetation of surrounding areas of the former Steep Rock Iron Mines site. • Additional vegetation removal along pipeline route. • Vegetation communities mainly boreal forest and open wetlands. • Wildlife species observed and/or known do not include rare, threatened or endangered species. • Potential impacts from spills/accidents along pipeline.	• Poor quality of water in Pit limits habitat suitability for most biota. • Anecdotal evidence suggests some fish may be present. • Pipeline crosses a number of small streams. • Discharge of poor quality water from Pit. Water treatment will be required to mitigate downstream effects. • Routing of pipeline across dams on Marmion Lake may require widening of dam crests, with minor loss of adjacent aquatic habitat. • Potential impacts from spills/accidents along pipeline	• Site is classified as industrial land use and is currently vacant. • Option viewed favourably by local communities since it partly addresses some of the on-going environmental liabilities that could ultimately affect downstream users. • Potential for pipeline accidents could raise public opposition.	• Significant risks/potential liabilities due to length of pipeline over public lands. • Long term water treatment commitments. • Unknown environmental liabilities on-site. • Site security concerns. • Significant on-site construction and/or remediation may be required.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TAILINGS MANAGEMENT FACILITY (SITE 5)
TAILINGS MANAGEMENT FACILITY (SITE 2)
TAILINGS MANAGEMENT FACILITY (SITE 3)
TAILINGS MANAGEMENT FACILITY (SITE 4)
TAILINGS MANAGEMENT FACILITY (HOGARTH PIT)
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Lynxhead Bay
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Upper Seine Bay
Hawk Bay
Finlayson Lake
Marmion Lake
Steep Rock Lake
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LEGEND
Road
River/Stream
Lake
Tailings Management Facility Options
Wetland
Project Location
DRAFT
REFERENCES
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Base Data - MNR NRVIS, obtained 2004, CANMAP v2006.4
Produced by Golder Associates Ltd under licence from
Ontario Ministry of Natural Resources, © Queens Printer 2008
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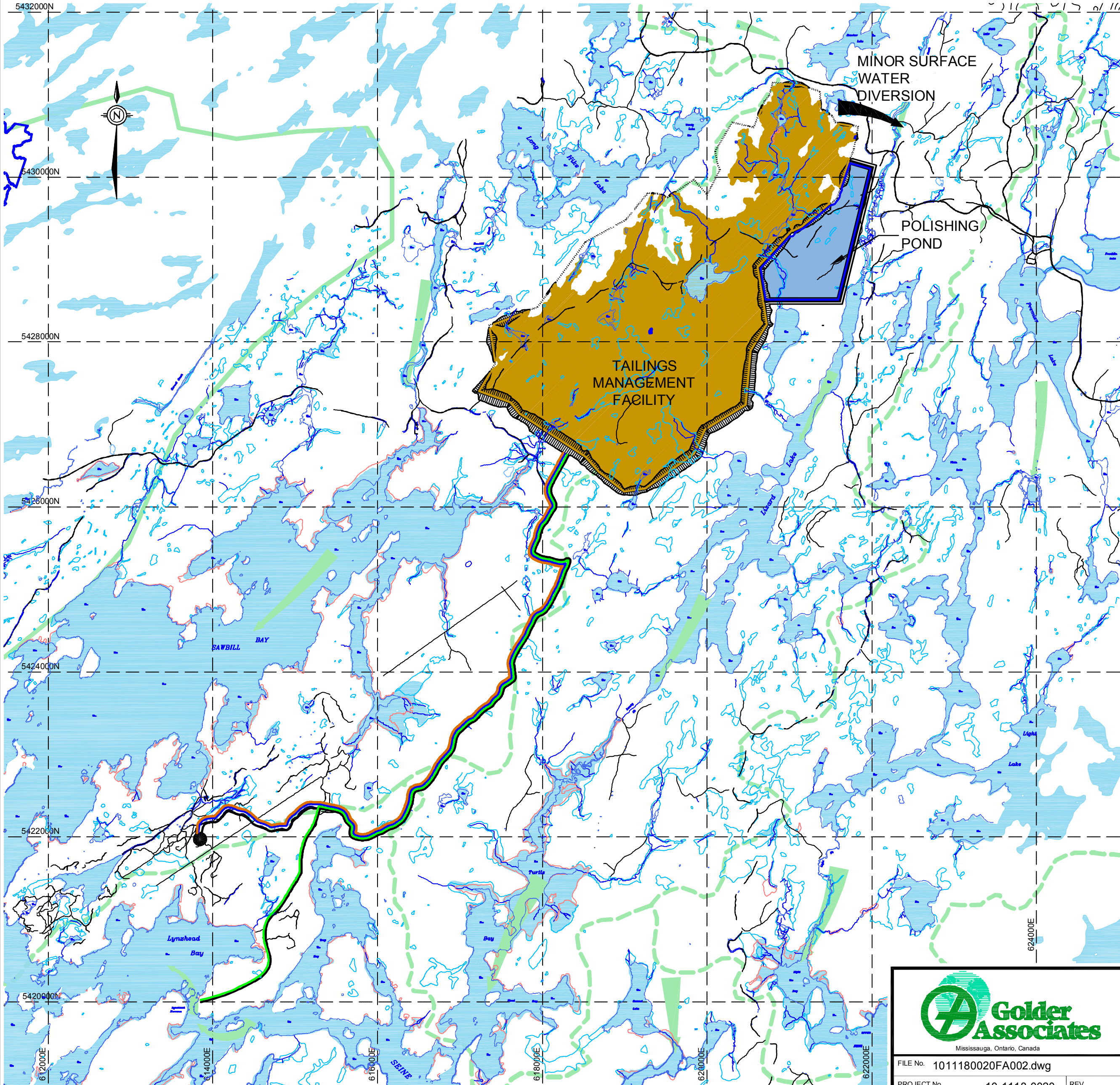
ATIKOKAN, ONTARIO, CANADA
FIGURE F-1



LEGEND:

- MINE / PROCESSING PLANT
- TAILINGS MANAGEMENT FACILITY
- TAILINGS PIPELINE (FROM MILL TO TMF - 8.8 Km)
- EFFLUENT DISCHARGE LINE (FROM TMF TO LYNXHEAD NARROWS (10.1Km)
- WATER RECLAIM LINE (FROM TMF TO PROCESS PLANT - 8.8 Km)
- CONTAINMENT DAM LOCATION
- REGIONAL SUB.WATERSHED
- LOCAL SUBWATERSHED
- SURFACE WATER DRAINAGE DIRECTION

NOTE:

1. THIS WAS CHOSEN AS ALTERNATIVE #1.

REFERENCE:

LIDAR CONTOURS - PROVIDED BY AEROGEOMATICS LTD AND OSISKO HAMMOND REEF PROJECT LTD. (1m RESOLUTION, JULY 2010)

1 0 1 2

SCALE 1:50000 KM

Golder Associates
Mississauga, Ontario, Canada

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PROJECT No. 10-1118-0020 REV. -	REVIEW	KAB	FIGURE F-2

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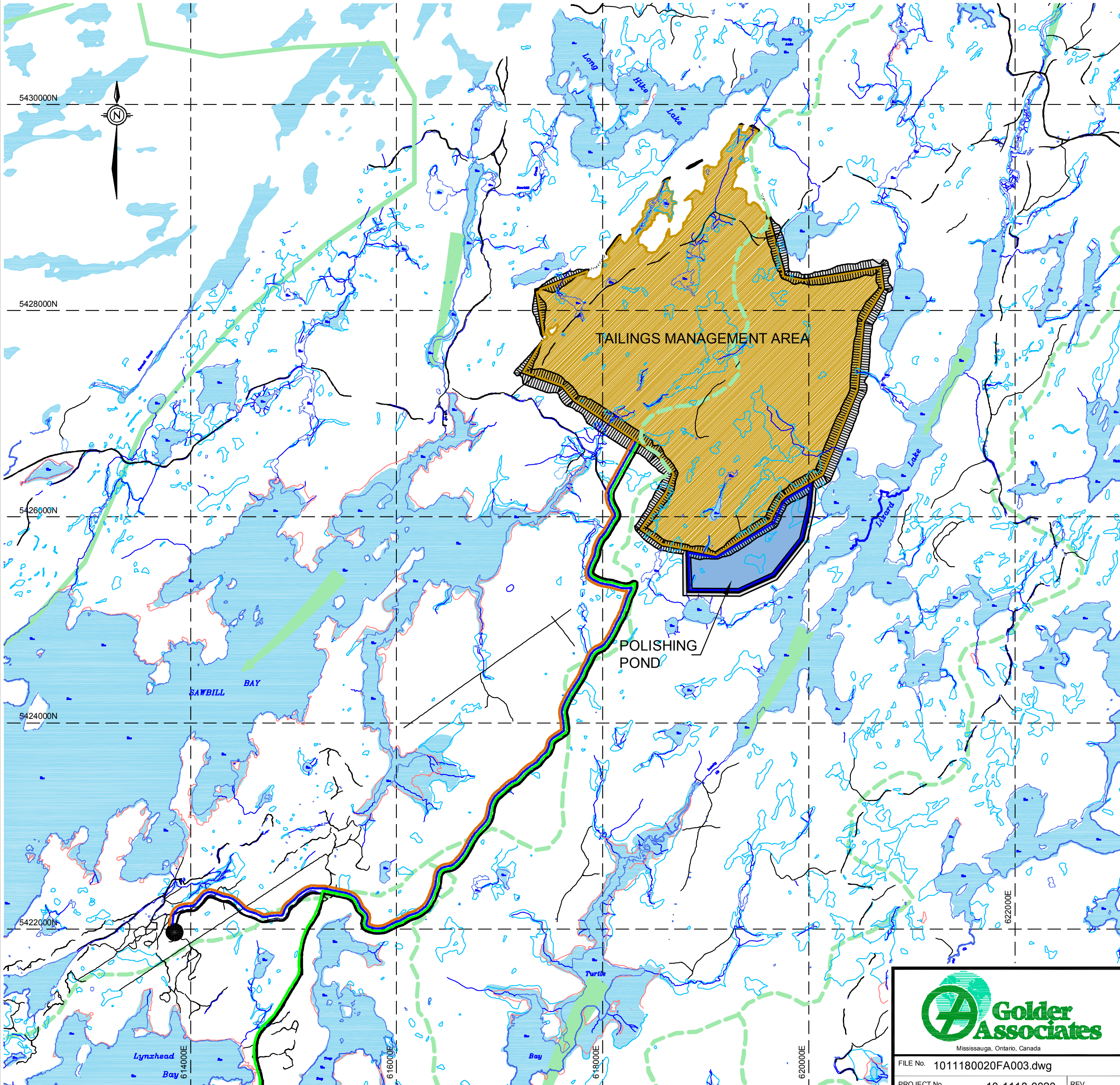

LEGEND:

- MINE / PROCESSING PLANT
- TAILINGS MANAGEMENT FACILITY
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- EFFLUENT DISCHARGE LINE (FROM TMF TO LYNXHEAD NARROWS (10.1Km)
- WATER RECLAIM LINE (FROM TMF TO PROCESS PLANT - 8.8 Km)
- CONTAINMENT DAM LOCATION
- REGIONAL SUB.WATERSHED
- LOCAL SUBWATERSHED
- SURFACE WATER DRAINAGE DIRECTION

NOTE:

1. THIS WAS CHOSEN AS BASE CASE.

REFERENCE:

LIDAR CONTOURS - PROVIDED BY AEROGEOMATICS LTD AND OSISKO HAMMOND REEF PROJECT LTD. (1m RESOLUTION, JULY 2010)

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Golder Associates
Mississauga, Ontario, Canada

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CAD	TDR
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REVIEW	KAB
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PROJECT No.	10-1118-0020
REV.	-

TITLE

CONCEPTUAL TAILINGS MANAGEMENT FACILITY LAYOUT SITE 2

OSISKO HAMMOND REEF PROJECT

FIGURE **F-3**

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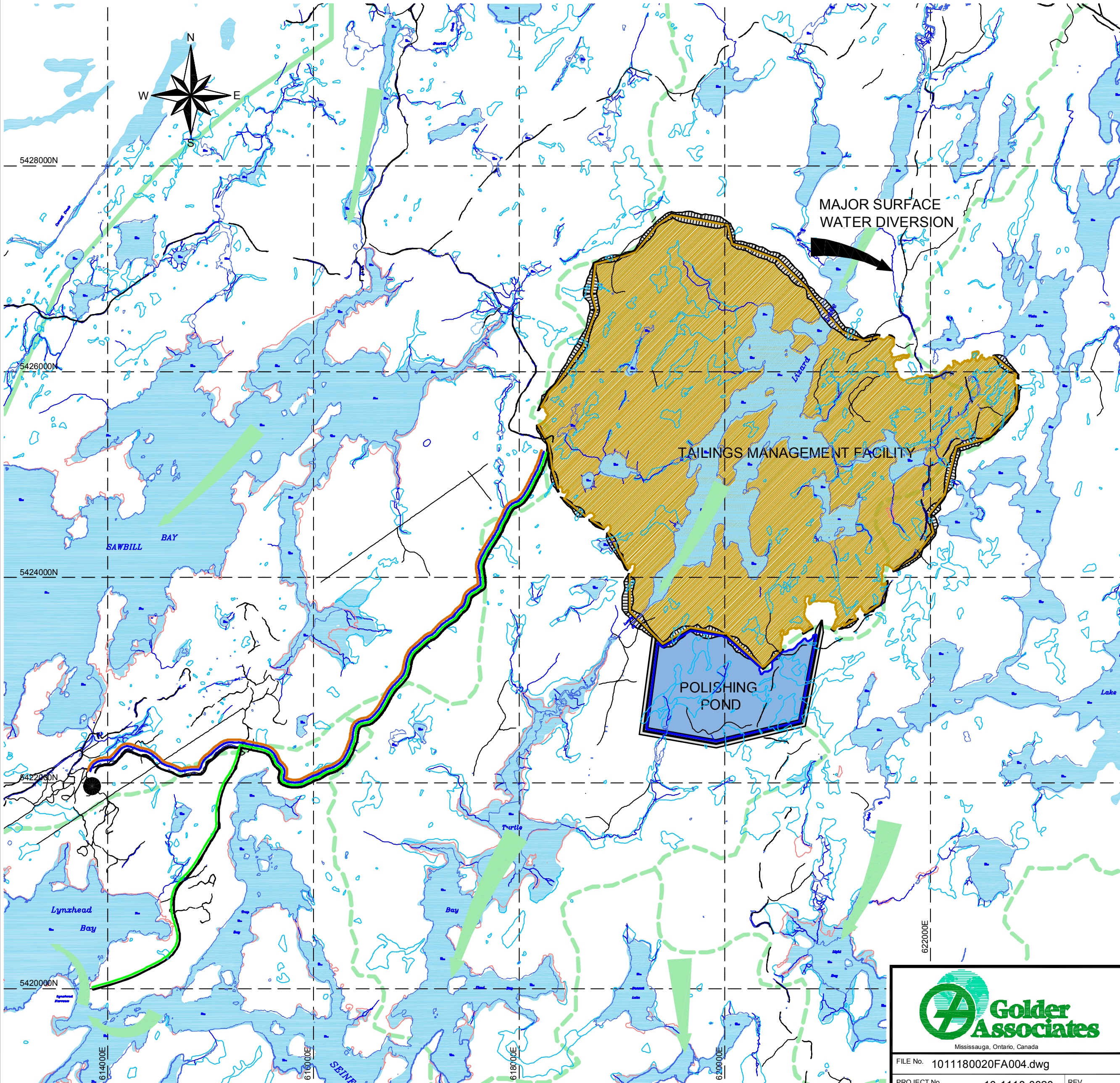

LEGEND:

- MINE / PROCESSING PLANT
- TAILINGS MANAGEMENT FACILITY
- TAILINGS PIPELINE (FROM MILL TO TMF - 6.8 Km)
- EFFLUENT DISCHARGE LINE (FROM TMF TO LYNXHEAD NARROWS -8.1 Km)
- WATER RECLAIM LINE (FROM TMF TO PROCESS PLANT - 6.8 Km)
- CONTAINMENT DAM LOCATION
- REGIONAL SUB.WATERSHED
- LOCAL SUBWATERSHED
- SURFACE WATER DRAINAGE DIRECTION

REFERENCE:

LIDAR CONTOURS - PROVIDED BY AEROGEOMATICS LTD AND OSISKO HAMMOND REEF PROJECT LTD. (1m RESOLUTION, JULY 2010)

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SCALE 1:40000 METRES

Golder Associates
Mississauga, Ontario, Canada

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REVIEW	KAB
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PROJECT No.	10-1118-0020
REV.	-

TITLE

CONCEPTUAL TAILINGS MANAGEMENT FACILITY LAYOUT SITE 3

OSISKO HAMMOND REEF PROJECT

FIGURE **F-4**

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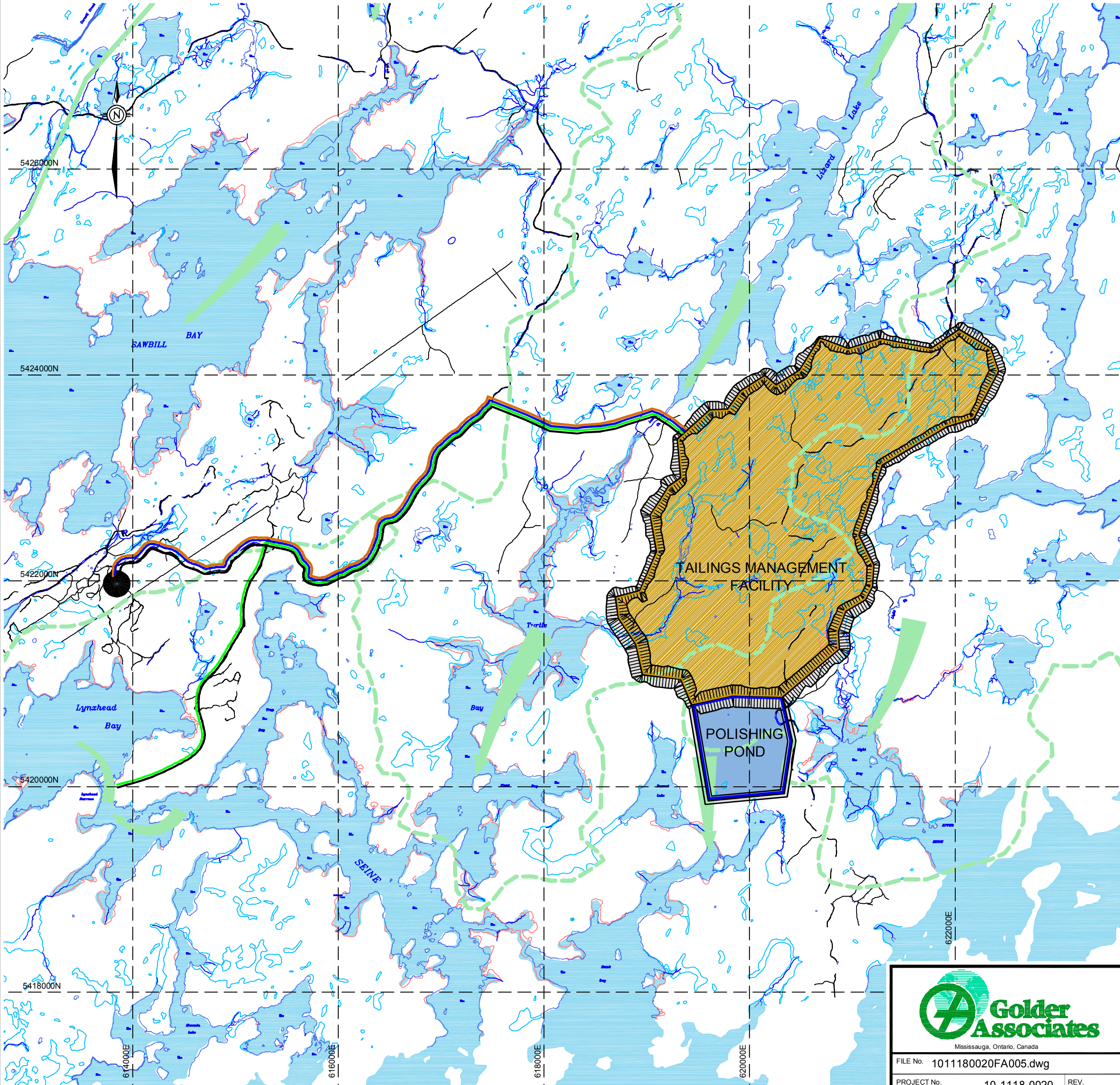

LEGEND:

- MINE / PROCESSING PLANT
- TAILINGS MANAGEMENT FACILITY
- TAILINGS PIPELINE (FROM MILL TO TMF - 7.2 Km)
- EFFLUENT DISCHARGE LINE (FROM TMF TO LYNXHEAD NARROWS (8.4 Km)
- WATER RECLAIM LINE (FROM TMF TO PROCESS PLANT - 7.2 Km)
- CONTAINMENT DAM LOCATION
- REGIONAL SUB.WATERSHED
- LOCAL SUBWATERSHED
- SURFACE WATER DRAINAGE DIRECTION

NOTE:

1. THIS WAS CHOSEN AS ALTERNATIVE #2.

REFERENCE:

LIDAR CONTOURS - PROVIDED BY AEROGEOMATICS LTD AND OSISKO HAMMOND REEF PROJECT LTD. (1m RESOLUTION, JULY 2010)

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Golder Associates, Mississauga, Ontario, Canada	SCALE: AS SHOWN	TITLE: **CONCEPTUAL TAILINGS MANAGEMENT FACILITY LAYOUT SITE 4**	
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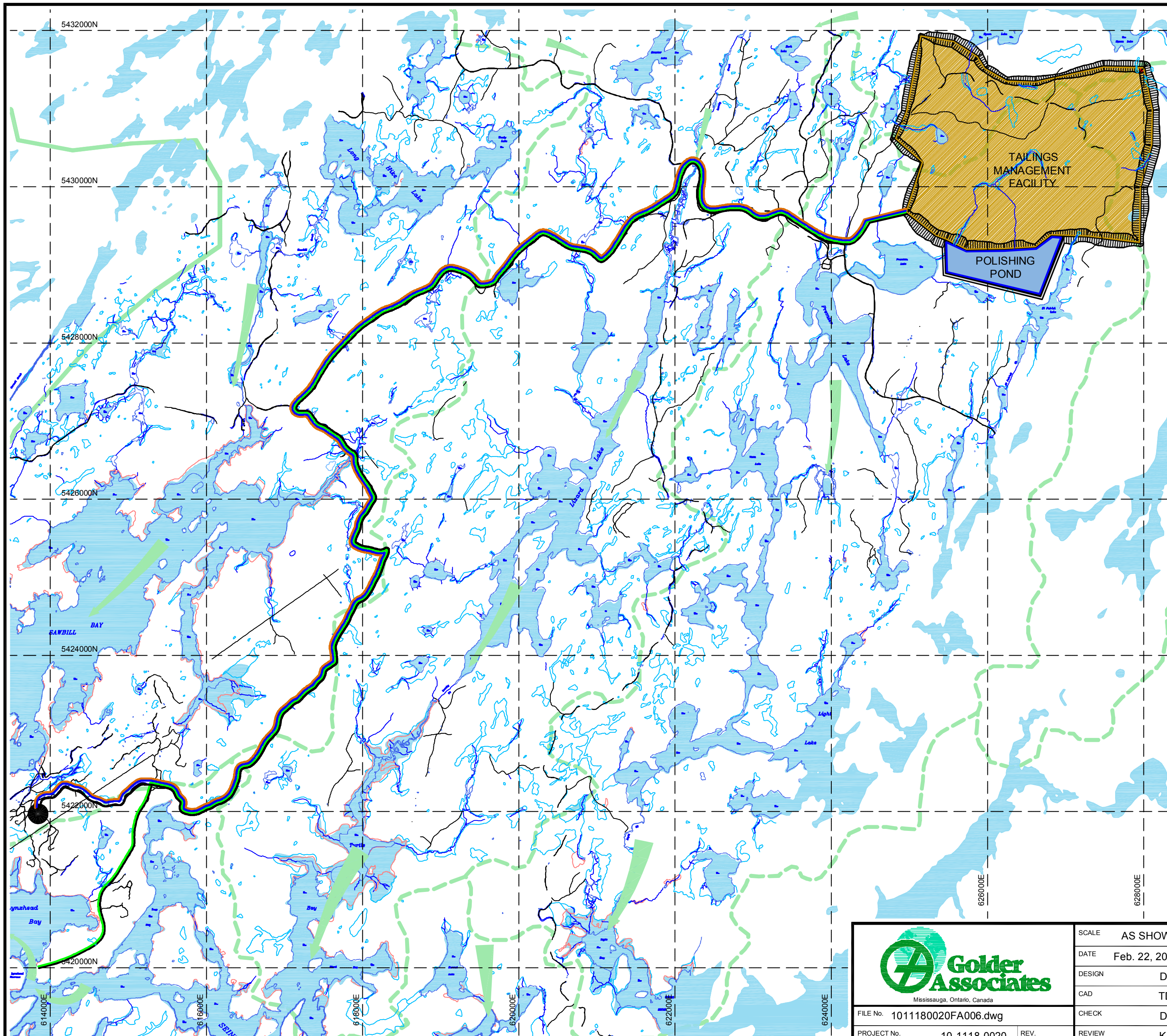
	DESIGN: DCJ		
	CAD: TDR		
FILE No. 1011180020FA005.dwg	CHECK: DCJ	OSISKO HAMMOND REEF PROJECT	FIGURE **F-5**
PROJECT No. 10-1118-0020 REV. -	REVIEW: KAB		

PLOT DATE: April 1, 2011
FILENAME: T:\Projects\2010\10-1118-0020 (BR, Atikokan)\-FA-\1011180020FA005.dwg



LEGEND:

- MINE / PROCESSING PLANT
- TAILINGS MANAGEMENT FACILITY
- TAILINGS PIPELINE (FROM MILL TO TMF - 19.7 Km)
- EFFLUENT DISCHARGE LINE (FROM TMF TO LYNXHEAD NARROWS (21.0 Km)
- WATER RECLAIM LINE (FROM TMF TO PROCESS PLANT - 19.7 Km)
- CONTAINMENT DAM LOCATION
- REGIONAL SUB.WATERSHED
- LOCAL SUBWATERSHED
- SURFACE WATER DRAINAGE DIRECTION

REFERENCE:
LIDAR CONTOURS - PROVIDED BY AEROGEOMATICS LTD AND OSISKO HAMMOND REEF PROJECT LTD. (1m RESOLUTION, JULY 2010)

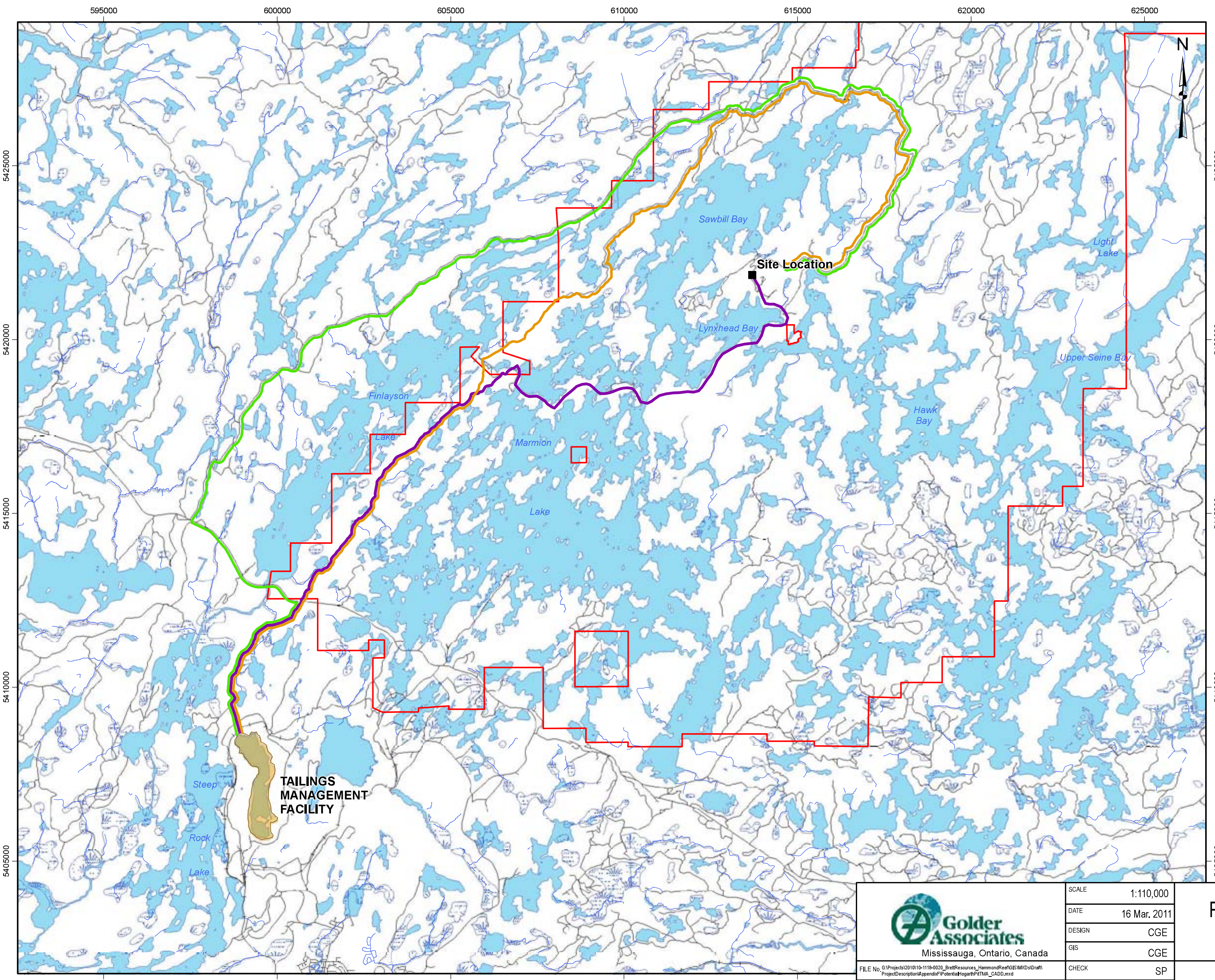
1 0 1 2
SCALE 1:50000 KM

Golder Associates
Mississauga, Ontario, Canada

SCALE	AS SHOWN	TITLE	CONCEPTUAL TAILINGS MANAGEMENT FACILITY LAYOUT SITE 5
DATE	Feb. 22, 2011		
DESIGN	DCJ		
CAD	TDR		
CHECK	DCJ		OSISKO HAMMOND REEF PROJECT
REVIEW	KAB	FIGURE	F-6

FILE No. 1011180020FA006.dwg
PROJECT No. 10-1118-0020 REV. -

PLOT DATE: March 16, 2011
FILENAME: T:\Projects\2010\10-1118-0020 (BR, Atikokan)\-FA-\1011180020FA006.dwg



LEGEND

- Access Road/Tailings Pipeline (38 km option)
- Access Road/Tailings Pipeline (45 km option)
- Tailings Pipeline (26 km option)
- Road
- River/Stream
- Lake
- Tailings Management Facility
- Wetland
- Project Location

DRAFT

REFERENCES

Base Data - Provided by OSISKO Hammond Reef Gold Project Ltd
Base Data - MNR NRVIS, obtained 2004, CANMAP v2006.4
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

0 1,000 2,000 4,000 6,000 8,000
METRES

Golder Associates
Mississauga, Ontario, Canada

SCALE	1:110,000		
DATE	16 Mar, 2011		
DESIGN	CGE		
GIS	CGE		
CHECK	SP		
REVIEW	RJ		
FILE No.	G:\Projects\2010\10-1118-0020_BrettResources_HammondReef\GIS\MXDs\Draft\ProjectDescription\AppendixF\PotentialHogarthPitTMA_CADD.mxd		
PROJECT No.	10-1118-0020	REV.	2.0

POTENTIAL HOGARTH PIT TAILINGS MANAGEMENT FACILITY

HAMMOND REEF GOLD PROJECT
ATIKOKAN, ONTARIO, CANADA

FIGURE F-7

OSISKO

March 22, 2011

Ms. Linda Jeffrey
Minister of Natural Resources
Ministry of Natural Resources
Office of the Minister
Room 6630, Whitney Block
99 Wellesley Street West
Toronto ON M7A 1W3

Dear Ms. Jeffrey:

I am writing this letter in follow up to a letter I sent you September 3rd 2010 regarding Osisko Mining Corporation's proposed Hammond Reef project on a portion of the former Steep Rock mine site.

Osisko has completed a comprehensive evaluation of six options for tailings impoundment sites; five are on-site Greenfield options and the sixth option is a Brownfield option that involves pumping slurry to the Steep Rock mine site's Hogarth Pit through a pipeline. The evaluation focused on environmental impacts, operability, constructability, permitting requirements, long-term liabilities, stakeholder preference, and economics.

After a thorough review, we have decided to exclude use of the Steep Rock mine site for tailings management. The off-site brownfield option that uses the Steep Rock mine's Hogarth Pit for tailings deposition has several operational challenges associated with a 30 km pipeline, in addition to permitting challenges, extensive baseline data collection requirements (that will not be needed for the other five options), and numerous other liabilities associated with it. Therefore, the final submission of our Project Description to the CEAA will not include the off-site Hogarth Pit option.

Again, on behalf of our entire Corporation, I wish to proffer our gratitude. I look forward to continuing working with your Ministry on the Hammond Reef Gold project.

Sincerely,

OSISKO MINING CORPORATION

Jean-Sebastian David
Vice President, Sustainable Development

cc: Mr. Luc Lessard, Senior Vice President & COO
Ms. Alexandra Drapack, Manager, Sustainable Development

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